Reactive and resilient: the contrasting behaviour of monazite and titanite during deformation (The Forno-Rosarolo shear zone; Ivrea-Verbano Zone)

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Complete List of Authors:	Langone, Antonio; University of Pavia, Department of Earth and Environmental Sciences Simonetti, Matteo; Istituto Superiore per la Protezione e la Ricerca Ambientale Dipartimento per il Servizio Geologico d'Italia; Istituto Superiore per la Protezione e la Ricerca Ambientale Dipartimento per il Servizio Geologico d'Italia Corvò, Stefania; University of Pavia, Department of Earth and Environmental Sciences Bonazzi, Mattia; University of Pavia, Department of Earth and Environmental Sciences Maino, Matteo; University of Pavia, Department of Earth and Environmental Sciences Piazolo, Sandra; University of Pavia, Department of Earth and Environmental Orlando, Andrea; National Research Council, Institute of Geosciences and Earth Resources Braschi, Eleonora; National Research Council, Institute of Geosciences and Earth Resources
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Reactive and resilient: the contrasting behaviour of monazite and titanite during deformation (The Forno-Rosarolo shear zone; Ivrea-Verbano Zone)

Langone A.^{1*}, Simonetti M.³, Corvò S.^{1,2*}, Bonazzi, M.^{1,2}, Maino, M.^{1,2}, Orlando, A.,⁴ Braschi, E.⁴, Piazolo, S.⁵

1 Department of Earth and Environmental Sciences, University of Pavia, Pavia, Italy

2 Institute of Geosciences and Earth Resources of Pavia, C.N.R., Pavia, Italy

5 3 Geological Survey of Italy, ISPRA, Roma, Italy

4 Institute of Geosciences and Earth Resources of Florence, C.N.R., Firenze, Italy

5 School of Earth and Environment, University of Leeds, Leeds, United Kingdom

*Corresponding author: antonio.langone@unipv.it; stefania.corvo@unipv.it

0 ABSTRACT

Dating the shear zone activity remains challenging and depends on geochronometer reactivity. We investigate the Forno-Rosarolo Shear Zone (Ivrea-Verbano Zone, Italy), developed in the intermediate-low continental crust under amphibolite-facies conditions. Sheared paragneisses and calc-silicates were dated using in-situ U–(Th–)Pb monazite and titanite geochronology.

Three monazite generations (MNZI-III) were identified based on microstructural position, internal features, chemical zoning (Th, Y), and isotopic data. Deformation was mainly recorded by MNZII, with high-Y domains yielding Triassic dates (average ages of: 238±8 and 222±8 Ma). Rare, highly fractured or porous MNZIII grains provided younger dates (202±8 to 184±6 Ma). MNZI, abundant in protomylonites, retains regional metamorphism, linking monazite U–Th–Pb data to fabric evolution.

Titanite shows different zoning features and chemistry as function of the surrounding mineral
 assemblage: i) strongly zoned grains are mostly associated with silicate-rich layers; ii)
 homogeneous grains are generally within the silicate-poor layers. Both types show a
 decoupling between chemistry, almost completely related to the peak metamorphism, and

U–Pb isotopes. Deformation microstructures promoted a total reset of the U–Pb dataset at the beginning of deformation and a subsequent volume diffusion through the grains: the innermost domains of both titanite types provide a Triassic lower intercept age (240±5 Ma) while the rims/tips, locally coinciding with high strained portions, define an alignment of isotopic data with a Jurassic lower intercept age (186±6 Ma). This study highlights how combining monazite and titanite geochronology refines the timing and duration of deformation, particularly in large-scale shear zones involving different lithologies.

34 Keywords:

Mylonites, monazite, titanite, petrochronology, geochemistry, microstructure, U–(Th–)Pb

1. INTRODUCTION

Constraining the timing of ductile deformation is crucial for understanding the tectono-metamorphic evolution of intermediate-lower crustal domains in both continental and oceanic crust (e.g., Xypolias, 2010; Oriolo et al., 2018). Mylonites reflect zones of high strain where dominantly ductile deformation has been localized. Mylonitic shear zones occur at all scales in the lithosphere and may provide pathways that localize fluids and secondary alteration (e.g., Beach, 1976; Austrheim, 2013; Kirkland et al., 2023). These rocks may thus preserve key evidence for the kinematics and structure of an orogen as well as of rift-related systems. Dating the evolution of the shear zones has been described as one of the most difficult problems in geochronology (e.g., Oriolo et al., 2018; Kirkland et al., 2023). In addition to the dating of major fabric-forming minerals, *in-situ* geochronology or petrochronology on minor and accessory minerals may provide direct constraints on the timing of deformation (e.g., Piazolo et al., 2012) as it allows linking isotopic dating, microstructures, geochemistry and thermobarometry. In recent years, the combination, simultaneously or not, of isotopic

ratios and trace element for accessory and minor minerals with in-situ techniques, opens the possibility to date the small syn-kinematic domains developed on pre-existing grains (e.g., Simonetti et al., 2020, 2021b; Carosi et al., 2022; Moser et al., 2022; Walters et al., 2022; Kirkland et al., 2023; Kavanagh-Lepage et al. 2023; Corvò et al, 2023). Among the accessory minerals, monazite and titanite are the most promising being present in different rock types and, most important being more reactive with respect to other accessory minerals, i.e., zircon. Both chronometers have been shown to develop chemical zoning as function of metamorphic reactions with and without deformation allowing to link the ages to specific geologic events (Engi, 2017; Hetherington et al., 2017; Kohn, 2017; Kohn, et al., 2017).

The usefulness of monazite as a geochronometer is due to its lattice properties allowing it to contain high concentration of Th and U and low amounts of common-Pb (Parrish, 1990). Monazite is common in metapelitic/metapsammitic rocks with Ca-poor and Al-rich bulk compositions at metamorphic conditions above upper greenschist facies (e.g., Spear and Pyle, 2010). Unlike zircon, monazite has a higher reactivity, it is able to preserve isotopic inheritance and to record P-T conditions from prograde to retrograde (e.g., Langone et al., 2011). Monazite may develops chemical zoning that can be linked to a specific metamorphic reaction related to static or dynamic (re)crystallization of both major and accessory rock forming minerals (e.g., Wawrzenitz et al., 2012; Hetherington et al., 2017). In the last years, the combination of in situ U-Th-Pb data with the geochemical composition of the dated monazites allowed to establish the timing of complex geologic events (e.g., Shaw et al., 2001; Williams & Jercinovic, 2002; Rasmussen & Muhling 2007; Di Vincenzo et al., 2007; Janots et al., 2012; Wawrzenitz et al., 2012; Williams & Jercinovic, 2012; Didier et al., 2014; Grand'Homme et al., 2016; Kohn, 2016; Regis et al., 2016; Bosse & Villa 2019; Bergemann et al., 2020; Simonetti et al., 2020, 2021b; Schulz, 2021; Carosi et al., 2022). Although monazite can be useful to date tectonic events in rocks from the middle and lower crust Page 5 of 235

Geological Magazine

(Erickson et al., 2015; Williams & Jercinovic, 2012, Mottram and Cottle, 2024), it has been documented that monazite is able to record shearing by fluid-assisted dissolution and growth on rims at low amphibolite facies metamorphic condition (e.g., Terry et al., 2000) or even lower metamorphic conditions (e.g., Shaw et al., 2001).

Recently, it has been demonstrated that titanite microstructures can be used to date hyper velocity meteorite impacts (e.g., Papapavlou et al., 2017; McGregor et al., 2021) as well as the activity of ductile shear zones developed within continental crustal rocks (e.g., Gordon et al., 2021; Moser et al., 2022; Kavanagh-Lepage et al., 2023; Corvò et al., 2023). Conversely to monazite, the adoption of titanite as a geochronometer is complicated by two main issues. Firstly, it has a strong affinity for Pb and thus it may incorporate common lead during crystallization (e.g., Kohn, 2017). Consequently, most titanite U–Pb measurements require correction for substantial common Pb before age interpretations, e.g., by regressing less radiogenic and more radiogenic measurements on an inverse isochrons (Tera-Wasserburg diagrams) to derive an age. Secondly, the temperature range for diffusive Pb-loss within the grains is somewhat disputed. Titanite has been traditionally considered as a thermochronometer with closure temperatures of 650°C and 750°C determined experimentally for titanite crystals with 0.5 and 5mm radii, respectively and considering a cooling of about 5°C/Myr (Cherniak, 1993). In contrast with the experimental studies, several studies on natural titanite grains suggest that the U-Pb isotope system may be resistant to volume diffusion at temperature of up to 800°C (Kohn, 2017; Hartnady et al., 2019) providing crystallization ages (and not cooling ages) and referring to titanite as a petrochronometer (e.g., Hartnady et al., 2019; Holder et al., 2019; Olierook et al., 2019; Scibiorski et al., 2019; Kirkland et al., 2020; Gordon et al., 2021; Moser et al., 2022; Walters et al., 2022). Besides 56 100 these two main issues several authors (e.g., Gordon et al., 2021; Moser et al., 2022; ⁵⁸ 101 59 Kavanagh-Lepage et al., 2023; Corvò et al., 2023), highlighted a decoupling between the

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> U–Pb isotopic system and some trace elements and a strong dependence on the mineral assemblage of the hosting microdomain for titanite during (e.g., Corvò et al., 2023).

In this contribution we aim to assess the robustness and utility of the two geochronometers in deciphering the tectono-metamorphic history of high strain rocks. We present monazite and titanite microstructural, chemical and isotopic data from mylonitic paragneisses and calc-silicates from an extensional shear zone affecting the continental crustal section of the lvrea-Verbano Zone. This zone is ideally suited for our study since it has been object of detail reconstructions of strain distribution and lithological make-up. It has been shown that both monazite and titanite are present in the main lithologies. Importantly, the zone records different tectono-metamorphic events, the timing of which remains disputed (e.g., Siegesmund et al., 2008; Garde et al., 2015; Simonetti et al., 2023). Here we i) describe the behaviour of monazite and titanite under the same shearing conditions, ii) shed light on the timing of deformation by U-Th-Pb dating of monazite and titanite and on the petrologic evolution of mylonites during deformation, iii) discuss the complementary and contrasting utility of these two geochronometers in dating deformation in mid- to lower crustal rocks.

118 2. GEOLOGICAL SETTING

The Ivrea-Verbano Zone (IVZ) in north-western Italy represents a cross-section through the middle to lower continental crust of the Southern Alpine basement (Fig. 1A). During the Alpine collision, the IVZ underwent vertical exhumation and open folding, but it escaped the metamorphic overprint (Henk et al., 1997; Rutter et al., 2007; Wolff et al., 2012). The IVZ is delimited by the Insubric Line northward, while south-eastward, it is juxtaposed to the Serie dei Laghi Unit by the Late-Variscan Cossato–Mergozzo–Brissago Line, which is in turn crosscut by the Pogallo Line (Fig. 1A; Boriani et al., 1990).

The IVZ is traditionally subdivided in three main units (Fig. 1A), from NW-SE: i) the mantle peridotites; ii) the Mafic Complex, and iii) a volcano-sedimentary metamorphic sequence, Page 7 of 235

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Geological Magazine

namely the Kinzigite Formation. The latter is considered as the originally upper part of the 128 129 tilted crustal section made up of a heterogeneous group of metasediments, comprising mainly metapelites with intercalated metabasic rocks (i.e., volcanic sediments and MORB-130 like lavas) and minor marbles/calc-silicates and guartzites (Zingg, 1990; Schmid, 1993; Quick et al., 2002; Kunz et al., 2014). At a regional scale, peak metamorphic grade decreases from granulite (~900 °C and 900 MPa) to amphibolite facies (~600 °C and ~400 MPa) from NW to SE (Schmid & Wood, 1976; Brodie & Rutter, 1987; Zingg, 1990; Schmid, 135 1993; Redler et al., 2012; Kunz et al., 2014; Kunz & White, 2019). The highest degree of metamorphic conditions has been recorded by paragneiss septa (i.e., depleted granulite) forming layers within the Mafic Complex (Fig. 1A; Sinigoi et al., 1996; Ewing et al., 2013). The progressive switch at the mid to lower crustal levels from granulite to amphibolite facies is marked by a transition zone of \sim 1-5 kilometres (Fig. 1B) that experienced extensive migmatization processes (e.g., Redler et al., 2012; Kunz et al., 2014; Carvalho et al., 2019). In the north-eastern part of the IVZ, this transition zone hosts two mylonitic shear zones, namely the Anzola (Brodie and Rutter, 1987; Corvò et al., 2022; 2023) and the Forno-Rosarolo shear zones (Siegesmund et al., 2008; Simonetti et al., 2023). Although described as separate shear zones and often named in different way (see Simonetti et al., 2021a), these structures have been interpreted as a single fault system, with NNE-SSW strike (e.g., Rutter et al., 2007), associated to the Triassic-Jurassic (180-230 Ma) rift-related tectonic (Beltrando et al., 2015; Petri et al., 2019; Simonetti et al., 2023; Corvò et al., 2023). In this time interval, crustal thinning (<10 km thick) was accommodated by several shear zones active during different phases of rifting (Manatschal et al., 2007; Mohn et al., 2012) at different crustal levels (e.g., Beltrando et al., 2015).

3. GEOCHRONOLOGICAL BACKGROUND

Geological Magazine

153 Several authors, by using geochronological and/or thermochronological techniques, aimed 154 to constrain the timing of the main geodynamic episodes that characterised the evolution of the crustal section of the IVZ. Here we report a summary of the main tectono-metamorphic 155 10156 event well recorded by both geo- and thermochronometers.

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¹² The rare occurrence of Carboniferous (Pennsylvanian) metamorphic (i.e., 316±3 Ma U–Pb 13 14 15 158 on zircon, Ewing et al. 2013, 2015; 311±2 Ma garnet-whole rock Lu-Hf isochrons, Connop 16 17 159 et al., 2024) and magmatic ages (i.e., 314 ±5 Ma U–Pb on zircon Klötzli et al., 2014) 18 19 160 indicates that the pervasive amphibolite- and granulite-facies mineral parageneses of the 20 21 ⁻161 IVZ formed after the peak of Variscan compressional deformation and plutonism.

24 162 The IVZ recorded mostly tectono-metamorphic and magmatic events during the Permian as 25 26 163 documented by dating of different accessory minerals from metamorphic (e.g., Henk et al., 27 20 29 164 28 1997; Vavra et al., 1999; Guergouz et al., 2018; Kunz et al., 2018; Williams et al., 2022; 30 31 165 Wyatt et al., 2022, Corvò et al., 2024) and magmatic rocks (e.g., Peressini et al., 2007; 32 33 166 Karakas et al., 2018). This High-Temperature (HT) event has been confirmed also recently 34 ³⁵ by both in-situ garnet U-Pb dating (Bartoli et al., 2024) and garnet-whole rock Lu-Hf 36 37 ₃₈ 168 isochrons (Connop et al., 2024) of metamorphic samples across the crustal section. The 39 pervasive amphibolite- and granulite-facies mineral parageneses formed during the Permian 40 169 41 ⁴² 170 lithospheric thinning, well documented across the Alps (e.g., Schuster & Stüwe, 2012). 43

44 45¹⁷¹ The geochronological studies performed on metamorphic rocks across the IVZ crustal 46 section revealed also that the HT conditions persisted for several Myr. Thanks to a 47 172 48 ⁴⁹ 173 systematic study of textures, REE content and U-Pb ages of zircon and monazite grains, 50 51 174 51 Guergouz et al. (2018) inferred that the minimum duration for high-temperature 53 metamorphism should be between 20 and 30 Myr. Kunz et al. (2018) dated granulitic rocks 54 175 55 56 176 by zircon U–Pb and suggested that the HT metamorphic conditions lasted for a longer time 57 58 177 interval, up to 60 Myr. A recent study of monazite across the crustal section exposed in the 59 60 178 Valle Strona di Omegna reported dates mostly in the range 240-320 Ma with two main

Page 9 of 235

peaks at circa 290 and 270 Ma (Williams et al., 2022). According to these authors, the 179 180 monazite textural and chemical features indicate that these dates record the timing of prepeak to peak metamorphic conditions. The long-lasting persistency of HT conditions agrees 181 10 182 with the model proposed by Schuster & Stüwe (2012) suggesting lithospheric thinning with negligible surface subsidence between 290 and 240 Ma.

15 184 Magmatism and deformation associated with the Triassic-Jurassic Tethyan rifting largely 17 185 overprinted the Permian crustal section (e.g., Beltrando et al., 2015). A review of both 186 geochronological and thermochronological Triassic-Jurassic data has been recently ⁻¹₂₂ 187 published (Simonetti et al., 2021a). Here we synthetize isotopic data related to post Permian 24 188 deformation events recorded by the IVZ crustal section. One of the oldest studies focused 26 189 on deformation was provided by Brodie et al. (1989) by dating with Ar-Ar method syn-20 29 190 kinematic hornblende from mylonitic amphibolites of the Anzola shear zone (Fig. 1A). These 31 191 authors obtained two ages at 215±5 Ma and 210±5 Ma that were interpreted by the authors 33 192 in terms of the effects of grain-size reduction on the closure temperature for argon in ³⁵ 193 hornblende and help further to chart the cooling history of the rocks. The activity of the ₃₈ 194 Anzola Shear Zone has been recently constrained by Corvò et al. (2023) by U-Pb 40 195 petrochronology of titanite from mylonites consisting of alternating amphibolites and calc-⁴² 196 silicates. These authors obtained a Jurassic lower intercept age $(188 \pm 2 \text{ Ma})$ from rims/tips 45¹⁹⁷ of titanite grains showing different chemistry and a major concentration of dislocations with respect to the inner domains. The Jurassic deformation was also recorded at different crustal 47 198 49 199 levels by rocks showing different metamorphic conditions. The most prominent rifting-related ⁵¹ 52 200 structure in the southern portion of the IVZ is the Pogallo Line, which is interpreted as a low-53 54 201 angle normal fault that accommodated thinning (Hodges & Fountain, 1984) between Triassic 55 56 202 and Jurassic age (ca. 210 and 170 Ma; Zingg, 1990; Mulch et al., 2002; Wolff et al., 2012) 57 ⁵⁸ 203 under decreasing temperatures from amphibolite- to greenschist-facies conditions. In the 59 60 204 northern sector of the IVZ, Late Triassic to Early Jurassic ductile shear zones developed

within (ultra)mafic rocks of the lower crust (U-Pb zircon data, Langone et al., 2018; 205 206 hornblende Ar-Ar data, Boriani & Villa, 1997 of mylonitic metagabbro in Val Cannobina) and mantle peridotites (e.g., U-Pb zircon data, Corvò et al., 2020) under upper-amphibolite to 207 10 208 granulite facies conditions (Brodie, 1981; Kenkmann, 2000; Kenkmann and Dresen, 2002; 11 ¹² 209 Degli Alessandrini, 2018; Langone et al., 2018). 13

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- ¹⁹212 3. METHODS 20

²¹₂₂213 3.1 Sampling strategy

23 24 214 For geochronology, we selected metapelites showing different microstructural features 25 (protomylonitic and mylonitic fabric) and composition (biotite-rich and biotite-poor) for 26 2 1 5 27 ²⁸216 monazite dating and a calc-silicate sample for titanite dating (Table 1). All the samples are 29 30 30 31 217 coming from the transition between the high-strain and the low strain zones of the shear 32 zone (Simonetti et al., 2023). Monazite samples were collected from one outcrop along the 33 218 34 ³⁵219 road whereas titanite-bearing sample is coming from another outcrop along the river, about 36 ³⁷₃₈220 150m southward (Fig. 1B). Monazite was analysed within six thin sections from a biotite-39 poor (VSDO-13B) and two biotite-rich paragneisses (VSDO-13A and VSDO-13M; Fig. 2; 40 221 41 42 222 Table 1). 43

⁴⁴/₂₂₃ Titanite was studied on different thin sections of mylonitic calc-silicates. The analyses were 45 46 47 224 carried out in a (50 µm-thick) thin section of a representative sample (VSDO-12R2B; Table 48 49 2 25 1; Fig. 3). The samples were oriented on the field and thin sections are made parallel to the 50 ⁵¹ 226 mineral lineation and perpendicular to the main foliation, therefore along the XZ plane of the 52 ⁵³ 54 227 finite strain ellipsoid.

- 55 56 228
- 58 229 3.2 Monazite and titanite chemistry
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Page 11 of 235

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Thin sections were polished, C-coated and inspected using a Scanning Electron Microscope
 (SEM; Mira3, TESCAN) hosted at Earth and Environmental Sciences Department of Pavia
 University, in order to observe monazite and titanite microstructural position, internal
 features and zoning in Back-Scattered Electron (BSE).

The composition and zoning of monazite grains were characterized by acquiring X-ray maps 15 235 (for P, Ca, Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Th and U) and chemical analyses with a JEOL 8200 Super Probe electron microprobe hosted at the University of Milano (Italy) and a 17 236 ¹⁹237 CAMECA SX-Five microprobe hosted in the Service CAMPARIS Sorbonne University 21 22 238 (Paris). An accelerating voltage of 15 kV, a beam current of 5 and of 150 nA (respectively 24 2 39 for chemical analysis and X-ray maps) and a spot size of 1 µm were used for the JEOL 8200 26 2 4 0 Super Probe. The CAMECA SX-Five microprobe was set at 15 kV, a beam current of 5 and ²⁸ 29 241 of 230 nA for the maps. Monazite formula, normalised to 16 oxygens, were obtained with an 31 242 in-house excel spreadsheet. Results are provided in Table S1 (Supplementary Material). 33 2 4 3 X-ray compositional maps (Si, Ti, Al, Ca, Fe, F, Zr, Nb, La, Ce, Nd) and chemical analyses ³⁵ 244 (Si, Ti, Al, Fe, Mn, Ca, Na, P, Zr, Nb, La, Ce, Nd, Cl, and F) of titanite were acquired with a ₃₈ 245 JEOL 8230 Super Probe electron microprobe hosted at the University of Florence (Italy). An

accelerating voltage of 15 kV, a beam current of 20 and of 100 nA (respectively for chemical
analysis and X-ray maps) and a spot size of 1 µm were used for chemical analyses, whereas
variable spot size was considered according to map size for the compositional map. Titanite
stoichiometry was calculated using the method of Oberti et al. (1981). Results are provided
in Table S2 (Supplementary Material).

3.3 Imaging and quantitative microstructural analysis (EBSD)

In order to analyse the microstructural features, several monazite and titanite grains from
 the studied samples were selected for obtaining Electron-Backscattered Diffraction (EBSD)
 maps in thin section using the FEI Quanta 650 FEG–ESEM (with Oxford X–max 80 SDD)

3 EDS, Oxford/HKL Nordleys EBSD system and Aztec software) at the LEMAS, University of 256 4 5 257 Leeds, UK. A working distance of 20 mm, a 70° stage tilt, accelerating voltage of 20 kV and 6 7 a step size of 0.5-1 µm were used for analyses. Post processing included correcting for wild 258 8 9 10 2 5 9 spikes and down to a 5 nearest neighbour zero solutions correction. Quantitative orientation 11 ¹²260 analyses are presented by maps, pole and dislocation analysis methods using AztecCrystal 13 14 15 261 2.2 (Oxford Instruments). Pole figures (PF) for monazite and titanite crystallographic system 16 17 262 (monoclinic; (100), (010), (001), lower hemisphere projection on plane XZ), and 18 ¹⁹ 263 misorientation profiles tendentially from core to rim or from the low to high distorted domains 20 21 22⁻¹264 across the grains are used to assess orientation changes locally and within whole grains. 23 24 265 So called Grain Reference Orientation Deviation (GROD) maps are presented to highlight 25 26 266 the pattern and degree of lattice distortions inside grains. These colour-coded maps show 27 ²⁸ 29 267 the change in crystal orientation with respect to its average orientation. Lattice distortions 30 31 268 within deformed grains were quantified by calculation of the local dislocation density using 32 33 269 the "Weighted Burgers vector" (WBV) analysis following the approach described by Wheeler 34 ³⁵ 270 et al. (2009; 2024) and Timms et al. (2019). Specifically, we performed a loop around the 36 37 ₃₈271 area of titanite grains where the LA-ICP-MS spot analyses was taken. The derived 39 dislocation density value refers to the number of geometrically necessary dislocations that 40 272 41 42 43 273 are needed to accommodate the measured lattice distortion over the area in which the LA-44 45 274 ICP-MS spot was taken. 46

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⁵¹₅₂ 277 Monazite and titanite U-(Th-)Pb dating was carried out using a laser ablation, inductively ⁵³₅₄ 278 coupled, plasma mass spectrometry (LA-ICP-MS) at CNR-Istituto di Geoscienze e ⁵⁵₅₆ 279 Georisorse U.O. Pavia (Italy). Analytical details, with the technical/methodological ⁵⁸₅₉ 280 parameters following the PlasmaAge recommendation, are reported within Table S3 ⁶⁰₂₈₁ (Supplementary Material). Page 13 of 235

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The large size of titanite grains/domains allowed us to collect simultaneously trace element concentrations and U-Th-Pb isotopes. Trace element concentrations were calculated using SiO₂ as the internal standard and the concentration of 29.8 wt.%, average obtained from EMPA analyses. NIST610 was used as primary reference materials, MKED-1 and TTN150 (Klemme et al., 2008) were analysed as quality control. The relative standard deviation for MKED-1 is better than 18% and concentrations are typically within better than 5% for Zr. Nb, Nd, Sm, Tb, Dy, Ho, Er, Tm, Hf, Th, and U; better than 11% for AI, Ti, Mn, Fe, Pr, Eu, Gd, Yb, Lu and Pb of expected values for 'MKED-1' (Spandler et al., 2016). Vanadium, Y, La, and Ce are less accurate (21-13%). Moacir monazite (Cruz et al., 1996; Seydoux-Guillaume et al., 2002a,b; Gasquet et al., 2010) and MKED-1 titanite (Spandler et al. 2016) were used as the primary standards for U-(Th-)Pb dating and were run every ~ 10 unknowns. Precision and accuracy are reported within Table S3 (Supplementary Material).

The software GLITTER ® was used for data reduction (van Achterbergh et al., 2001) of both isotopic ratio and trace elements. IsoplotR (Vermeesch, 2018) was used for representing isotopic data of both monazite and titanite; ages are provided together with the 2sigma uncertainties. Monazite data with discordance higher than 5% and/or a spot overlap were excluded to avoid data bias. The ²³⁸U/²⁰⁶Pb and ²⁰⁷Pb/²⁰⁶Pb isotopic ratios for each analysis are presented uncorrected for common lead in Tera-Wasserburg concordia diagram using IsoplotR (Vermeesch, 2018).

Full analytical results are for monazite and titanite are reported as Supplementary Material Table S4 and S5, respectively.

3.5 Zr-in-titanite thermometer

The Zr-in titanite thermometer of Hayden et al. (2008) was used to calculate titanite 60 307 temperatures. Uncertainties for the are given at 2σ , propagated assuming \pm 0.1 GPa for 308 pressure estimates, 2σ variation of the Zr concentration in titanite and the 2σ uncertainties

309 given by the authors for their calibration of the thermometer (see Cruz-Uribe et al., 2014).

310 Temperature estimates are reported in Table S5 (Supplementary Material).

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4.FIELD OBSERVATIONS AND GENERAL PETROGRAPHY

The Forno-Rosarolo Shear Zone (FRSZ), also known as Rosarolo Shear Zone (Siegesmund 17 3 1 4 18 ¹⁹₂₀ 315 et al., 2008), crops out in the IVZ section of the Strona di Omegna valley between the 21 22 316 Rosarolo and Forno villages (Fig. 1B). It was recently mapped and characterised in detail 23 24 3 17 by Simonetti et al. (2023). It is a NE-SW-oriented shear zone with a thickness of about 500m. 25 ²⁶ 318 Mylonitic foliation is subvertical, in places steeply dipping toward the NW. A sinistral top-to-27 ²⁸ 29 319 the-SW sense of shear is well highlighted by the presence of δ - and σ -type porphyroclasts, 30 31 320 shear boudins, flanking structures and winged inclusions in all the involved lithologies 32 33 321 (Simonetti et al. 2023). The FRSZ developed in a narrow area described as the transition 34 ³⁵₃₆ 322 zone between the amphibolite- and granulite-facies metamorphic rocks (Redler et al., 2012; 37 ₃₈ 323 Kunz et al., 2014). Several lithologies are involved in the deformation, in particular 39 40 324 paragneisses, metabasites, and locally calc-silicates (Simonetti et al., 2023). The margins 41 42 43 325 of the shear zone are characterised by two low-strain domains (Fig. 1B), with different 44 45 326 thickness, made by anastomosed protomylonites and mylonites layers surrounding weakly 46 deformed lenses, whereas the high-strain core (Fig. 1B) consists of alternating mylonites 47 327 48 ⁴⁹ 328 and ultramylonites. The sheared rocks are characterised by a foliation-oriented NE-SW and 50 51 329 51 dipping at variable angle, between 42° and 88°, toward the NW and a mineral lineation 53 54 330 plunging at moderate angle toward the NE (Fig. 1B). 55

The protomylonitic biotite-poor paragneiss is coarse grained and consists of quartz, feldspars, sillimanite, garnet and minor biotite (Fig. 2A). Rutile, zircon, monazite, oxides and sulphides are accessories. Intracrystalline deformation is recognizable in all major phases. Page 15 of 235

Geological Magazine

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Feldspars show undulose extinction and deformation lamellae, they are only locally 334 335 fractured, and biotite shows kinks of the cleavage. Quartz is coarse-grained and present lobate grain boundaries and window and pinning structures. Sometimes chessboard 336 10 3 37 extinction microstructure is also present. Locally, quartz-rich domains are characterised by 12 13 338 a gradual grain size reduction and by the presence of both subgrains and new grains forming 15 339 a "core and mantle structure" around larger grains. The prismatic sections of sillimanite show 17 3 4 0 undulose extinction. These rocks are affected by intense fracturing and veining at high angle ¹⁹341 with respect to the foliation. Fractures and veins are generally closely spaced and crosscut 22 342 the grains. This late brittle event promoted the replacement of the primary assemblage by 24 3 4 3 secondary minerals such as chlorite, white mica, epidote, ilmenite. Monazite occurs in ²⁶ 344 different textural positions: totally or partially enclosed within garnet or sillimanite ²⁸ 29 345 porphyroblasts (Fig. 2D), within or among recrystallized quartz grains. Rarely monazite 31 346 shows jagged contours as evidence for partial replaced by allanite (Fig. S1, Supplementary 33 3 47 Material) but locally it is affected by intense fracturing.

³⁵ 348 Protomylonitic biotite-rich paragneisses are characterised by biotite, sillimanite, garnet, 38 3 4 9 feldspars and guartz (Fig. 2B, E). Monazite, zircon, rutile, and graphite are common 40 3 5 0 accessories. These paragneisses show a migmatitic texture overprinted by a well-defined 42 43 351 foliation marked by layers of elongated biotite and large sillimanite prisms with subordinate 44 45 352 guartz-feldspathic layers (Fig. 2B, E). This foliation wraps around rounded to elliptical garnet 46 grains which contain numerous inclusions of matrix-forming minerals (Fig. 2B, E). 47 3 5 3

⁴⁹ 354 Feldspars generally show evidence of ductile deformation such as undulose extinction and 50 51 52 355 51 deformation lamellae. Quartz is coarse-grained and presents lobate grain boundaries. 53 54 356 Locally window and pinning structures and deformation lamellae can be recognized. Some 55 56 3 57 grains also display chessboard extinction microstructure. 57

⁵⁸ 358 Sillimanite prisms show undulose extinction and deformation bands whereas the cleavage 60 359 of biotite is kinked. Sillimanite fish, asymmetric mantled porphyroclasts and S-C-C' fabric 3 360 occur indicating a sinistral top-to-the-SW sense of shear. Brittle features are rare as well as 4 5 361 the occurrence of secondary minerals such as chlorite after biotite and garnet, ilmenite after 6 362 rutile. 8

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10 3 6 3 Mylonitic paragneisses from the high strain zone show the same mineral assemblage of 11 ¹²364 those from the low strain zone but differ for a more apparent mylonitic fabric (Fig. 2C, F). 13 14 15 365 The foliation is marked by alternating melanocratic and leucocratic layers. The formers are 16 17 366 made mainly of biotite and sillimanite whereas the leucocratic ones consist of quartz and 18 ¹⁹ 367 feldspars (Fig. 2C, F). As porphyroclasts we observed mainly garnet, sillimanite and 20 21 22 368 feldspars. Garnet occurs as rounded or elongated grains parallel to the foliation and, 23 24 369 compared to less deformed rocks, it experienced an apparent grain size reduction (Fig. 2C, 25 26 3 7 0 F). Sillimanite occurring in basal section commonly forms fish-shaped porphyroclasts rarely 27 ²⁸ 29 371 replaced at the edges by retrograde white-mica. The prismatic sections are generally 30 31 372 elongated parallel to the foliation and show evidence for both ductile deformation, such as 32 33 373 undulose extinction and kinking, and brittle deformation such as necking and fractures. Also 34 ³⁵ 374 in these samples monazite is rarely partially replacement by allanite growing syn-37 ₃₈ 375 kinematically (Fig. S1, Supplementary Material).

40 3 7 6 Calc-silicates are well exposed in a small outcrop along the river (Fig. 1B). They are 41 42 377 43 characterised by large (up to few centimetres) whitish clasts containing feldspars and mafic 44 45 378 minerals (clinopyroxene and amphibole) surrounded by a greyish fine-grained matrix (Fig. 46 3A, B). At the microscale they show a well-developed foliation and mylonitic fabric (Fig. 3A-47 379 48 ⁴⁹ 380 H). The largest porphyroclasts are made of feldspars whereas clinopyroxene and garnet are 50 51 52 381 51 smaller (Fig. 3A-H). Calc-silicate shows a compositional layering consisting of calcite-rich 53 54 382 layers alternating with layers richer in silicates (Fig. 3A, B). The latter are generally thinner 55 56 383 and are made of plagioclase, quartz, green-amphibole and biotite with rare or minor calcite 57 ⁵⁸ 384 (Fig. 3C, D). Due to the low modal abundance of calcite, they can be defined as carbonate-59 60 385 bearing calc-silicate layers. The thicker calcite-rich layers contain (sub)rounded to elliptical

grains of clinopyroxene and feldspars; anhedral garnet, locally showing a poikiloblastic texture, are also common (Fig. 3E-H). Titanite is an abundant accessory mineral whereas allanite and zircon are less common (Fig. 3G). Feldspars and clinopyroxene show evidence for intracrystalline deformation such as undulose extinction; deformation twins are well recognizable within plagioclase (Fig. 3D, F, H). Thin ribbons of recrystallized quartz are also common in the carbonate-bearing calc-silicate layers (Fig. 3D, H). Features indicative of brittle deformation are also common: major minerals as well as titanite and allanite show fractures, locally associated to a small displacement of fragments. Fractures are filled by secondary minerals such as calcite, chlorite and epidote. Retrograde replacement of primary mineral assemblage is not only localised along fractures; within the calcite poor layers, clinozoisite is abundant and generally replaces feldspars.

398 5. MONAZITE

9 **5.1 Monazite composition**

We identified a total of 32 monazite grains in the biotite-rich paragneisses and 4 monazite grains in the biotite-poor paragneisses (Table S6, Supplementary Material). Results of EPMA analysis are reported in Table S1 (Supplementary Material). The monazite grains analysed are rare earth element (REE) phosphate with Ce as the dominant REE (Fig. 4) and thus they can be classified as monazite-(Ce) according to Linthout (2007). Monazites from protomylonites are characterised, on average, by a higher huttonite component (Fig. 4) due to the increase of Th and U with respect to Ca + Si following the solid solution between cheralite (Ca(Th,U)(PO₄)₂) and huttonite (Th,U)SiO₄ end-members (Forster, 1998; Linthout, 2007).

Among the analysed elements, Nd, Y, and La show apparent variations as function of the
 rock fabric. While Y and La are on average higher within monazite from mylonites, Nd has
 an opposite trend (Fig. 4B-C; Table S1). The Th/U ratio does not change significantly within

3 412 the two different sheared rocks (Fig. 4C; Table S1) and it has values comparable to those 4 413 reported for monazite within granulites exposed in the Valle Strona di Omegna (Williams et 414 al., 2022; Fig. 4D). 8

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¹²416 5.2 Monazite textural position and zoning

14 15 417 Protomylonite: Biotite-poor paragneiss (VSDO-13B1)

17418 Here we selected 4 monazite grains (Mnz1a, Mnz4a, Mnz6a and Mnz6b) that are among ¹⁹419 grains of major rock-forming minerals or included within a sillimanite porphyroblast (Fig. 5, 22 420 Table S6).

24 4 2 1 Mnz1a and 6b have an elongated shape whereas Mnz6a has a more irregular shape with 25 26 4 2 2 cuspate terminations. All these grains are characterised by a large Th-rich core surrounded 27 28 423 by thin rims/edges with lower Th content. Y is generally homogeneous within the large core 29 30 31 424 and tends to be higher in the outermost domains (a few µm) of the grains (Fig. 5A-B). Mnz4a 32 33 4 2 5 is stubby (Fig. 5B) and differs from the other grains since it shows opposite zoning features: 34 ³⁵ 426 on one side, towards the foliation, high-Th and low-Y domains occur. This grain is also 36 37 ₃₈ 427 characterised by intense fractures that crosscut the entire grain, and it has numerous fine-39 40 428 grained pores/inclusions aligned almost parallel to the main fractures (Fig. 5B).

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45⁴³⁰ Protomylonite: Biotite-rich paragneisses (VSDO-13A1)

46 In sample VSDO-13A1 a total of 9 grains were characterised by X-ray maps: 8 grains are 47 431 48 ⁴⁹ 432 located along the main foliation and 1 is included in garnet (Table S6). 50

52 433 51 The monazite grains located along the main foliation show a variable size and shape 53 54 4 3 4 (TableS6), and all presents apparent chemical zoning for Y and Th (Fig. 5A-D and S2; Table 55 56 4 3 5 S1). The most common zoning pattern consists of large cores richer in Th and poorer in Y 57 ⁵⁸436 surrounded by thinner irregular rims richer in Y and poorer in Th (e.g., Mnz6b Fig. 5C and 59 60 437 Mnz2a, 8a, Fig. S2). The Th distribution in the internal domains is irregular and locally riches

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concentrations up to 12wt.% (ThO₂). Locally Y-rich bands alternate with Th-rich ones (e.g., Mnz4a, Fig. 5B). Monazite grains totally or partially enclosed within garnet are characterised by a patchy zoning of both Y and Th (e.g., Mnz7a, Fig. 5D). Less commonly Y is almost homogeneously distributed within the grain whereas Th looks oscillating (e.g., Mnz1a Fig. 5A).

444 Mylonites: paragneisses

Sheared paragneisses (*VSDO-13M1*, *VSDO-13M2* and *VSDO-13M4*) contain abundant monazite grains. Twenty-three grains were selected as representative of different textural positions and were fully characterised (EPMA chemical analyses and X-ray maps; Table S1): 13 are located along the main foliation, 3 are in the strain shadow around porphyroclasts, 4 are in contact with garnet and 3 are totally or partially included within garnet porphyroclasts (Table S6). Some of these monazite features are shown in Fig. 5 and S2. The X-ray maps of selected monazite grains revealed that monazite shows three main different zoning patterns.

i) Ten of the analysed twenty-three grains do not show a clear core-rim zoning and are
 locally characterised by internal domains poorer in Y and external domain richer Y (e.g.,
 Mnz7, VSDO-13M1; Mnz7 VSDO-13M2; Mnz14, VSDO-13M4, Fig. 5E). In these grains Y
 and Th are correlated.

ii) Seven of the analysed twenty-three grains show irregular shapes with inner domains richer in Y and external domains Y-depleted. In these grains the zoning pattern of Th is not apparently correlated with Y (e.g., Mnz6, VSDO-13M1; Mnz4 VSDO-13M4, Fig. 5H).

iii) Five of the analysed twenty-three grains are elongated (high aspect ratio) and show richer
 Y cores and poorer Y rims/tips (Mnz15, Mnz11 and Mn10 VSDO-13M2, Fig. 5F-G). Also, in
 these grains the zoning pattern of Th is not apparently correlated with Y.

A patchy distribution of both Th and Y was observed for one grain partially included within
garnet (e.g., Mnz15, VSDO-13M4).

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5.3 Monazite quantitative orientation data

¹² 467 Four monazite grains from the studied samples were analysed by EBSD (Fig. 6). Two from 13 14 15 468 the protomylonitic paragneiss (Mnz2a, Mnz6B, VSDO-13A1) and two from the mylonitic 16 paragneiss (Mnz1, Mnz2, VSDO-13M1). All monazite grains show significant distortions (up 17 469 18 ¹⁹470 to 12°) regardless of the degree of strain intensity of the two different samples. However, 20 21 22 471 monazite grains from mylonites show higher degree of distortions strongly localised at the 23 24 472 rims/tips of the grain with respect to those from protomylonites. In all grains, the systematic 25 26 473 orientation of the main grain (blue colour) with little changes of distortions towards the rims 27 ²⁸ 29 474 (red colour) is highlighted not only by EBSD maps but also by the profile and pole figures 30 31 475 (Mnz2a, Mnz2; Fig. 6A, D). The single blue points in pole figures emphasise the occurrence 32 33 476 of neoblasts (e.g., Mnz6B, Mnz1; Fig. 6B, C).

Monazite from the protomylonite (VSDO-13A1) shows slightly continuous and discontinuous increasing lattice distortions from core to rim (around 5-8°; Fig. 6A, B). The higher degree of distortion is focused on the rim/tips (Mnz2A; Fig. 6A) and locally, when changes in orientation due to the occurrence of grain boundaries occurred (Mnz6B; Fig. 6B).

⁴⁴ 481 Monazite from the mylonite (VSDO-13M1) presents significant lattice distortions especially ⁴⁶ 47 482 focused on the rim/tips (up to 12° ; Fig. 6C, D). These locally developed into distinct ⁴⁸ neoblasts (Mnz1; Fig. 6C) or are reached from the continuous increasing of distortions from ⁵¹ 52 484 core to rim (Mnz2; Fig. 6D).

56 486 5.4 Monazite U-Th-Pb dating
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⁵⁸₅₉487 **Protomylonites**

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Page 21 of 235

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Geological Magazine

A total of eighty-eight analyses were performed on 12 monazite grains within the protomylonites (4 grains from the biotite-poor sample; Fig. 7A-B; Tab. S4). Sixty-three data resulted concordant (% of concordance >95%) for both ²⁰⁶Pb/²³⁸U vs ²⁰⁷Pb/²³⁵U and ²⁰⁶Pb/²³⁸U vs ²⁰⁸Pb/²³²Th systematics in the range of 314±6 Ma to 184±6 Ma. The dominant Carboniferous-Permian dates (57% of the total dataset) were obtained mostly from cores of monazite occurring within the foliation and from one grain enclosed within garnet. These grains are characterised by both cores to rim zoning features (low-Y cores or inner domains surrounded by high Y rims and/or external domains) or patchy zoning (Figs. 7B, S3). The Triassic data (33% of the total dataset) were obtained mostly from high-Y external portions (Fig. 7B) whereas the youngest Jurassic dates were obtained from one high-Y grain occurring as satellite around a larger grain (Fig. S3), a high-Y rim of a monazite with patchy zoning and a Y-rich domain of a grain showing numerous fractures and pores (e.g., Mnz4a, VSDO13-B1).

502 Mylonites

A total of eighty-eight analyses were performed on 21 monazite grains within the mylonites (Fig. 7A-B; Tab. S4). Sixty-one ${}^{206}Pb/{}^{238}U$ data resulted concordant (% of concordance >95%) with respect to both ${}^{207}Pb/{}^{235}U$ and ${}^{208}Pb/{}^{232}Th$ data. Although dates show a huge spread from 290 ± 14 Ma to 188 ± 6 Ma they fall mostly in the Triassic period (36 data, 59% of the entire dataset). The minor Carboniferous-Permian dates (8 data, 13% of the entire dataset) were obtained mostly from cores of monazite occurring within the foliation and from two grains partially or totally enclosed within garnet. These grains are characterised by both cores to rim zoning features (low-Y cores or inner domains surrounded by high Y rims and/or external domains) or patchy zoning. The Triassic and Jurassic dates (53 data, 87% of the entire dataset) were obtained from high-Y rims surrounding low-Y cores and from high-Y elongated or anhedral grains along the foliation (Fig. 7B, S4).

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5 6 515	6 TITANITE
7 8 516	6.1 Titanite textural position
9 10 517 11	Titanite is found generally as elongated grains aligned with the foliation (Fig. 8) with
$\frac{12}{13}518$	dimensions up to $600x250 \ \mu\text{m}$. Locally, small grains occur as satellites around larger titanite
14 15 519	grains (Fig. 8A, B). Rarely titanite is observed within clinopyroxene porphyroclasts (e.g.,
16 17 520	Ttn11; Fig. 8H). Two sets of fractures were observed within titanite (Fig. 8), one set is parallel
¹⁹ 521 20	to the cleavage and the second one is generally at high angle with respect to the foliation
²¹ 22 522	and crosscut the entire grains. In this latter case, fractures are filled by secondary minerals
23 24 523 25	such as chlorite, albite, epidote, ilmenite. In titanite inclusions of feldspars, calcite, chlorite,
26 524 27	epidote, apatite, zircon and rarely rutile were observed. Trails of small inclusions/pore are
²⁸ 29 525	also common (Fig. 8).
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32 33 527 34	6.2 Titanite zoning, chemistry and thermometry
³⁵ 36 528	Based on textural and chemical features titanite can be subdivided in two main types. Type
37 38 529	"Z" titanite is apparently zoned in BSE images with darker tips/terminations and brighter
39 40 530 41	cores (Fig. 8A-D). Rarely, the darker domains are more extended, partially enveloping the
⁴² 531 43	grain (Fig. 8B-D). Locally, zoning features are crosscut by brighter parallel bands reflecting
44 45 532	twins (Fig. 8B-D). Type "Z" titanite occurs generally within the silicate-rich layers. Type "unZ"
46 47 533 48	titanite is relatively unzoned in BSE images (Fig. 8E- G) and occurs mostly within the calcite-
49 534 50	rich layers. Both types can coexist within the same textural site within a distance of a few
⁵¹ 52 535	microns (Fig. 8G, H) at the boundary between the two compositional layers (i.e., calcite-rich
53 54 536 55	and silicate-rich layers). The apparent chemical differences between the two types of titanite
56 537 57	have been further documented by X-ray maps of both types (Figs. S5 and S6). According
⁵⁸ 538 59	to the X-ray maps of two selected grains of type "Z" titanite large cores with higher La_2O_3 ,

Geological Magazine

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539 Ce_2O_3 and Nd_2O_3 and Nb_2O_5 are surrounded by thinner rims/tips with lower REE (Fig. S5). 540 The distribution of elements within the cores is indicative of a sector zoning.

Quantitative chemical analyses of titanite are reported in Table S2 and Fig. 9A-B. Type "unZ" titanite grains have on average lower TiO₂ (35.9 ± 0.7 wt.%) and Fe₂O₃ (0.34 ± 0.04 wt.%) contents with respect to zoned titanite (TiO₂= 36.6 ± 0.6 wt.%; Fe₂O₃= 0.39 ± 0.05 wt.%) and higher Al₂O₃ content (2.5 ± 0.3 vs 2.0 ± 0.3 wt.%; Fig. 9A). The CaO content of type "Z" titanite is highly scattered and on average lower (27.8 ± 0.5 wt.%) than the CaO content of unzoned titanite (28.2 ± 0.2 wt.%; Fig. 9B). Analogously, fluorine is on average higher for the type "unZ" titanite with respect to type "Z" (0.76 ± 0.07 vs 0.59 ± 0.07 wt.%; Fig. 9B).

Fourteen titanite grains were analysed for trace element composition confirming significant differences between the two types of titanite (zoned vs unzoned) and from core to rims of zoned titanite grains. The normalised REE patterns reveal that the two different types of titanite show similar trends with LREE fractionated over HREE (Fig. 9C-D). This is particularly apparent for type "Z" titanite (Fig. 9C), and one type "unZ" grain characterised by a significant depletion of HREE (e.g., Ttn23; Fig. 9D). Type "Z" titanite differs also for a more pronounced negative Eu anomaly that is weak or absent for homogeneous titanite (Fig. 9C, D). Type "Z" titanite grains are characterised also by a more pronounced intragrain variation of the REE patterns (Fig. 9C). Generally, the dark external domains have LREE lower than 10000 times CI whereas the bright inner domains have LREE higher than 10000 times CI (Fig. 9C, E).

⁴⁹ 559 Zirconium has an opposite trend with respect to REE (Fig. 9E) being on average higher ⁵¹ 560 within inner domains of type "unZ" homogeneous titanite grains with respect to type "Z" ⁵³ 561 titanite (Zr<1600 ppm). This difference is much more apparent for the dark external domains ⁵⁵ of type "Z" titanite where Zr is <500 ppm (Fig. 9E). The two types of titanite are well ⁵⁸ 563 distinguishable in terms of Nd contents. The type "unZ" grains are generally poorer in Nd ⁶⁰ 564 (<1000 ppm) with respect to type "Z" titanite (Fig. 9E).

By adopting the Zr-in-titanite thermometer of Hayden et al. (2008) the obtained temperatures 565 range from 741 to 866°C for type "Z" titanite and from 744 to 919°C for type "unZ" titanite. 566 The external domains of both types of titanite are systematically poorer in Zr content and 567 10 568 thus provide lower temperatures with respect to the internal domains (Fig. 9F). The obtained ¹² 569 temperature values overlap the peak temperature conditions estimated from the surrounding 15 570 metabasite and metapelitic rocks equilibrated under high-grade metamorphic conditions 17 571 (e.g., Kunz & White, 2019; Fig. 9F).

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6.3 Titanite quantitative orientation data

24 574 Seventeen titanite grains were analysed with EBSD; we present four representative grains 26 575 in terms of deformation and type (type "Z" Fig. 10A-D, type "unZ", Fig. 10-H). Most of the ²⁸ 29 576 analysed grains show at least one set of polysynthetic straight to slightly kinked twin lamellae 31 577 (e.g. Fig. 10). The twins have a thickness of about 0.5 µm, cross the grain and terminate 33 578 against grain boundaries with a disorientation from the host grain by $\sim 74^{\circ}/<102>$ in ³⁵ 579 accordance with previous studies (Timms et al., 2019; McGregor et al., 2021; Corvò et al. ₃₈ 580 2023).

While twins are common for the two studied titanite type grains ("Z" and "unZ"), the other 40 581 41 ⁴² 582 deformation features differ between them. 43

44 45 583 Type "Z" titanite shows lattice distortions up to 21° focused to rims/tips (10 grains; ttn2, ttn4, 46 ttn5, ttn7, ttn10, ttn23, ttn24 ttn34, ttn27, Ttn40; Fig. 10A-D), whereas type "unZ" titanite has 47 584 48 ⁴⁹ 585 diffuse and weak (<5°) intracrystalline lattice distortions (six grains; ttn18, ttn19, ttn3, ttn16, 50 51 52 586 51 ttn25, ttn26; Fig. 10E-H). One exceptional elongated grain (ttn17) exhibits fragmented 53 54 587 (domino like) texture with stepped variation of the distortion angle and minor subgrains (Fig. 55 56 588 10H). Quantification of the local dislocation density (measured as Weighted Burgers vector, 57 ⁵⁸ 589 59 hereafter WBV) for type "Z" and type "unZ" grains provides average values for laser spot

analyses of 0.0043 μ m⁻¹ and 0.0018 μ m⁻¹, respectively (Tab. S5). Overall, for both titanite types, deformation and orientation changes do not perfectly overlap the chemical zoning.

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10 593 **6.4 Titanite U–Pb dating**

¹² 594 A total of 73 petrochronological analyses were performed on 14 grains within a mylonitic 13 14 15 595 calc-silicate (VSDO-12R2B). Results are summarised in Tab. S5 and Fig. 11. The U-Pb 16 data are dispersed on the Tera-Wasserburg diagram defining a large U-Pb field suggesting 17 596 18 ¹⁹ 597 ternary mixing between different common Pb values and multiple radiogenic Pb 20 21 21 598 components. In order to interpret the U-Pb data, we looked for alignment of the isotopic 23 24 599 data correlated with textural position, chemistry and/or deformation microstructure (i.e., 25 26 600 dislocations density) for each titanite type, namely type "Z" and type "unZ" (Fig. 11).

²⁸₂₉ 601 By considering the average dislocation density calculated for each U–Pb analytical spot, no ³⁰₃₁ 602 clear correlations are apparent (Fig. 11A, B). A weak correlation with Σ LREE and isotopic ³²data is appreciable especially for zoned titanite (type "Z"; Fig. 11C). The analytical spots ³⁵₃₆ 604 collected from domains richer in LREE are generally located to the left of the data population ³⁷₃₈ 605 (Fig. 11C, D).

40 606 The location of the analysis spots shows a slight systematic in the TW diagram (Fig. 11E, 41 42 43 607 F): external domains/tips of both types show a good alignment on the TW defining a lower 44 45 608 intercept at 186 ± 6 Ma (Fig. 11G). The entire dataset is bounded by another regression line 46 47 609 mostly coinciding with the innermost domains of both zoned and homogeneous titanite 48 ⁴⁹ 610 50 grains. This regression line has a lower intercept age at 240 ± 5 Ma. The U–Pb data between 51 52 611 the two regression lines refer to cores and intermediate positions (Fig. 11E-G).

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⁵⁶₅₇ 613 **7. DISCUSSION**

⁵⁸₅₉614 **7.1** Behaviour of monazite as function of the deformation fabric

615 As shown in the Kernel Density Estimation plots of Fig. 12A, the distribution of concordant 616 data of monazite grains within protomylonites range broadly from Carboniferous-Permian (52% of the data) to Triassic (48% of the data) with rare Jurassic dates. This spread is 617 10618 partially overlapping the monazite radiometric data from unsheared metamorphic rocks 11 12 619 13 collected along the Valle Strona di Omegna crustal section (Fig. 12B; Henk et al., 1997; 14 15 620 Guergouz et al., 2018; Williams et al., 2022; Wyatt et al., 2022). Conversely, the distribution 16 17 621 of U-Th-Pb concordant data of monazite grains within mylonites is tighter being almost 18 ¹⁹ 622 made by Triassic-Jurassic dates (85% of the data; Fig. 12A) which are scarce in previous 20 21 --- 623 studies of unsheared metamorphic rocks from the same crustal section (Fig. 12B). 23

24 6 24 These different distributions of U-Th-Pb concordant data between monazite from 25 26 6 2 5 protomylonites and mylonites are correlated with textures, microstructure and chemistry 27 ²⁸ 29 626 (zoning features). Monazite grains from protomylonites have stubby or rounded shapes (low 30 31 627 aspect ratio) and are generally larger with respect to monazite from mylonites (Fig. 5, Table 32 33 628 S6). They are generally characterised by large homogeneous cores surrounded by thin rims 34 ³⁵₃₆ 629 with lobate boundaries towards the cores (Fig. 5). Conversely, within mylonites monazite 37 ₃₈ 630 grains show higher aspect ratios (highly elongated grains), chemical zoning revealed more 39 40 631 complex features with larger rims/tips over cores or and/or opposite chemical trends from 41 42 632 43 core to rims with respect monazite from protomylonites (Fig. 5). These results are generally 44 45⁴³633 consistent with the microstructural results that show higher degree of distortions strongly 46 localised at the rims/tips of the monazite grains from mylonites with respect to those from 47 634 48 ⁴⁹ 635 protomylonites (Fig. 6). 50

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7.2 Presence of three distinct monazite generations 54 637

56 638 Combining textural features with chemical data, X-ray maps and isotopic data we recognized 57 ⁵⁸ 639 three generations of monazite. The main features of the three different generations are 59 60 640 schematized in Figure 13A.

Page 27 of 235

Geological Magazine

The first generation of monazite (MNZI) is defined by grains partially or totally included within 641 642 garnet porphyroclasts (shielding effect) and domains of monazite occurring along the foliation. MNZI grains/domains are more abundant within protomylonites (Figs., 7 and 13A) 643 10 6 4 4 and are associated with Carboniferous-Permian concordant dates (314-250 Ma). Monazite $^{12}_{13}645$ grains from mylonites partially enclosed within garnet were also able to locally preserve old 15 646 dates but often discordant (e.g., Janots et al., 2008). The preservation of old dates within the foliation is a common feature of sheared rocks (e.g., Langone et al., 2011) and highlights 17 647 ¹⁹ 648 the heterogeneous behaviour of monazite (or more generally of geochronometers) as 22 649 function of the hosting microdomain and shear partitioning. MNZI grains/domains are 24 6 50 generally characterized by patchy zoning of both Th and Y and/or cores poorer in Y with 26 651 respect to the rims/ external domains. The patchy zoning of both Th and Y is probably the ²⁸₂₉652 result of an aggregation of small monazite grains in lower-amphibolite facies rock, 31 653 pseudomorph after (probable) allanite (e.g., Skrzypek et al., 2018; Williams et al., 2018). 33 654 The low Y cores of MNZI grains lying along the foliation or in contact with matrix-forming ³⁵₃₆655 minerals (Fig. 13A) formed likely during or after garnet growth that is able to fractionate Y ₃₈ 656 as well as HREE (e.g., Rubatto et al., 2006; Taylor et al., 2014).

40 657 The second generation of monazite (MNZII) refers to rims/domains with higher Y 42 658 43 concentrations (MNZIIa, Fig. 13A) with respect to cores or adjacent domains (i.e., MNZI). 45⁴⁴659 MNZIIa domains are characterised by lobate, inward-penetrating shapes with sharp contact 46 with the inner domains suggesting the migration of a reaction front. These features have 47 660 48 ⁴⁹ 661 been suggested as criteria for identify the Coupled Dissolution-Precipitation process (CDP; 50 51 52 662 51 Putnis, 2009; Harlov et al., 2011; Varga et al., 2020) and have been attributed to the inward 53 progression of fluids/melts changing chemistry and or isotopic record (Putnis, 2009; 54 663 55 Weinberg et al., 2020, Varga et al. 2020). MNZIIa rims/domains are common within 56 664 57 ⁵⁸ 665 protomylonites but are more developed within mylonitic samples where they can be the 2/3 59 60 666 of the grain (Figs. 5, 7, 13A). The isotopic data relative to the MNZIIa define a Triassic cluster

1 2 3 of concordant dates (weighted average of 222 ± 8 Ma). The second generation of monazite 667 4 5 is not only restricted to domains of replacement but also is seen as whole grains with 668 6 7 669 elongated shapes (high aspect ratio) and high Y content almost homogeneously distributed 8 9 ¹⁰ 670 along the grain or with low Y "tips" (MNZIIb on Fig.13A). Monazite grains with these features 11 $^{12}_{13}671$ were observed exclusively within mylonites and provided Triassic dates (weighted average 14 15 672 of 238 ± 8 Ma; Figs. 7, 13A). The internal, external and isotopic features suggest a syn-16 17 673 kinematic development of MNZIIb grains/domains whose ages are related to a specific 18 ¹⁹ 674 tectonic event (e.g., Williams & Jercinovic, 2002). The observed textural and internal 21 22 675 features suggest that the Y-rich MNZIIb grains are probably the result of a more pervasive 23 24 6 7 6 CDP process that, as well as for MNZIIa, it may reflect a period of monazite formation 25 ²⁶ 677 27 coevally with the breakdown of garnet (releasing Y). The higher proportion of MNZII over 28 29 678 MNZI within mylonites is correlated with a more intense garnet break-down (Fig. 13A) as 30 documented by grain size reduction and shaping of garnet becoming smaller, elliptic or 31 679 32 ³³ 680 rounded. The Y released during garnet break-down is thus incorporated within the external 34 35 36³⁶681 domains (MNZIIa) and/or grains (MNZIIb) of monazite formed by CDP. 37 38 682 The last generation of monazite (MNZIII) is defined by a few grains/domains providing 39 40 683 mostly Jurassic concordant dates (nine data; dates ranging from 202±8 to 184±6 Ma; Fig. 41 42 43⁶⁸⁴ 13A). MNZIII grains/domains were observed mainly within protomylonites (e.g., Mnz4a, 44 VSDO-13B1; Mnz6c, VSDO-13A1; Mnz8c, VSDO-13A2; Fig. 5 and S1) and rarely within 45 685 46 ⁴⁷ 686 mylonites (Mnz9, VSDO-13M1 in Fig. S1; Fig. 13A). MNZIII is mostly defined by small, 48 49 .9 50⁶⁸⁷ isolated grains occurring as satellites around larger grains and by domains of grains 51 52 688 characterised by i) numerous fractures and/or ii) anhedral shapes and/or iii) numerous 53 54 689 pores. The relatively large spread of dates and the presence of interconnected nano- and 55 ⁵⁶ 690 57 micro-porosity, as well as fractures, are markers that can indicate a late interaction with fluid 58 59 691 (e.g., Harlov et al., 2011) and/or a partial replacement of monazite by a nanomixture of the 60 different monazite generations (e.g., Grand'Homme et al., 2016; Hentschel et al., 2020). 692

27Cambridge University Press

Page 29 of 235

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The observed generations of monazite do not show well defined age clusters being the concordant U–Th–Pb smeared from Carboniferous to Jurassic (Figs. 7 and 12A). This is more apparent for protomylonitic samples. In order to explain this continuous distribution of the concordant U–Th–Pb data two possible phenomena can be argued: i) the physical mixing of domains with different ages within the grain and/or ii) the partial resetting of monazite during subsequent events. Weinberg et al. (2020) studied monazite in migmatites and suggested that the physical mixing had not influence on the age spread that was mainly controlled by the fact that the radiogenic Pb was not completely removed during the CDP reactions occurred during the younger events (Seydoux-Guillaume et al., 2003). Therefore, we here interpret the observed dates distribution within sheared rocks as reflecting inheritance from the regional HT metamorphism (MNZI), the development of syn-shearing domains/grains by CDP during Triassic (MNZII, 238±8 – 222±8 Ma), the late alteration of monazite grains/domains (MNZIII) during Jurassic by interaction with fluids locally promoted by intracrystalline deformation.

7.3 Titanite heterogeneity controlled by the local environment

Two types of titanite were recognized within the calc-silicate sample: i) titanite characterised by an apparent zoning, higher REE content and lying mostly within calcite-poor layers (type "Z" titanite); ii) homogeneous titanite with lower REE contents and occurring preferentially within calcite-rich layers (type "unZ" titanite). The main features of the two titanite types are schematized in Figure 13B.

The occurrence of these two distinct types of titanite within the same thin section suggests that the calc-silicate sample is made of different protoliths, i.e., siliciclastic/volcanoclastic and carbonate/marl (Fig. 13B). The same observation has been recently made by Corvò et al. (2022; 2023) for titanite within mylonitic rocks from the Anzola Shear Zone from the adjacent Ossola valley (Fig. 1A). In these rocks the chemistry of titanite together with the

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mineral assemblages suggests the presence of alternating layers made of amphibolites and calc-silicates, i.e. former siliciclastic/volcanoclastic and carbonate/marl layers, respectively. The local environment exerted a fundamental role also on the deformation features recorded by titanite (Fig. 13B). While deformation twinning is common for both "Z" and "unZ" types, titanite grains from calcite-poor portions (type "Z") show higher lattice distortions (up to 21°) focused to rims/tips with respect to "unZ" titanite from calcite-rich portions. A similar correlation between microstructure and the composition of the microdomain hosting titanite has been described for the banded (amphibolites – calc-silicates) mylonites of the Anzola Shear Zone exposed in the adjacent Ossola valley (Fig. 1A; Corvò et al., 2023).

729 **7.4 Petrogenesis of titanite vs U–Pb record: a decoupling between chemistry and** 730 **isotopes**

Figure 13B summarizes the suggested petrogenetic evolution of titanite as well as the observed microstructures and the isotopic record. Titanite is occurring within the matrix and is also included within clinopyroxene porphyroclasts (Fig. 8H). In both cases it shows the same zoning and chemical features. These observations suggest that titanite formed at least coevally with the peak metamorphic assemblage during the Permian high-temperature regional metamorphism. Since the occurrence of sphene in metamorphic rocks is strongly controlled by bulk composition (Frost et al., 2001), the composite nature of our sample, i.e., former siliciclastic/volcanoclastic and carbonate/marl layers, would imply different metamorphic reactions for the formation of titanite. According to phase relations diagram for calcite-bearing rocks titanite could be produced and stable at high temperatures and X(H₂O) conditions during regional metamorphism by reactions involving calcite, quartz, rutile \pm clino/zoisite (e.g., Frost et al., 2001; Kohn, 2017). Within the silicate-rich layers, the formation of titanite during metamorphism needs further reactants such as chlorite, clinopyroxene, amphibole, plagioclase and ilmenite (e.g., Frost et al., 2001; Kohn, 2017). Page 31 of 235

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The reactions involving the above-mentioned reactants may explain the formation of titanite observed within both calcite-poor and calcite-rich domains of the studied sample during the HT regional metamorphism. The apparent zoning consisting of a depletion of LREE, Y and Zr in the external portions of type "Z" titanite can be explained by two alternative processes. This feature is compatible with the occurrence of large allanite (LREE-rich epidote) grains grown almost coevally with titanite within the silicate-rich layers (Fig. 3G). Alternatively, the LREE depletion of the external domains for titanite could be related by the occurrence of clinozoisite developed during deformation (Fig. 3H). The lack of an apparent zoning within type "unZ" titanite and the occurrence of clinozoisite within both layers suggest that the observed zoning is a primary feature due to the formation of allanite almost coevally with titanite (stage2 on Fig. 13B).

The pre-shear mineral assemblages of both calcite-poor and calcite-rich layers contain garnet. The observed REE pattern for titanite may be useful to unravel the genetic relationships between garnet and titanite. The lack of a significant and general HREE fractionation for the analysed titanite grains (Fig. 9C, D) indicate that titanite probably predates garnet formation. Alternatively, the possible HREE fractionation exerted by garnet coeval or predating titanite is extremely local (e.g., Ttn23, Fig. 9D). According to the P-T-X(CO₂) modelling of Rapa et al. (2017) for both calcite-poor and calcite-rich domains of calcsilicates from Himalaya, different episodes of titanite growth are predicted before the formation of garnet-bearing assemblages. These observations are more compatible with our first hypothesis of a garnet postdating titanite. Summarizing, the observed titanite grains are the result of different metamorphic reactions, as function of the hosting microdomains, producing allanite almost coevally with titanite (stage 2 on Fig.13B) and predating garnet during regional HT metamorphism. This petrogenetic reconstruction is coherent with the Zrin-titanite temperature estimates obtained for internal domains of titanite indicating high 770 temperature conditions (919 \pm 82 – 746 \pm 50°C). These temperatures overlap, or are even

3 higher than, the peak temperatures estimated from the adjacent mafic and pelitic 771 4 5 772 metamorphic rocks (Fig. 9; Kunz & White 2019). Even though, the titanite rims provided 6 7 lower temperature with respect to the cores (850 \pm 57 - 741 \pm 49°C) these remain still 773 8 9 10 774 significantly higher with respect to the gualitative (syn-kinematic mineral assemblages 11 12 12¹²775 suggest epidote-bearing amphibolite facies conditions) and quantitative estimates of 14 15776 temperature conditions of deformation (<700°C; Simonetti et al., 2023). 16 17 777 Contrarily to monazite showing three distinct generations it has not been possible to define 18 19 778 different generations for titanite combining U-Pb isotopes with chemistry and 20 21 22 779 microstructures (Fig. 13B). The U-Pb data obtained from titanite are bounded by two 23 24 780 regression lines with lower intercept ages at 240±5 and 186±6 Ma (Fig. 11; 13B). These two 25 ²⁶781 regression lines are correlated with textural position being the oldest related to the cores 27 28 29 782 and the youngest linked to the rims/tips of titanite. The time interval framed by the two 30 regression lines does not fit with (postdate) the main peaks of the Permian regional high-31 783 32 ³³ 784 temperature metamorphism that has been constrained, in extreme detail, with zircon (Ewing 34 ³⁵ 36 785 et al., 2013; Kunz et al., 2018), monazite (Williams et al., 2022; Wyatt et al., 2022) and 37 garnet (Connop et al., 2024; Bartoli et al., 2024) along the same crustal section (Fig. 12B). 38 786 39 40 787 The oldest possible intercept age from the innermost portion of titanite grains points to 41 42 43 788 Triassic (TTNII? in Fig. 13B) indicating that this accessory mineral was not able to clearly 44 45 789 retain the age of crystallisation (TTNI? in Fig. 13B). The Triassic lower intercept age 46 47 790 obtained from the innermost titanite domains could thus reflect: i) the crystallization/cooling 48 ⁴⁹791 age, or ii) a total reset of the isotopic system within a pre-existing grain. As discussed above, 50 51 52 792 titanite formed during the Permiam regional metamorphism, coevally with the first generation 53 54 793 of monazite (MNZI in Fig. 13A) therefore the first hypothesis is unlikely. The studied crustal 55 56 794 levels experienced high temperature conditions for a long-time interval causing a spread of 57 59 795 the zircon (Ewing et al., 2013; Kunz et al., 2018) and monazite ages (Williams et al., 2022; 60 796 Wyatt et al., 2022). At these temperatures the U-Pb system of zircon and monazite was

Page 33 of 235

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Geological Magazine

797 partially reset whereas within titanite it was completely open until Triassic. Alternatively, a 798 Triassic event caused a total reset of the titanite U-Pb record. The U-Pb data distribution 799 strongly correlated with the position within the grain of titanite could reflect a volume diffusion process enhanced by deformation twins (e.g. Bonamici et al., 2015; Moser et al., 2022; Corvò et al., 2023; Kavanagh-Lepage et al., 2023) that are common features of both titanite types (Fig. 13B). At the high temperature stage of shearing the development of deformation twins promoted the evacuation of the radiogenic ions (e.g., Kavanagh-Lepage et al., 2023). The oldest lower intercept age obtained from the inner portions of titanite is partially overlapping the age of syn-kinematic monazite (i.e., MNZII: 222±8 and 238±8 Ma). This observation supports the alternative interpretation of the old lower intercept age marks the beginning of deformation. The U–Pb lower intercept age obtained from the external domains (rims/tips) partially showing evidence for intracrystalline deformation (localised higher dislocation density) of both titanite types (TTNIII in Fig. 13B) may thus reflect the end of volume diffusive loss of Pb and a localized deformation-induced isotopic reset (Stearns et al., 2015; Moser et al., 2022). Recently, Corvò et al. (2023) reported the same interpretation for titanite grains within the Anzola Shear Zone, that can be considered as the NE prolongation of the shear zone studied in this work.

In summary, titanite preserved the internal features (chemistry and zoning) from the Permian 44 45 815 regional metamorphic event while the U-Pb data have no memory of it, recording mostly the deformation-induced resetting and volume diffusion. Several authors have recently 47 816 ⁴⁹ 817 described similar features studying titanite in sheared rocks (Kavanagh-Lepage et al., 2023; 51 52 818 Corvò et al., 2023): deformation influenced the U-Pb system without promoting significant 54 819 modification of titanite chemistry (geochemical decoupling).

7.5 Complementary behaviour of monazite and titanite

3 Combining the chemical, isotopic and microstructural features we recognised a contrasting 822 4 5 823 behaviour of monazite and titanite that likely provided complementary information (Figs. 11-6 7 13). The former experienced an intense reactivity (CDP) during Triassic with the involvement 824 8 9 10 825 of garnet (e.g., Y-enriched rims/domains/grains; MNZII on Fig. 13A). Locally, it developed 11 ¹² 826 internal features (chemistry, fractures, pores) suggesting a fluid assisted phase of isotopic 13 14 15 827 perturbance during Jurassic (MNZIII on Fig. 13A). Monazite was also able to substantially 16 17 828 preserve the age information relative to the prograde HT metamorphism, resulting thus 18 ¹⁹ 829 partially resilient to the subsequent deformation events (MNZI on Fig. 13A). 20 21 22 830 Titanite on the contrary was almost chemically unreactive during deformation preserving the 23 24 831 zoning features developed during the prograde metamorphism (chemical resiliency). On the 25 26 832 other hand, titanite has not retained the age of the Permian HT metamorphism (TTNI? on 27 ²⁸ 29 833 Fig. 13B), as documented by monazite in this work and from literature (Bartoli et al., 2024; 30 31 834 Cannop et al., 2024; Wyatt et al., 2022; Williams et al., 2022; Henk et al., 1997). A similar 32 33 835 decoupling between chemistry and U-Pb isotopic data has been already described for 34 ³⁵₃₆ 836 titanite in amphibolite and calc-silicate (Holder & Hacker 2019; Kavanagh-Lepage et al., 37 ₃₈ 837 2023; Corvò et al., 2023). Titanite demonstrated a more pronounced intracrystalline 39 deformation, with respect to monazite, as documented by deformation twins across the 40 838 41 ⁴² 839 grains and the localization of dislocations at rims/tips. These features could be responsible 43 44 45⁴⁴840 for the observed decoupling, allowing more efficiently the mobility of U and Pb isotopes 46 (along the dislocation boundaries, e.g., Bonamici et al., 2015) with respect to the other trace 47 841 48 ⁴⁹ 842 elements. Moreover, in presence of abundant silicates surrounding titanite the deformation 50 51 843 at the rim/tips is generally more intense and thus the U-Pb data of these domains might 53 54 844 reflect both volume diffusion and recrystallization. 55 56 845 Combining the complementary information from the two investigated geochronometers and 57

thanks to their different behaviour during shearing it has been possible to reconstruct the timing of the shear zone activity otherwise only partially recorded.

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849 7.6 Regional implications: rift-related shear zone activity from Middle Triassic 850 (Ladinian) to Early Jurassic (Sinemurian)

The Forno-Rosarolo shear zone developed within metasedimentary rocks characterised by metamorphic conditions at the transition between granulite and amphibolite facies (Redler et al., 2012; Kunz et al., 2014; Kunz & White, 2019; Simonetti et al., 2023). Deformation overprinted mainly paragneisses and metabasites, which experienced extensive partial melting during Permian time. Petrographic and microstructural observation on mylonitic paragneisses suggest that deformation developed under amphibolite facies conditions (~650 °C and ~0.55GPa; Simonetti et al., 2023). The rare occurrence of chlorite at the expense of biotite and the sillimanite replacement by white mica indicate that mylonites were poorly affected by green-schist retrograde overprint (Simonetti et al., 2023).

Integrating the U–Th–Pb data with textural, microstructural and chemical features of monazite, the activity of the shear zone can be constrained from two monazite generations. The main one, MNZII, documents the amphibolite facies ductile shearing with formation of tiny, syn-kinematic Y-rich monazite grains (238±8 Ma) and Y-rich rims (222±8 Ma) around old cores (MNZI: 314-250 Ma). This Triassic event represents the beginning of a syn-rift deformation that has been recorded at different crustal levels within the IVZ (e.g., Langone et al., 2018). During the late stage of the amphibolite-facies deformation, the interplay between deformation and fluids promoted the formation of the third generation of monazite (MNZIII; from 202±8 to 184±6 Ma) within sheared paragneisses and the formation of the rims/tips of titanite within the mylonitic calc-silicates (TTNIII; lower intercept age at 186±6 Ma). Both the last generation of monazite and the rim/tips of titanite can be attributed to the end of deformation under amphibolite facies condition across the Triassic-Jurassic boundary. It is interesting to note that recently a similar conclusion has been suggested by
873 Corvò et al. (2023) for the Anzola Shear Zone from the adjacent Ossola valley, i.e. a 874 northeast prolongation of the studied shear zone.

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10 876 **8. CONCLUSIONS**

The activity of the shear zone has been constrained at the Triassic-Jurassic time by combining geochemical and U–(Th)–Pb data from monazite and titanite within sheared migmatitic paragneisses and calc-silicates, respectively.

¹⁹ 880 Monazite chemical and isotopic signature is directly affected by its deformation history. In 20 21 22 881 protomylonitic paragneisses monazite preferentially retained ages related to the regional HT 23 24 882 metamorphism (resiliency) whereas in mylonites it was more able to record the deformation 25 26 883 events (reactivity). The Y-rich syn-kinematic domains/grains of monazite formed during 27 28 29 884 Triassic $(238 \pm 8 - 222 \pm 8 \text{ Ma})$ due to a CDP process coevally with the breakdown of garnet 30 31 885 (releasing Y).

33 886 On the contrary, although titanite was almost chemically unreactive during deformation 34 ³⁵ 887 (resiliency), its U-Pb isotopic system was not able to retain the Permian regional 37 38 888 metamorphism. The U–Pb data are correlated with textural and microstructural features. 39 40 889 The titanite innermost domains provide a Triassic lower intercept age (240 ± 5 Ma) indicating 41 ⁴² 890 a total isotopic reset at the beginning of deformation. This was favoured by the occurrence 43 44 45 891 of deformation twins across the titanite grains acting as preferential pathways for the U and 46 Pb isotopes. The rims/tips of titanite, partially overlapping the zone of accumulation of 47 892 48 ⁴⁹ 893 dislocations, define a Jurassic lower intercept age at 186±6 Ma. The entire U–Pb dataset is 50 51 52 894 thus reflecting the combined effect of a deformation-induced volume diffusion and 53 54 895 recrystallization.

The reconstructed timing of deformation suggests a strong causal relationship to the
 Triassic-Jurassic rifting event leading to the opening of the Alpine Tethys that affected the

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Page 37 of 235

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3 898 4	Adria continental crust. Hence, mid crustal shear zones such as the one studied played a
5 6 899	fundamental role in accommodating deformation.
7 8 900	Our study shows that combining age information from different geochronometers within
9 10 901 11	different protoliths and/or showing different fabric (i.e., protomylonitic and mylonitic) allows
¹² 902 13	to unveil the details of shear zone activity.
14 15 903	
16 17 904 18	
¹⁹ 905 20	Acknowledgement
²¹ 22 906	The following projects partially funded this research: PRIN2017 "Micro to Macro - how to
23 24 907 25	unravel the nature of the large magmatic events" (20178LPCPW- Langone Antonio);
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37 381475	Figure Ca	aptions							
39 40:476	Fig. 1 – Ge	eological	sketch ma	ap of the Ivrea-	Verbano Zon	e, modified after Ewing e	t al. (2015), S	Simonetti et al.	
41 4 2 477	(2021a; 20)23) and	Corvò et a	al. (2022). In Aj) the location	s of Triassic-Jurassic she	ear zones (in	red) dated by	
43 44478	U–Pb meth	hod are a	fter Lango	one et al., 2018	8 (Finero area) and Corvò et al., 2023	(Anzola area). The studied	
45 4 0 479	area is delimited by the black box. B) Schematic structural and geological map of the Forno-Rosarolo shear								
47 48 48	zone (mod	dified afte	er Bertolar	ni 1968 and Si	monetti et al	., 2023) with location of	samples and	alysed for the	
49 50 ⁴⁸¹	geochrono	logy.							
521482	Fig. 2 – Th	nin sectio	n scans (A	A-C) of sheared	paragneisse	s and BSE images (D-F)	showing som	e textural and	
54483	petrograph	nic details	s. Dashed	l white boxes	on BSE imaç	ges in D-F, enclose son	ne monazite	grains whose	
55 561484 57	internal zo	ning is sh	own in Fi	gure 5. Mineral	abbreviation	s after Whitney and Evar	ıs (2010).		
58 59485	Fig. 3 – ⊺	hin secti	on scans	(A-B) of shear	red calc-silica	tes with thin silicate-rich	ו layers high	lighted by the	
⁶⁰ 1486	dashed bra	acket on	the left si	de of each ima	age. Micropho	otographs show the main	ו petrographi	c and textural	

31487 features under both plane (C, E) and crossed (D, F) polarised lights of calcite-poor (C, D) and calcite-rich 51488 layers (E, F). The BSE image in G highlights the presence of large allanite grain close to titanite. The 71489 microphotograph in H shows the occurrence or retrograde clinozoisite under both plane (left side) and crossed 91490 (right side) polarised lights.

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 $^{11}_{12}_{12}_{12}_{1491}$ Fig. 4 – Mineral chemistry of monazite from mylonites (red squares) and protomylonites (blue circles). A) ¹³1492 14 Monazite composition and classification according to Linthout (2007), B) Y (a.p.f.u.) versus La (a.p.f.u.), C) 15493 Th/U versus Nd (a.p.f.u.). D) Th/U ratio of monazite from metasedimentary rocks with different metamorphic 16 17/494 degree from the Valle Strona di Omegna after Williams et al. (2022). 18

19 201495 Fig. 5 – BSE and chemical X-ray maps (Y, Th) of monazite grains within proto- and mylonitic paragneisses 21 22 496 (A-H). The textural position of each monazite grain is reported within the Y-map. The locations of monazite in 23 24 497 A and B are reported in Fig. 2D, locations of monazite grains in D and F are shown in Fig. 2E and 2F, 25 26 498 respectively.

28,499 Fig. 6 - Representative Y maps and microstructural features of monazite within A, B) protomylonitic (A, B) and 29 3**Q** 500 mylonitic (C, D) paragneisses. Microstructural features are shown as relative crystallographic orientation maps 31 32/501 (GROD angle map), misorientation profile diagrams (a-b) and pole figure plots for (001) to highlight degrees 33 34 502 of distortion across the monazite grain. The numbered white circles represent the LA-ICP-MS spot analyses 35 3d 503 performed on monazite grains numbered according to the U-Pb analyses reported in Tables S4. It is 37 38 504 interesting to note that there is no overlap between Y-zoning and increasing distortions. Both maps and plots ³⁹ 40⁵⁰⁵ show the increasing distortions focused on the rim/tips of the grains. Pole figures are plotted in lower $^{41}_{42}_{42}506$ hemisphere, equal area projections in the sample x-y-z reference frame. The colours of point in pole figures 43 44 507 reflect the colours of the GROD angle map. Black arrows highlight the way of dispersions.

48 508 Fig. 7 - Summary of concordant monazite U-Th-Pb data for protomylonitic and mylonitic paragneisses 47 48 509 organised in ascending order for each sample. The length of boxes represents the apparent ages with the 2o 49 5d 510 uncertainty. Data are coloured as function of the textural position (A) and the Y content of the relative analytical 51 521511 spot (B). The weighted average of two clusters obtained from specific grains/domains are also reported in A). 53 54 512 The location of the analytical spots is shown on the X-ray maps and BSE images.

59513 Fig. 8 – High contrast BSE images of titanite within calc-silicates showing textural and internal features. A-D) 57 58/514 Type "Z" (Zoned) titanite consisting of large brighter cores surrounded by thin darker asymmetric rims. Small 59 6**q**515 titanite grains occurring as satellites close to the large grains are shown in A and B. E-G) Type "unZ" (unzoned) Page 61 of 235

Geological Magazine

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titanite without apparent zoning. In both Types, fractures (yellow arrows) at high angle with respect to the foliation are common. Two sets of twins are highlighted by green and purple arrows and are more pronounced within the Type Z titanite. H) BSE Image of a textural site showing the location of titanite grains within the matrix reported in G), and a grain included within a clinopyroxene porphyroclast. The inset is the high contrast BSE image of this included grain.

¹³1521 14 **Fig. 9** – Diagrams of titanite chemistry showing the differences between the two main Types. A) TiO_2 (wt.%) 15/1522 vs Al_2O_3 (wt.%), B) CaO (wt.%) vs F (wt.%). The grey areas enclose the data from the two Types. C) and D) 17 523 Chondrite-normalized REE patterns of Type "Z" and "unZ", respectively (chondrite values from McDonough 19524 and Sun, 1995). For comparison, the Chondrite-normalized REE patterns of titanite grains from sheared 211525 amphibolite and calc-silicate layers from the Anzola Shear Zone are reported in grey (Corvò et al., 2023). E) 23/526 Nd (ppm) vs Zr (ppm), F) Temperature (°C) estimate according to the Zr-in-titanite thermometry (calibration of 251527 Hyden et al., 2008). The grey shaded box indicates the Temperature conditions for the regional metamorphism 26 271528 obtained by Kunz and White (2019) with P-T pseudosection calculations for unsheared metabasic and 28 29 529 metapelitic rocks at the boundary of the shear zone.

31/530 32 Fig. 10 - BSE and microstructural features of titanite within calc-silicates (sample VSDO-12R2) in Cal-poor 33 531 calc-silicates (A-D; Type "Z") layers and Cal-rich calc-silicates (E-H; Type "unZ"). Microstructural features are 35 532 shown as relative crystallographic orientation maps (GROD angle map), misorientation profile diagrams (a-b) 371533 and pole figure plots for (100), (010), (001) showing the orientation of titanite grain, grain boundaries, subgrains 38 391534 and twins. The numbered white circles represent the LA-ICP-MS spot analyses performed on titanite grains 40 411535 numbered according to the U–Pb analyses reported in Table S5. It is interesting to note that there is no overlap 42 431536 between BSE-zoning and increasing distortions. While titanites Type "Z" show the increase of distortions 44 4<u>4</u>537 focused on the rim/tips of the grains, titanites Type "unZ" show little degree of distortion spread across the 46 47 538 whole grain. Pole figures are plotted in lower hemisphere, equal area projections in the sample x-y-z reference 48 49 539 frame. The colours of point in pole figures reflect the colours of the GROD angle map. Black arrows highlight 50 51 51 the way of dispersions.

Fig. 11 – Tera-Wasserburg diagrams of titanite U–Pb data from Type "Z" (A, C, E) and Type "unZ" (B, D, F) from sample VSDO-12R2. Each ellipse represents a U–Pb datapoint and is coloured as function of: the relative microstructure, defined as the Weighted Burger Vector (A, B); the Σ LREE (C, D) and its position within the grain, i.e., core vs rim (E, F). G) Cumulative Tera-Wasserburg diagram for both titanite types showing the regression lines anchored to Stacey and Kramers (1975) common Pb ratios considering the U–Pb data from 31546 the innermost cores (green filled ellipses) and outermost rims/tips (red filled ellipses) of titanite grains. The 51547 relative lower intercept ages are also reported. The datapoints delimited by a dashed line were not included in 71548 the calculation of the intercept ages.

9 10 10 10 Fig. 12 - Kernel Density Estimation (KDE) of U-(Th-)Pb monazite data for sheared (A; this work) and $11_{12}^{11}_{12}_{12}_{12}_{12}$ unsheared (B; from literature data) metasedimentary rocks exposed in Val d'Ossola di Omegna. A) ²⁰⁶Pb/²³⁸U 13 1551 14 monazite dates for mylonitic (reddish filled KDE curve and datapoints) and protomylonitic (bluish filled KDE 15/1552 curve and datapoints) samples. The grey bands represent the lower intercept ages and relative uncertainties 16 17 553 obtained for the titanite from the sheared calc-silicate (this work). 18

19 201554 Data points (small circles below the curve) in B) refer to: a)²⁰⁸Pb/²³²Th monazite dates from amphibolite- to 21 22 555 granulite-facies metasediments, after Wyatt et al. (2022); b) ²⁰⁶Pb/²³⁸U corrected monazite dates from 23 24 556 amphibolite- to granulite facies metasediments, after Williams et al. (2022); c) 207Pb/206Pb monazite data from ²⁵ 26 amphibolite-facies metasediment, after Guergouz et al. (2018); d) monazite U-Pb ages, after Henk et al. ²⁷1558 28 (1997).

30 559 Fig. 13 - Synoptic summary of different generations of monazite (A) within protomylonitic and mylonitic 32560 paragneisses and titanite (B) within mylonitic calc-silicates. For each generation the main microstructures, 34561 chemical zoning features and U-Pb data are reported as well as the main mineral assemblages.

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³⁹ 40⁵⁶³ Supplementary materials

42 43 564 **Figures Supplementary**

45 46 565 Fig. S1 – BSE images of monazite from different samples showing replacement textures with allanite growth.

48 566 Fig. S2 - BSE images and chemical X-ray maps (Y, Th) of monazite grains within proto- and mylonitic 5q 567 paragneisses.

52 53 568 Fig. S3 - U-Th-Pb data of monazite within protomylonites from each analysed grain (left column) and ordered 54 55 569 (right column). Box high is the 2σ uncertainty. On the diagrams of the left column the concordance between 56 57570 the two U-Pb systems is shown by a colour code reported on the top of the column; the unfilled boxes are the 58 59 571 ²⁰⁸Pb/²³²Th data. The textural position of the grain is also shown as well as information about the chemistry.

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The diagrams on the right column highlight isotopic data concordant (green filled boxes) and discordant (unfilled and dashed boxes) for the three systems.

Fig. S4 - U-Th-Pb data of monazite within mylonites from each analysed grain (left column) and ordered (right column). Box high is the 2σ uncertainty. On the diagrams of the left column the concordance between the two U-Pb systems is shown by a colour code reported on the top of the column; the unfilled boxes are the ²⁰⁸Pb/²³²Th data. The textural position of the grain is also shown as well as information about the chemistry. The diagrams on the right column highlight isotopic data concordant (green filled boxes) and discordant (unfilled and dashed boxes) for the three systems.

Fig. S5 – BSE and X-ray maps of zoned (Type "Z") titanites within calc-silicate. The darker shade on the BSE image or cold colours in the X-ray maps for the external domains indicate lower content of LREE. The coloured scale of the X-ray maps represents the intensity of the characteristic X-ray emission for each elements.

Fig. S6 - BSE and X-ray maps of zoned (Type "unZ") titanites within calc-silicate. The coloured scale of the X-ray maps represents the intensity of the characteristic X-ray emission for each element.

Tables Supplementary

- Tab. S1 EPMA (major and minor elements) chemical results for monazite.
- Tab. S2 Monazite textural features.
- Tab. S3 LA-ICP-MS U–(Th–)Pb data analytical details.
- Tab. S4 U–Th–Pb monazite data.
- Tab. S5 EPMA (major and minor elements) chemical results for titanite.
- Tab. S6 U-Pb and trace elements titanite data.

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Table 1 - Summary of mineral assemblage, accessory minerals, type of fabric and analysed minerals for the studied samples.

Sample name (coordinates)	Rock type	Mineral assemblage (accessory minerals)	Type of fabric	Analysed accessory mineral for geochronology
VSDO-13B (45.932198, 8.290887)	biotite-poor paragneiss	Sil, Grt, Qz, Pl, Kfs, Bt (Mnz, Rt, Zrn)	protomylonitic fabric	monazite
VSDO-13A (45.932198, 8.290887)	biotite-rich paragneisses	Bt, Sil, Grt, Qz, Pl, Kfs (Mnz, Rt, Zrn)	protomylonitic fabric	monazite
VSDO-13M1; VSDO-13M2; VSDO-13M4;	biotite-rich paragneisses	Bt, Sil, Grt, Qz, Pl, Kfs (Mnz, Rt, Zrn)	mylonitic (locally ultramylonitic) fabric	monazite
(45.932412, 8.292021)		6		
VSDO-12R2B (45.930638, 8.292250)	calc-silicate	Cal, Pl, Kfs, Amp, Cpx, Bt, Bt ± Grt, Scp, Aln (Ttn, Zrn, Ap)	mylonitic fabric	titanite
	-		~	

2	Table S1 - EPMA Mor	nazite			
3	Microprobe Lab	MILANO	MILANO	MILANO	MILANO
4	Sample	VSDO-13B1	VSDO-13B1	VSDO-13B1	VSDO-13B1
5	Mnz#	MN76A-1	MN76A-2	MNZ6A-3	MN76A-4
6	Textural Position	Dim	Int	Int	
/	Textural Position	IXIIII	III	III	Core
9	(10()				
10	(wt%)				
11	P2O5	30.04	29.92	30.38	30.17
12	SiO2	0.22	0.42	0.41	0.19
13	ThO2	5.24	8.58	8.24	6.29
14	UO2	0.31	0.33	0.31	0.30
15	La2O3	13 13	11 68	11.83	13 27
10 17	$C_{e}^{2}O_{3}^{3}$	28.46	26.30	26.17	27.23
17	Dr2O3	20.40	20.00	20.17	27.20
19	FIZO3	J. IZ	2.52	2.74	2.90
20	Nd2O3	12.71	12.82	12.12	11.65
21	Sm2O3	1.80	2.22	2.02	2.16
22	Gd2O3	1.09	1.41	1.45	1.34
23	Dy2O5	0.04	0.00	0.00	0.08
24	Y2O3	0.12	0.16	0.05	0.38
25 26	CaO	1.19	1.69	1.82	1.37
20	Total	97 47	98.05	97 54	97 40
28	rotar	01.41	00.00	07.04	07.40
29	(a p f u)				
30	(a.p.i.u.)	4.04	4.00	4.04	4.04
31	P	1.01	1.00	1.01	1.01
32	Si	0.01	0.02	0.02	0.01
33 34	Th	0.05	0.08	0.07	0.06
34	U	0.00	0.00	0.00	0.00
36	La	0.19	0.17	0.17	0.19
37	Ce	0.41	0.38	0.38	0.39
38	Pr	0.05	0.04	0.04	0.04
39	Nd	0.00	0.18	0.01	0.16
40	Sm	0.10	0.10	0.17	0.10
41	SIII	0.02	0.03	0.03	0.03
42 43	Ga	0.01	0.02	0.02	0.02
44	Dy	0.00	0.00	0.00	0.00
45	Y	0.00	0.00	0.00	0.01
46	Са	0.05	0.07	0.08	0.06
47					
48	ΣΙΛ	1.02	1.02	1.03	1.02
49	ΣIX	0.97	0.97	0.96	0.97
50 51		1 00	1 00	1 00	1 00
52	04140	1.55	1.55	1.55	1.55
53					
54					
55	Mnz	93.64	90.30	89.68	92.86
56	Cher.	5.44	7.88	8.54	6.31
57	Hutt.	0.92	1.82	1.77	0.83
58 50	summ	100	100	100	100
59 60					

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2					
3	MILANO	MILANO	MILANO	MILANO	MILANO
4	VSDO-13B1	VSDO-13B1	VSDO-13B1	VSDO-13B1	VSDO-13B1
6	MNZ6A-5	MNZ6A-6	MNZ6B-1	MNZ6B-2	MNZ6B-3
7	Core	Rim	Rim	Int	Int
8					
9			1		
10	30.04	29 74	30.25	30.23	30.06
11	0 16	0.22	0.18	0.24	0 32
12	5.05	5 20	4.62	5.46	7.42
14	0.90	0.00	4.02	0.40	7.42
15	0.29	0.38	0.28	0.25	0.19
16	13.37	12.99	13.47	12.93	12.51
17	27.23	28.14	28.88	28.69	26.92
18	2.73	3.04	2.95	3.12	2.88
19	12.09	13.09	12.62	12.50	12.57
20	1.97	2.14	2.11	2.12	1.74
22	1.66	1.36	1.31	1.29	1.45
23	0.20	0.05	0.03	0.16	0.02
24	0.39	0 15	0 12	0 12	0.12
25	1 20	1 15	0.04	1 17	1 55
26	07.23	07.02	0.34	00.00	07.76
27 28	97.37	97.03	97.75	90.20	97.70
29					
30					
31	1.01	1.00	1.01	1.01	1.01
32	0.01	0.01	0.01	0.01	0.01
33	0.05	0.05	0.04	0.05	0.07
34 35	0.00	0.00	0.00	0.00	0.00
36	0.20	0.19	0.20	0.19	0.18
37	0.40	0.41	0.42	0.41	0.39
38	0.04	0.04	0.04	0.04	0.04
39	0.17	0.19	0.18	0.18	0.18
40	0.17	0.10	0.10	0.10	0.10
41 42	0.03	0.00	0.00	0.03	0.02
43	0.02	0.02	0.02	0.02	0.02
44	0.00	0.00	0.00	0.00	0.00
45	0.01	0.00	0.00	0.00	0.00
46	0.05	0.05	0.04	0.05	0.07
47					
48 70	1.02	1.01	1.02	1.02	1.02
50	0.97	0.98	0.97	0.97	0.97
51	1.99	1.99	1.99	1.99	1.99
52					
53					
54	03 30	93.84	94 97	93 68	Q1 <u>4</u> 3
55 56	5 02	5 0 <i>1</i>	A 26	5 21	7 12
57	0.80	0.02	T.20	1 00	1 20
58	0.07	0.92	0.77	1.00	1.39
59	100	100	100	100	100
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MILANO MILANO MILANO MILANO MILANO MILANO VSDO-13B1 VSDO-13B1 VSDO-13B1 VSDO-13B1 VSDO-13B1 MILANO MILANO VSDO-13B1 MILANO MILANO	1					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	2					
OSDO-1361 VSDO-1361 NZ68-7 NIX NIX AA.1 10 0.16 0.17 0.15 0.20 0.15 0.20 0.15 0.20 1.168 2.26 2.10 1.68 2.26 1.10 1.06 1.168 2.26 1.16 0.18 0.64 2.26 1.16 0.18 0.64 2.26 1.26 1.18 1.25 0.20	4					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	5	VSDO-13B1	VSDO-13B1	VSDU-13B1	VSDU-13B1	VSD0-13B1
7 Core Core Int Rim Rim 9 30.19 30.05 30.45 29.77 30.15 11 30.19 30.05 30.45 29.77 30.15 12 0.16 0.13 0.15 0.18 0.26 13 5.60 5.73 5.54 5.94 3.76 14 0.21 0.17 0.15 0.29 0.15 15 12.71 12.82 13.11 13.03 14.99 17 27.21 27.98 27.86 27.24 28.76 16 2.95 3.15 2.87 3.18 3.16 12.09 12.75 13.08 12.76 11.06 21 1.86 2.30 2.26 2.10 1.68 22 1.47 1.49 1.36 1.51 1.44 23 0.00 0.17 0.22 0.15 0.20 24 0.14 0.16 0.18 <td< td=""><td>6</td><td>MNZ6B-4</td><td>MNZ6B-5</td><td>MNZ6B-6</td><td>MNZ6B-7</td><td>MNZ4A-1</td></td<>	6	MNZ6B-4	MNZ6B-5	MNZ6B-6	MNZ6B-7	MNZ4A-1
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	7	Core	Core	Int	Rim	Rim
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	8					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	9					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	10	30.19	30.05	30.45	29.77	30.15
13 5.60 5.73 5.54 5.94 3.76 14 0.21 0.17 0.15 0.29 0.15 15 12.71 12.82 13.11 13.03 14.99 17 27.21 27.98 27.86 27.24 28.76 18 2.95 3.15 2.87 3.18 3.16 100 0.07 0.22 0.15 0.20 1.86 2.30 2.26 2.10 1.68 22 1.47 1.49 1.36 1.51 1.44 23 0.00 0.17 0.22 0.15 0.20 24 0.14 0.14 0.16 0.18 0.64 25 0.14 0.14 0.16 0.18 0.64 26 1.25 1.26 1.18 1.25 0.78 27 96.33 98.13 98.40 97.58 97.03 38 0.00 0.00 0.00 0.00 0.00 30 0.5 0.05 0.05 0.05 0.03	11	0.16	0.13	0.15	0.18	0.26
144 0.21 0.17 0.15 0.54 0.54 0.16 15 12.71 12.82 13.11 13.03 14.99 17 27.21 27.98 27.86 27.24 28.76 18 2.95 3.15 2.87 3.18 3.16 12.59 12.75 13.08 12.76 11.06 21 1.86 2.30 2.26 2.10 1.68 22 1.47 1.49 1.36 1.51 1.44 23 0.00 0.17 0.22 0.15 0.20 24 0.14 0.14 0.16 0.18 0.64 25 1.26 1.18 1.25 0.78 27 96.33 98.13 98.40 97.58 97.03 29 0.01 0.01 0.01 0.01 0.01 31 1.02 1.01 1.01 1.00 1.01 32 0.04 0.45 0.05	13	5.60	5 73	5.10	5.04	3 76
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	14	0.00	0.17	0.15	0.20	0.15
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	15	0.21	0.17	0.15	0.29	0.15
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	16	12.71	12.82	13.11	13.03	14.99
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	17	27.21	27.98	27.86	27.24	28.76
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	18	2.95	3.15	2.87	3.18	3.16
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	19	12.59	12.75	13.08	12.76	11.06
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	20	1.86	2.30	2.26	2.10	1.68
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	22	1.47	1.49	1.36	1.51	1.44
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	23	0.00	0 17	0.22	0.15	0.20
250.140.140.160.160.07 26 1.251.261.181.250.78 27 96.3398.1398.4097.5897.03 30 1.021.011.011.001.01 31 1.021.011.010.010.01 33 0.050.050.050.050.03 34 0.000.000.000.000.00 35 0.000.000.000.000.00 36 0.190.190.190.190.22 37 0.400.410.400.400.42 38 0.040.050.030.030.02 40 0.180.180.180.180.18 41 0.030.030.030.030.02 42 0.020.020.020.020.02 43 0.000.000.000.000.00 44 0.050.050.050.050.03 47 49 1.031.011.021.011.02 48 1.031.011.021.011.02 49 0.960.980.970.980.97 51 1.991.991.991.991.99 52 53 5.745.385.733.54 55 93.4893.7393.9793.5295.38 56 5.835.745.385.733.54 56 <	24	0.00	0.17	0.16	0.18	0.64
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	25	1.25	1.26	1 10	1.25	0.04
27 96.33 98.13 98.40 97.58 97.03 28 30 1.02 1.01 1.01 1.00 1.01 31 1.02 1.01 1.01 0.00 1.01 0.01 33 0.05 0.05 0.05 0.03 0.03 34 0.00 0.00 0.00 0.00 0.00 35 0.00 0.00 0.00 0.00 0.00 35 0.00 0.40 0.41 0.40 0.42 36 0.19 0.19 0.19 0.19 0.22 37 0.40 0.41 0.40 0.40 0.42 38 0.04 0.05 0.04 0.05 0.05 40 0.18 0.18 0.18 0.18 0.16 41 0.03 0.03 0.03 0.02 0.02 42 0.02 0.02 0.02 0.02 0.02 44 0.00 0.00 0.00 0.00 0.01 45 0.0	26	1.20	1.20	1.10	1.25	0.70
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	2/	96.33	98.13	98.40	97.58	97.03
301.021.011.011.001.01 31 1.021.010.000.010.010.01 32 0.010.050.050.050.03 33 0.050.050.000.000.00 34 0.000.000.000.000.00 35 0.000.000.000.000.00 36 0.190.190.190.190.22 37 0.400.410.400.400.42 38 0.040.050.040.050.05 40 0.180.180.180.180.18 41 0.030.030.030.030.02 42 0.020.020.020.020.02 43 0.000.000.000.000.00 44 0.050.050.050.050.03 47 49 1.031.011.021.011.02 49 1.031.011.021.011.02 49 1.031.011.991.991.99 51 1.991.991.991.991.99 52 5.83 5.74 5.38 5.73 3.54 55 93.48 93.73 93.97 93.52 95.38 56 5.83 5.74 5.38 5.73 3.54 55 93.48 93.73 93.97 93.52 95.38 56 5.83 5.74	20 29					
31 1.02 1.01 1.01 1.00 1.01 32 0.01 0.00 0.01 0.01 0.01 33 0.05 0.05 0.05 0.05 0.03 34 0.00 0.00 0.00 0.00 0.00 35 0.00 0.00 0.00 0.00 0.00 36 0.19 0.19 0.19 0.22 37 0.40 0.41 0.40 0.40 0.42 38 0.04 0.05 0.04 0.05 0.05 40 0.18 0.18 0.18 0.18 0.18 41 0.03 0.03 0.03 0.02 0.02 42 0.02 0.02 0.02 0.02 43 0.00 0.00 0.00 0.00 44 0.05 0.05 0.05 0.03 47 49 1.03 1.01 1.02 1.01 49 1.03 1.01 1.02 1.01 1.02 49 1.03 1.01 1.02 1.01 1.02 51 1.99 1.99 1.99 1.99 1.99 52 5.83 5.74 5.38 5.73 3.54 55 93.48 93.73 93.97 93.52 95.38 56 5.83 5.74 5.38 5.73 3.54 56 5.83 5.74 5.38 5.73 3.54 57 0.69 0.53 0.65	30					
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	31	1.02	1.01	1.01	1.00	1.01
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	32	0.01	0.00	0.01	0.01	0.01
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	33	0.05	0.05	0.05	0.05	0.03
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	34	0.00	0.00	0.00	0.00	0.00
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	35 36	0 19	0 19	0 19	0 19	0 22
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	37	0.40	0.41	0.40	0.40	0.42
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	38	0.40	0.41	0.40	0.40	0.42
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	39	0.04	0.05	0.04	0.05	0.05
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	40	0.18	0.18	0.18	0.18	0.16
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	41	0.03	0.03	0.03	0.03	0.02
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	42	0.02	0.02	0.02	0.02	0.02
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	43 11	0.00	0.00	0.00	0.00	0.00
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	45	0.00	0.00	0.00	0.00	0.01
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	46	0.05	0.05	0.05	0.05	0.03
48 1.03 1.01 1.02 1.01 1.02 49 0.96 0.98 0.97 0.98 0.97 50 1.99 1.99 1.99 1.99 1.99 51 1.99 1.99 1.99 1.99 1.99 52	47					
49 1.00 1.01 1.01 1.01 1.02 50 0.96 0.98 0.97 0.98 0.97 51 1.99 1.99 1.99 1.99 1.99 52 53 54 55 93.48 93.73 93.97 93.52 95.38 54 55 93.48 93.73 93.97 93.52 95.38 56 5.83 5.74 5.38 5.73 3.54 57 0.69 0.53 0.65 0.75 1.08 58 100 100 100 100 100	48	1 03	1 01	1 02	1 01	1 02
50 0.30 0.30 0.37 0.30 0.37 51 1.99 1.99 1.99 1.99 1.99 52 53 54 55 93.48 93.73 93.97 93.52 95.38 56 5.83 5.74 5.38 5.73 3.54 57 0.69 0.53 0.65 0.75 1.08 58 100 100 100 100 100	49	0.96	0.08	0.07	0.08	0.07
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	50	1.00	1.00	1.00	1.00	1.00
53 54 55 93.48 93.73 93.97 93.52 95.38 56 5.83 5.74 5.38 5.73 3.54 57 0.69 0.53 0.65 0.75 1.08 58 100 100 100 100 100	51	1.99	1.99	1.99	1.99	1.99
54 55 93.48 93.73 93.97 93.52 95.38 56 5.83 5.74 5.38 5.73 3.54 57 0.69 0.53 0.65 0.75 1.08 58 100 100 100 100 100	52 53					
5593.4893.7393.9793.5295.38565.835.745.385.733.54570.690.530.650.751.085810010010010010060	54					
565.835.745.385.733.54570.690.530.650.751.08581001001001001005960	55	93.48	93.73	93.97	93.52	95.38
57 0.69 0.53 0.65 0.75 1.08 58 100 100 100 100 100 59 0 100 100 100 100	56	5.83	5.74	5.38	5.73	3.54
⁵⁸ 100 100 100 100 100 100	57	0.69	0.53	0.65	0.75	1.08
59 60	58	100	100	100	100	100
	60 60					

1					
2					
5 4	MILANO				MILANO
5	VSDO-13B1	VSDO-13B1	VSDO-13B1	VSDO-13B1	VSDO-13B1
6	MNZ4A-2	MNZ4A-3	MNZ4A-4	MNZ4A-5	MNZ4A-6
7	Rim	Core	Core	Rim	Rim
8					
9					
10	29.92	30.07	29.51	29.83	29.79
11 12	0.29	0.22	0.40	0 47	0.31
13	6.78	4 33	7 94	4 98	3 53
14	0.10	4.00 0.14	0.42	4.00 0.00	0.00
15	0.17	12.07	10.42	0.90	12.60
16	12.43	13.07	12.55	13.04	13.09
17	27.42	27.69	26.88	26.89	28.90
18 10	3.09	3.16	2.86	3.35	3.49
20	12.87	12.51	11.26	11.85	11.83
21	1.69	2.38	1.72	2.16	2.20
22	1.21	1.90	1.32	1.80	1.55
23	0.23	0.37	0.21	0.46	0.15
24	0.05	1.19	0.09	0.82	0.86
25 26	1.34	0.92	1.60	1.04	0.74
20 27	97 49	97.95	96 77	97 58	97.80
28	07.40	07.00	50.77	07.00	57.00
29					
30	4.04	4.04	1.00	1.00	4.00
31	1.01	1.01	1.00	1.00	1.00
32	0.01	0.01	0.02	0.02	0.01
33	0.06	0.04	0.07	0.04	0.03
35	0.00	0.00	0.00	0.01	0.01
36	0.18	0.19	0.19	0.19	0.20
37	0.40	0.40	0.39	0.39	0.42
38	0.04	0.05	0.04	0.05	0.05
39 40	0.18	0.18	0.16	0.17	0.17
40	0.02	0.03	0.02	0.03	0.03
42	0.02	0.02	0.02	0.02	0.02
43	0.00	0.00	0.00	0.01	0.00
44	0.00	0.00	0.00	0.07	0.02
45	0.00	0.02	0.00	0.02	0.02
40 47	0.00	0.04	0.07	0.04	0.05
48	4.00	4.04	4.00	4.00	4.04
49	1.02	1.01	1.02	1.02	1.01
50	0.97	0.98	0.97	0.97	0.98
51	1.99	1.99	1.99	1.99	1.99
52					
53 54					
55	92.55	94.96	90.74	93.32	95.42
56	6.21	4.12	7.52	4.71	3.31
57	1.24	0.92	1.74	1.97	1.28
58	100	100	100	100	100
59					100
00					

2					
3	MILANO	MILANO	MILANO	MILANO	MILANO
4	VSDO-13B1	VSDO-13B1	VSDO-13B1	VSDO-13B1	VSDO-13B1
5				MN74A 10	
6					
7	RIM	RIM	RIM	RIM	l Kim
8					
9					
10 11	29.75	30.09	29.47	29.99	29.66
17	0 20	0 22	0.37	0.26	0 40
13	4.75	4.56	7.03	5 36	0.12
14	4.75	4.50	7.00	0.00	9.12
15	0.25	0.13	0.20	0.24	0.19
16	13.34	13.72	12.76	13.35	11.66
17	28.35	27.18	27.29	28.29	25.74
18	2.97	2.91	2.75	3.26	2.79
19	12.40	12.05	12.89	12.28	12.13
20	1.96	2.14	1.88	1.76	1.81
21	1 17	1 76	0.89	0 99	1 12
23	0.20	0.40	0.05	0.00	0.26
24	0.20	0.40	0.05	0.00	0.20
25	0.38	1.19	0.05	0.26	0.06
26	1.04	0.95	1.43	1.07	1.78
27	96.77	97.29	97.13	97.10	96.72
28					
29					
30 31	1 01	1 01	1 00	1 01	1 00
32	0.01	0.01	0.01	0.01	0.02
33	0.01	0.01	0.01	0.01	0.02
34	0.04	0.04	0.00	0.05	0.06
35	0.00	0.00	0.00	0.00	0.00
36	0.20	0.20	0.19	0.20	0.17
37	0.42	0.39	0.40	0.41	0.38
38	0.04	0.04	0.04	0.05	0.04
39 40	0.18	0.17	0.18	0.17	0.17
40 41	0.03	0.03	0.03	0.02	0.02
42	0.02	0.02	0.01	0.01	0.01
43	0.02	0.02	0.01	0.01	0.01
44	0.00	0.01	0.00	0.00	0.00
45	0.01	0.03	0.00	0.01	0.00
46	0.04	0.04	0.06	0.05	0.08
47					
48	1.02	1.02	1.01	1.02	1.02
49 50	0.98	0.97	0.98	0.97	0.97
51	1.99	1.99	1.99	1.99	1,99
52					
53					
54	04.00	04.04	04.00	04.00	00.75
55	94.38	94.81	91.80	94.00	89.75
56	4.76	4.28	6.61	4.90	8.48
5/	0.86	0.91	1.60	1.09	1.77
50 50	100	100	100	100	100
60					

1					
2					
3	MILANO	MILANO	MILANO	MILANO	MILANO
4 5	VSDO-13B1	VSDO-13B1	VSDO-13B1	VSDO-13B1	VSDO-13B1
5	MNZ1A-2	MNZ1A-3	MNZ1A-4	MNZ1A-5	MNZ1A-6
7	Int	Rim	Core	Core	Rim
8	-				
9					
10	20.05	20.60	20.47	20.07	20.00
11	30.05	29.09	30.17	29.97	29.00
12	0.11	0.22	0.17	0.25	0.31
13	5.98	6.21	6.18	6.21	7.42
14 15	0.26	0.16	0.18	0.24	0.23
15	12.37	12.50	12.60	12.59	12.08
17	27.26	27.39	27.08	27.05	26.72
18	3 07	2 73	3 30	3 27	2 90
19	12 7/	13 13	12 47	12.80	12.00
20	0.40	0.10	2.47	12.09	2.20
21	2.10	2.20	2.00	2.20	2.10
22	1.63	1.57	1.60	1.33	1.36
23	0.01	0.14	0.26	0.00	0.17
24 25	0.12	0.13	0.14	0.04	0.15
26	1.37	1.35	1.33	1.39	1.53
27	97.16	97.50	97.54	97.42	97.14
28				-	-
29					
30	1 01	1 00	1 01	1 01	1 01
31	1.01	1.00	1.01	1.01	1.01
32 22	0.00	0.01	0.01	0.01	0.01
33	0.05	0.06	0.06	0.06	0.07
35	0.00	0.00	0.00	0.00	0.00
36	0.18	0.18	0.18	0.18	0.18
37	0.40	0.40	0.39	0.39	0.39
38	0.04	0.04	0.05	0.05	0.04
39	0.18	0 19	0.18	0 18	0 17
40	0.03	0.03	0.03	0.03	0.03
41 42	0.00	0.00	0.00	0.00	0.03
43	0.02	0.02	0.02	0.02	0.02
44	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00
46	0.06	0.06	0.06	0.06	0.07
47					
48	1.02	1.01	1.02	1.02	1.02
49 50	0 97	0.98	0 97	0 97	0.97
50 51	1 99	2 00	1 99	1 99	1 99
52	1.00	2.00	1.00	1.00	1.00
53					
54	00.00	00.00		00 <i>- i</i>	
55	93.20	92.89	93.13	92.54	91.49
56	6.34	6.19	6.14	6.39	7.14
57	0.47	0.92	0.73	1.07	1.36
58	100	100	100	100	100
72					

2					
3	MILANO	MILANO	MILANO	MILANO	MILANO
4		VSDO-13B1	VSDO-13B1		VSD0-13B1
5					
6		IVIINZ IA-O	IVIINZ IA-9		
7	Int	Int	Rim	Rim	Int
8					
9					
10	30.08	30.32	29.70	29.70	29.74
11	0.13	0.15	0.43	0.34	0.24
12	5.10	5 79	0.40	0.04	6.51
14	0.49	0.00	0.00	0.05	0.01
15	0.08	0.32	0.15	0.31	0.24
16	13.06	13.04	12.02	11.93	12.55
17	28.09	27.79	25.94	25.98	27.29
18	3.45	2.88	2.44	3.18	2.94
19	12.72	12.73	13.01	12.29	12.70
20	2 06	1 91	2 00	1 84	1 98
21	1 50	1 78	1 / 2	1.01	1.33
22	0.40	0.00	0.40	0.00	0.09
24	0.10	0.00	0.10	0.00	0.06
25	80.0	0.16	0.15	0.14	0.02
26	1.15	1.24	1.65	1.69	1.42
27	98.08	98.11	97.88	97.09	97.04
28					
29					
30 21	1 01	1 01	1 00	1 00	1 01
37	0.01	0.01	0.02	0.01	0.01
33	0.01	0.01	0.02	0.01	0.01
34	0.05	0.05	0.08	0.08	0.06
35	0.00	0.00	0.00	0.00	0.00
36	0.19	0.19	0.18	0.18	0.18
37	0.41	0.40	0.38	0.38	0.40
38	0.05	0.04	0.04	0.05	0.04
39	0.18	0.18	0.18	0.18	0.18
40 //1	0.03	0.03	0.03	0.03	0.03
42	0.00	0.00	0.00	0.00	0.00
43	0.02	0.02	0.02	0.01	0.02
44	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00
46	0.05	0.05	0.07	0.07	0.06
47					
48	1.01	1.02	1.02	1.02	1.02
49 50	0.98	0.97	0.98	0.97	0.98
51	1 99	1 99	1 99	1 99	1 99
52	1.00	1.00	1.00	1.00	1.00
53					
54	04.00	00.00	00.44	00 50	~~~~
55	94.22	93.66	90.41	90.53	92.38
56	5.24	5.68	7.71	7.99	6.57
57	0.54	0.66	1.89	1.48	1.05
58	100	100	100	100	100
60					
1					
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2					
3	MILANO	MILANO	MILANO	MILANO	
4 5	VSDO-13B1	VSDO-13B1	VSDO-13A1	VSDO-13A1	
5	MNZ1A-12	MNZ1A-13	MNZ2A-1	MNZ2A-2	
7	Rim	Core	Rim	Rim	
, 8		0010			
9					
10					
11	30.00	29.11	30.47	29.56	
12	0.22	0.53	0.13	0.08	
13	5.92	8.90	3.29	2.77	
14	0 11	0 14	0 27	0 18	
15	13 50	11.62	15.21	15.67	
16	20.00	26.17	20.70	27.00	
/ 10	20.00	20.17	20.70	27.99	
10 10	2.99	2.78	3.21	3.00	
20	11.91	12.29	11.66	11.04	
21	2.12	1.89	1.85	1.88	
22	1.42	1.15	1.71	1.46	
23	0.16	0.14	0.12	0.24	
24	0.41	0.22	0.29	0.24	
25	1 30	1.68	0.76	2 45	
26 27	09.15	06.62	0.70	06 56	
27 28	90.15	90.02	97.70	90.00	
20					
30					
31	1.00	0.99	1.02	1.00	
32	0.01	0.02	0.01	0.00	
33	0.05	0.08	0.03	0.03	
34	0 00	0 00	0.00	0 00	
35	0.20	0.17	0.22	0.23	
30 37	0.20	0.17	0.42	0.20	
38	0.41	0.59	0.42	0.41	
39	0.04	0.04	0.05	0.04	
40	0.17	0.18	0.16	0.16	
41	0.03	0.03	0.03	0.03	
42	0.02	0.02	0.02	0.02	
43	0.00	0.00	0.00	0.00	
44 45	0.01	0.00	0.01	0.01	
45 46	0.06	0.07	0.03	0 10	
47	0.00	0.07	0.00	0.10	
48	1 01	1 01	1 02	1 00	
49	1.01	1.01	1.02	1.00	
50	0.98	0.98	0.97	1.02	
51	1.99	1.99	1.99	2.03	
52					
53 54					
54 55	93.20	89.78	96.01	89.22	
55	5.89	7.90	3.42	10.46	
57	0.00	2 32	0.56	0.32	
58	100	100	100	100	
59	100	100	100	100	

1					
2					
4					
5	VSDU-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1
6	MNZ2A-3	MNZ2A-4	MNZ2A-5	MNZ2A-6	MNZ2A-7
7	Mantle	Core	Core	Core	Core
8					
9					
10 11	30.60	29.98	29.46	30.03	29.90
12	0.09	0.26	0.76	0.32	0.27
13	2.63	4 74	4 66	4 96	4 99
14	0.17	0.18	4.00 0.21	0.07	4.00 0.30
15	16 50	14.90	0.21	15.07	15 40
16	10.59	14.09	14.39	15.24	10.42
17	29.50	28.19	30.29	29.30	28.98
18 10	3.03	3.16	3.82	2.95	3.47
20	11.69	11.97	13.17	11.78	12.07
21	1.87	1.48	1.22	1.59	1.47
22	1.73	1.16	0.41	1.01	0.70
23	0.11	0.15	0.13	0.00	0.00
24	0.47	0.56	0.00	0.12	0.06
25	0.54	1 01	0.54	0.97	0.97
20 27	00 03	07 73	0.00	08.34	08.61
28	33.03	91.15	33.00	30.34	30.01
29					
30	4.04	4.9.4		4.00	4.00
31	1.01	1.01	0.98	1.00	1.00
32	0.00	0.01	0.03	0.01	0.01
33 24	0.02	0.04	0.04	0.04	0.04
35	0.00	0.00	0.00	0.00	0.00
36	0.24	0.22	0.21	0.22	0.22
37	0.42	0.41	0.44	0.42	0.42
38	0.04	0.05	0.05	0.04	0.05
39	0 16	0 17	0 19	0 17	0 17
40	0.03	0.02	0.02	0.02	0.02
41	0.00	0.02	0.02	0.02	0.02
43	0.02	0.02	0.01	0.01	0.01
44	0.00	0.00	0.00	0.00	0.00
45	0.01	0.01	0.00	0.00	0.00
46	0.02	0.04	0.02	0.04	0.04
47					
48 70	1.02	1.02	1.01	1.02	1.01
50	0.97	0.98	0.98	0.98	0.98
51	1.99	1.99	1.99	1.99	1.99
52					
53					
54	97 26	04 35	Q <u>4</u> 51	04 34	04 53
55 56	21.20 2 20	Δ - .00 Λ ΕΛ	0 2 Q	/ 22	0 1 .00 ۸ 26
57	2.00	4.04	2.00	4.00	4.00
58	0.30	1.10	3.11	1.34	1.12
59	100	100	100	100	100
60					

2					
3	MILANO	MILANO	MILANO	MILANO	MILANO
4	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1
5	MNZ2A-8	MNZ2A-9	MNZ2A-10	MNZ6B-1	MNZ6B-2
0 7	Rim	Rim	Core	Rim	Rim
, 8			0010		
9				I	
10			~~~~	~~~~	
11	26.85	29.23	29.80	29.85	30.31
12	2.36	0.62	0.29	0.27	0.31
13	11.40	5.21	4.42	7.10	6.73
14	0.11	0.10	0.26	0.19	0.24
15	12.40	14,10	16.12	13.41	12.97
10 17	27.32	29.32	29.42	26.40	26.33
18	202	2 16	20.42	20.40	2 05
19	2.93	3.10	3.00	2.74	2.90
20	12.29	12.60	11.39	11.84	12.23
21	0.89	1.16	1.21	1.93	2.16
22	0.53	0.94	0.60	1.37	1.59
23	0.02	0.35	0.13	0.21	0.12
24	0.03	0.11	0.15	0.38	0.39
25 26	0.68	0.77	1.00	1.53	1.43
20	97.82	97.66	97.85	07.21	97 76
28	57.02	07.00	57.00	57.21	57.70
29					
30					
31	0.92	0.99	1.00	1.01	1.01
32	0.10	0.02	0.01	0.01	0.01
33	0.11	0.05	0.04	0.06	0.06
34 25	0.00	0.00	0.00	0.00	0.00
36	0.19	0.21	0.24	0.20	0.19
37	0 41	0.43	0.43	0.38	0.38
38	0.04	0.05	0.04	0.04	0.04
39	0.04	0.00	0.04	0.04	0.04
40	0.10	0.10	0.10	0.17	0.17
41	0.01	0.02	0.02	0.03	0.03
42	0.01	0.01	0.01	0.02	0.02
45 44	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.01	0.01
46	0.03	0.03	0.04	0.07	0.06
47					
48	1 02	1 01	1 01	1 02	1 02
49	0.07	0.08	0.08	0.08	0.07
50	1.00	0.90	0.90	0.90	1.00
51	1.99	1.99	2.00	1.99	1.99
52 53					
55 54					
55	86.94	93.95	94.34	91.77	92.08
56	3.07	3.45	4.45	7.09	6.60
57	9.99	2.60	1.21	1.15	1.32
58	100	100	100	100	100
59	100	100	100	100	100

2					
3	MILANO	MILANO	MILANO	MILANO	MILANO
4	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1
5	MNZ6R 3	MNZ6R /	MNZ6R 5	MNZ6R 6	MNZ6R Z
6					
7	Core	Mantie	Core	Mantie	Mantie
8					
9					
10	30.31	28.99	28.68	28.18	26.98
12	0.21	0.89	1.16	1.30	2.30
13	6 29	7 75	7.60	7 70	12.26
14	0.20	0.15	0.10	0.14	0.10
15	0.10	0.15	0.19	0.14	0.10
16	13.27	12.32	12.64	12.45	11.74
17	27.65	27.40	27.62	28.10	25.88
18	2.83	3.04	3.18	3.18	2.53
19	12.81	13.45	13.35	13.84	12.00
20	1.93	1.83	1.58	1.63	1.02
22	1.25	0.65	0.71	0.46	0.82
23	0.16	0.00	0.00	0.00	0.00
24	0.10	0.00	0.00	0.00	0.00
25	0.10	1 10	0.03	0.00	0.03
26	1.42	1.10	0.84	0.77	0.98
27	98.32	97.59	97.58	97.74	96.64
28					
29					
31	1.01	0.98	0.97	0.96	0.93
32	0.01	0.04	0.05	0.05	0.09
33	0.06	0.07	0.07	0.07	0.11
34	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00
36	0.19	0.10	0.19	0.19	0.10
3/ 20	0.40	0.40	0.41	0.41	0.39
30	0.04	0.04	0.05	0.05	0.04
40	0.18	0.19	0.19	0.20	0.18
41	0.03	0.03	0.02	0.02	0.01
42	0.02	0.01	0.01	0.01	0.01
43	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00
45	0.06	0.00	0.00	0.00	0.00
40 47	0.00	0.05	0.04	0.05	0.04
48	4.00	4.00	4.00	4.04	4.00
49	1.02	1.02	1.02	1.01	1.03
50	0.97	0.97	0.97	0.98	0.96
51	1.99	1.99	1.99	1.99	1.99
52					
53					
54 55	92 65	91 18	91 26	91 10	85 45
55 56	6 47	5.02	3 80	3 45	4 55
57	0.77	2 20	1 02	5.75 5 / E	4.00 10.00
58	0.00	3.00	4.90	0.40	10.00
59	100	100	100	100	100
60					

2					
3	MILANO	MILANO	MILANO	MILANO	MILANO
4	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1
5	MNZ6B-8	MNZ6B-9	MNZ6B-10	MNZ6B-11	MNZ6B-12
6 7	Mantle	Mantle	Core	Mantle	Core
/ Q	Manue	Manue	COLE	Manue	Core
9					
10					
11	28.02	28.30	29.95	28.38	27.97
12	1.19	1.22	0.32	1.09	0.18
13	7.23	9.64	6.84	9.56	6.84
14	0.01	0 24	0 22	0 13	0 14
15	13 18	12 20	12.28	12.60	12 57
16	20 61	72.23	72.20	26.74	27.27
1/ 19	20.01	21.12	27.30	20.74	21.31
10	3.20	2.89	3.04	3.15	2.71
20	12.94	12.53	12.63	13.14	12.49
21	1.22	1.14	1.87	1.20	1.82
22	0.38	0.33	1.37	0.60	0.82
23	0.00	0.06	0.08	0.00	0.05
24	0.00	0.06	0.18	0.04	0.02
25	0.70	1.08	1 / 2	1 37	1.45
26	0.70	07.54	07.57	00.00	04.42
27	90.08	97.51	97.57	98.09	94.43
20					
30					
31	0.97	0.97	1.01	0.97	0.99
32	0.05	0.05	0.01	0.04	0.01
33	0.07	0.09	0.06	0.09	0.06
34	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00
30 27	0.20	0.10	0.10	0.19	0.19
38	0.43	0.41	0.40	0.39	0.42
39	0.05	0.04	0.04	0.05	0.04
40	0.19	0.18	0.18	0.19	0.19
41	0.02	0.02	0.03	0.02	0.03
42	0.01	0.00	0.02	0.01	0.01
43	0.00	0.00	0.00	0.00	0.00
44 45	0.00	0.00	0.00	0.00	0.00
45 46	0.03	0.05	0.06	0.06	0.06
47	0.00	0.00	0.00	0.00	0.00
48	1 01	1 0 2	1 0 2	1 01	1 00
49	1.01	1.02	1.02	1.01	1.00
50	0.98	0.98	0.97	0.99	1.01
51	1.99	1.99	1.99	2.00	2.00
52					
53					
54 55	91.78	89.71	92.09	89.12	92.39
56	3 17	5 01	6 55	6 25	6 83
57	5 06	5 28	1 26	4 63	0.00
58	100	100	1.00	400	400
59	100	100	100	100	100

1					
2					
3 4	MILANO	MILANO	MILANO	MILANO	MILANO
5	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1
6	MNZ6B-13	MNZ6B-14	MNZ6B-15	MNZ6B-16	MNZ6B-17
7	Mantle	Mantle	Rim	Mantle	Mantle
8					
9					
10	28.65	27 87	30 14	27 78	28.56
11	1 08	1 55	0.32	1 75	1 17
12	7.00	9.04	6.02	9.06	6.92
14	7.39	0.04	0.93	0.90	0.03
15	0.19	0.07	0.32	0.00	0.17
16	12.10	12.92	13.20	12.62	12.84
17	27.71	28.50	27.13	28.39	28.15
18	3.12	3.23	2.82	3.19	3.05
19	13.46	12.84	11.80	13.11	13.05
20	1.80	1.13	1.54	0.93	1.74
22	0.80	0.58	1.52	0.34	1.04
23	0.09	0.00	0.10	0.09	0.04
24	0.00	0.00	0.10	0.00	0.01
25	0.00	0.00	1 22	0.00	0.00
26	0.00	0.02	1.32	0.09	0.76
2/	97.27	97.35	97.47	97.84	97.42
20					
30					
31	0.98	0.96	1.01	0.95	0.97
32	0.04	0.06	0.01	0.07	0.05
33	0.07	0.07	0.06	0.08	0.06
34	0.00	0.00	0.00	0.00	0.00
36	0.18	0.19	0.19	0.19	0.19
37	0.41	0.42	0.39	0.42	0.41
38	0.05	0.05	0.00	0.05	0.04
39	0.00	0.00	0.04	0.00	0.04
40	0.19	0.19	0.17	0.19	0.19
41	0.02	0.02	0.02	0.01	0.02
42 43	0.01	0.01	0.02	0.00	0.01
44	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.01	0.00	0.00
46	0.04	0.03	0.06	0.03	0.03
47					
48	1.02	1.02	1.02	1.02	1.02
49 50	0.97	0.97	0.96	0.97	0.97
50 51	1 99	1 99	1 99	1 99	1 99
52	1.00	1.00	1.00	1.00	1.00
53					
54	04.00	00.00	00.47	00 57	04 50
55	91.39	90.69	92.47	89.57	91.58
56	4.01	2.78	6.14	3.11	3.50
57 58	4.60	6.53	1.39	7.33	4.92
59	100	100	100	100	100
60					

1					
2			_		_
3	MILANO	MILANO	MILANO	MILANO	MILANO
4	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1
5	MNZ6B-18	MNZ6B-19	MNZ6B-20	MNZ6B-21	MNZ6B-22
7	Core	Mantle	Rim	Rim	Rim
8					
9					
10	20.11	20.40	20.09	20.07	20.14
11	30.11	29.40	29.90	30.27	30.14
12	0.18	0.74	0.23	0.34	0.22
13	6.11	9.21	6.92	6.86	6.19
14	0.25	0.11	0.23	0.25	0.26
15	12.16	12.00	12.92	12.63	12.56
17	27.89	26.62	26.58	27.03	26.45
18	3.03	2.77	3.08	3.11	2.67
19	13 25	12 53	12 04	12 19	12 11
20	1 84	1 57	2 01	2.02	1.81
21	1.04	0.55	2.01	2.02	1.01
22	1.09	0.55	1.54	1.20	1.24
23	0.11	0.35	0.26	0.14	0.69
25	0.14	0.12	0.37	0.41	1.81
26	1.27	1.69	1.46	1.42	1.37
27	97.43	97.66	97.62	97.93	97.52
28					
29					
30 31	1 01	0 99	1 01	1 01	1 01
32	0.01	0.03	0.01	0.01	0.01
33	0.06	0.00	0.06	0.06	0.06
34	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00
36	0.18	0.18	0.19	0.18	0.18
3/	0.41	0.39	0.39	0.39	0.38
30 30	0.04	0.04	0.04	0.04	0.04
40	0.19	0.18	0.17	0.17	0.17
41	0.03	0.02	0.03	0.03	0.02
42	0.01	0.01	0.02	0.02	0.02
43	0.00	0.00	0.00	0.00	0.01
44	0 00	0 00	0.01	0.01	0.04
45 46	0.05	0.07	0.06	0.06	0.06
40	0.00	0.07	0.00	0.00	0.00
48	1 0 0	1 0 2	1 0 2	1 0 2	1 0 2
49	1.02	1.02	1.02	1.02	1.02
50	0.97	0.97	0.98	0.97	0.98
51	1.99	1.99	1.99	1.99	1.99
52					
53 54					
55	93.35	88.98	92.25	91.99	92.80
56	5.86	7.84	6.74	6.54	6.26
57	0.79	3,18	1.01	1.48	0.94
58	100	100	100	100	100
59	100	100	100	100	100

2					
3	MILANO	MILANO	MILANO	MILANO	MILANO
4		VSD0-13A1			
5					
6	IVIINZOB-23	WINZOB-24		IVIINZOU-Z	
7	Rim	Mantle	Rim	Mantle	Mantle
8					
9					
10	29.86	29.13	29 55	27 54	28 49
11	0.22	0.00	0.54	1 07	1 01
12	0.52	0.00	0.54	1.07	1.21
15 1/I	7.15	8.92	1.55	10.03	7.26
15	0.25	0.26	0.15	0.13	0.09
16	12.44	12.20	12.58	12.39	12.61
17	27.20	27.02	27.51	27.69	28.36
18	2 91	2 88	2 82	3 30	3 12
19	12.00	12.00	12.02	12 44	13 77
20	12.00	12.40	12.20	12.44	1.17
21	2.04	1.08	1.60	0.90	1.43
22	1.41	0.68	0.85	0.48	0.66
23	0.29	0.00	0.00	0.05	0.06
24	0.39	0.03	0.20	0.09	0.00
25	1.48	1.41	1.40	0.81	0.77
20	97 75	97 54	96 95	97 71	97 84
28	01.10	07.01	00.00	07.71	07.01
29					
30					
31	1.00	0.98	1.00	0.94	0.97
32	0.01	0.03	0.02	0.08	0.05
33	0.06	0.08	0.07	0.09	0.07
34	0.00	0.00	0.00	0.00	0.00
35	0.18	0 18	0 19	0 18	0 19
30	0.10	0.10	0.10	0.10	0.10
38	0.39	0.40	0.40	0.41	0.42
39	0.04	0.04	0.04	0.05	0.05
40	0.17	0.18	0.17	0.18	0.20
41	0.03	0.02	0.02	0.01	0.02
42	0.02	0.01	0.01	0.01	0.01
43	0.00	0.00	0.00	0.00	0.00
44	0.01	0.00	0 00	0 00	0 00
45	0.06	0.06	0.06	0.04	0.03
40 47	0.00	0.00	0.00	0.04	0.00
48	4.00	4.00	4.00	4.00	4.00
49	1.02	1.02	1.02	1.02	1.02
50	0.98	0.97	0.97	0.97	0.98
51	1.99	1.99	1.99	1.99	1.99
52					
53					
54	91 80	89 66	<u>91 14</u>	88 43	Q1 44
55 56	6 91	6 54	6 50	3 66	2 /7
50	0.01	0.04	0.00	3.00	J.47
58	1.39	3.79	2.30	1.91	5.09
59	100	100	100	100	100
60					

1					
2					
5 4					
5	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1
6	MNZ6C-4	MNZ6C-5	MNZ6C-6	MNZ6C-7	MNZ6A-1
7	Core	Core	Mantle	Core	Rim
8					
9					
10	29.96	30.01	28.03	29.85	29.82
11	0.38	0.25	1 30	0 23	0.25
13	7 30	7.05	7 57	7 53	7.02
14	0.27	0.14	0.10	0.16	0.21
15	0.27	0.14	12.02	0.10	12.04
16	12.27	12.23	13.02	12.10	12.84
17	26.84	27.14	28.79	27.37	27.16
18 10	2.98	2.82	2.93	2.93	3.19
20	13.31	13.40	13.06	12.96	11.73
21	1.85	2.01	1.48	2.02	1.79
22	1.23	1.20	0.54	0.88	1.14
23	0.22	0.18	0.00	0.00	0.17
24	0.05	0.17	0.00	0.00	0.36
25	1 51	1 52	0.73	1 61	1 43
20 27	08 17	08 12	07.54	07.60	07 11
27	50.17	30.12	37.34	97.09	57.11
29					
30	4.00	4.00		4.00	
31	1.00	1.00	0.96	1.00	1.01
32	0.01	0.01	0.05	0.01	0.01
33	0.07	0.06	0.07	0.07	0.06
35	0.00	0.00	0.00	0.00	0.00
36	0.18	0.18	0.19	0.18	0.19
37	0.39	0.39	0.43	0.40	0.40
38	0.04	0.04	0.04	0.04	0.05
39	0 19	0 19	0 19	0 18	0 17
40 41	0.03	0.03	0.02	0.03	0.02
41	0.00	0.00	0.02	0.00	0.02
43	0.02	0.02	0.01	0.01	0.02
44	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.01
46	0.06	0.06	0.03	0.07	0.06
4/ 10					
40 49	1.02	1.01	1.01	1.01	1.02
50	0.98	0.98	0.98	0.98	0.97
51	1.99	1.99	2.00	1.99	1.99
52					
53					
54 55	91 45	91 97	91 28	91 57	92 29
55 56	6 93	6 97	3 26	7 46	6 65
57	1 60	1 06	5.20	0 D D	1 07
58	1.02	1.00	0.47	0.90	1.07
59	100	100	100	100	100
60					

1					
2					
4					
5	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1
6	MNZ6A-2	MNZ6A-3	MNZ6A-4	MNZ6A-5	MNZ6A-6
7	Mantle	Rim	Core	Mantle	Rim
8					
9					
10	27 98	29 69	28 18	29 15	29 96
11 12	1 42	0.25	1.32	0.72	0.31
13	7.54	7.20	0.43	8.57	6.23
14	0.40	1.21	9.40	0.57	0.25
15	0.10	0.33	0.23	0.09	0.25
16	12.66	12.08	12.51	12.38	12.46
17	28.45	27.01	27.53	26.75	27.45
18	3.51	3.12	2.77	2.92	2.97
19 20	13.45	12.72	12.40	12.66	13.41
20	1.03	2.10	1.40	1.53	1.92
22	0.65	1.17	0.63	0.89	1.00
23	0.17	0.09	0.00	0.00	0.19
24	0.00	0 16	0.00	0 15	0 15
25	0.55	1.55	1 13	1.40	1 27
26	0.55	07.54	07.52	07.04	07.57
27	97.53	97.54	97.53	97.21	97.57
20					
30					
31	0.96	1.00	0.96	0.99	1.01
32	0.06	0.01	0.05	0.03	0.01
33	0.07	0.07	0.09	0.08	0.06
34 25	0.00	0.00	0.00	0.00	0.00
36	0.19	0.18	0.19	0.18	0.18
37	0.42	0.39	0.41	0.39	0.40
38	0.05	0.05	0.04	0.00	0.04
39	0.05	0.00	0.04	0.04	0.04
40	0.19	0.10	0.10	0.10	0.19
41	0.01	0.03	0.02	0.02	0.03
42 43	0.01	0.02	0.01	0.01	0.01
44	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00
46	0.02	0.07	0.05	0.06	0.05
47					
48	1.02	1.01	1.02	1.02	1.02
49 50	0.98	0.98	0.98	0.97	0.97
50	1 99	1 99	1 99	1 99	1 99
52	1.00	1.00	1.00	1.00	1.00
53					
54	04 50	04 75	00.40	00.00	00.00
55	91.53	91.75	89.16	90.38	92.82
56	2.49	7.17	5.19	6.49	5.85
5/ 59	5.98	1.08	5.65	3.14	1.34
50 59	100	100	100	100	100
60					

1					
2					
3	MILANO	MILANO	MILANO	MILANO	MILANO
4 5	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1
6	MNZ6A-7	MNZ6A-8	MNZ6A-9	MNZ6A-10	MNZ6A-11
7	Rim	Rim	Rim	Core	Rim
8					
9					
10	20 17	29.40	28 53	28 70	30.02
11	0.50	0.40	0.00	0.06	0.25
12	0.50	0.49	0.09	0.90	0.25
13	7.00	1.31	8.80	7.30	7.02
15	0.18	0.15	0.18	0.20	0.22
16	12.80	12.73	12.80	13.03	13.08
17	27.16	26.70	26.41	27.98	27.16
18	2.86	2.86	2.73	3.13	2.97
19 20	12.50	12.40	11.90	12.96	11.84
20 21	1.96	1.62	1.44	1.68	1.93
22	1.05	1.23	1.28	0.67	1.64
23	0.09	0.20	0.34	0.00	0.16
24	0.00	0.48	0.04	0.00	0.10
25	1.02	1.24	1 21	0.00	1 26
26	1.23	1.34	1.31	0.90	1.30
27	97.01	96.97	96.89	97.71	97.99
20 29					
30					
31	0.99	1.00	0.98	0.98	1.01
32	0.02	0.02	0.04	0.04	0.01
33	0.06	0.07	0.08	0.07	0.06
34 25	0.00	0.00	0.00	0.00	0.00
36	0.19	0.19	0.19	0.19	0.19
37	0 40	0.39	0 39	0 41	0.39
38	0.04	0.04	0.04	0.05	0.04
39	0.01	0.01	0.01	0.00	0.07
40	0.10	0.10	0.17	0.13	0.17
41 42	0.03	0.02	0.02	0.02	0.03
42	0.01	0.02	0.02	0.01	0.02
44	0.00	0.00	0.00	0.00	0.00
45	0.01	0.01	0.00	0.00	0.01
46	0.05	0.06	0.06	0.04	0.06
47					
48	1.01	1.02	1.01	1.02	1.02
49 50	0.98	0.98	0.98	0.98	0.97
51	1.99	1.99	1.99	1.99	1.99
52					
53					
54	02 22	01 66	00 08	01 61	02 63
55 56	561	6 00	6 07	1 2/	6 22.00
50 57	0.0 4 0.40	0.22	0.07	4.04	1.00
58	2.13	2.13	3.83	4.05	1.08
59	100	100	100	100	100
60					

1					
2					
5 4					
5	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1
6	MNZ6A-12	MNZ6A-13	MNZ6A-14	MNZ6A-15	MNZ6A-16
7	Rim	Mantle	Mantle	Rim	Rim
8					
9					
10	29.75	27.63	28.21	29.83	29.57
11	0.27	1.38	1 45	0.30	0.29
13	6.40	8 25	7.03	7 18	6.73
14	0.40	0.20	7.90	0.16	0.73
15	0.30	0.24	0.09	0.10	0.14
16	12.65	12.54	12.87	12.71	13.24
17	26.88	28.81	28.85	26.76	26.62
18	3.27	3.54	3.34	2.61	2.79
19 20	12.13	13.25	13.45	11.76	12.15
21	1.94	1.01	1.25	1.97	2.03
22	1.36	0.30	0.53	1.47	1.51
23	0.23	0.00	0.00	0.00	0.29
24	0.28	0.00	0.00	0.29	0.37
25	1 34	0.78	0.61	1 52	1 39
26 27	06.80	0772	08.59	06.57	07.11
27	90.09	91.15	90.00	90.57	97.11
29					
30					
31	1.01	0.95	0.96	1.01	1.00
32	0.01	0.06	0.06	0.01	0.01
33 24	0.06	0.08	0.07	0.07	0.06
35	0.00	0.00	0.00	0.00	0.00
36	0.19	0.19	0.19	0.19	0.20
37	0.39	0.43	0.42	0.39	0.39
38	0.05	0.05	0.05	0.04	0.04
39	0 17	0 19	0 19	0 17	0 17
40	0.03	0.01	0.02	0.03	0.03
47	0.00	0.01	0.02	0.00	0.00
43	0.02	0.00	0.01	0.02	0.02
44	0.00	0.00	0.00	0.00	0.00
45	0.01	0.00	0.00	0.01	0.01
46	0.06	0.03	0.03	0.07	0.06
4/					
40 49	1.02	1.01	1.02	1.02	1.01
50	0.97	0.99	0.98	0.97	0.98
51	1.99	2.00	1.99	1.99	1.99
52					
53					
54	92 61	90 71	91 25	91 56	92 37
55 56	6.21	3 51	2 71	7 12	6 38
57	1 12	5.78	6.04	1 22	1 25
58	1.10	J.70 400	100	1.02	1.20
59	100	100	100	100	100
60					

2					
3	MILANO	MILANO	MILANO	MILANO	MILANO
4	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1
5	MNZ64_17	MN764-18	MN764_10	MN764-20	MN764-21
6	Montlo			Coro	
/	Manue	RIIII	Core	Core	Core
8					
9 10					
11	25.77	28.67	28.47	29.94	28.58
12	2.68	0.37	1.07	0.20	0.92
13	14 41	6 83	7 08	6 19	7 09
14	0.24	0.27	0.08	0.19	0.16
15	10.00	12.64	12 22	10.10	12 50
16	10.99	12.04	13.23	12.14	12.59
17	25.40	20.72	28.64	28.03	28.20
18 10	2.18	3.05	3.43	3.03	2.87
19 20	11.47	12.02	13.11	13.20	13.12
20	0.82	1.66	1.47	2.08	1.49
22	0.56	1.11	0.60	0.90	0.98
23	0.00	0.03	0 07	0 11	0.01
24	0.00	0.00	0.05	0.08	0.06
25	1 10	1.20	0.05	1.00	0.00
26	1.12	1.29	0.76	1.20	0.93
27	95.96	95.44	98.07	97.36	97.00
28					
30					
31	0.91	0.99	0.97	1.01	0.98
32	0.11	0.02	0.04	0.01	0.04
33	0 14	0.06	0.06	0.06	0.07
34	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00
36	0.17	0.19	0.20	0.10	0.19
3/ 20	0.39	0.40	0.42	0.41	0.42
30	0.03	0.05	0.05	0.04	0.04
40	0.17	0.18	0.19	0.19	0.19
41	0.01	0.02	0.02	0.03	0.02
42	0.01	0.01	0.01	0.01	0.01
43	0.00	0.00	0.00	0.00	0.00
44	0.01	0.02	0.00	0.00	0.00
45	0.01	0.02	0.00	0.00	0.00
40 17	0.05	0.00	0.05	0.05	0.04
48	4.00	4.04	4.04	4.00	4.04
49	1.02	1.01	1.01	1.02	1.01
50	0.97	0.99	0.98	0.97	0.98
51	1.99	2.00	2.00	1.99	1.99
52					
53					
54	82 95	92 37	92 10	93 23	91.83
55 56	5 28	6.00	3 10	5 02	4 26
57	11 77	1 62	J.72 1 10	0.52	7.20
58	11.//	1.03	4.40	C0.U	3.91
59	100	100	100	100	100

1					
2					
4					
5	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1
6	MNZ6A-22	MNZ6A-23	MNZ6A-24	MNZ6A-25	MNZ7A-1
7	Mantle	Core	Core	Core	Rim
8					
9					•
10	28 51	29 78	28 00	29 04	29.00
 10	1 17	0.20	1 52	0.84	0.93
12	7 22	7 17	0.94	0.04 7.04	7.24
14	7.55	7.17	9.04	7.94	7.24
15	0.18	0.22	0.33	0.09	0.02
16	12.89	12.61	12.30	12.70	13.81
17	28.58	27.03	27.30	27.43	28.23
18	3.11	2.85	3.19	2.75	3.11
19	13.28	12.87	12.38	12.93	12.50
20	1.35	1.90	1.16	1.64	1.47
22	0.59	1.30	0.41	0.86	0.91
23	0.10	0.18	0.00	0.00	0.00
24	0.10	0.10	0.00	0.00	0.00
25	0.04	1 51	1.02	1 1 2	1.02
26	0.73	1.31	1.03	1.13	1.01
27	97.86	97.75	97.46	97.35	98.26
20 29					
30					
31	0.97	1.00	0.96	0.99	0.98
32	0.05	0.01	0.06	0.03	0.04
33	0.07	0.06	0.09	0.07	0.07
34	0.00	0.00	0.00	0.00	0 00
35	0.00	0.19	0.18	0.00	0.20
30	0.10	0.10	0.10	0.10	0.41
38	0.42	0.39	0.40	0.40	0.41
39	0.05	0.04	0.05	0.04	0.05
40	0.19	0.18	0.18	0.19	0.18
41	0.02	0.03	0.02	0.02	0.02
42	0.01	0.02	0.01	0.01	0.01
43	0.00	0.00	0.00	0.00	0.00
44 45	0.00	0.00	0.00	0.00	0.00
46	0.03	0.06	0.04	0.05	0.04
47					
48	1 02	1 01	1 02	1 02	1 02
49	0.08	0.08	0.07	0.07	0.08
50	0.90	0.90	1.00	1.00	0.90
51	1.99	1.99	1.99	1.99	1.99
<i>5</i> ∠ 53					
54					
55	91.81	92.16	88.72	91.18	91.56
56	3.27	6.97	4.74	5.20	4.55
57	4.92	0.87	6.54	3.62	3.89
58	100	100	100	100	100
59 60					-
00					

MILANO MILANO<	2					
4 VSDC-13A1 VSDC-1	3	MILANO	MILANO	MILANO	MILANO	MILANO
5 MNZ7A-2 MNZ7A-3 MNZ7A-4 MNZ7A-5 MNZ7A-6 Rim Mantle Core Core Mantle 10 29.49 30.06 29.56 29.64 29.26 11 29.49 30.06 29.56 29.64 29.26 12 0.26 0.19 0.28 0.33 0.66 13 4.85 4.08 4.37 4.01 4.17 14 0.27 0.45 0.32 0.51 0.25 16 14.12 13.54 15.11 14.01 13.92 17 28.09 2.98 3.27 3.38 3.15 20 1.32 1.42 0.77 1.77 1.54 21 1.32 1.42 0.77 1.77 1.54 23 0.31 1.80 0.03 0.71 0.75 26 1.03 0.94 0.83 0.90 0.57 27 96.74 97.00 97.87 </td <td>4</td> <td>VSDO-13A1</td> <td>VSDO-13A1</td> <td>VSDO-13A1</td> <td>VSDO-13A1</td> <td>VSDO-13A1</td>	4	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1
Rim Mantle Core Core Mantle 0 29,49 30.06 29,56 29,64 29,26 11 $29,49$ 30.06 29,56 29,64 29,26 12 0.26 0.19 0.28 0.33 0.66 13 4.85 4.08 4.37 4.01 4.17 14 0.27 0.45 0.32 0.51 0.25 16 14.12 13.54 15.11 14.01 13.92 17 28.09 27.49 29.62 28.16 28.95 18 2.90 2.98 3.27 3.38 3.15 19 12.06 11.73 12.30 12.02 12.20 1.87 1.72 1.32 1.83 1.88 22 1.32 1.42 0.77 0.71 0.75 26 0.31 1.80 0.03 0.71 0.75	5	MNZ7A-2	MNZ7A-3	MNZ7A-4	MNZ7A-5	MNZ7A-6
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	0 7	Rim	Mantle	Core	Core	Mantle
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	7 8	T XIIII	Mantie	0010	0010	Mantie
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	9					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	10	00.40	~~~~	~~ ~~	~~~~	
12 0.26 0.19 0.28 0.33 0.66 13 4.85 4.08 4.37 4.01 4.17 14 0.27 0.45 0.32 0.51 0.251 15 14.12 13.54 15.11 14.01 13.92 16 14.12 13.54 15.11 14.01 13.92 17 28.09 27.49 29.62 28.16 28.95 18 2.90 2.98 3.27 3.38 3.15 19 12.06 11.73 12.30 12.02 12.20 21 1.87 1.72 1.32 1.83 1.88 22 1.32 1.42 0.77 1.77 1.54 23 0.17 0.60 0.08 0.43 0.43 24 0.31 1.80 0.03 0.71 0.75 25 0.31 1.80 0.03 0.71 0.75 26 1.03 0.94 0.83 0.90 0.57 27 96.74 97.00 97.87	11	29.49	30.06	29.56	29.64	29.26
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	12	0.26	0.19	0.28	0.33	0.66
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	13	4.85	4.08	4.37	4.01	4.17
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	14	0.27	0.45	0.32	0.51	0.25
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	15 16	14.12	13.54	15.11	14.01	13.92
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	10 17	28.09	27 49	29.62	28 16	28.95
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	18	2 00	2 98	3 27	3 38	3 15
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	19	12.00	2.30	12 20	12.00	12 20
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	20	12.00	170	12.30	12.02	12.20
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	21	1.87	1.72	1.32	1.83	1.88
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	22	1.32	1.42	0.77	1.77	1.54
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	23	0.17	0.60	0.08	0.43	0.43
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	24 25	0.31	1.80	0.03	0.71	0.75
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	26	1.03	0.94	0.83	0.90	0.57
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	27	96.74	97.00	97.87	97.70	97.72
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	28					
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	29					
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	30	1 00	1 01	1 00	1 00	0.00
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	31	1.00	1.01	1.00	1.00	0.99
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	32 33	0.01	0.01	0.01	0.01	0.03
350.000.000.000.000.00 36 0.210.200.220.210.20 37 0.410.400.430.410.42 38 0.040.040.050.050.05 39 0.170.170.180.170.17 41 0.030.020.020.030.03 42 0.020.020.010.020.02 43 0.000.010.000.010.01 44 0.040.040.040.020.02 45 0.010.040.040.040.02 46 0.040.040.040.040.02 47 $$	34	0.04	0.04	0.04	0.04	0.04
36 0.21 0.20 0.22 0.21 0.20 37 0.41 0.40 0.43 0.41 0.42 38 0.04 0.04 0.05 0.05 0.05 39 0.17 0.17 0.18 0.17 0.17 40 0.03 0.02 0.02 0.03 0.03 42 0.02 0.02 0.01 0.02 0.02 43 0.00 0.01 0.00 0.01 0.01 44 0.00 0.01 0.00 0.01 0.02 44 0.04 0.04 0.04 0.04 0.02 45 0.01 0.04 0.04 0.04 0.02 46 0.04 0.04 0.04 0.04 0.02 47 7 7 7 9.99 9.98 0.98 51 1.99 1.99 2.00 2.00 1.99 52 53 54 94.22 94.96 95.10 94.63 94.77 56 4.67 4.25 3.73 4.02 2.52 57 1.11 0.79 1.17 1.36 2.72 58 100 100 100 100 100	35	0.00	0.00	0.00	0.00	0.00
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	36	0.21	0.20	0.22	0.21	0.20
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	37	0.41	0.40	0.43	0.41	0.42
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	38	0.04	0.04	0.05	0.05	0.05
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	39	0.17	0.17	0.18	0.17	0.17
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	40 41	0.03	0.02	0.02	0.03	0.03
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	42	0.00	0.02	0.01	0.02	0.02
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	43	0.02	0.02	0.01	0.02	0.02
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	44	0.00	0.01	0.00	0.01	0.01
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	45	0.01	0.04	0.00	0.01	0.02
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	46	0.04	0.04	0.04	0.04	0.02
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	4/					
19 0.98 0.97 0.99 0.98 0.98 51 1.99 1.99 2.00 2.00 1.99 52 53 54 55 94.22 94.96 95.10 94.63 94.77 56 4.67 4.25 3.73 4.02 2.52 57 1.11 0.79 1.17 1.36 2.72 58 100 100 100 100 100	48 70	1.01	1.02	1.01	1.01	1.01
51 1.99 1.99 2.00 2.00 1.99 52 53 54 55 94.22 94.96 95.10 94.63 94.77 56 4.67 4.25 3.73 4.02 2.52 57 1.11 0.79 1.17 1.36 2.72 58 100 100 100 100 100	49 50	0.98	0.97	0.99	0.98	0.98
52 53 54 55 94.22 94.96 95.10 94.63 94.77 56 4.67 4.25 3.73 4.02 2.52 57 1.11 0.79 1.17 1.36 2.72 58 100 100 100 100 100	51	1.99	1.99	2.00	2.00	1.99
53 54 55 94.22 94.96 95.10 94.63 94.77 56 4.67 4.25 3.73 4.02 2.52 57 1.11 0.79 1.17 1.36 2.72 58 100 100 100 100 100	52					
54 94.22 94.96 95.10 94.63 94.77 56 4.67 4.25 3.73 4.02 2.52 57 1.11 0.79 1.17 1.36 2.72 58 100 100 100 100 100	53					
55 54.22 54.90 55.10 94.05 94.77 56 4.67 4.25 3.73 4.02 2.52 57 1.11 0.79 1.17 1.36 2.72 58 100 100 100 100 100	54	01 22	01 06	05 10	04 63	04 77
50 4.07 4.25 5.75 4.02 2.52 57 1.11 0.79 1.17 1.36 2.72 58 100 100 100 100 100	55 56	J4.22 1 67	34.30 1 DE	30.10 0.70	JH.UJ	JH.//
$\frac{57}{58}$ 1.11 U.79 1.17 1.36 2.72	50 57	4.07	4.20	3.13	4.02	2.52
	57 58	1.11	0.79	1.1/	1.36	2.72
59 100 100 100 100 100 100	59	100	100	100	100	100

2					
3	MILANO	MILANO	MILANO	MILANO	MILANO
4	VSD0-13A1				VSD0-13A1
5					
6	WINZ/A-/	IVIINZIA-O	WINZ/A-9	IVIINZ/A-IU	
7	Rim	Rim	Core	Rim	Mantle
8					
9					
10 11	29.80	29.73	29.90	28.90	29.45
11	0.32	0.24	0.28	0.69	0.48
12	4.76	4.76	4.25	4.50	1 60
14	4.70	4.70	4.20	4.50	4.00
15	0.28	0.39	0.30	0.46	0.15
16	14.25	14.03	14.33	14.20	14.16
17	28.53	28.45	28.77	29.32	28.39
18	3.01	2.77	2.84	3.20	3.35
19	12.30	12.37	12.37	12.56	12.23
20	1 67	1 80	1 79	1 72	1 92
21	1.07	1.60	1.70	0.02	1 20
22	0.00	0.25	0.27	0.92	0.14
24	0.22	0.25	0.37	0.00	0.14
25	0.34	0.31	0.91	0.26	0.42
26	0.85	0.98	0.95	0.56	0.85
27	97.80	97.69	98.58	97.28	97.51
28					
29					
30 21	1 00	1 00	1 00	0.98	0.99
32	0.01	0.01	0.01	0.03	0.02
33	0.01	0.01	0.01	0.00	0.02
34	0.04	0.04	0.04	0.04	0.04
35	0.00	0.00	0.00	0.00	0.00
36	0.21	0.21	0.21	0.21	0.21
37	0.41	0.41	0.42	0.43	0.41
38	0.04	0.04	0.04	0.05	0.05
39 40	0.17	0.18	0.17	0.18	0.17
40 41	0.02	0.02	0.02	0.02	0.03
42	0.02	0.02	0.02	0.01	0.02
43	0.02	0.02	0.02	0.01	0.02
44	0.00	0.00	0.00	0.00	0.00
45	0.01	0.01	0.02	0.01	0.01
46	0.04	0.04	0.04	0.02	0.04
47					
48	1.02	1.01	1.01	1.01	1.01
49 50	0.98	0.98	0.99	0.98	0.98
51	1,99	1.99	2.00	1.99	1.99
52					
53					
54	04 70		04.00	04.04	04 47
55	94.78	94.54	94.68	94.64	94.17
56	3.86	4.43	4.18	2.49	3.80
5/	1.36	1.03	1.14	2.88	2.02
50 50	100	100	100	100	100
60					

2					
3	MILANO	MILANO	MILANO	MILANO	MILANO
4	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1
5	MNI77A 12	MNIZZA 13		MNIZZA 15	MN77R 1
6					
7	Mantie	Mantie	RIM	RIM	RIM
8					
9					
10	30.01	30.00	29.56	29.23	30.09
12	0.33	0.29	0.27	0.49	0.15
13	4 20	4 54	4 38	5.22	3.68
14	4.23	0.20	4.00	0.10	0.00
15	0.31	0.30	0.33	0.19	0.37
16	14.14	13.44	13.88	14.15	13.91
17	28.25	27.40	28.12	28.30	26.57
18	3.13	2.88	3.12	3.24	2.78
19	12.11	12.16	11.88	12.02	11.56
20	1.79	1.98	1.87	1.79	2.43
21 22	1.62	1 52	1 52	1 11	2 34
23	0.22	0.25	0.26	0.03	0.50
24	0.52	0.23	0.20	0.03	0.50
25	1.35	1.49	0.37	0.36	1.66
26	0.85	0.96	0.94	0.98	0.92
27	98.50	97.28	96.50	97.11	96.95
28					
29					
30 21	1 00	1 01	1 01	0 99	1 01
21 22	0.01	0.01	0.01	0.00	0.01
33	0.01	0.01	0.01	0.02	0.01
34	0.04	0.04	0.04	0.05	0.03
35	0.00	0.00	0.00	0.00	0.00
36	0.21	0.20	0.21	0.21	0.20
37	0.41	0.40	0.41	0.42	0.39
38	0.04	0.04	0.05	0.05	0.04
39	0 17	0 17	0 17	0 17	0 16
40	0.02	0.03	0.03	0.02	0.03
41 42	0.02	0.00	0.00	0.02	0.00
43	0.02	0.02	0.02	0.01	0.03
44	0.00	0.00	0.00	0.00	0.01
45	0.03	0.03	0.01	0.01	0.04
46	0.04	0.04	0.04	0.04	0.04
47					
48	1.01	1.02	1.02	1.01	1.02
49	0.98	0.97	0.98	0.98	0.97
50	1.00	1.00	1.00	2.00	1.00
51	1.99	1.99	1.99	2.00	1.99
52 53					
54					
55	94.90	94.47	94.56	93.51	95.24
56	3.75	4.32	4.30	4.42	4.14
57	1.35	1.20	1.14	2.07	0.62
58	100	100	100	100	100
59	100	100	100	100	100

1					
2					
4					
5	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1
6	MNZ7B-2	MNZ7B-3	MNZ7B-4	MNZ7B-5	MNZ7B-6
7	Rim	Core	Core	Core	Core
8					
9					
10	30.04	29 82	29 44	29 82	30.01
11	0.08	0.34	0.29	0.36	0.32
12	3.67	4.26	4 22	4.24	4 10
14	0.07	4.20	4.52	4.04	4.10
15	0.39	0.42	0.39	0.01	0.44
16	13.79	13.93	13.82	13.86	14.25
17	26.40	28.54	28.15	28.21	28.31
18	2.68	3.17	3.06	3.03	2.94
19	11.42	12.13	12.13	11.56	12.30
20	2.66	2.12	2.01	1.86	2.01
22	2.51	1.28	1.26	1.17	1.52
23	0.96	0.39	0.10	0.41	0.25
24	1 95	0.63	0.70	0.98	0.38
25	0.04	0.03	1 25	0.90	0.00
26	0.94	0.07	1.55	0.00	0.92
2/	97.50	97.91	96.54	97.07	97.75
20					
30					
31	1.01	1.00	1.00	1.00	1.01
32	0.00	0.01	0.01	0.01	0.01
33	0.03	0.04	0.04	0.04	0.04
34	0.00	0.00	0.00	0.01	0.00
35 36	0.20	0.20	0.20	0.20	0.21
37	0.38	0.41	0.41	0.41	0.41
38	0.00	0.41	0.41	0.41	0.41
39	0.04	0.05	0.04	0.04	0.04
40	0.16	0.17	0.17	0.10	0.17
41	0.04	0.03	0.03	0.03	0.03
42	0.03	0.02	0.02	0.02	0.02
45 44	0.01	0.01	0.00	0.01	0.00
45	0.04	0.01	0.00	0.02	0.01
46	0.04	0.04	0.06	0.04	0.04
47					
48	1.01	1.01	1.01	1.02	1.02
49	0.98	0.98	0 99	0.97	0.97
50 51	1 00	1 00	2.00	1 00	1 00
52	1.99	1.99	2.00	1.55	1.99
53					
54				• •	• ·
55	95.46	94.66	92.72	94.55	94.52
56	4.21	3.91	6.05	3.91	4.12
57	0.33	1.44	1.23	1.54	1.36
58 50	100	100	100	100	100
60					

1					
2					
3 ⊿	MILANO	MILANO	MILANO	MILANO	MILANO
4 5	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A1
6	MNZ7B-7	MNZ7B-8	MNZ7B-9	MNZ7B-10	MNZ7B-11
7	Rim	Rim	Core	Rim	Rim
8					
9					
10	29.60	29.86	30.31	29 90	29 18
11	0.26	0.30	0.31	0.45	0.67
12	4.20	4.04	4.45	4 96	0.07
14	4.29	4.04	4.45	4.00	4.74
15	0.38	0.37	0.08	0.17	0.12
16	13.99	13.97	14.19	13.71	13.94
17	28.32	27.42	28.38	27.48	30.08
18	3.24	3.20	2.96	3.17	3.76
19 20	12.01	11.39	12.37	11.97	12.98
20	1.89	1.50	1.86	1.81	1.03
22	1.42	1.09	1.09	1.59	0.86
23	0.05	0.52	0.48	0.38	0.26
24	0.28	2.35	0.33	1.56	0.15
25	0.90	0.90	0.98	0.83	0.52
26 27	0.00	06.02	08.28	07.88	08.20
27	90.04	90.92	90.20	97.00	90.29
29					
30		4.00	4.04	4.00	0.00
31	1.01	1.00	1.01	1.00	0.99
32	0.01	0.01	0.01	0.02	0.03
33 34	0.04	0.04	0.04	0.04	0.04
35	0.00	0.00	0.01	0.00	0.00
36	0.21	0.20	0.21	0.20	0.21
37	0.42	0.40	0.41	0.40	0.44
38	0.05	0.05	0.04	0.05	0.05
39	0.17	0.16	0.17	0.17	0.18
40 41	0.03	0.02	0.03	0.02	0.01
42	0.02	0.01	0.01	0.02	0.01
43	0.02	0.01	0.01	0.02	0.00
44	0.00	0.01	0.01	0.00	0.00
45	0.01	0.05	0.01	0.03	0.00
46	0.04	0.04	0.04	0.04	0.02
47 48			(
49	1.02	1.01	1.02	1.02	1.01
50	0.98	0.98	0.97	0.97	0.98
51	1.99	1.99	1.99	1.99	1.99
52					
53					
54 55	94.79	94.75	94.29	94.43	94.91
55	4.09	4.00	4.42	3.70	2.32
57	1 12	1 26	1 29	1 87	2 77
58	100	100	100	100	100
59	100	100	100	100	100
60					

2				
3	MILANO	MILANO	MILANO	MILANO
4	VSDO-13A1	VSDO-13A1	VSDO-13A1	VSDO-13A2
5				
6	IVIINZ / D-IZ	WINZ / D-13	VIINZ / D - 14	IVIINZOA-I
7	Core	Core	Rim	Mantle
8				
9				
10	20.64	20.01	20 72	20.07
11	29.04	30.01	29.12	30.07
12	0.27	0.42	0.41	0.30
13	4.44	4.25	4.70	5.14
14	0.55	0.44	0.41	0.43
15	13.08	14.05	1/ 31	1/ 18
16	10.90	14.05	14.51	14.10
17	28.40	27.69	28.54	27.50
18	3.13	3.41	3.09	3.40
19	12.17	11.96	12.00	11.86
20	1 94	2.06	2 05	1 93
21	1.01	1.65	1.24	1.00
22	1.44	1.05	1.34	1.54
23	0.24	0.49	0.30	0.14
2 4 25	0.34	0.79	0.16	0.43
26	0.92	0.90	1.00	1.14
27	97 46	98 12	98.04	98.07
28	01110	00.12	00.01	00.01
29				
30				
31	1.00	1.00	1.00	1.00
32	0.01	0.02	0.02	0.01
33	0 04	0 04	0 04	0.05
34	0.04	0.04	0.04	0.00
35	0.00	0.00	0.00	0.00
36	0.21	0.20	0.21	0.21
37	0.42	0.40	0.41	0.40
38	0.05	0.05	0.04	0.05
39	0 17	0 17	0 17	0 17
40	0.17	0.17	0.17	0.17
41	0.03	0.03	0.03	0.03
42	0.02	0.02	0.02	0.02
43	0.00	0.01	0.00	0.00
44 45	0.01	0.02	0.00	0.01
45 46	0 04	0 04	0.04	0.05
40 47	0.04	0.04	0.04	0.00
48		4.00		4.00
49	1.01	1.02	1.01	1.02
50	0.98	0.97	0.98	0.98
51	1.99	1.99	1.99	1.99
52				
53				
54		.		
55	94.72	94.23	93.79	93.58
56	4.15	4.02	4.49	5.16
57	1.13	1.75	1.71	1.26
58	100	100	100	100
59	100	100	100	100
60				

2					
3	MILANO	MILANO	MILANO	MILANO	MILANO
4	VSDO-13A2	VSDO-13A2	VSDO-13A2	VSDO-13A2	VSDO-13A2
5	MN78A-2	MNZ8A-3	MN78A-4	MNZ8A-5	MN78A-6
6 7	core	Mantle	Mantle	Mantle	Mantle
7 8	0010	Wantie	Mantie	Wantie	Martic
9					
10					
11	29.97	29.47	27.35	29.99	27.70
12	0.28	0.43	1.99	0.23	1.43
13	5.16	5.72	9.14	5.31	7.82
14	0.38	0.17	0.07	0.36	0.07
15	13,95	13.91	12.95	14.09	13.42
10	28.60	28 57	28.65	27.26	28.41
18	20.00	3 15	3.26	3 16	3 10
19	10.00	10 10	10 50	11.07	10 40
20	12.39	12.19	12.55	11.97	12.40
21	1.68	1.74	0.72	2.35	1.17
22	0.98	0.70	0.18	1.91	0.63
23	0.00	0.00	0.00	0.10	0.15
24 25	0.08	0.01	0.04	0.49	0.00
25	1.08	1.05	0.49	1.08	0.60
27	97.84	97.11	97.37	98.30	96.89
28	•••••				
29					
30	1 01	1 00	0.04	1.00	0.06
31	1.01	1.00	0.94	1.00	0.96
32	0.01	0.02	80.0	0.01	0.06
33	0.05	0.05	0.08	0.05	0.07
35	0.00	0.00	0.00	0.00	0.00
36	0.20	0.21	0.19	0.21	0.20
37	0.41	0.42	0.43	0.39	0.42
38	0.05	0.05	0.05	0.05	0.05
39	0.18	0.17	0.18	0.17	0.18
40 41	0.02	0.02	0.01	0.03	0.02
42	0.02	0.02	0.01	0.00	0.02
43	0.01	0.01	0.00	0.00	0.01
44	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.01	0.00
46	0.05	0.04	0.02	0.05	0.03
4/					
48 70	1.02	1.02	1.02	1.01	1.01
4 9 50	0.97	0.98	0.97	0.98	0.98
51	1.99	1.99	1.99	1.99	1.99
52					
53					
54	03 04	03 37	80 30	0/ 15	01 26
55	30.34 1 00	30.01	00.00 0 00	JH. 1J 1 00	31.20 0.74
50 57	4.09	4.79	2.23	4.69	2.71
57 58	1.1/	1.84	8.39	0.96	6.03
59	100	100	100	100	100

1					
2					
4					
5	VSDO-13A2	VSDO-13AZ	VSDO-13AZ	VSDO-13AZ	VSDU-13AZ
6	MNZ8A-7	MNZ8A-8	MNZ8A-9	MNZ8A-10	MNZ8A-11
7	Core	Mantle	Core	Mantle	Rim
8					
9					
10	29 69	29 75	29 67	29.83	27 44
11	0.23	0.36	0.42	0.29	1 87
13	4.61	4.67	4.07	4.66	8.06
14	4.01	4.07	4.97	4.00	0.90
15	0.79	0.17	0.27	0.09	0.09
16	13.44	13.77	14.32	14.54	13.05
17	28.29	28.04	28.75	27.86	28.19
18	3.33	3.19	2.83	3.14	3.39
19 20	12.39	11.59	12.34	11.69	12.38
20	1.75	1.53	1.97	1.41	0.75
22	1.29	1.39	0.99	1.67	0.40
23	0.08	0.61	0.00	0.37	0.00
24	0 10	1 47	0 10	1 27	0.00
25	1 11	0.04	1.03	0.00	0.00
26	07.40	0.94	07.66	0.90	0.47
27	97.10	97.49	97.00	97.72	90.98
20					
30					
31	1.01	1.00	1.00	1.00	0.95
32	0.01	0.01	0.02	0.01	0.08
33	0.04	0.04	0.04	0.04	0.08
34 25	0.01	0.00	0.00	0.00	0.00
36	0.20	0.20	0.21	0.21	0.20
37	0.41	0.41	0.42	0.40	0.42
38	0.05	0.05	0.04	0.05	0.05
39	0.00	0.00	0.04	0.00	0.00
40	0.10	0.10	0.10	0.17	0.10
41	0.02	0.02	0.03	0.02	0.01
42 43	0.02	0.02	0.01	0.02	0.01
44	0.00	0.01	0.00	0.00	0.00
45	0.00	0.03	0.00	0.03	0.00
46	0.05	0.04	0.04	0.04	0.02
47					
48	1.01	1.01	1.02	1.01	1.02
49	0.98	0 98	0 98	0.98	0 97
50 51	1 99	1 99	1 99	1 99	1 99
52	1.00	1.00	1.00	1.00	1.00
53					
54	00.00	04.07	00.00	04.75	00.04
55	93.96	94.27	93.60	94.75	89.91
56	5.06	4.22	4.62	4.03	2.14
5/	0.97	1.51	1.77	1.22	7.95
<i>3</i> 0 59	100	100	100	100	100
60					

2					
3	MILANO	MILANO	MILANO	MILANO	MILANO
4	VSDO-13A2	VSDO-13A2	VSDO-13A2	VSDO-13A2	VSDO-13A2
5	MNZ8A-12	MNZ8A-13	MNZ8B-1	MNZ8B-2	MNZ8B-3
0 7	Rim	Mantle	Rim	Mantle	Mantle
, 8		Mantio		Mantio	Martie
9					
10		~~	~~		~~
11	30.23	29.57	29.73	29.26	29.57
12	0.29	0.31	0.17	0.22	0.21
13	5.45	4.55	4.59	5.34	3.23
14	0.24	0.09	0.26	0.25	0.30
15 16	13.60	14.08	13.36	13.95	14.28
10	26.82	28 20	26 75	27 88	29 90
18	2.66	3 00	2 72	2 94	3 50
19	2.00	11 96	11 60	11 75	12.00
20	11.50	11.00	11.09	0.04	12.90
21	2.08	1.60	1.98	2.21	1.85
22	1.96	1.17	1.58	1.43	1.29
23	0.16	0.48	0.65	0.29	0.07
24 25	0.65	1.17	2.12	0.37	0.09
26	1.11	0.94	0.97	1.13	0.68
27	96.75	97.11	96.57	97.03	97.87
28					
29					
30	1 02	1 00	1 01	1 00	1 00
31	1.02	1.00	0.01	1.00	1.00
32 33	0.01	0.01	0.01	0.01	0.01
34	0.05	0.04	0.04	0.05	0.03
35	0.00	0.00	0.00	0.00	0.00
36	0.20	0.21	0.20	0.21	0.21
37	0.39	0.41	0.39	0.41	0.44
38	0.04	0.04	0.04	0.04	0.05
39	0.16	0.17	0.17	0.17	0.18
40 41	0.03	0.02	0.03	0.03	0.03
42	0.00	0.02	0.02	0.00	0.00
43	0.00	0.02	0.02	0.02	0.02
44	0.00	0.01	0.01	0.00	0.00
45	0.01	0.02	0.05	0.01	0.00
46	0.05	0.04	0.04	0.05	0.03
4/ 10					
40 49	1.03	1.01	1.01	1.01	1.01
50	0.96	0.98	0.98	0.99	0.99
51	1.98	2.00	1.99	2.00	2.00
52					
53					
54	03 50	04 40	04 87	02 01	06 12
55 56	50.05 5 1 A	قד.דט ۸ ۵۵	лл1	50.01	20.12
50 57	J. 14	4.20	4.41	5.15	3.UZ
58	1.27	1.31	0.72	0.94	0.86
59	100	100	100	100	100

1					
2					
4					
5	VSDO-13A2	VSDO-13A2	VSDO-13A2	VSDO-13A2	VSDO-13A2
6	MNZ8B-4	MNZ8B-5	MNZ8B-6	MNZ8B-7	MNZ8B-8
7	Mantle	Rim	Mantle	Mantle	Core
8					
9					
10	29 67	29 69	29 65	29 55	29 47
 10	0 15	0.13	0.23	0.19	0.22
12	3.03	4 71	5.44	5 12	4.72
14	5.05	4.71	0.07	0.15	4.73
15	0.05	0.18	0.27	0.25	0.80
16	14.44	13.69	14.11	13.82	13.46
17	30.23	27.22	27.47	27.48	27.92
18	3.61	2.65	2.44	3.31	3.00
19	12.68	11.71	11.78	11.91	11.93
20	1.99	1.75	2.28	1.98	2.18
22	1.00	1.75	1.57	1.68	2.00
23	0.00	0.35	0.41	0.52	0 14
24	0.00	1 70	0.19	0.60	0.52
25	0.17	1.70	0.49	1.04	1 10
26	0.00	1.02	1.20	1.04	1.10
2/	97.70	96.55	97.34	97.47	97.53
20 20					
30					
31	1.00	1.01	1.00	1.00	1.00
32	0.01	0.01	0.01	0.01	0.01
33	0.03	0.04	0.05	0.05	0.04
34	0 00	0.00	0.00	0.00	0.01
35	0.21	0.20	0.21	0.20	0.20
30 37	0.21	0.20	0.21	0.20	0.20
38	0.44	0.40	0.40	0.40	0.41
39	0.05	0.04	0.04	0.05	0.04
40	0.18	0.17	0.17	0.17	0.17
41	0.03	0.02	0.03	0.03	0.03
42	0.01	0.02	0.02	0.02	0.03
43	0.00	0.00	0.01	0.01	0.00
44 45	0.00	0.04	0.01	0.01	0.01
46	0.03	0.04	0.05	0.04	0.05
47					
48	1 01	1 01	1 01	1 01	1 01
49	0.00	0.09	0.09	0.00	0.00
50	0.99	0.90	0.90	0.99	0.99
51	2.00	1.99	2.00	2.00	2.00
<i>3∠</i> 53					
54					
55	96.39	94.80	93.58	94.46	94.08
56	3.01	4.64	5.47	4.73	4.97
57	0.61	0.56	0.96	0.81	0.95
58	100	100	100	100	100
59 60					
00					

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2					
3 4	MILANO	MILANO	MILANO	MILANO	MILANO
5	VSDO-13A2	VSDO-13A2	VSDO-13A2	VSDO-13A2	VSDO-13A2
6	MNZ8B-9	MNZ8B-10	MNZ8B-11	MNZ8B-12	MNZ8B-13
7	Core	Core	Core	Mantle	Mantle
8					
9					
10	29.86	29 72	30.06	27 97	27 29
11	0.25	0.18	0 14	1 46	2.06
12	4.27	5.04	2.01	6.07	0.17
14	4.27	0.04	2.91	0.97	9.17
15	0.00	0.99	0.00	0.00	0.19
16	13.78	13.50	14.08	13.93	13.03
17	27.90	27.56	29.25	29.00	28.89
18	3.00	3.19	3.53	3.50	3.20
20	12.23	11.82	12.34	13.27	12.70
21	2.16	1.67	2.24	1.02	0.69
22	1.39	1.44	1.36	0.00	0.27
23	0.36	0.51	0.06	0.00	0.10
24	0.65	0.64	0.21	0.00	0.00
25	1 03	1 24	0.81	0.54	0.51
20 27	07 /0	07.51	97 57	07.66	0.01
28	57.45	57.51	51.51	97.00	30.03
29					
30	4.00	4.00	4.04	0.00	0.00
31	1.00	1.00	1.01	0.96	0.93
32	0.01	0.01	0.01	0.06	0.08
33 34	0.04	0.05	0.03	0.06	0.08
35	0.01	0.01	0.01	0.00	0.00
36	0.20	0.20	0.21	0.21	0.19
37	0.41	0.40	0.43	0.43	0.43
38	0.04	0.05	0.05	0.05	0.05
39	0.17	0.17	0.17	0.19	0.18
40 41	0.03	0.02	0.03	0.01	0.01
42	0.02	0.02	0.02	0.00	0.00
43	0.02	0.02	0.02	0.00	0.00
44	0.00	0.01	0.00	0.00	0.00
45	0.01	0.01	0.00	0.00	0.00
46	0.04	0.05	0.03	0.02	0.02
47 78					
49	1.01	1.01	1.02	1.02	1.02
50	0.98	0.98	0.98	0.98	0.98
51	1.99	2.00	1.99	2.00	1.99
52					
53					
54	94 28	93 57	95 79	91 59	89 16
55 56	4 66	5.65	3.62	2 37	2 29
57	 1 NA	0.00	0.02	6.04	2.20 2.55
58	1.00	100	100	100	100
59	100	100	100	100	100
60					

1					
2					
4					
5	VSDO-13AZ	VSDO-13AZ	VSDO-13AZ	VSDO-13AZ	VSDU-13AZ
6	MNZ8B-14	MNZ8B-15	MNZ8B-16	MNZ8B-17	MNZ8B-18
7	Mantle	Mantle	Mantle	Core	Mantle
8					
9					
10	27 07	26 73	28 50	30 13	29 77
11 12	1 82	2 22	0.95	0 14	0.38
13	8 76	10 56	5 72	3.17	5.24
14	0.70	0.00	0.10	0.27	0.24
15	0.10	0.20	0.19	0.37	0.20
16	13.34	12.89	13.72	14.67	14.42
17	28.52	27.86	29.93	29.66	27.38
18	3.07	3.19	3.10	3.10	2.81
19 20	12.94	12.46	12.76	13.05	11.83
20	0.74	0.61	0.81	2.07	1.83
22	0.41	0.49	0.40	1.02	1.44
23	0.16	0.05	0.00	0.02	0.08
24	0.02	0.01	0.00	0.19	0.66
25	0.42	0.60	0.65	0.68	1.01
26	0.42	0.00	0.05	0.00	
27	97.44	97.87	90.73	98.24	97.00
20					
30					
31	0.94	0.92	0.98	1.01	1.00
32	0.07	0.09	0.04	0.01	0.02
33	0.08	0.10	0.05	0.03	0.05
34 25	0.00	0.00	0.00	0.00	0.00
36	0.20	0.19	0.20	0.21	0.21
37	0.43	0.42	0 44	0.43	0.40
38	0.05	0.05	0.05	0.04	0.10
39	0.00	0.00	0.00	0.18	0.04
40	0.19	0.10	0.10	0.10	0.17
41	0.01	0.01	0.01	0.03	0.03
42 43	0.01	0.01	0.01	0.01	0.02
44	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.01
46	0.02	0.03	0.03	0.03	0.04
47					
48	1.01	1.01	1.02	1.01	1.02
49	0.98	0.98	0 98	0.98	0 97
50 51	2 00	2 00	1 99	1 99	1 99
52	2.00	2.00	1.00	1.00	1.00
53					
54	00.40	07.00	00.00	00.44	00 70
55	90.46	87.99	93.06	96.41	93.76
56	1.89	2.69	2.95	3.02	4.61
5/	7.64	9.32	3.99	0.57	1.62
<i>3</i> 0 59	100	100	100	100	100
60					

2					
3	MILANO	MILANO	MILANO	MILANO	MILANO
4	VSDO-13A2	VSDO-13A2	VSDO-13A2	VSDO-13A2	VSDO-13A2
5	MN78B-19	MN78B-20	MN78B-21	MN78B-22	MNZ8C-1
6 7	Core	Mantle	Mantle	Rim	Rim
7 8	0010	Mantie	Wantie		
9					I
10					
11	30.05	29.77	29.82	29.69	29.90
12	0.22	0.22	0.24	0.20	0.28
13	4.14	5.37	3.26	5.29	6.10
14	0.73	0.18	0.31	0.21	0.48
15	13.93	13.56	14,10	14.00	13.65
10 17	28.61	27 77	29.89	27 53	26.94
18	2 00	2 90	2 1 9	21.00	20:04
19	5.09	2.00	3.10	3.19	2.03
20	12.14	11.79	12.03	11.71	11.52
21	1.83	2.18	2.13	1.95	2.21
22	1.67	1.59	1.04	1.46	2.03
23	0.12	0.21	0.00	0.21	0.38
24 25	0.52	0.46	0.07	0.51	0.60
25 26	0.95	1.14	0.69	1.09	1.26
20	98.00	97 04	97.36	97.03	98 18
28	00.00	07.01	01.00	07.00	00.10
29					
30	4.04	4.04	4.04	4.04	4.00
31	1.01	1.01	1.01	1.01	1.00
32	0.01	0.01	0.01	0.01	0.01
33 24	0.04	0.05	0.03	0.05	0.05
34 35	0.01	0.00	0.00	0.00	0.00
36	0.20	0.20	0.21	0.21	0.20
37	0.41	0.41	0.44	0.40	0.39
38	0.04	0.04	0.05	0.05	0.04
39	0.17	0.17	0.18	0.17	0.16
40	0.17	0.17	0.10	0.17	0.10
41	0.02	0.03	0.03	0.03	0.03
42 43	0.02	0.02	0.01	0.02	0.03
44	0.00	0.00	0.00	0.00	0.00
45	0.01	0.01	0.00	0.01	0.01
46	0.04	0.05	0.03	0.05	0.05
47					
48	1.02	1.02	1.02	1.01	1.01
49 50	0.98	0.98	0.98	0.98	0.98
50 51	1 00	1 00	1 00	1 00	1 00
52	1.55	1.55	1.00	1.55	1.55
53					
54					
55	94.80	93.82	95.87	94.18	93.09
56	4.27	5.22	3.11	4.97	5.72
57	0.93	0.96	1.02	0.85	1.19
58 50	100	100	100	100	100
リブ					

23MILANOMILANOMILANOMILANOM4VSDO-13A2VSDO-13A2VSDO-13A2VSDO-13A2VSI5MNZ8C-2MNZ8C-3MNZ8C-4MNZ8C-5M7CoreCoreCoreMantleM8	IILANO DO-13A2 NZ8C-6 Vantle 29.47 0.53 5.63
4VSDO-13A2VSDO-13A2VSDO-13A2VSDO-13A2VSDO-13A2VSI5MNZ8C-2MNZ8C-3MNZ8C-4MNZ8C-5MI7CoreCoreCoreMantleM8	DO-13A2 NZ8C-6 Mantle 29.47 0.53 5.63
5VSDO-13A2VSDO	DO-13A2 NZ8C-6 Vantle 29.47 0.53 5.63
6 MNZ8C-2 MNZ8C-3 MNZ8C-4 MNZ8C-5 MI 7 Core Core Core Mantle M 8	NZ8C-6 Mantle 29.47 0.53 5.63
7 Core Core Core Mantle M	Vantle 29.47 0.53 5.63
8	29.47 0.53 5.63
	29.47 0.53 5.63
9	29.47 0.53 5.63
¹⁰ 11 27 66 27 12 27 52 29 77	0.53 5.63
12 1.81 2.18 1.71 0.26	5.63
13 0.15 10.39 9.76 5.90	5.05
14 0.00 0.20 0.17 0.20	0.04
15 0.00 0.20 0.17 0.29	0.04
16 13.42 12.31 12.88 13.84	13.95
17 28.70 27.80 28.31 26.89	28.42
¹⁸ 3.29 2.90 3.27 2.87	3.40
12.49 12.42 12.51 11.58	12.44
0.77 0.99 0.98 2.31	1.49
22 0.24 0.50 0.53 1.39	0.98
23 0.00 0.00 0.00 0.34	0.34
²⁴ 0.07 0.00 0.03 0.75	0.73
25 0.67 0.00 0.03 0.73	0.75
26 0.05 0.06 0.02 1.25	0.70
27 98.25 97.49 97.29 97.32	98.19
20	
30	
31 0.94 0.93 0.95 1.00	0.99
32 0.07 0.09 0.07 0.01	0.02
³³ 0.08 0.10 0.08 0.05	0.05
$\frac{34}{25}$ 0.00 0.00 0.00 0.00	0.00
35 36 0 20 0 18 0 19 0 20	0.20
37 0.42 0.41 0.42 0.39	0.41
38 0.95 0.41 0.42 0.00	0.41
³⁹ 0.10 0.04 0.05 0.04	0.00
40 0.18 0.18 0.16	0.18
41 0.01 0.01 0.03	0.02
⁴² 0.00 0.01 0.01 0.02	0.01
⁴³ 0.00 0.00 0.00 0.00	0.00
45 0.00 0.00 0.00 0.02	0.02
46 0.03 0.03 0.03 0.05	0.03
47	
⁴⁸ 102 102 102 101	1 01
$\frac{49}{102}$ 0.98 0.97 0.98 0.98	0.08
50 0.50 0.57 0.50 0.50	1.00
51 1.89 1.89 1.89 1.89	1.99
52	
54	
₅₅ 89.55 87.68 89.95 93.30	94.31
56 2.91 3.09 2.82 5.62	3.49
⁵⁷ 7.54 9.23 7.23 1.09	2.20
⁵⁸ 100 100 100 100	100
60	

2 3 4 5 6 7 8	MILANO VSDO-13A2 MNZ8C-7 Core	MILANO VSDO-13A2 MNZ8C-8 Rim	MILANO VSDO-13A2 MNZ8C-9 Rim	PARIS VSDO-13M1 MNZ7-1 Mantle
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	27.62 1.99 10.54 0.10 12.42 28.01 3.18 12.43 0.61 0.49 0.06	30.19 0.24 5.58 0.16 13.74 27.44 3.07 11.63 2.25 1.40 0.18	29.19 0.24 5.37 0.23 14.29 26.83 2.51 11.23 2.58 1.91 0.00	29.42 0.26 5.00 0.16 13.95 28.20 2.89 10.97 2.05 1.03
24 25 26 27 28 29	0.19 0.72 98.37	0.48 1.20 97.56	0.58 1.07 96.03	0.60 1.01 95.77
30 31 32 33 34 35 36 37 38	0.94 0.08 0.10 0.00 0.18 0.41	1.01 0.01 0.05 0.00 0.20 0.40	1.00 0.01 0.05 0.00 0.21 0.40	1.01 0.01 0.05 0.00 0.21 0.42
39 40 41 42 43 44 45 46 47	0.05 0.18 0.01 0.01 0.00 0.00 0.03	0.04 0.16 0.03 0.02 0.00 0.01 0.05	0.04 0.16 0.04 0.03 0.00 0.01 0.05	0.04 0.16 0.03 0.01 0.00 0.01 0.04
47 48 49 50 51 52 53 53	1.02 0.97 1.99	1.02 0.97 1.99	1.01 0.98 1.99	1.02 0.97 1.99
55 56 57 58 59	88.37 3.25 8.38 100	93.50 5.47 1.03 100	94.04 4.92 1.05 100	94.20 4.67 1.14 100

Page 101 of 235

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4 5	VSDO-13M1	VSDO-13M1	VSDO-13M1	VSDO-13M1	VSDO-13M1
6	MNZ7-2	MNZ7-3	MNZ7-4	MNZ7-5	MNZ7-6
7	Core	Core	Core	Core	Rim
8					
9					
10	20 47	20.06	20.36	20.51	20.68
11	23.47	29.00	29.30	29.01	29.00
12	0.31	0.31	0.32	0.34	0.32
13 14	4.79	4.40	5.71	4.68	5.00
15	0.11	0.43	0.10	0.43	0.06
16	13.75	15.22	13.94	14.24	13.95
17	28.94	27.77	29.07	27.99	27.53
18	3.46	2.99	3.14	3.25	3.40
19	12 58	11.60	11.93	11 87	12 02
20	2 11	2 13	1 00	2 12	2 32
21	2.11	2.15	1.99	2.12	2.52
22	0.94	1.03	0.94	0.83	1.07
23					
25	0.11	0.34	0.09	0.20	0.41
26	0.90	0.84	1.07	0.87	0.96
27	97.76	96.32	98.13	96.35	96.73
28					
29					
30	1 00	1 00	0 99	1 00	1 01
37	0.01	0.01	0.00	0.01	0.01
33	0.01	0.01	0.01	0.01	0.01
34	0.04	0.04	0.05	0.04	0.05
35	0.00	0.00	0.00	0.00	0.00
36	0.20	0.23	0.21	0.21	0.21
37	0.42	0.41	0.43	0.41	0.40
38	0.05	0.04	0.05	0.05	0.05
39 40	0.18	0.17	0.17	0.17	0.17
40	0.03	0.03	0.03	0.03	0.03
42	0.01	0.01	0.01	0.01	0.01
43	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00
45	0.00	0.01	0.00	0.00	0.01
46	0.04	0.04	0.05	0.04	0.04
4/					
40	1.01	1.01	1.01	1.02	1.02
50	0.98	0.98	0.99	0.97	0.97
51	2.00	1.99	2.00	1.99	1.99
52					
53					
54	94 63	04 86	03 80	04 53	94 24
55 56	0 1 .05 ۸ ۵٦	2 2 2 2	1 96	Δ Π .00 Λ Ω1	1 20
50 57	4.07	J.0Z	4.00	4.01	4.39
58	1.30	1.32	1.34	1.40	1.38
59	100	100	100	100	100
60					

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4	VSDO-13M1	VSDO-13M1	VSDO-13M1	VSDO-13M1	VSDO-13M1
5	MNI77_7	MNI77-8	MNI78_1	MNI78_2	MN78-3
6				Martia	
7	Core	Core	Mantie	Mantie	Core
8					
9					
10	29.32	29.57	29.12	29.45	29.55
11 12	0.34	0.35	0.34	0.31	0.29
12	1 60	1 10	5.02	5.04	4.00
14	4.00	4.10	5.05	5.04	4.99
15	0.38	0.35	0.10	0.20	0.15
16	14.37	14.71	13.41	13.89	14.04
17	28.51	28.02	28.46	27.22	26.91
18	3.05	3.73	2.94	3.48	3.07
19	11 03	11 21	11 26	11 48	11 89
20	2.26	1 05	2.42	2.64	2 01
21	2.20	1.00	2.43	2.04	2.01
22	1.03	0.67	1.70	2.11	1.13
23					
24	0.18	0.25	0.43	0.43	0.41
25	0.88	0.80	1.02	1.03	0.98
20	96.92	95 70	96.24	97 27	96.26
28	00.02	55.70	50.24	57.27	00.20
29					
30					
31	1.00	1.01	1.00	1.00	1.01
32	0.01	0.01	0.01	0.01	0.01
33	0.04	0.04	0.05	0.05	0.05
34	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00
36	0.21	0.22	0.20	0.21	0.21
3/ 20	0.42	0.41	0.42	0.40	0.40
30	0.04	0.05	0.04	0.05	0.04
40	0.17	0.16	0.16	0.16	0.17
41	0.03	0.03	0.03	0.04	0.04
42	0.01	0.01	0.02	0.03	0.02
43	0.01	0.00	0.02	0.00	0.02
44	0.00	0.00	0.00	0.00	0.00
45	0.00	0.01	0.01	0.01	0.01
46	0.04	0.03	0.04	0.04	0.04
47					
48	1.01	1.02	1.01	1.01	1.02
49	0.98	0.96	0 99	0.98	0.97
50 51	1 00	1 00	2.00	2.00	1 00
57	1.99	1.55	2.00	2.00	1.99
53					
54					
55	94.59	94.79	93.88	94.03	94.25
56	3.97	3.71	4.66	4.67	4.52
57	1.44	1.50	1.46	1.30	1.23
58	100	100	100	100	100
59	100	100	100	100	100
60					

Page 103 of 235

2 3	PARIS	PARIS	PARIS	PARIS	
4					
5	VSD0-13M1	VSDO-13M1	VSDO-13M1	VSDO-13M1	VSD0-13M1
6	MNZ8-4	MNZ8-5	MNZ8-6	MNZ8-7	MNZ9-1
7	Core	Core	Mantle	Mantle	Rim
8					
9					1
10	20.26	20.21	20.22	20.20	20.01
11	29.20	29.31	29.33	29.30	29.01
12	0.86	0.29	0.29	0.30	0.38
13	5.33	5.27	5.52	5.94	5.18
14 15	0.20	0.15	0.19	0.01	0.14
15	13.76	13.84	14.86	14.95	13.08
17	26 63	27 31	26 28	25 02	25 71
18	2 52	2 00	3 51	2 70	3 16
19	11.00	2.33	11 00	2.70	10 20
20	11.20	10.55	11.00	11.10	10.20
21	2.24	2.51	2.89	1.92	2.02
22	1.03	1.67	1.94	1.51	1.22
23					
24	0.61	0.92	0.49	2.15	1.86
25 26	1.09	1.04	1.06	1.12	1.04
20	95 46	96.08	97.66	96 74	93.80
28	00.40	00.00	57.00	50.74	00.00
29					
30					
31	1.00	1.00	1.00	1.00	1.01
32	0.03	0.01	0.01	0.01	0.02
33	0.05	0.05	0.05	0.05	0.05
34	0.00	0 00	0 00	0 00	0 00
35	0.20	0.21	0.22	0.22	0.20
30 27	0.20	0.21	0.22	0.22	0.20
38	0.39	0.40	0.39	0.37	0.39
39	0.04	0.04	0.05	0.04	0.05
40	0.16	0.15	0.16	0.16	0.15
41	0.03	0.03	0.04	0.03	0.03
42	0.01	0.02	0.03	0.02	0.02
43	0.00	0.00	0.00	0.00	0.00
44	0.01	0.02	0.01	0.05	0.04
45	0.05	0.02	0.05	0.05	0.05
40 17	0.05	0.04	0.05	0.05	0.05
48	4.00	4.04	4.04	4.04	4.00
49	1.03	1.01	1.01	1.01	1.02
50	0.95	0.98	0.99	0.99	0.96
51	1.99	1.99	2.00	2.00	1.99
52					
53					
54	91 27	93 97	94 00	93 60	93 40
55 56	5 01	A 77	م الم الم الم	Б 10	1 02
57	0.01	4.00	4.13	J. 12	4.32
58	3.12	1.20	1.21	1.28	1.07
59	100	100	100	100	100
60					

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4	VSDO-13M1	VSDO-13M1	VSDO-13M1	VSDO-13M1	VSDO-13M1
5	MN79-2	MN79-3	MN79-4	MN79-5	MN79-6
6	Core	Core		Dim	Core
/	COLE	COLE	COLE	NIII	Core
0 0					
9 10					
11	29.61	29.50	29.75	29.73	29.62
12	0.35	0.33	0.31	0.26	0.32
13	6.27	5.65	5.24	5.54	5.31
14	0.09	0 16	0 14	0 10	0.09
15	13 56	13 52	14 11	13 78	13 70
16	13.30	10.02	07.05	15.70	10.70
/ 10	27.70	20.00	27.00	25.43	20.00
10 10	3.37	3.38	3.34	3.40	2.77
20	12.04	11.45	11.35	10.45	11.55
21	2.32	1.62	2.01	2.06	2.33
22	0.45	0.70	1.11	1.33	1.46
23					
24	0 15	0.32	0.36	2 40	0 78
25	1 22	1.02	1.05	1 09	1 12
26	1.22	1.00	1.05	1.00	1.13
2/ 20	97.33	90.58	90.05	95.65	97.94
20 29					
30					
31	1.00	1.00	1.01	1.01	1.00
32	0.01	0.01	0.01	0.01	0.01
33	0.06	0.05	0.05	0.05	0.05
34	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00
36 27	0.20	0.20	0.21	0.20	0.20
37 38	0.41	0.42	0.41	0.37	0.42
39	0.05	0.05	0.05	0.05	0.04
40	0.17	0.16	0.16	0.15	0.16
41	0.03	0.02	0.03	0.03	0.03
42	0.01	0.01	0.01	0.02	0.02
43	0.00	0.00	0.00	0.00	0.00
44	0 00	0.01	0.01	0.05	0.02
45 46	0.05	0.05	0.05	0.05	0.05
40 47	0.05	0.05	0.05	0.05	0.05
48	4.00	4.00	4.00	4.00	4.04
49	1.02	1.02	1.02	1.02	1.01
50	0.98	0.97	0.97	0.97	0.99
51	1.99	1.99	1.99	1.99	2.00
52					
53					
54 55	92.91	93.61	93.83	93.90	93.64
56	5 58	4 98	4 84	5 00	5 04
57	1 51		т. ст 1 22	1 10	1 21
58	1.01	1.41	1.00	1.10	1.31
59	100	100	100	100	100

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4					
5					
6	MINZ9-7	IVINZZ-1	IVINZZ-Z	IVINZZ-3	IVINZZ-4
7	Core	Rim	Core	Core	Core
8					
9					
10	20.72	20.74	20.67	20 72	20.40
11	29.72	29.74	29.07	29.12	29.49
12	0.32	0.29	0.28	0.28	0.39
13	5.28	4.28	4.33	4.23	6.24
14	0.15	0.36	0.34	0.36	0.07
15 16	13.90	12.93	14.61	13.86	15.77
17	28 79	27 87	28 46	28 44	25 90
18	2 50	2.9.1	2 50	2 17	2.06
19	5.59	2.01	2.00	3.17	2.90
20	11.73	12.93	12.91	12.85	10.93
21	1.90	1.93	1.96	2.23	1.91
22	1.23	1.19	0.94	1.09	0.46
23					
24	0 27	0 25	0 14	0 23	0 74
25	1.06	0.20	0.02	0.02	1 10
26	1.00	0.07	0.92	0.92	1.10
27	98.18	95.71	97.05	97.57	95.99
28					
29					
31	1.00	1.01	1.00	1.00	1.00
32	0.01	0.01	0.01	0.01	0.02
33	0.05	0.01	0.01	0.01	0.02
34	0.05	0.04	0.04	0.04	0.00
35	0.00	0.00	0.00	0.00	0.00
36	0.20	0.19	0.22	0.20	0.23
37	0.42	0.41	0.42	0.42	0.38
38	0.05	0.04	0.04	0.05	0.04
39	0 17	0 19	0 18	0 18	0 16
40	0.03	0.03	0.03	0.03	0.03
41 42	0.00	0.00	0.03	0.05	0.03
42	0.02	0.02	0.01	0.01	0.01
44	0.00	0.00	0.00	0.00	0.00
45	0.01	0.01	0.00	0.00	0.02
46	0.05	0.04	0.04	0.04	0.05
47					
48	1 01	1.03	1 02	1 01	1 02
49	0.09	0.06	0.02	0.09	0.07
50	0.90	0.90	0.90	0.90	0.97
51	1.99	1.98	1.99	1.99	1.99
52 52					
55 54					
55	93.91	94.71	94.66	94.68	93.21
56	4 76	4 03	4 15	4 14	5 10
57	1 22	1.00	1 10	1 10	1 60
58	1.00	1.20	1.13	1.13	1.09
59	100	100	100	100	100
60					

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4	VSDO-13M1	VSDO-13M1	VSDO-13M1	VSDO-13M1	VSDO-13M1
5	MNI72 5	MNI72 6	MNI71 1	MNI71 2	MNI71 3
6					
7	Core	RIM	RIM	Core	Core
8					
9					
10	29.42	29.69	29.95	29.56	29.69
17	0.28	0.26	0.27	0.29	0.34
12	1 20	4.60	5.41	4.02	4 70
14	4.30	4.02	5.41	4.92	4.79
15	0.39	0.25	0.20	0.16	0.23
16	13.96	14.03	13.94	14.01	14.20
17	29.14	28.27	27.15	28.98	29.13
18	3.81	2.74	3.18	3.36	3.17
19	12 21	11 72	11 04	12 23	12 70
20	2.21	2.67	2.46	2.20	2.00
21	2.24	2.07	2.40	2.23	2.09
22	0.61	1.90	1.53	0.20	0.38
23					
24 25	0.10	0.38	0.50	0.09	0.22
25	0.93	0.97	1.09	0.96	0.95
27	97 46	97 77	96 92	96 99	97 89
28	01110	01111	00.02	00100	01100
29					
30	4.00	4.00		4.00	4.00
31	1.00	1.00	1.01	1.00	1.00
32	0.01	0.01	0.01	0.01	0.01
33	0.04	0.04	0.05	0.04	0.04
34 25	0.00	0.00	0.00	0.00	0.00
35	0.21	0 21	0 20	0 21	0.21
37	0.43	0.41	0.40	0.42	0.42
38	0.43	0.41	0.40	0.42	0.42
39	0.06	0.04	0.05	0.05	0.05
40	0.17	0.17	0.16	0.17	0.18
41	0.03	0.04	0.03	0.03	0.03
42	0.01	0.03	0.02	0.00	0.01
43	0.00	0.00	0.00	0.00	0.00
44	0 00	0.01	0.01	0 00	0.00
45	0.00	0.01	0.05	0.00	0.00
40	0.04	0.04	0.05	0.04	0.04
47 48			(
49	1.01	1.01	1.02	1.01	1.01
50	0.99	0.98	0.97	0.98	0.98
51	2.00	1.99	1.99	1.99	1.99
52					
53					
54	01 65	01 55	02 70	04 40	04 22
55	94.00	94.00	30.19	94.4U	94.JZ
56 57	4.19	4.38	5.04	4.38	4.27
5/ 50	1.15	1.08	1.17	1.22	1.41
50 59	100	100	100	100	100
60					

Page 107 of 235

2		DADIS		DADIS	DADIS
4	FARIO	FARIS	PARIS	FARIS	
5	VSDO-13M1	VSDO-13M1	VSDO-13M1	VSDO-13M1	VSDO-13M1
6	MNZ1-4	MNZ1-5	MNZ6-1	MNZ6-2	MNZ6-3
7	Core	Core	Rim	Rim	Core
8					
9			I		
10	00.00	00.00	00.74	00 70	00.00
11	29.66	29.66	29.71	29.76	29.92
12	0.27	0.29	0.25	0.25	0.23
13	5.29	5.53	4.99	5.02	4.92
14	0.14	0.24	0.13	0.20	0.25
15	14 17	13 93	13.90	13 94	13 55
10 17	28.45	20.16	26.00	27 12	27.67
17 18	20.40	23.10	20.99	21.12	21.01
10	4.13	3.73	2.61	3.11	3.15
20	11.96	11.98	10.66	11.40	11.00
21	2.41	2.31	2.42	2.26	2.22
22	0.64	1.06	1.42	1.13	1.40
23					
24	0.05	0 13	0.67	0.80	1 07
25	1.05	1.09	1.07	1.06	1.07
26	1.05	1.00	1.07	1.00	1.02
2/	98.70	99.60	95.06	96.78	96.79
20 20					
30					
31	1.00	0.99	1.02	1.01	1.01
32	0.01	0.01	0.01	0.01	0.01
33	0.05	0.05	0.05	0.05	0.04
34	0.00	0.05	0.00	0.00	0.04
35	0.00	0.00	0.00	0.00	0.00
36	0.21	0.20	0.21	0.21	0.20
37	0.41	0.42	0.40	0.40	0.40
38	0.06	0.05	0.04	0.05	0.05
39	0.17	0.17	0.15	0.16	0.16
40 41	0.03	0.03	0.03	0.03	0.03
47	0.00	0.00	0.00	0.00	0.00
43	0.01	0.01	0.02	0.01	0.02
44	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.01	0.02	0.02
46	0.04	0.05	0.05	0.05	0.04
47					
48	1.01	1.00	1.03	1.02	1.02
49	0.99	0 99	0.96	0.97	0.97
50	2.00	2.00	1.00	1.00	1.00
51 52	2.00	2.00	1.99	1.99	1.99
53					
54					
55	94.15	93.99	93.87	94.02	94.31
56	4.73	4.81	5.02	4.88	4.69
57	1,13	1.20	1.11	1.09	1.00
58	100	100	100	100	100
59	100	100	100	100	100
60					
2					
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3	PARIS	PARIS	PARIS	PARIS	PARIS
4	VSDO-13M1	VSDO-13M1	VSDO-13M1	VSDO-13M1	VSDO-13M1
5	MN76-4	MNZ6-5	MNZ6-6	MNZ6-7	MNZ6-8
6	Core	Dim	Dim	Core	Core
/	COIE		INITI	COLE	COLE
0					
9 10					
10	29.97	29.30	29.20	29.47	29.44
12	0.27	0.37	0.22	0.33	0.39
13	5 68	646	4 95	3 94	6 28
14	0.00	0.03	0.22	0.27	0.20
15	0.11	0.03	0.23	0.37	0.30
16	14.45	15.16	13.07	13.23	12.73
17	26.21	26.43	26.29	28.15	27.66
18	3.26	2.40	3.01	3.23	3.38
19	9.96	10.53	11.37	13.48	11.70
20	2 18	1 95	2 27	2 67	1 84
21	1 57	1.00	1.60	1.04	0.55
22	1.57	1.54	1.09	1.04	0.55
23					
25	2.52	1.37	1.48	0.12	0.13
26	1.15	1.16	1.15	0.77	1.20
27	98.12	96.62	95.41	97.12	95.58
28					
29					
30	1 00	1 00	1 00	1 00	4.04
31	1.00	1.00	1.00	1.00	1.01
32	0.01	0.01	0.01	0.01	0.02
33 24	0.05	0.06	0.05	0.04	0.06
34 35	0.00	0.00	0.00	0.00	0.00
36	0.21	0.22	0.20	0.20	0.19
37	0.38	0.39	0.39	0.41	0 4 1
38	0.00	0.00	0.00	0.41	0.41
39	0.05	0.04	0.04	0.05	0.05
40	0.14	0.15	0.17	0.19	0.17
41	0.03	0.03	0.03	0.04	0.03
42	0.02	0.02	0.02	0.01	0.01
43	0.00	0.00	0.00	0.00	0.00
44	0.05	0.03	0.03	0.00	0.00
45 46	0.05	0.05	0.05	0.03	0.05
40 47	0.00	0.00	0.00	0.00	0.00
48	4.04	4.04	4.04	4.00	4.00
49	1.01	1.01	1.01	1.02	1.02
50	0.98	0.98	0.98	0.98	0.97
51	1.99	1.99	1.99	1.99	1.99
52					
53					
54	03 60	03 07	03 75	05 12	02 66
55	90.09 E 10	50.01	55.75	JJ. 12	52.00 E GE
50 57	5.10	5.33	5.30	3.50	CO.C
58	1.13	1.59	0.95	1.38	1.69
59	100	100	100	100	100
60					

Page 109 of 235

 PARIS PARIS PARIS PARIS VSDO-13M1 VSDO-13M1 VSDO-13M1 VSDO-13M1 VSDO-13M1 VSDO-13M1 VS MNZ5-1 MNZ5-2 MNZ5-3 MNZ5-4 I Rim Core Core Rim 8 	PARIS DO-13M1 MNZ5-5 Mantle 29.73 0.31
4 5 6VSDO-13M1VSDO-13M1VSDO-13M1VSDO-13M1VS6 7 7MNZ5-1MNZ5-2MNZ5-3MNZ5-4I7 8RimCoreCoreRim	DO-13M1 MNZ5-5 Mantle 29.73 0.31
6 MNZ5-1 MNZ5-2 MNZ5-3 MNZ5-4 I 7 Rim Core Core Rim 8	29.73 0.31
7 Rim Core Core Rim	29.73 0.31
7 RIM Core Core RIM 8	29.73 0.31
8	29.73 0.31
	29.73 0.31
10	29.73 0.31
¹⁰ 29.92 30.02 30.33 24.46	0.31
12 0.25 0.25 0.23 11.74	••••
13 490 457 446 435	3 00
14 0.12 0.12 0.00 0.12	0.00
15 0.12 0.13 0.09 0.12	0.33
16 14.07 13.64 15.52 12.43	14.73
17 25.99 26.45 26.47 24.34	29.55
¹⁸ 3.20 3.11 2.61 2.80	3.25
$\frac{19}{20}$ 11.30 10.74 11.03 9.42	11.85
20 21 2.52 2.00 1.90 1.68	2.24
121 128 0.97 1.14 0.76	0.78
23	0.70
24 0.65 0.42 0.08 0.06	0.22
25 0.05 2.42 2.08 0.96	0.33
26 1.02 0.97 0.93 1.01	0.77
²⁷ 95.89 95.98 97.67 94.66	97.88
28	
29	
1.02 1.01 1.01 0.77	1.00
32 0.01 0.01 0.01 0.44	0.01
³² 0.01 0.01 0.01 0.14	0.01
³⁴ 0.00 0.00 0.00 0.00	0.04
35 0.00 0.00 0.00 0.00	0.00
36 0.21 0.20 0.23 0.17	0.22
³⁷ 0.38 0.39 0.38 0.33	0.43
³⁸ 0.05 0.05 0.04 0.04	0.05
$\frac{39}{40}$ 0.16 0.15 0.16 0.13	0.17
40 41 0.03 0.03 0.02	0.03
42 0.02 0.01 0.01 0.01	0.01
⁴³ 0.00 0.00 0.00	0.01
44 0.01 0.05 0.00 0.00	0.00
45 0.01 0.05 0.04 0.02	0.01
46 0.04 0.04 0.04 0.04	0.03
47	
⁴⁸ 1.03 1.02 1.02 1.21	1.01
50 0.96 0.96 0.97 0.80	0.98
50 51 1.98 1.99 1.99 2.01	1 99
52	1.00
53	
54	05.05
55 94.13 94.44 94.80 59.99	95.25
56 4.78 4.46 4.22 3.38	3.45
⁵ / 1.09 1.09 0.98 36.63	1.31
⁵⁸ 100 100 100 100	100
60	

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4 5	VSDO-13M1	VSDO-13M1	VSDO-13M1	VSDO-13M1	VSDO-13M1
5	MNZ10-1	MNZ10-2	MNZ10-3	MNZ10-4	MNZ10-5
7	Rim	Mantle	Mantle	Core	Core
8					
9					
10	00.00	00.45	~~~~	00.40	00.05
11	29.99	30.15	30.20	29.40	29.95
12	0.30	0.35	0.28	0.76	0.25
13	4.92	5.14	5.14	10.07	5.56
14	0.12	0.18	0.10	0.01	0.33
15	13 97	15 10	13 99	10 67	12 53
10 17	26.54	27.84	27 / 3	25.75	26.00
17	20.04	27.04	27.40	20.70	20.00
10	2.85	2.87	3.28	3.24	2.11
20	10.45	10.41	10.42	13.76	12.23
21	2.06	1.98	2.40	2.13	2.36
22	1.21	1.45	2.04	0.64	1.34
23					
24	1.20	1.53	0.97	0.13	0.10
25	1 04	1 03	1 07	1 60	1 28
20 27	04 76	08.76	08.24	08.15	04 70
27	94.70	90.70	30.24	90.15	34.70
29					
30					
31	1.02	1.00	1.01	0.99	1.02
32	0.01	0.01	0.01	0.03	0.01
33	0.04	0.05	0.05	0.09	0.05
34 25	0.00	0.00	0.00	0.00	0.00
35 26	0.21	0.22	0.20	0.16	0 19
30	0.30	0.40	0.20	0.10	0.10
38	0.03	0.40	0.40	0.57	0.00
39	0.04	0.04	0.05	0.05	0.04
40	0.15	0.15	0.15	0.20	0.18
41	0.03	0.03	0.03	0.03	0.03
42	0.02	0.02	0.03	0.01	0.02
43	0.00	0.00	0.00	0.00	0.00
44 45	0.03	0.03	0.02	0.00	0.00
45 46	0.04	0.04	0.05	0 07	0.06
47		••••		••••	
48	1.03	1 02	1 02	1 02	1 03
49	1.05	0.02	1.02	0.07	1.05
50	0.95	0.98	0.97	0.97	0.95
51	1.98	1.99	1.99	1.99	1.98
52					
53 54					
55	93.78	93.93	93.93	89.21	92.81
56	4.91	4.62	4.88	7.48	6.09
57	1 31	1 44	1 18	3 31	1 11
58	100	100	100	100	100
59	100	100	100	100	100
60					

3 PARIS PARIS PARIS PARIS PARIS VSDO-13M1 VSDO-13M1 VSDO-13M1 VSDO-13M1 VSDO-13M1 VSDO-13M1 VSDO-13M1 VSDO-13M1 MNZ10-1 6 MM210-6 MMX10-7 MNZ10-7 MNZ10-1 Rim MIN210-1 7 Core Mantle 0 0 0.24 0.36 0.24 10 29.63 29.97 29.66 29.66 29.66 12 0.56 0.28 0.36 0.24 1.3 13 8.36 5.13 5.03 5.56 0.22 16 11.64 14.98 14.48 14.23 10.22 16 1.63 25.89 26.34 25.36 301 12 2.41 1.13 10.95 301 1.35 21 2.31 2.23 2.29 2.13 2.29 1.35 22 0.11 1.07 1.66 1.11 1.01 1.01 22 <th>2</th> <th></th> <th></th> <th></th> <th></th>	2				
4 VSDO-13M1 VSDO-13M1 VSDO-13M1 VSDO-13M1 VSDO-13M1 VSDO-13M1 6 MMZ10-6 MMZ10-7 MMZ10-8 MINZ10-1 Rim 7 Core Mantle MINZ10-8 MINZ10-1 Rim 9 . 0.56 0.28 0.36 0.24 3.36 10 29.66 0.15 0.22 1.56 0.28 0.36 11 0.56 0.28 0.36 0.24 3.35 11 1.64 14.98 14.48 14.23 3.25.89 26.34 25.36 12 2.31 2.23 2.29 2.13 3.0.95 3.01 1.95 21 2.31 2.23 2.29 2.13 3.25 9.97 9.97 1.90 1.35 22 0.45 1.72 1.90 1.01 1.01 1.32 23 0.11 1.07 1.66 1.11 1.97 9.05 0.05 0.05 0.05	3	PARIS	PARIS	PARIS	PARIS
5 ODD 10MT ODD 10MT ODD 10MT ODD 10MT 7 Core Mantle MIN210-8 MIN210-10 7 Core Mantle Rim 10 29.63 29.97 29.66 29.66 12 0.56 0.28 0.36 0.24 13 8.36 5.13 5.03 5.56 14 0.13 0.26 0.15 0.22 16 11.64 14.98 14.48 14.23 19 14.20 11.34 11.33 10.95 21 2.31 2.23 2.29 2.13 22 0.45 1.72 1.90 1.35 24 1.47 1.07 1.66 1.11 25 0.11 1.47 1.00 1.01 26 1.47 1.07 1.66 1.11 27 99.07 97.10 97.25 95.79 28 0.04 0.04 0.04 0.04	4		VSD0-13M1		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	5				
7 Core Mantle Rim 9 10 29.63 29.97 29.66 29.66 11 29.63 29.97 29.66 29.66 29.66 12 0.56 0.28 0.36 0.21 13 8.36 5.13 5.03 5.56 14 0.13 0.26 0.15 0.22 15 0.14 14.98 14.48 14.23 17 26.63 25.89 26.34 25.36 18 3.27 2.62 2.59 3.01 19 14.20 11.34 11.33 10.95 21 2.31 2.23 2.29 2.13 22 0.45 1.72 1.90 1.35 23 0.47 1.07 1.66 1.11 24 0.01 0.01 0.01 3.01 25 0.11 1.47 1.00 1.01 26 1.47 1.07 1.66 95.79 31 0.99 1.01 1.00 0.01 <t< td=""><td>6</td><td>MINZ10-6</td><td>MINZ10-7</td><td>MINZ10-8</td><td>WINZ10-1</td></t<>	6	MINZ10-6	MINZ10-7	MINZ10-8	WINZ10-1
8 29.63 29.97 29.66 29.66 11 29.63 0.28 0.36 0.24 13 8.36 5.13 5.03 5.56 15 0.13 0.26 0.15 0.22 16 11.64 14.98 14.48 14.23 17 26.63 25.89 26.34 25.36 18 3.27 2.62 2.59 3.01 20 14.20 11.34 11.33 10.95 21 2.31 2.23 2.29 2.13 22 0.45 1.72 1.90 1.35 24 1.47 1.07 1.66 1.11 25 1.47 1.07 1.66 1.11 26 1.47 1.07 1.66 1.01 25 0.01 0.01 0.01 3.01 26 1.47 1.07 1.66 1.11 27 99.07 97.10 97.25 95.79 26 1.47 1.02 0.01 0.01 30 <td>7</td> <td>Core</td> <td>Mantle</td> <td></td> <td>Rim</td>	7	Core	Mantle		Rim
9 29.63 29.97 29.66 29.66 11 29.63 0.36 0.24 13 8.36 5.13 5.03 5.56 14 0.13 0.26 0.15 0.22 15 11.64 14.98 14.48 14.23 17 26.63 25.89 26.34 25.36 18 3.27 2.62 2.59 3.01 14.20 11.34 11.33 10.95 21 2.31 2.23 2.29 2.13 22 0.45 1.72 1.90 1.35 23 0.45 1.72 1.90 1.35 24 0.45 0.11 1.47 1.00 1.01 25 1.47 1.07 1.66 1.11 1.22 25 0.11 1.00 0.01 0.01 0.01 26 1.47 1.07 0.66 0.5 0.55 0.05 31 0.99 1.01 1	8				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	9				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	10	00.00	00.07	00.00	00.00
12 0.56 0.28 0.36 0.24 13 8.36 5.13 5.03 5.56 14 0.13 0.26 0.15 0.22 15 11.64 14.98 14.48 14.23 17 26.63 25.89 26.34 25.36 18 3.27 2.62 2.59 3.01 20 14.20 11.34 11.33 10.95 21 2.31 2.23 2.29 2.13 22 0.45 1.72 1.90 1.35 23 0.45 1.72 1.90 1.32 24 0.11 1.47 1.10 1.32 25 0.11 1.47 1.00 1.01 26 1.47 1.07 1.66 1.11 27 99.07 97.10 97.25 95.79 28 0.02 0.01 0.01 0.01 31 0.99 1.01 1.00 1.01 32 0.02 0.03 0.03 0.05 34	11	29.63	29.97	29.66	29.66
13 8.36 5.13 5.03 5.56 14 0.13 0.26 0.15 0.22 15 11.64 14.98 14.48 14.23 17 26.63 25.89 26.34 25.36 18 3.27 2.62 2.59 3.01 19 14.20 11.34 11.33 10.95 21 2.31 2.23 2.29 2.13 22 0.45 1.72 1.90 1.35 24 1.47 1.07 1.66 1.11 25 1.47 1.07 1.66 1.11 26 1.47 1.00 1.01 0.01 31 0.99 1.01 1.00 1.01 32 0.02 0.01 0.01 0.01 33 0.02 0.01 0.01 0.01 34 0.00 0.00 0.00 0.00 35 0.00 0.04 0.04 0.04 39 0.38 0.38 0.37 38 0.05	12	0.56	0.28	0.36	0.24
14 0.13 0.26 0.15 0.22 15 11.64 14.98 14.48 14.23 17 26.63 25.89 26.34 25.36 18 3.27 2.62 2.59 3.01 20 14.20 11.34 11.33 10.95 21 2.31 2.23 2.29 2.13 22 0.45 1.72 1.90 1.35 24 0.11 1.47 1.10 1.32 25 0.41 1.47 1.06 1.11 27 99.07 97.10 97.25 95.79 28 0.02 0.01 0.01 0.01 31 0.99 1.01 1.00 1.01 32 0.02 0.01 0.01 0.01 33 0.88 0.38 0.37 0.99 34 0.00 0.00 0.00 0.00 35 0.00 0.03 0.02 0.03 36 0.05 0.04 0.04 0.04 40	13	8.36	5.13	5.03	5.56
15 0.10 0.20 0.11 0.12 16 11.64 14.98 14.48 14.23 17 26.63 25.89 26.34 25.36 18 3.27 2.62 2.59 3.01 19 14.20 11.34 11.33 10.95 21 2.31 2.23 2.29 2.13 22 0.45 1.72 1.90 1.35 24 1.47 1.07 1.66 1.11 25 0.11 1.47 1.10 1.32 26 1.47 1.07 1.66 1.11 27 99.07 97.10 97.5 95.79 28	14	0.13	0.26	0 15	0.22
16 11.04 14.38 14.40 14.25 17 26.63 25.89 26.34 25.36 18 3.27 2.62 2.59 3.01 19 14.20 11.34 11.33 10.95 21 2.31 2.23 2.29 2.13 22 0.45 1.72 1.90 1.35 24 0.45 1.72 1.90 1.35 25 0.11 1.47 1.10 1.32 26 1.47 1.07 1.66 1.11 27 99.07 97.10 97.25 95.79 28 0.02 0.01 0.01 0.01 31 0.99 1.01 1.00 1.01 32 0.02 0.01 0.01 0.00 33 0.08 0.05 0.05 0.05 34 0.00 0.00 0.00 0.00 35 0.00 0.03 0.03 0.03 36 0.05 0.04 0.04 0.04 40	15	11 64	14.00	14 40	14.00
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	16	11.04	14.98	14.48	14.23
18 3.27 2.62 2.59 3.01 19 14.20 11.34 11.33 10.95 21 2.31 2.23 2.29 2.13 22 0.45 1.72 1.90 1.35 24 0.45 1.72 1.90 1.35 25 0.11 1.47 1.07 1.66 1.11 27 99.07 97.10 97.25 95.79 28 0.02 0.01 0.01 0.01 31 0.99 1.01 1.00 1.01 32 0.02 0.01 0.01 0.01 33 0.08 0.05 0.05 0.05 34 0.00 0.00 0.00 0.00 35 0.00 0.04 0.04 0.04 40 0.20 0.16 0.16 0.16 41 0.03 0.03 0.02 0.03 42 0.01 0.02 0.03 0.02 <td>17</td> <td>26.63</td> <td>25.89</td> <td>26.34</td> <td>25.36</td>	17	26.63	25.89	26.34	25.36
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	18	3.27	2.62	2.59	3.01
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	19	14 20	11.34	11.33	10.95
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	20	2.21	2.22	2 20	2 12
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	21	2.31	2.23	2.29	2.13
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	22	0.45	1.72	1.90	1.35
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	23				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	24	0.11	1.47	1.10	1.32
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	25	1 47	1 07	1.66	1 11
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	26	1.77	07.40	07.05	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	27	99.07	97.10	97.25	95.79
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	28				
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	29				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	30 21	0 99	1 01	1 00	1 01
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	21 22	0.00	0.01	0.01	0.01
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	22	0.02	0.01	0.01	0.01
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	37	0.08	0.05	0.05	0.05
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	35	0.00	0.00	0.00	0.00
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	36	0.17	0.22	0.21	0.21
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	37	0.30	0.38	0.38	0.37
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	38	0.00	0.00	0.00	0.07
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	39	0.05	0.04	0.04	0.04
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	40	0.20	0.16	0.16	0.16
42 0.01 0.02 0.03 0.02 43 0.00 0.00 0.00 0.01 44 0.00 0.03 0.02 0.03 45 0.00 0.03 0.02 0.03 46 0.06 0.05 0.07 0.05 47 - - - - 48 1.01 1.02 1.01 1.02 50 0.98 0.97 0.99 0.96 51 1.99 1.99 2.00 1.99 52 - - - - 54 - - - 93.76 55 90.92 93.94 91.14 93.76 5.21 56 6.71 4.89 7.38 5.21 5.21 57 2.37 1.17 1.48 1.03 1.00 59 100 100 100 100 100 100	41	0.03	0.03	0.03	0.03
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	42	0.01	0.02	0.03	0.02
44 0.00 0.00 0.00 0.00 45 0.00 0.03 0.02 0.03 46 0.06 0.05 0.07 0.05 47	43	0.00	0.00	0.00	0.00
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	44	0.00	0.00	0.00	0.00
46 0.06 0.05 0.07 0.05 47 1.01 1.02 1.01 1.02 48 1.01 1.02 1.01 1.02 49 0.98 0.97 0.99 0.96 50 0.98 0.97 0.99 0.96 51 1.99 1.99 2.00 1.99 52	45	0.00	0.03	0.02	0.03
47 48 1.01 1.02 1.01 1.02 49 0.98 0.97 0.99 0.96 50 0.98 0.97 0.99 0.96 51 1.99 1.99 2.00 1.99 52 - - - 93.76 53 - - 55 90.92 93.94 91.14 93.76 56 6.71 4.89 7.38 5.21 5.21 57 2.37 1.17 1.48 1.03 59 100 100 100 100	46	0.06	0.05	0.07	0.05
48 1.01 1.02 1.01 1.02 49 0.98 0.97 0.99 0.96 50 1.99 1.99 2.00 1.99 52	47				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	48	1 01	1 02	1 01	1 02
50 0.98 0.97 0.99 0.99 0.96 51 1.99 1.99 2.00 1.99 52 53 90.92 93.94 91.14 93.76 54 55 90.92 93.94 91.14 93.76 56 6.71 4.89 7.38 5.21 57 2.37 1.17 1.48 1.03 58 100 100 100 100	49	0.00	0.07	0.00	0.00
51 1.99 1.99 2.00 1.99 52 1.99 1.99 1.99 53 1.99 1.99 1.99 54 90.92 93.94 91.14 93.76 56 6.71 4.89 7.38 5.21 57 2.37 1.17 1.48 1.03 59 100 100 100 100	50	0.90	0.97	0.99	0.90
52 53 54 55 90.92 93.94 91.14 93.76 56 6.71 4.89 7.38 5.21 57 2.37 1.17 1.48 1.03 58 100 100 100 100	51	1.99	1.99	2.00	1.99
53 54 90.92 93.94 91.14 93.76 55 90.92 93.94 91.14 93.76 56 6.71 4.89 7.38 5.21 57 2.37 1.17 1.48 1.03 58 100 100 100 100	52				
54 90.92 93.94 91.14 93.76 55 6.71 4.89 7.38 5.21 57 2.37 1.17 1.48 1.03 58 100 100 100 100	53				
55 6.71 4.89 7.38 5.21 57 2.37 1.17 1.48 1.03 58 100 100 100 100	54	00 02	03 01	Q1 1 <i>1</i>	03 76
56 6.71 4.89 7.38 5.21 57 2.37 1.17 1.48 1.03 58 100 100 100 100	55	0.32	4.00	7 00	55.70
57 2.37 1.17 1.48 1.03 58 100 100 100 100 60 100 100 100 100	56	0./1	4.89	1.38	5.21
⁵⁸ 100 100 100 100 100	5/	2.37	1.17	1.48	1.03
60	20 50	100	100	100	100
	59 60				

3 PARIS PARIS PARIS PARIS PARIS PARIS VSDO-13M2 MNZ10-6 MINZ10-7 MINZ10-7 MINZ10-8 MINZ10-8 MINZ10-8 MINZ10-8 MINZ10-8 MINZ10-6 MINZ10-6 MINZ10-6 MINZ10-6 MINZ10-6 MINZ10-6 MINZ10-6 MINZ10-6 MINZ10-6 MINZ10-7 MINZ10-7 Q.29.5 3.06 Q.29.2 Q.214 Q.29.7 Q.216 Q.29.7 Q.216 Q.29.7 Q.216 Q.29.7 Q.216 Q.29.7 Q.216 Q.214 Q.214 Q.224 Q.214 Q.224 Q.214 Q.224 <thq.21< th=""> <thq.221< th=""></thq.221<></thq.21<>	2					
45 VSDO-13M2 VSDO-	3	PARIS	PARIS	PARIS	PARIS	PARIS
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	4	VSDO-13M2	VSDO-13M2	VSDO-13M2	VSDO-13M2	VSDO-13M2
Mantle Core Core Rim Core N 0 0.24 0.23 0.37 0.23 0.24 11 0.24 0.23 0.37 0.23 0.24 13 5.43 5.44 6.86 5.49 5.39 11 0.09 0.15 0.00 0.19 0.11 13 5.43 5.44 2.95 3.06 2.92 11 13.27 12.91 14.13 14.72 14.10 17 24.57 24.97 27.14 25.97 24.73 19 0.43 10.52 10.05 10.65 10.07 11 1.99 2.18 2.30 1.79 21 1.18 1.68 0.87 1.48 1.81 125 2.50 3.01 1.23 1.09 2.24 26 1.06 1.08 1.18 1.07 1.05 122 0.21 0.21 0	5	MN710-2	MN710-3	MN710-4	MNZ10-5	MN710-6
Martie Core Core Run Core 9 0 29.82 29.31 29.64 29.97 11 29.88 29.82 29.31 29.64 29.97 12 0.24 0.23 0.37 0.23 0.24 13 5.43 5.44 6.86 5.49 5.39 14 0.09 0.15 0.00 0.19 0.11 16 13.27 12.91 14.13 14.72 14.00 17 24.57 24.97 27.14 25.97 24.73 18 3.44 2.89 2.95 3.06 2.92 10 1.43 10.52 10.05 10.63 10.07 21 1.91 1.99 2.18 2.30 1.79 22 1.18 1.68 0.87 1.48 1.81 23 1.06 1.08 1.18 1.07 1.05 24 2.50 3.01 1.01 <td< td=""><td>6</td><td>Montlo</td><td>Coro</td><td></td><td>Dim</td><td>Coro</td></td<>	6	Montlo	Coro		Dim	Coro
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	/	Manue	COLE	COLE	RIIII	Core
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	8					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	9 10					
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	11	29.88	29.82	29.31	29.64	29.97
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	12	0.24	0.23	0.37	0.23	0.24
14 0.05 0.17 0.00 0.19 0.11 15 13.27 12.91 14.13 14.72 14.10 17 24.57 24.97 27.14 25.97 24.73 18 3.44 2.89 2.95 3.06 2.92 19 10.43 10.52 10.05 10.63 10.07 20 1.91 1.99 2.18 2.30 1.79 21 1.91 1.99 2.18 2.30 1.79 22 1.18 1.68 0.87 1.48 1.81 24 2.50 3.01 1.23 1.09 2.24 26 1.06 1.08 1.18 1.07 1.05 27 94.65 95.25 96.69 96.15 94.62 28 0.01 0.01 0.01 0.01 0.01 31 1.02 1.01 1.00 1.01 1.02 29 0.01 0.01 0.01 0.01 0.01 0.01 33 0.05 0.05 <t< td=""><td>13</td><td>5 43</td><td>5 44</td><td>6 86</td><td>5 49</td><td>5 39</td></t<>	13	5 43	5 44	6 86	5 49	5 39
15 0.09 0.13 0.13 0.13 0.17 0.11 16 13.27 12.91 14.13 14.72 14.10 17 24.57 24.97 27.14 25.97 24.73 18 3.44 2.89 2.95 3.06 2.92 10 1.91 1.99 2.18 2.30 1.79 22 1.18 1.68 0.87 1.48 1.81 23 1.191 1.99 2.18 2.30 1.79 24 2.50 3.01 1.23 1.09 2.24 26 1.06 1.08 1.18 1.07 1.05 27 94.65 95.25 96.69 96.15 94.62 28 0.01 0.01 0.01 0.01 0.01 31 1.02 1.01 1.00 1.01 1.02 32 0.01 0.01 0.01 0.01 0.01 33 0.05 0.05 0.06 0.05 0.05 34 0.00 0.00 0.	14	0.00	0.15	0.00	0.10	0.00
16 13.27 12.91 14.13 14.12 14.10 17 24.57 24.97 27.14 25.97 24.73 18 3.44 2.89 2.95 3.06 2.92 19 10.43 10.52 10.05 10.63 10.07 21 1.91 1.99 2.18 2.30 1.79 22 1.18 1.68 0.87 1.48 1.81 24 25 2.50 3.01 1.23 1.09 2.24 26 1.06 1.08 1.18 1.07 1.05 27 94.65 95.25 96.69 96.15 94.62 28 0.01 0.01 0.01 0.01 0.01 31 1.02 1.01 1.00 1.01 1.02 33 0.05 0.05 0.06 0.05 0.05 34 0.00 0.00 0.00 0.00 0.00 35 0.00 0.03 0.03 0.03 0.02 36 0.20 0.15	15	12.03	12.01	14 12	14 70	14.10
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	16	13.27	12.91	14.13	14.72	14.10
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	17	24.57	24.97	27.14	25.97	24.73
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	18	3.44	2.89	2.95	3.06	2.92
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	19	10.43	10.52	10.05	10.63	10.07
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	20	1.91	1.99	2.18	2.30	1.79
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	21	1 18	1.68	0.87	1 48	1 81
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	23	1.10	1.00	0.07	1.40	1.01
25 2.50 3.01 1.23 1.09 2.24 26 1.06 1.08 1.18 1.07 1.05 27 94.65 95.25 96.69 96.15 94.62 28 29 20 20 20 20 31 1.02 1.01 1.00 1.01 1.02 32 0.01 0.01 0.01 0.01 0.01 33 0.05 0.05 0.06 0.05 0.05 34 0.00 0.00 0.00 0.00 0.00 36 0.20 0.19 0.21 0.22 0.21 37 0.36 0.37 0.40 0.38 0.36 38 0.05 0.04 0.04 0.04 0.04 40 0.15 0.15 0.14 0.15 0.14 41 0.03 0.03 0.03 0.02 0.02 42 0.02 0.02 0.01 0.02 0.02 43 0.00 0.00 0.00 0.00 0.00 44 0.05 0.05 0.05 0.05 0.05 44 1.03 1.02 1.01 1.02 1.03 50 0.95 0.96 0.98 0.97 0.95 51 1.98 1.99 1.99 1.99 1.98 52 93.92 93.93 92.94 94.06 93.97 55 93.92 93.93 92.94 94.06 93.97	24	0.50	0.04	4.00	4 00	0.04
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	25	2.50	3.01	1.23	1.09	2.24
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	26	1.06	1.08	1.18	1.07	1.05
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	27	94.65	95.25	96.69	96.15	94.62
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	28					
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	29					
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	30 21	1 02	1 01	1 00	1 01	1 02
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	37	0.01	0.01	0.01	0.01	0.01
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	33	0.01	0.01	0.01	0.01	0.01
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	34	0.05	0.05	0.06	0.05	0.05
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	35	0.00	0.00	0.00	0.00	0.00
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	36	0.20	0.19	0.21	0.22	0.21
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	37	0.36	0.37	0.40	0.38	0.36
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	38	0.05	0.04	0.04	0.04	0.04
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	39	0 15	0 15	0 14	0 15	0 14
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	40	0.03	0.03	0.03	0.03	0.02
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	41 12	0.00	0.00	0.00	0.00	0.02
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	43	0.02	0.02	0.01	0.02	0.02
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	44	0.00	0.00	0.00	0.00	0.00
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	45	0.05	0.06	0.03	0.02	0.05
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	46	0.05	0.05	0.05	0.05	0.05
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	47					
49 0.95 0.96 0.98 0.97 0.95 51 1.98 1.99 1.99 1.99 1.98 52	48	1.03	1.02	1.01	1.02	1.03
50 1.00 1.00 1.00 1.00 51 1.98 1.99 1.99 1.99 1.98 52 53 54 55 93.92 93.93 92.94 94.06 93.97 56 5.00 5.06 5.48 4.95 4.97 57 1.08 1.02 1.58 0.99 1.05 58 100 100 100 100 100	49 50	0.95	0.96	0 98	0 97	0.95
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	50 51	1 08	1 00	1 00	1 00	1 08
53 54 55 93.92 93.93 92.94 94.06 93.97 56 5.00 5.06 5.48 4.95 4.97 57 1.08 1.02 1.58 0.99 1.05 58 100 100 100 100 100	52	1.50	1.55	1.00	1.00	1.50
54 5593.9293.9392.9494.0693.97565.005.065.484.954.97571.081.021.580.991.0558100100100100100	53					
5593.9293.9392.9494.0693.97565.005.065.484.954.97571.081.021.580.991.0558100100100100100	54					
565.005.065.484.954.97571.081.021.580.991.055810010010010010060	55	93.92	93.93	92.94	94.06	93.97
571.081.021.580.991.055810010010010010060	56	5.00	5.06	5.48	4.95	4.97
⁵⁸ 59 100 100 100 100 100	57	1.08	1.02	1.58	0.99	1.05
59 60	58	100	100	100	100	100
	59 60					

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4					
5	VSDU-13IVIZ	VSD0-13IVIZ	VSDU-13IVIZ	VSDU-13IVIZ	VSDO-13IVIZ
6	MNZ10-7	MNZ11-1	MNZ11-2	MNZ11-3	MNZ11-4
7	Mantle	Rim	Manlte	Core	Core
, 8					
9		I			
10					
11	29.95	29.53	29.87	30.06	30.08
12	0.24	0.39	0.21	0.24	0.22
13	5 40	6.62	5 15	5.05	1 50
14	5.40	0.02	J. IJ	5.05	4.50
15	0.08	0.06	0.01	0.07	0.10
16	14.30	14.59	15.67	14.92	14.17
17	26.74	26.50	28.04	26.82	27.31
18	3 15	2.86	3 1 2	2.84	3.03
19	J. IJ	2.00	J. 4 2	2.04	5.05
20	10.75	10.26	10.69	10.63	10.76
21	1.90	1.92	1.54	1.74	2.05
22	1.66	1.23	1.05	1.08	1.38
23					
24	0.55	4.40	0 74	0.00	0.00
25	2.55	1.13	0.71	2.28	2.60
26	1.05	1.14	1.08	0.99	0.94
27	98.73	96.78	97.43	97.50	98.00
28					
29					
30					
31	1.00	1.00	1.00	1.01	1.01
32	0.01	0.02	0.01	0.01	0.01
33	0.05	0.06	0.05	0.05	0.04
34	0.00	0.00	0.00	0.00	0.04
35	0.00	0.00	0.00	0.00	0.00
36	0.21	0.22	0.23	0.22	0.21
37	0.39	0.39	0.41	0.39	0.39
38	0.05	0.04	0.05	0.04	0.04
39	0.00	0.04	0.00	0.15	0.04
40	0.15	0.15	0.15	0.15	0.15
41	0.03	0.03	0.02	0.02	0.03
42	0.02	0.02	0.01	0.01	0.02
43	0 00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00
45	0.05	0.02	0.02	0.05	0.05
46	0.04	0.05	0.05	0.04	0.04
47					
48	1 01	1 02	1 01	1 02	1 01
49	0.00	0.07	0.09	0.07	0.09
50	0.99	0.97	0.90	0.97	0.90
51	2.00	1.99	1.99	1.99	1.99
52					
53					
54	04.00	02.04	04.24	04.40	04 00
55	94.29	93.01	94.24	94.49	94.00
56	4.71	5.28	4.87	4.51	4.21
57	1.00	1.70	0.89	1.00	0.90
58	100	100	100	100	100
59	100		100	100	100
60					

1	
2	
³ PARIS PARIS PARIS PARIS	PARIS
⁴ VSDO-13M2 VSDO-13M2 VSDO-13M2 VSDO-13M2 V	SDO-13M2
5 MNZ11-5 MNZ15-1 MNZ15-2 MNZ15-3	MN715-4
6 Mantlo Pim Coro Mantlo	Dim
	NIII
9	
10 30.30 29.94 30.22 29.77	29.36
12 0.20 0.26 0.23 0.41	0.54
13 4 35 5 40 5 06 6 75	6 28
14 0.16 0.10 0.08 0.00	0.20
15 0.10 0.10 0.00 0.00	0.00
16 13.58 15.11 15.08 15.17	16.23
17 26.78 27.50 26.72 28.18	28.66
¹⁸ 2.95 3.25 2.95 2.92	3.32
¹⁹ 10.16 10.60 10.30 10.68	10.40
20 2.37 2.10 1.87 2.00	1 29
21 2.01 2.10 1.01 2.00 2.00 1.01 2.00 2.00 1.01 2.00 2.00 1.01 2.00 2.	0.10
22 I.04 U.70 I.47 U.03	0.19
23	
$\frac{24}{25}$ 2.88 0.63 1.97 1.08	0.26
26 0.87 1.07 1.00 1.21	0.97
²⁷ 97.01 97.18 97.27 98.99	97.52
28	
29	
30	0.00
31 1.01 1.01 1.01 0.99	0.99
³² 0.01 0.01 0.02	0.02
³³ 0.04 0.05 0.05 0.06	0.06
0.00 0.00 0.00 0.00	0.00
35 0.20 0.22 0.22 0.22	0 24
37 0.39 0.40 0.39 0.41	0.42
$\frac{38}{38}$ 0.04 0.05 0.09 0.01	0.42
³⁹ 0.04 0.05 0.04 0.04	0.05
40 0.14 0.15 0.15 0.15	0.15
41 0.03 0.03 0.03 0.03	0.02
⁴² 0.02 0.01 0.02 0.01	0.00
⁴³ 0.00 0.00 0.00 0.00	0.00
⁴⁴ 47 0.06 0.01 0.04 0.02	0.01
	0.04
46 0.04 0.05 0.04 0.05	0.04
47	
$\frac{10}{49}$ 1.02 1.02 1.02 1.01	1.01
50 0.97 0.97 0.97 0.99	0.98
51 1.99 1.99 1.99 2.00	1.99
52	
53	
54 05 21 02 00 04 46 02 04	02.20
55 90.21 90.99 94.40 92.91	93.29
56 3.97 4.89 4.55 5.38	4.40
^{5/} 0.83 1.11 1.00 1.71	2.30
⁵⁸ 100 100 100 100	100

Page 115 of 235

2				_	
3	PARIS	PARIS	PARIS	PARIS	PARIS
4	VSDO-13M2	VSDO-13M2	VSDO-13M2	VSDO-13M2	VSDO-13M2
5					
6		IVIINZO-Z	IVIINZO-3		IVIINZ7-Z
7	Rim	Core	Rim	Rim	Core
8					
9				•	
10	20.04	20.77	20.61	20.11	20.40
11	29.04	29.11	29.01	30.11	30.49
12	0.19	0.24	0.28	0.21	0.19
13	5.51	6.03	7.10	3.89	4.23
14	0.08	0.50	0.13	0.10	0.23
15	16 00	14 43	14 10	16 76	15 85
10 17	27 52	28.07	27 44	20.00	27.14
17 19	21.52	20.07	27.44	29.00	27.14
10	3.31	2.97	2.86	3.34	3.31
20	10.25	10.84	11.27	10.48	10.36
21	1.75	1.66	1.89	1.66	2.10
22	0.84	0.74	1.29	0.74	1.51
23		•		•	
24	0 00	0 56	0 50	0.62	1 0 2
25	0.00	0.50	0.50	0.63	1.92
26	1.15	1.35	1.38	0.79	0.92
27	97.58	97.43	98.16	97.93	99.04
28					
29					
30	1 01	1 00	1 00	1 01	1 01
31	1.01	1.00	1.00	1.01	1.01
32 22	0.01	0.01	0.01	0.01	0.01
27	0.05	0.05	0.06	0.03	0.04
35	0.00	0.00	0.00	0.00	0.00
36	0.23	0.21	0.21	0.24	0.23
37	0.40	0.41	0.40	0.42	0.39
38	0.40	0.41	0.40	0.42	0.00
39	0.05	0.04	0.04	0.05	0.05
40	0.15	0.15	0.16	0.15	0.14
41	0.02	0.02	0.03	0.02	0.03
42	0.01	0.01	0.02	0.01	0.02
43	0.00	0.00	0.00	0.00	0.00
44	0.02	0.01	0.01	0.01	0 04
45	0.02	0.01	0.01	0.01	0.04
46	0.05	0.00	0.00	0.03	0.04
47					
40 40	1.01	1.01	1.01	1.02	1.02
50	0.98	0.98	0.99	0.98	0.97
51	1 99	1 99	2 00	1 99	1 99
52			2.00		
53					
54					
55	93.96	92.80	92.49	95.60	95.14
56	5.22	6.18	6.31	3.53	4.07
57	0.81	1.02	1.20	0.88	0.78
58	100	100	100	100	100
59	100	100	100	100	100
60					

1					
2					
3	PARIS	PARIS	PARIS	PARIS	
4					
5					
6	IVINZ7-3	IVIINZ7-4	C-1ZVIIVI	IVIINZ7-0	
7	Rim	Core	Core	Rim	
8					
9					
10	20.00	20.00	20.20	20.00	
11	30.20	30.28	30.38	30.23	
12	0.24	0.22	0.20	0.30	
13	3.86	4.66	4.50	6.76	
14	0.02	0.02	0 10	0.04	
15	17.03	16 /0	15 10	15 74	
16	17.03	10.49	13.19	13.74	
17	31.50	29.03	30.35	27.93	
18	3.42	3.02	2.97	2.71	
19	10.70	10.08	10.89	10.81	
20	1 40	1 64	1 68	1 54	
21	0.57	1.04	0.60	0.00	
22	0.57	1.10	0.69	0.88	
23					
2 4 25	0.16	0.27	0.34	0.71	
25	0.68	0.93	0.99	1.26	
20	00 75	07.83	08 52	00.37	
27	33.15	97.00	90.5Z	33.57	
20					
30					
31	1.00	1.01	1.01	1.00	
32	0.01	0.01	0.01	0.01	
33	0.03	0.04	0.04	0.06	
34	0.03	0.04	0.04	0.00	
35	0.00	0.00	0.00	0.00	
36	0.25	0.24	0.22	0.23	
37	0.45	0.42	0.44	0.40	
38	0.05	0.04	0.04	0.04	
39	0.15	0.14	0.15	0.15	
40	0.15	0.14	0.15	0.15	
41	0.02	0.02	0.02	0.02	
42	0.01	0.02	0.01	0.01	
43	0.00	0.00	0.00	0.00	
44	0.00	0.01	0.01	0.01	
45	0.03	0.04	0.04	0.05	
40	0.05	0.04	0.04	0.05	
4/ 10					
40 /0	1.01	1.02	1.02	1.01	
49 50	0.99	0.97	0.97	0.98	
51	2 00	1 99	1 99	1 99	
52	2.00	1.00	1.00	1.00	
53					
54					
55	96.08	94.89	94.70	93.08	
56	2.96	4.20	4.45	5.67	
57	0.96	0.01	0.85	1 25	
58	400	400	400	1.20	
59	100	100	100	100	
60					

Page 117 of 235

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4					
5					
6	MINZ14-1	WINZ14-2	MINZ14-3	MINZ14-4	MINZ14-5
7	Rim	Core	Core	Core	Core
8					
9					
10	20.02	20.07	00 EE	20.20	20.70
11	30.02	29.97	29.55	30.30	29.78
12	0.43	0.51	0.52	0.27	0.44
13	5.13	5.32	5.64	4.77	5.02
14	0.32	0.36	0.36	0.12	0.31
15	14 17	12 75	13.09	12 61	13.62
16	14.17 20 02	20.00	27.66	27.04	20.02
17	20.03	20.00	27.00	27.04	20.37
10	3.30	3.19	3.99	2.96	3.34
20	12.74	11.78	11.98	12.51	12.35
20	2.06	2.16	2.32	2.27	2.19
22	1 01	1 08	1 24	1 55	1 14
23	1.01	1.00		1.00	
24	0.50	0.00	0.00	0.04	0.05
25	0.52	0.32	0.36	0.84	0.25
26	0.88	0.88	0.92	0.96	0.85
27	98.80	97.30	98.17	97.01	97.66
28					
29					
30	1 00	1 01	1 00	1 0 2	1 00
31	1.00	1.01	1.00	1.02	1.00
32	0.02	0.02	0.02	0.01	0.02
33 24	0.05	0.05	0.05	0.04	0.05
24 25	0.00	0.00	0.00	0.00	0.00
36	0 21	0 19	0 19	0 18	0.20
37	0.40	0.42	0.40	0.30	0.41
38	0.40	0.42	0.40	0.03	0.41
39	0.05	0.05	0.06	0.04	0.05
40	0.18	0.17	0.17	0.18	0.18
41	0.03	0.03	0.03	0.03	0.03
42	0.01	0.01	0.02	0.02	0.02
43	0 00	0.00	0.00	0.00	0.00
44	0.01	0.01	0.01	0.02	0.01
45	0.01	0.01	0.01	0.02	0.01
46	0.04	0.04	0.04	0.04	0.04
4/					
48	1.02	1.03	1.02	1.03	1.02
49 50	0.97	0.96	0.97	0.95	0.97
51	1 99	1 98	1 99	1 98	1 99
52	1.00	1.00	1.00	1.00	1.00
53					
54					
55	94.25	93.79	93.64	94.36	94.31
56	3.95	4.02	4.17	4.46	3.84
57	1.80	2.19	2.19	1.18	1.85
58	100	100	100	100	100
59	100	100	100	100	100
60					

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4
5	MNI714 6	MNI714 7			
6			IVIINZ9-1	IVIINZ9-Z	MINZ9-3
7	Mantle	Rim	Mantle	Rim	Core
8					
9			-		
10	30.00	30.30	29.89	30.20	29 90
11	0 32	0.24	0.20	0.23	0.20
12	0.52	0.24	0.29	0.23	0.20
13	5.26	5.67	6.47	4.84	5.59
14	0.09	0.23	0.06	0.12	0.44
16	14.02	14.71	13.27	13.92	12.64
17	28.64	27.49	27.85	27.65	26.60
18	3 16	3 05	3 50	3 16	3 27
19	11 00	11 62	12.64	11 00	11 62
20	11.90	11.02	12.04	11.09	11.02
21	2.01	2.11	1.96	2.25	2.19
22	0.76	1.45	0.75	1.48	1.29
23					
24	0.22	0.98	0.10	1.04	1.01
25	1.06	1 17	1 27	0.96	1 24
26			00.05	0.30	
27	97.51	99.55	98.35	97.24	96.54
20					
29					
31	1.01	1.00	1.00	1.01	1.01
32	0.01	0.01	0.01	0.01	0.01
33	0.05	0.05	0.06	0.01	0.05
34	0.05	0.05	0.00	0.04	0.05
35	0.00	0.00	0.00	0.00	0.00
36	0.21	0.21	0.19	0.20	0.19
37	0.42	0.39	0.40	0.40	0.39
38	0.05	0.04	0.05	0.05	0.05
39	0 17	0.16	0.18	0 16	0 17
40	0.17	0.10	0.10	0.10	0.17
41	0.03	0.03	0.03	0.03	0.03
42	0.01	0.02	0.01	0.02	0.02
45 44	0.00	0.00	0.00	0.00	0.00
45	0.00	0.02	0.00	0.02	0.02
46	0.05	0.05	0.05	0.04	0.05
47					
48	1 0 2	1 01	1 01	1 02	1 0 2
49	1.02	1.01	1.01	1.02	1.02
50	0.97	0.98	0.98	0.96	0.97
51	1.99	1.99	1.99	1.99	1.99
52					
53					
54	93 84	93 79	92 97	94 63	93 34
55	1 00	50.13	52.31	4 20	50.0 1 E 70
50 57	4.03	J.Z I	5.79	4.39	5.78 0.00
57 58	1.34	1.01	1.24	0.98	0.88
59	100	100	100	100	100
60					

Page 119 of 235

2					
5 Л	PARIS	PARIS	PARIS	PARIS	PARIS
	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4
6	MNZ9-4	MNZ9-5	MNZ13-1	MNZ13-2	MNZ13-3
7	Eim	Core	Rim	Core	Mantle
8					
9			I		
10	00.05	00.00	00.44	00.45	00.00
11	30.05	29.63	30.14	30.15	29.83
12	0.26	0.43	0.21	0.20	0.25
13	4.93	6.35	5.01	4.74	4.86
14	0.15	0.61	0.11	0.16	0.13
15	14 39	12 88	13 99	13 86	14 26
16 17	27.46	25.70	28 10	25 50	27 70
17 18	27.40	20.70	20.10	20.00	21.19
10	3.09	2.98	3.06	2.48	3.30
20	12.73	11.81	11.72	10.24	12.66
21	2.46	2.59	2.15	2.03	2.22
22	1.30	1.37	1.44	1.73	1.03
23					
24	1.21	1.59	1.14	2.50	0.31
25	1.05	1 18	1 04	0.96	0.95
26	00.22	07.40	00 12	0.30	0.00
27	99.33	97.49	90.13	95.30	90.15
20					
30					
31	1.00	1.00	1.01	1.02	1.00
32	0.01	0.02	0.01	0.01	0.01
33	0.04	0.06	0.04	0.04	0.04
34	0 00	0.01	0.00	0.00	0.00
35	0.21	0.10	0.00	0.00	0.00
30 27	0.21	0.13	0.20	0.20	0.21
38	0.39	0.37	0.41	0.37	0.40
39	0.04	0.04	0.04	0.04	0.05
40	0.18	0.17	0.16	0.15	0.18
41	0.03	0.04	0.03	0.03	0.03
42	0.02	0.02	0.02	0.02	0.01
43	0.00	0.00	0.00	0.00	0.00
44	0.03	0.03	0.02	0.05	0.01
45	0.00	0.00	0.02	0.00	0.01
40 47	0.04	0.05	0.04	0.04	0.04
48	4.04	4.00	4.04	4.00	4.04
49	1.01	1.02	1.01	1.03	1.01
50	0.99	0.98	0.98	0.95	0.98
51	2.00	1.99	1.99	1.98	1.99
52					
53					
54	94 33	92 77	94 44	94 61	94 67
55 56	4 62	5 4 1	4 67	A 51	4 28
57	7.02 1 AF	1 00	0.00	1.01 0 00	4.20
58	60.1	1.02	0.90	0.00	CU.1
59	100	100	100	100	100
60					

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4
5	MN713-4	MN713-5	MN713-6	MN713-7	MN78-1
6		Core	Core	Mantle	
/	Core	COLE	COLE	Manue	
9					
10					
11	30.10	30.04	30.20	29.83	30.31
12	0.28	0.23	0.24	0.22	0.26
13	4.12	5.17	4.69	4.61	4.52
14	0 18	0 14	0 12	0.05	0 21
15	13 71	13.46	14 48	14 00	13.07
16	27.06	24 59	25.04	27.15	77.07
17 19	27.90	24.50	25.94	27.15	27.25
10	2.80	2.55	2.56	3.24	3.32
20	12.90	10.85	9.60	13.00	12.50
21	2.57	1.89	1.89	2.25	2.33
22	1.36	1.63	1.26	0.88	1.12
23					
24	0.37	2.62	2.60	0.51	0.99
25	0.83	1.06	1.07	0.96	0.08
26	0.05	05.01	05.70	0.30	0.30
27	97.85	95.01	95.70	90.78	97.29
20					
30					
31	1.01	1.02	1.02	1.01	1.02
32	0.01	0.01	0.01	0.01	0.01
33	0.04	0.05	0.04	0.04	0.04
34	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00
30 27	0.20	0.20	0.21	0.21	0.19
38	0.41	0.30	0.38	0.40	0.39
39	0.04	0.04	0.04	0.05	0.05
40	0.18	0.16	0.14	0.19	0.18
41	0.04	0.03	0.03	0.03	0.03
42	0.02	0.02	0.02	0.01	0.01
43	0.00	0.00	0.00	0.00	0.00
44	0.01	0.06	0.06	0.01	0.02
45	0.04	0.05	0.05	0.04	0.04
40 47	0.04	0.05	0.05	0.04	0.04
48	4.00	4.00	4.00	4.00	4.00
49	1.02	1.03	1.03	1.02	1.03
50	0.97	0.95	0.95	0.97	0.96
51	1.99	1.98	1.98	1.99	1.99
52					
53					
54 55	95.06	93 99	93 98	94 68	94 45
55 56	2 76	5 01	A 06	<i>A A</i> 0	<i>A A</i> 6
57	1 10	1.00	1.00	т. т .	4.40
58	1.1Ŏ	1.00	1.00	0.93	1.09
59	100	100	100	100	100
60					

Page 121 of 235

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4					
5					
6	WINZ8-Z	IVINZ8-3	IVINZ8-4	IVINZ8-5	
7	Core	Core	Core	Rim	Rim
8					
9					I
10	20.00	20.02	20.00	20 72	20.42
11	29.80	30.02	30.00	29.72	30.43
12	0.31	0.26	0.29	0.23	0.24
13	5.94	6.63	7.73	4.15	5.29
14	0.03	0.07	0.04	0.16	0.18
15	14 45	14 00	14 05	13 25	14 27
16 17	20.20	26.22	27.00	27.56	29.70
17 10	29.29	20.32	27.00	27.50	20.70
10	3.40	3.17	3.28	3.39	3.18
20	12.59	10.78	11.03	12.67	12.12
20	1.95	1.55	1.79	2.48	2.13
22	0.73	0.54	0.81	1.74	1.17
23	••		••••		
24	0.40	0.00	0.42	4.04	0.70
25	0.18	0.00	0.43	1.04	0.70
26	1.13	1.35	1.53	0.92	1.03
27	100.16	95.86	98.38	97.81	99.46
28					
29					
30	0.00	1 0 2	1 00	1 00	1 00
31	0.99	1.02	1.00	1.00	1.00
32	0.01	0.01	0.01	0.01	0.01
33 24	0.05	0.06	0.07	0.04	0.05
34	0.00	0.00	0.00	0.00	0.00
36	0.21	0.21	0.20	0.19	0.21
37	0.42	0.30	0.30	0.40	0.41
38	0.42	0.05	0.05	0.40	0.41
39	0.05	0.05	0.05	0.05	0.05
40	0.18	0.15	0.16	0.18	0.17
41	0.03	0.02	0.02	0.03	0.03
42	0.01	0.01	0.01	0.02	0.02
43	0.00	0.00	0.00	0.00	0.00
44	0.00	0.01	0.01	0.02	0.01
45	0.00	0.01	0.01	0.02	0.01
46	0.05	0.00	0.00	0.04	0.04
47					
40 40	1.00	1.03	1.02	1.01	1.01
49 50	1.00	0.96	0.98	0.98	0.98
51	2 00	1 98	1 99	2 00	1 99
52	2.00			2.00	
53					
54		6 6 . . –	• • • • •	e + e +	- • <i>i</i> =
55	93.76	92.45	91.68	94.91	94.43
56	4.97	6.41	7.07	4.11	4.60
57	1.27	1.14	1.25	0.98	0.98
58	100	100	100	100	100
59	100	100	100	100	100
60					

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4
5	MNZ11-2	MNZ11-3	MNZ11-4	MNZ11-5	MNZ11-6
7	Core	Rim	Core	Core	Rim
, 8	0010		0010	0010	
9					
10	~~~~	00.44	00.40	~~~~	
11	30.05	30.44	30.42	30.25	30.32
12	0.31	0.25	0.22	0.21	0.24
13	5.21	5.15	4.69	5.21	4.82
14	0.04	0.12	0.12	0.12	0.15
15	16 43	14 50	14 48	14 99	15.03
16	70.40 29.01	27.29	26.92	29.27	27.51
17 19	20.01	27.20	20.02	20.21	27.51
10	2.73	2.99	2.69	2.45	2.98
20	10.82	11.77	10.43	11.77	11.25
21	1.39	1.89	2.17	2.28	2.27
22	0.42	1.56	1.23	1.58	1.24
23					
24	0.40	0.76	2.43	0.69	0.80
25	0.95	1.08	1 01	1 12	1.05
20 27	0.00	09.47	07.12	00.25	07 72
27	90.75	90.47	97.15	99.20	91.12
29					
30					
31	1.01	1.01	1.01	1.00	1.01
32	0.01	0.01	0.01	0.01	0.01
33	0.05	0.05	0.04	0.05	0.04
34	0.00	0.00	0.00	0.00	0.00
35	0.24	0.21	0.21	0.22	0.22
30 37	0.24	0.21	0.21	0.22	0.22
38	0.41	0.39	0.39	0.41	0.40
39	0.04	0.04	0.04	0.03	0.04
40	0.15	0.17	0.15	0.16	0.16
41	0.02	0.03	0.03	0.03	0.03
42	0.01	0.02	0.02	0.02	0.02
43	0.00	0.00	0.00	0.00	0.00
44 45	0.01	0.02	0.05	0.01	0.02
45 46	0.04	0.05	0.04	0.05	0.04
47	0.01	0.00	0.01	0.00	0.01
48	1 02	1 02	1 0 2	1 01	1 02
49	1.02	1.02	1.02	1.01	1.02
50	0.96	0.97	0.96	0.98	0.97
51	1.99	1.99	1.99	1.99	1.99
52					
53					
5 4 55	94.28	94.07	94.48	94.16	94.24
56	4.38	4.88	4.59	4.97	4.73
57	1 34	1 04	0.94	0.87	1 03
58	100	100	100	100	100
59	100	100	100	100	100
60					

Page 123 of 235

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4					
5					
6	IVINZ6-1	WINZ6-Z	IVINZ6-3	IVINZ5-1	MINZ5-Z
7	Core	Core	Mantle		Rim
8					
9				1	
10	00.74	20.46	20.22	20.07	20.95
11	29.71	29.40	29.33	29.87	29.85
12	0.29	0.33	0.25	0.21	0.19
13	6.30	7.07	5.37	5.35	4.71
14	0.07	0.06	0.09	0.13	0.11
15	13 64	13 15	13 74	14 03	14.56
16 17	29.59	29.45	27.96	26.10	26.99
17 10	20.00	20.45	27.00	20.10	20.00
10	3.22	3.41	3.02	2.87	3.19
20	11.76	11.32	11.51	10.40	11.43
20	1.86	1.79	2.25	2.06	1.73
22	0.30	0.62	1.04	1.69	0.82
23	0100	0.01			0.02
24	0.40	0.45	0.47	0.64	2.00
25	0.12	0.15	0.47	2.01	2.06
26	1.28	1.40	1.16	1.06	1.01
27	97.23	97.47	96.54	97.30	97.25
28					
29					
30	1 00	1 00	1 00	1 01	1 01
31	1.00	1.00	1.00	1.01	1.01
32	0.01	0.01	0.01	0.01	0.01
33 24	0.06	0.06	0.05	0.05	0.04
35	0.00	0.00	0.00	0.00	0.00
36	0.20	0.19	0.20	0.21	0.21
37	0.42	0.42	0.41	0.38	0.30
38	0.42	0.42	0.41	0.00	0.00
39	0.05	0.05	0.04	0.04	0.05
40	0.17	0.16	0.17	0.15	0.16
41	0.03	0.02	0.03	0.03	0.02
42	0.00	0.01	0.01	0.02	0.01
43	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.01	0.06	0 04
45	0.00	0.00	0.01	0.00	0.04
46	0.05	0.00	0.05	0.05	0.04
4/					
40 40	1.02	1.01	1.01	1.01	1.01
49 50	0.98	0.98	0.98	0.98	0.98
51	1 99	2 00	2 00	1 99	1 99
52		2.00	2.00		
53					
54		e e	6 - - -	e · • • -	• • • • -
55	92.88	92.15	93.60	94.25	94.62
56	5.86	6.42	5.34	4.85	4.57
57	1.25	1.43	1.06	0.90	0.81
58	100	100	100	100	100
59	100	100	100	100	100
60					

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4
5	MN75-3	MN75-4	MN75-5	MN712-1	MN712-2
6	Coro	Dim	Dim	Dim	Dim
/	Cole				
0 0					
9 10					
11	29.40	29.45	29.32	29.81	29.60
12	0.36	0.22	0.21	0.29	0.29
13	6 58	5 11	5 03	6 79	6 65
14	0.02	0 14	0.16	0.07	0.00
15	14 47	1/ 01	15 10	14 56	14 50
16	14.47	14.01	15.10	14.50	14.30
17	26.32	20.80	26.99	25.34	27.11
18	2.29	2.93	3.25	2.71	3.35
20	10.45	10.74	11.07	10.86	10.46
20	1.97	2.12	2.27	1.86	1.73
22	1.26	1.33	1.42	1.12	0.92
23	•				
24	1 76	0 70	0.67	1 05	1 29
25	1.70	0.79	0.07	1.05	1.20
26	1.22	1.05	1.04	1.25	1.25
27	96.67	95.92	96.59	95.72	97.70
28					
29					
31	1.00	1.01	1.00	1.01	1.00
32	0.01	0.01	0.01	0.01	0.01
33	0.06	0.05	0.05	0.06	0.06
34	0.00	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00
36	0.21	0.22	0.22	0.22	0.21
37	0.39	0.40	0.40	0.37	0.40
38	0.03	0.04	0.05	0.04	0.05
39 40	0.15	0.15	0.16	0.16	0.15
40	0.03	0.03	0.03	0.03	0.02
42	0.02	0.02	0.02	0.01	0.01
43	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00
45	0.04	0.02	0.01	0.02	0.03
46	0.05	0.05	0.04	0.05	0.05
47					
48	1.01	1.02	1.01	1.02	1.01
49 50	0.98	0.97	0.99	0.96	0.98
50	1 99	1 99	2 00	1 99	1 99
52	1.00	1.00	2.00	1.00	1.00
53					
54	00.00	04.40	04.00	00.04	00.07
55	92.82	94.18	94.39	92.84	93.07
56	5.63	4.88	4.72	5.89	5.70
57	1.55	0.94	0.89	1.27	1.23
58 50	100	100	100	100	100
52					

Page 125 of 235

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4
5	MN712-3	MN712-4	MN712-5	MN712-6	MN712-7
6	Coro	Coro	Mantlo	Mantlo	Dim
/	COLE	COIE	Manue	Manue	N IIII
8					
9 10					
10	29.65	29.37	29.48	29.64	29.80
12	0.34	0.34	0.22	0.23	0.22
13	7 25	7.05	5.46	5 30	5.88
14	0.02	0.02	0.40	0.00	0.00
15	0.02	0.03	0.10	0.10	0.04
16	14.43	13.86	14.48	14.47	14.23
17	25.71	25.51	26.55	26.10	26.83
18	2.43	2.61	3.36	3.25	2.93
19	10 72	11 17	11 10	11 34	10 96
20	1 00	1 00	1 02	2 13	1.82
21	1.00	1.30	1.02	2.10	1.02
22	1.14	1.12	1.21	1.40	1.02
25 24					
25	1.34	1.28	0.84	0.82	1.09
26	1.34	1.32	1.11	1.11	1.23
27	96.64	95.53	96.68	96.92	96.99
28					
29					
30	4.00	4.00	4.04	4.04	4.04
31	1.00	1.00	1.01	1.01	1.01
32	0.01	0.01	0.01	0.01	0.01
33	0.07	0.06	0.05	0.05	0.05
34 25	0.00	0.00	0.00	0.00	0.00
36	0.21	0.21	0.22	0.21	0.21
37	0.38	0.38	0.39	0.38	0.39
38	0.00	0.00	0.05	0.00	0.03
39	0.04	0.04	0.05	0.05	0.04
40	0.15	0.16	0.16	0.16	0.16
41	0.03	0.03	0.03	0.03	0.03
42	0.02	0.01	0.02	0.02	0.01
43	0.00	0.00	0.00	0.00	0.00
44	0.03	0.03	0.02	0.02	0.02
45	0.06	0.06	0.05	0.05	0.05
40 47	0.00	0.00	0.00	0.00	0.00
48	4.00	4.00	4.00	4.00	4.00
49	1.02	1.02	1.02	1.02	1.02
50	0.97	0.97	0.98	0.97	0.97
51	1.99	1.99	1.99	1.99	1.99
52					
53					
54	02.20	0.0.35	03.00	02 97	02 27
55	92.29	92.00	93.90	33.01	93.31
56	6.24	6.1/	5.15	5.13	5.68
5/	1.47	1.49	0.94	1.00	0.95
50 50	100	100	100	100	100
60					

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4
5	MN74-1	MN74-2	MN74-3	MN74-4	MN74-5
6	Mantle	Dim	Mantle		Mantle
/ Q	Manue		Manue	COLE	Manue
9					
10					
11	30.10	30.15	29.95	30.25	30.28
12	0.19	0.22	0.24	0.23	0.21
13	4.53	5.09	4.96	4.98	4.73
14	0 17	0.05	0.01	0.05	0 14
15	14 15	14 87	13.84	15 12	14 58
16 17	26 76	27.20	27.18	27.15	26.04
17	20.70	21.29	27.10	27.15	20.94
19	3.30	3.30	3.05	2.12	2.48
20	9.48	10.42	10.62	10.81	10.40
21	1.65	1.95	1.68	1.84	1.95
22	1.47	1.15	1.22	1.36	1.44
23					
24	2.81	1.80	2.12	2.07	2.32
25	0 97	1 04	0 99	0.98	0.95
20 27	05.03	07 50	06.13	07.07	06.08
28	30.30	97.59	30.13	51.51	30.30
29					
30					
31	1.01	1.01	1.01	1.01	1.01
32	0.01	0.01	0.01	0.01	0.01
33	0.04	0.05	0.04	0.04	0.04
34 25	0.00	0.00	0.00	0.00	0.00
35	0 21	0 22	0.20	0 22	0.21
37	0.30	0.20	0.40	0.20	0.30
38	0.05	0.05	0.40	0.03	0.03
39	0.05	0.05	0.04	0.04	0.04
40	0.13	0.15	0.15	0.15	0.15
41	0.02	0.03	0.02	0.02	0.03
42	0.02	0.02	0.02	0.02	0.02
43	0.00	0.00	0.00	0.00	0.00
44 45	0.06	0.04	0.05	0.04	0.05
46	0.04	0.04	0.04	0.04	0.04
47					
48	1 02	1 02	1 02	1 02	1 02
49	0.07	0.02	0.07	0.07	0.06
50	0.97	0.98	0.97	0.97	0.96
51	1.99	1.99	1.99	1.99	1.99
52					
55 57					
55	94.73	94.39	94.43	94.63	94.75
56	4.44	4.69	4.56	4.42	4.35
57	0.83	0.92	1.02	0.95	0.90
58	100	100	100	100	100
59	100	100	100	100	100
60					

Page 127 of 235

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4					
5					
6	IVINZ4-6	IVIINZ4-7	IVINZ4-8	MINZ15-1	MINZ15-Z
7	Core	Rim	Rim	Mantle	Core
8					
9				1	
10	20.20	20.77	20.20	20.04	20.70
11	30.29	29.77	30.20	30.01	29.70
12	0.22	0.25	0.25	0.25	0.29
13	5.43	5.04	5.24	5.08	5.17
14	0.11	0.09	0.07	0.19	0.01
15	14 43	14 45	14 92	13 49	13 95
16	25.76	27.17	26.96	26.70	27.50
1/ 10	25.70	27.17	20.00	20.72	27.59
10	2.47	3.08	3.09	3.20	3.48
19 20	10.42	10.40	10.50	10.59	11.97
20	1.94	2.04	1.64	2.23	2.18
27	1 65	1 29	1 1 1	1 79	0.88
23	1.00	1.20			0.00
24	4 07	4.00	4.00	0.00	o 17
25	1.97	1.86	1.96	2.39	0.47
26	1.10	1.07	1.01	1.09	0.97
27	96.11	97.26	97.16	97.70	96.73
28					
29					
30	1 0 2	1 00	1 01	1 01	1 01
31	1.02	1.00	1.01	1.01	1.01
32	0.01	0.01	0.01	0.01	0.01
33 24	0.05	0.05	0.05	0.05	0.05
24 25	0.00	0.00	0.00	0.00	0.00
36	0.21	0 21	0 22	0.20	0.21
37	0.37	0.40	0.30	0.30	0.40
38	0.07	0.40	0.03	0.05	0.40
39	0.04	0.04	0.04	0.05	0.05
40	0.15	0.15	0.15	0.15	0.17
41	0.03	0.03	0.02	0.03	0.03
42	0.02	0.02	0.01	0.02	0.01
43	0.00	0.00	0.00	0.00	0.00
44	0.04	0.04	0.04	0.05	0.01
45	0.04	0.04	0.04	0.05	0.01
46	0.05	0.05	0.04	0.05	0.04
4/					
48	1.03	1.01	1.02	1.02	1.02
49 50	0.96	0.98	0.97	0.98	0.97
51	1 98	1 99	1 99	1 99	1 99
52	1.00	1.00	1.00	1.00	1.00
53					
54					
55	93.93	94.12	94.31	94.05	94.31
56	5.11	4.84	4.62	4.90	4.44
57	0.96	1.04	1.08	1.04	1.25
58	100	100	100	100	100
59	100	100	100	100	100
60					

2					
3	PARIS	PARIS	PARIS	PARIS	PARIS
4 5	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4
5	MNZ15-3	MNZ15-4	MNZ15-5	MNZ15-6	MNZ15-7
7	Core	Core	Core	Core	Mantle
8					
9					
10	<u> </u>	~~	~~ ~~	~~ ~~	~~~~
11	29.81	29.57	29.79	29.70	29.63
12	0.25	0.34	0.28	0.27	0.25
13	5.25	4.61	5.57	4.55	5.00
14	0.29	0.54	0.57	0.04	0.15
15	13 40	12 47	12 77	13 41	14 56
16	27.20	25.16	27.44	28.06	25 70
17 19	27.39	25.10	27.44	20.90	20.19
10	3.07	3.66	3.75	3.48	3.41
20	11.09	12.46	11.92	12.53	10.76
21	2.54	2.78	2.39	2.19	1.95
22	2.11	1.49	1.17	1.19	1.38
23					
24	1 51	1 46	0 52	0.31	2 18
25	1.01	0.02	1 23	0.01	1.05
26	07.04	0.32	07.50	0.34	06.05
27	97.04	90.20	97.50	97.50	90.25
20					
30					
31	1.00	1.01	1.00	1.00	1.00
32	0.01	0.01	0.01	0.01	0.01
33	0.05	0.04	0.05	0.04	0.05
34	0 00	0.00	0.01	0.00	0 00
35	0.00	0.00	0.10	0.00	0.00
30 27	0.20	0.13	0.19	0.20	0.21
38	0.40	0.37	0.40	0.42	0.30
39	0.04	0.05	0.05	0.05	0.05
40	0.16	0.18	0.17	0.18	0.15
41	0.03	0.04	0.03	0.03	0.03
42	0.03	0.02	0.02	0.02	0.02
43	0.00	0.00	0.00	0.00	0.00
44 45	0.03	0.03	0.01	0.01	0.05
45 46	0.05	0.04	0.05	0.04	0.05
40	0.00	0.04	0.00	0.04	0.00
48	1 01	1.00	1 01	1 01	1 01
49	1.01	1.02	1.01	1.01	1.01
50	0.99	0.97	0.98	0.98	0.98
51	2.00	1.99	1.99	1.99	1.99
52					
53					
54 55	94.07	94.26	93.22	94.66	94,16
55	4 87	4 26	5.61	4 21	4 78
57	1.07	1 / 2	1 17	1 12	1.76
58	1.00	1.40	1.17	1.10	1.00
59	100	100	100	100	100
60					

Page 129 of 235

2 3	PARIS	PARIS	PARIS	PARIS	PARIS
4	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4	VSDO-13M4
5	MN715-8	MN710_1	MN710-2	MN710-3	MN710-4
6	Dim				
/	RIIII				
8					
9 10					
10	29.92	30.14	30.15	29.83	30.10
12	0.23	0.21	0.20	0.25	0.28
13	5 18	5.01	4 74	4.86	4 12
14	0.10	0.01		4.00	- 12
15	0.22	0.11	0.10	0.13	0.10
16	12.68	13.99	13.86	14.26	13.71
17	27.01	28.10	25.50	27.79	27.96
18	3.60	3.06	2.48	3.30	2.80
19	11.38	11.72	10.24	12.66	12.90
20	2 27	2 15	2.03	2 22	2 57
21	0.04	1 1 1	1 72	1 02	1.26
22	0.04	1.44	1.73	1.05	1.50
23					
25	2.82	1.14	2.50	0.31	0.37
26	1.09	1.04	0.96	0.95	0.83
27	98.49	98.12	94.57	97.60	97.16
28					
29					
30	1.00	1 01	1 02	1 00	1 01
31	1.00	1.01	1.02	1.00	1.01
32 22	0.01	0.01	0.01	0.01	0.01
37	0.05	0.04	0.04	0.04	0.04
35	0.00	0.00	0.00	0.00	0.00
36	0.18	0.20	0.20	0.21	0.20
37	0.39	0.41	0.37	0.40	0.41
38	0.05	0.04	0.04	0.05	0.04
39	0.16	0.16	0.15	0.00	0.18
40	0.10	0.10	0.15	0.10	0.10
41	0.03	0.03	0.03	0.03	0.04
4Z 43	0.01	0.02	0.02	0.01	0.02
44	0.00	0.00	0.00	0.00	0.00
45	0.06	0.02	0.05	0.01	0.01
46	0.05	0.04	0.04	0.04	0.04
47					
48	1 01	1 01	1 03	1 01	1 02
49	0.08	0.08	0.95	0.08	0.07
50	0.90	1.00	1.00	1.00	1.00
51	2.00	1.99	1.98	1.99	1.99
52 53					
55 54					
55	94.14	94.44	94.61	94.67	95.06
56	4.88	4.67	4.51	4.28	3.76
57	0.98	0.90	0.88	1.05	1.18
58	100	100	100	100	100
59	100	100	100	100	100
60					

2				
3	PARIS	PARIS	PARIS	
4				
5	v SDU-13IVI4	v SDO-13IVI4	vSDU-13IVI4	
6	MNZ10-5	MNZ10-6	MNZ10-7	
7				
8				
9				
10				
11	30.04	30.20	29.83	
12	0 23	0 24	0 22	
13	5.20 E 17	1 60	1 61	
14	5.17	4.69	4.01	
15	0.14	0.12	0.05	
15 16	13.46	14.48	14.00	
10	24 58	25 0/	27 15	
17 10	24.30	20.34	21.10	
10	2.55	2.56	3.24	
19 20	10.85	9.60	13.00	
20	1 89	1 89	2 25	
21 22	1.00	1.00	0.00	
22	1.03	1.20	0.88	
23				
24	2.62	2.60	0.51	
25	1.06	1.07	0.06	
26	1.00	1.07	0.90	
27	94.23	94.65	96.70	
28				
29				
30	4.00	4.00	4.04	
31	1.02	1.02	1.01	
32	0.01	0.01	0.01	
33	0.05	0.04	0.04	
34	0.00	0.07	0.04	
35	0.00	0.00	0.00	
36	0.20	0.21	0.21	
37	0.36	0.38	0.40	
38	0.04	0 04	0.05	
39	0.04	0.04	0.00	
40	0.16	0.14	0.19	
41	0.03	0.03	0.03	
42	0.02	0.02	0.01	
43	0.00	0.00	0.00	
44	0.00	0.00	0.00	
45	0.06	0.06	0.01	
46	0.05	0.05	0.04	
47	-			
48	4.00	4 00	4 00	
49	1.03	1.03	1.02	
50	0.95	0.95	0.97	
51	1 98	1.98	1 99	
52	1.00			
53				
54				
55	93.99	93.98	94.68	
56	5 01	4 96	4 40	
57	0.01	4.00	7.70	
50	1.00	1.06	0.93	
50 50	100	100	100	
22 22				
00				

ו 2	Table S2 - EPMA	A Titanite					
3	Ttn#	Tt	n2	Tt	n5		Ttn6
4	Ttn type	ZOI	ned	zor	ned		zoned
5	Analysis #	30	31	32	33	34	35
6 7	position	core	rim	core	rim	core	intermediate
8	(wt%)	0010		0010		0010	
9	(₩1/0) SiO2	29 72	30 30	30.08	30.41	30.02	20 74
10		36.01	36.00	35.86	36.03	35.80	25.14
11	1102	1 07	1 67	222	1 74	20.00	2 04
12 13	AIZO3	1.97	1.07	2.32	1.74	2.00	2.04
14	FeO	0.37	0.36	0.35	0.35	0.41	0.42
15	Fe2O3	0.41	0.40	0.39	0.39	0.45	0.47
16	MinO	0.05	0.05	0.11	0.05	0.13	0.08
17	CaO	26.93	27.62	27.53	28.23	27.21	27.10
10 19	Na2O	0.01	0.01	0.02	0.00	0.00	0.00
20	P2O5	0.06	0.04	0.05	0.04	0.11	0.16
21	ZrO2	0.06	0.00	0.12	0.01	0.12	0.09
22	Nb2O5	0.17	0.14	0.11	0.12	0.21	0.25
23	La2O3	0.23	0.02	0.20	0.00	0.23	0.27
24	Ce2O3	1.03	0.13	0.72	0.12	0.90	1.02
26	Nd2O3	0.70	0.17	0.27	0.15	0.48	0.70
27	CI	0.00	0.00	0.00	0.00	0.00	0.00
28	F	0.46	0.59	0.67	0.63	0.53	0.50
29 30	Total	97.77	97.97	98.41	98.78	98.23	97.96
31	O≡CI,F	0.19	0.25	0.28	0.26	0.22	0.21
32	Total-O≡CI,F	97.58	97.72	98.13	98.52	98.01	97.75
33							
34 25	(a.p.f.u.)						
36	Si	1.00	1.01	1.00	1.00	1.00	1.00
37	Ti	0.91	0.92	0.90	0.92	0.90	0.90
38	Al	0.08	0.07	0.09	0.07	0.08	0.08
39 40	Fe	0.01	0.01	0.01	0.01	0.01	0.01
40 41	Mn	0.00	0.00	0.00	0.00	0.00	0.00
42	Ca	0.97	0.98	0.98	1.00	0.97	0.98
43	Na	0.00	0.00	0.00	0.00	0.07	0.00
44	P	0.00	0.00	0.00	0.00	0.00	0.00
45 46	r 7r	0.00	0.00	0.00	0.00	0.00	0.00
47	Nb	0.00	0.00	0.00	0.00	0.00	0.00
48		0.00	0.00	0.00	0.00	0.00	0.00
49	La	0.00	0.00	0.00	0.00	0.00	0.00
50 51	Ce	0.01	0.00	0.01	0.00	0.01	0.01
52	INU CL	0.01	0.00	0.00	0.00	0.01	0.01
53		0.00	0.00	0.00	0.00	0.00	0.00
54	F T / I	0.05	0.06	0.07	0.07	0.06	0.05
55	lotal	3.05	3.06	3.07	3.07	3.06	3.06
56 57	F+CI	0.02	0.03	0.04	0.03	0.03	0.03
58	I ot-(F+CI)	3.03	3.03	3.04	3.04	3.03	3.03
59		_	_	_	_		
60	XTtn	0.911	0.925	0.899	0.922	0.906	0.907
	XAI,Fe-F	0.049	0.062	0.071	0.066	0.056	0.054

1							
2		тт	'n7		Ttn7hie		Ttn
4		701			Turr Dis		
5	20	201		20	2011eu	40	201
6	30	37	38	39	40	42	59
7	rim	core	rim	core	rim	new grain	core
9	20.07	20.40	20.24	00.74	20.27	20.00	20.74
10	30.27	30.10	30.34	29.74	30.37	30.26	30.74
11	36.99	36.37	37.09	36.18	37.17	37.72	35.93
12	1.67	2.09	1.65	2.23	1.74	1.64	2.41
13 14	0.35	0.39	0.42	0.42	0.31	0.27	0.33
15	0.39	0.43	0.47	0.46	0.34	0.30	0.36
16	0.06	0.06	0.11	0.15	0.09	0.10	0.06
17	28.19	27.32	28.03	27.11	27.98	28.39	28.42
18	0.02	0.01	0.03	0.02	0.01	0.01	0.01
20	0.03	0.08	0.02	0.12	0.04	0.05	0.03
21	0.00	0.11	0.00	0.05	0.02	0.00	0.52
22	0.14	0.15	0.14	0.27	0.26	0.12	0.09
23	0.06	0.25	0.02	0.15	0.00	0.01	0.00
24 25	0.10	0.87	0.06	0.87	0.14	0.12	0.12
26	0.19	0.50	0.13	0.66	0.32	0.07	0.12
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.61	0.57	0.58	0.55	0.55	0.61	0.75
29 30	98.67	98.87	98.61	98.52	99.01	99.38	99.51
31	0.26	0.24	0.24	0.23	0.23	0.26	0.31
32	98.41	98.63	98.37	98.28	98.77	99.12	99.20
33							
34							
36	1.00	1.00	1.00	0.99	1.00	0.99	1.01
37	0.92	0.91	0.92	0.91	0.92	0.93	0.89
38	0.07	0.08	0.06	0.09	0.07	0.06	0.09
39 40	0.01	0.01	0.01	0.01	0.01	0.01	0.01
40 41	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	1 00	0.97	0.99	0.97	0.99	1 00	1 00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45 46	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.01
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50 51	0.00	0.01	0.00	0.01	0.00	0.00	0.00
52	0.00	0.01	0.00	0.01	0.00	0.00	0.00
53	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54	0.06	0.06	0.06	0.06	0.06	0.06	0.08
55 56	3.07	3.06	3.00	3.06	3.Ub	3.07	3.08
50 57	0.03	0.03	0.03	0.03	0.03	0.03	0.04
58	3.04	3.03	3.03	3.03	3.03	3.03	3.04
59	0.007	0.007	0.004	0.004	0.004	0.000	0.007
60	0.925	0.907	0.924	0.901	0.924	0.929	0.897
	0.064	0.059	0.060	0.058	0.058	0.063	0.078

2						
3	າ35		า43			
4	ned		ZOI	ned		
5	60	65	66	67	68	
0 7	rim	core	core	rim	rim	average
8		0010	0010			average
9	30 53	20.78	30.07	30 54	30 / 1	30.2
10	30.55	29.70	30.07	30.54	30.41	30.2
11	30.97	30.10	36.01	37.29	36.99	30.0
12	2.00	2.27	2.31	1.72	1.95	2.0
13 1/1	0.34	0.27	0.34	0.37	0.30	0.4
15	0.37	0.30	0.38	0.41	0.34	0.39
16	0.03	0.04	0.09	0.04	0.03	0.1
17	28.38	27.13	27.76	28.45	27.99	27.8
18	0.01	0.00	0.00	0.01	0.00	0.01
19	0.04	0.22	0.08	0.01	0.08	0.07
20 21	0.03	0.00	0.09	0.00	0.01	0.07
21	0.13	0.04	0.07	0.03	0.05	0 14
23	0.00	0.24	0.13	0.02	0.00	0.10
24	0.00	0.24	0.10	0.02	0.04	0.10
25	0.03	0.99	0.74	0.03	0.32	0.40
26	0.01	0.72	0.52	0.14	0.28	0.34
27 28	0.00	0.01	0.00	0.00	0.00	0.00
29	0.67	0.52	0.66	0.63	0.60	0.59
30	99.16	98.41	98.86	99.27	99.05	98.7
31	0.28	0.22	0.28	0.27	0.25	0.2
32	98.88	98.19	98.58	99.01	98.80	98.4
33 24						
35						
36	1.00	1.00	1.00	1.00	1.00	1.0
37	0.91	0.91	0.90	0.92	0.92	0.9
38	0.08	0.09	0.09	0.07	0.08	0.1
39	0.01	0.01	0.01	0.01	0.01	0.0
40 //1	0.01	0.00	0.00	0.00	0.01	0.0
42	1.00	0.00	0.00	1.00	0.00	1.0
43	1.00	0.97	0.99	0.00	0.99	1.0
44	0.00	0.00	0.00	0.00	0.00	0.0
45	0.00	0.00	0.00	0.00	0.00	0.0
46	0.00	0.00	0.00	0.00	0.00	0.0
47 48	0.00	0.00	0.00	0.00	0.00	0.0
49	0.00	0.00	0.00	0.00	0.00	0.0
50	0.00	0.01	0.01	0.00	0.00	0.0
51	0.00	0.01	0.01	0.00	0.00	0.0
52	0.00	0.00	0.00	0.00	0.00	0.0
53	0.07	0.05	0.07	0.07	0.06	0.1
54 55	3.07	3.06	3.08	3.07	3.06	3.1
56	0.03	0.03	0.03	0.03	0.03	0.0
57	3 04	3.03	3.04	3.04	3.03	3.0
58	0.04	0.00	0.04	0.04	0.00	0.0
59	0.012	0.004	0 000	0 022	0.016	0.01
00	0.913	0.904	0.900	0.923	0.910	0.91
	0.070	0.055	0.069	0.066	0.062	0.06

2		-		T (05	T L 00	T 1 07
3		Iti	n15	Itn25	Itn26	ltn27
4 5		unz	oned	unzoned	unzoned	unzoned
6		43	44	45	46	47
7	std.dev	core	rim	core	core	core
8						
9	0.3	30,16	30.34	30.45	30.36	30.14
10	0.6	36.88	36.97	35 75	35 56	36 16
11	0.0	2 19	1 00	2 45	2 47	2 50
12	0.3	2.10	1.00	2.40	2.47	2.50
13	0.0	0.21	0.30	0.29	0.31	0.27
15	0.05	0.23	0.33	0.32	0.34	0.30
16	0.0	0.13	0.06	0.04	0.05	0.03
17	0.5	28.39	28.32	28.20	28.41	28.20
18	0.01	0.00	0.01	0.00	0.00	0.00
19	0.05	0.07	0.03	0.02	0.04	0.02
20	0 12	0.00	0.00	0.51	0 44	0.00
21	0.07	0.05	0.05	0.11	0.09	0.07
23	0.07	0.00	0.00	0.11	0.00	0.07
24	0.11	0.00	0.03	0.00	0.04	0.00
25	0.41	0.12	0.11	0.15	0.08	0.07
26	0.24	0.05	0.06	0.10	0.13	0.00
27	0.00	0.00	0.00	0.01	0.00	0.02
28	0.07	0.70	0.69	0.73	0.82	0.75
29 30	0.5	99.00	98.84	98.80	98.78	98.31
31	0.0	0.30	0.29	0.31	0.34	0.32
32	05	98 70	98 55	98 49	98 44	97 99
33				00110		01100
34						
35	0.0	0.00	1.00	1.00	1 00	1 00
36	0.0	0.99	1.00	1.00	1.00	1.00
37 38	0.0	0.91	0.92	0.89	0.88	0.90
39	0.0	0.08	0.07	0.10	0.10	0.10
40	0.0	0.01	0.01	0.01	0.01	0.01
41	0.0	0.00	0.00	0.00	0.00	0.00
42	0.0	1.00	1.00	1.00	1.00	1.00
43	0.0	0.00	0.00	0.00	0.00	0.00
44	0.0	0.00	0.00	0.00	0.00	0.00
45 46	0.0	0.00	0.00	0.00	0.00	0.00
40 47	0.0	0.00	0.00	0.01	0.01	0.00
48	0.0	0.00	0.00	0.00	0.00	0.00
49	0.0	0.00	0.00	0.00	0.00	0.00
50	0.0	0.00	0.00	0.00	0.00	0.00
51	0.0	0.00	0.00	0.00	0.00	0.00
52	0.0	0.00	0.00	0.00	0.00	0.00
53 54	0.0	0.07	0.07	0.08	0.09	0.08
55	0.0	3.08	3.08	3.08	3.09	3.09
56	0.0	0.04	0.04	0.04	0.04	0.04
57	0.0	3.04 2.01	3.04 3.04	3.04 3.04	3.04 3.05	3.04 3.05
58	0.0	5.04	0.04	5.04	0.00	0.00
59	0.04	0.040	0.040	0.000	0.004	0.000
60	0.01	0.910	0.919	0.896	0.894	0.896
	0.01	0.073	0.072	0.077	0.086	0.078

Page 135 of 235

1								
2 3	Ttn28	Ttn29	Ttn28	Ttr	30	Ttr	n31	Ttn
4	unzoned	unzoned	unzoned		aned		ned	
5	48	49	50	51	52	53	54	55
6	core	core	core	core	rim	core	rim	core
7 8	core	core	COLE	COLE	11111	COLE	11111	core
9	20.10	20.24	20.19	20.66	20.27	20 52	20 50	20.05
10	30.19	30.34	30.10	30.00	30.27	30.53	30.50	30.05
11	35.64	35.04	35.21	35.57	36.72	35.80	36.26	35.88
12	2.38	2.87	2.68	2.66	2.07	2.56	2.35	2.64
13 1 <i>1</i>	0.32	0.26	0.33	0.32	0.32	0.30	0.30	0.35
15	0.36	0.29	0.37	0.35	0.36	0.34	0.33	0.39
16	0.04	0.02	0.07	0.05	0.06	0.02	0.02	0.09
17	28.29	28.06	28.20	28.17	28.19	28.62	28.34	28.22
18	0.01	0.01	0.00	0.00	0.01	0.02	0.02	0.01
19	0.02	0.02	0.04	0.04	0.04	0.02	0.04	0.01
20	0.47	0.31	0.47	0.31	0.06	0.18	0.01	0.00
22	0.08	0.09	0.10	0.11	0.08	0.08	0.07	0.00
23	0.05	0.03	0.05	0.05	0.00	0.06	0.05	0.01
24	0.12	0 10	0.16	0.18	0.13	0.16	0.22	0.02
25	0.09	0.07	0.07	0.16	0.10	0.05	0.16	0.03
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
29	0.71	0.00	0.73	0.01	0.70	0.70	0.70	0.00
30	90.41	90.04	90.00	99.00	90.75	99.20	99.04	90.29
31	0.30	0.34	0.33	0.34	0.29	0.33	0.29	0.40
33	98.11	97.70	98.00	98.74	98.45	98.91	98.74	97.88
34								
35								
36	1.00	1.01	1.00	1.01	1.00	1.00	1.00	0.99
3/ 38	0.89	0.87	0.88	0.88	0.91	0.89	0.90	0.89
39	0.09	0.11	0.10	0.10	0.08	0.10	0.09	0.10
40	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	1.00	1.00	1.00	0.99	1.00	1.01	1.00	1.00
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
46	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49 50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54	2 00	2 00 2 00	3.00	3 00	0.07 2 AD	2 00	0.07 2 00	3 11
55 56	3.09	0.09	3.08	0.09	J.UO	0.03	0.00	J. I I 0.05
57	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05
58	3.05	3.05	3.05	3.05	3.04	3.05	3.04	3.00
59	0.007	0.000	0.005	0.007	0.044	0.000	0.000	0.000
60	0.897	0.880	0.885	0.887	0.911	0.892	0.900	0.888
	0.075	0.084	0.083	0.085	0.073	0.082	0.073	0.100

1							
2							
3	າ32	Ttn34		Ttr	า40	Ttn42	
4	oned	unzo	oned	unzo	oned	unzo	oned
5	56	57	58	61	62	63	64
6	rim	ooro	rim	ooro	rim	00	rim
/	11111	core	11111	core	11111	core	11111
0 0							
10	30.36	30.40	30.30	30.26	30.20	30.22	30.28
11	35.37	36.64	36.93	35.27	34.82	34.64	35.96
12	2.71	2.04	1.83	2.79	2.89	2.83	2.27
13	0.36	0.27	0.27	0.32	0.36	0.36	0.34
14	0.39	0.30	0.30	0.35	0.40	0.40	0.38
15	0.00	0.06	0.05	0.00	0.10	0.06	0.00
16	0.09	0.00	0.00	0.04	0.10	0.00	0.00
17 10	28.10	28.48	28.28	27.80	27.99	27.98	27.99
10	0.00	0.00	0.01	0.01	0.01	0.01	0.01
20	0.04	0.01	0.01	0.04	0.04	0.00	0.05
21	0.18	0.00	0.01	0.21	0.21	0.27	0.02
22	0.18	0.08	0.08	0.11	0.12	0.08	0.11
23	0.01	0.03	0.05	0.02	0.08	0.03	0.07
24	0.02	0.03	0.07	0.21	0.23	0.25	0.17
25	0.02	0.00	0.07	0.21	0.20	0.20	0.17
26	0.06	0.05	0.13	0.11	0.10	0.20	0.00
27 28	0.01	0.00	0.01	0.00	0.01	0.00	0.01
20	0.77	0.68	0.66	0.85	0.81	0.79	0.73
30	98.33	98.78	98.67	98.09	98.03	97.72	98.15
31	0.33	0.29	0.28	0.36	0.34	0.33	0.31
32	98.01	98.49	98.39	97.73	97.69	97.39	97.85
33							
34							
35	1 00	1 00	1 00	1 00	1 00	1 01	1 00
30 37	1.00	1.00	1.00	1.00	1.00	1.01	1.00
38	0.88	0.91	0.92	0.88	0.87	0.87	0.90
39	0.11	0.08	0.07	0.11	0.11	0.11	0.09
40	0.01	0.01	0.01	0.01	0.01	0.01	0.01
41	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	1.00	1.01	1.00	0.99	1.00	1.00	0.99
43	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 45	0 00	0 00	0.00	0.00	0.00	0.00	0 00
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00
47	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51	0.00	0.00	0.00	0.00	0.00	0.00	0.00
52	0.00	0.00	0.00	0.00	0.00	0.00	0.00
53 54	0.08	0.07	0.07	0.09	0.08	0.08	0.08
55	3.09	3.08	3.07	3.09	3.10	3.10	3.08
56	0.04	0.04	0.03	0.04	0.04	0.04	0.04
57	3.04 3.05	3.04 3.04	3.00 3.01	3.07 3.05	3.07 3.05	3.04 3.05	3.04 3.04
58	5.05	0.04	0.04	0.00	0.00	0.00	5.04
59	0.004	0.040	0.004	0.000	0.070	0.070	0.004
60	0.884	0.913	0.921	0.882	υ.8/6	υ.δ/δ	0.901
	0.081	0.071	0.069	0.089	0.085	0.084	0.077

4			
5			
6	01/0/000	atd day	
/ 8	average	Slu.uev	
9	<u> </u>	0.4	
10	30.3	0.1	
11	35.9	0.7	
12	2.5	0.3	
13	0.3	0.0	
14	0.34	0.04	
15	0.1	0.0	
17	28.2	0.2	
18	0.01	0.2	
19	0.07	0.07	
20	0.03	0.02	
21	0.18	0.18	
22	0.09	0.03	
23	0.04	0.02	
24 25	0.13	0.07	
26	0.09	0.05	
27	0.00	0.01	
28	0 76	0 07	
29	98.5	0.4	
30	0.3	0.4	
31	0.5	0.0	
33	90.2	0.4	
34			
35			
36	1.0	0.0	
37	0.9	0.0	
38 30	0.1	0.0	
40	0.0	0.0	
41	0.0	0.0	
42	1.0	0.0	
43	0.0	0.0	
44	0.0	0.0	
45	0.0	0.0	
47	0.0	0.0	
48	0.0	0.0	
49	0.0	0.0	
50	0.0	0.0	
51	0.0	0.0	
53	0.0	0.0	
54	0.1	0.0	
55	3.1	0.0	
56	0.0	0.0	
57	3.0	0.0	
58 59			
60	0.90	0.01	
	0.08	0 01	
	0.00	0.07	

LA-ICP-MS U-(Th-)Pb data analytical details

Laboratory & Sample Preparation	
Laboratory name	CNR-Istituto di Geoscienze e Georisorse U.O. Pavia (Italy)
Sample type/mineral	Monazite and titanite
Sample preparation	Polished thin section with a thickness of $30\mu m$ and/or $50\mu m$.
Imaging	BSE images with normal brightness/contrast setting and highly contrasted, MIRA3 TESCAN FE-SEM, 20kV, 16-17mm working distance
Laser ablation system	
Make, Model & type	Geolas 102 from Microlas
Ablation cell & volume	In-house built low volume cell, volume ca. 4 cm ³
Laser wavelength (nm)	193 nm
Pulse width (ns)	4 ns
Fluence (J.cm ⁻²)	7 J.cm ⁻²
Repetition rate (Hz)	3 Hz for monazite; 5 Hz for titanite
Ablation duration (secs)	40 secs
Ablation pit depth / ablation rate	Not measured
Spot diameter	10 □m for monazite; 25 or 35 □m for titanite
(⊔m) nominal/actual	4
Sampling mode /	Static spot ablation
Carrier gas	100% He in the cell, Ar make-up gas combined using a Y- piece 50% along the sample transport line to the torch.
Cell carrier gas flow (I/min)	0.44 l/min
ICP-MS	
Instrument	
Make, Model & type	Agilent 8900 ICP-MS
Sample introduction	Ablation aerosol (sample + He + Ar)
RF power (W)	1250W
Make-up gas flow (I/min)	0.44 I/min He + 0.91 I/min Ar
Detection system	Single quadrupole, dual detection, no-gas mode

Masses measured	Monazite: 202-208, 232, 238;
	titanite: 27, 29, 31, 43, 44, 49, 51, 55, 57, 89, 90, 93, 139, 140, 141, 146, 149, 151, 157, 159, 163, 165, 167, 169, 173, 175, 177, 198, 202-208, 232, 238 for titanite
Integration time per peak/dwell times (ms);	Monazite: ²⁰² Hg (50), ²⁰⁴ Pb (150), ²⁰⁶ Pb (20), ²⁰⁷ Pb (40), ²⁰⁸ Pb (10), ²³² Th (2), and ²³⁸ U (20);
quadrupole settling time between mass jumps	titanite: $Al^{27}(3)$, $Si^{29}(3)$, $P^{31}(3)$, $Ca^{43}(3)$, $Ca^{44}(3)$, $Ti^{49}(3)$, $V^{51}(3)$, $Mn^{55}(3)$, $Fe^{57}(3)$, $Y^{89}(5)$, $Zr^{90}(5)$, $Nb^{93}(5)$, $La^{139}(5)$, $Ce^{140}(5)$, $Pr^{141}(5)$, $Nd^{146}(5)$, $Sm^{149}(5)$, $Eu^{151}(5)$, $Gd^{157}(5)$, $Tb^{159}(5)$, $Dy^{163}(5)$, $Ho^{165}(5)$, $Er^{167}(5)$, $Tm^{169}(5)$, $Yb^{173}(5)$,
, , , , , , , , , , , , , , , , , , ,	Lu ¹⁷⁵ (5), Hf ¹⁷⁷ (5), Hg ¹⁹⁸ (5), Hg ²⁰² (5), Pb ²⁰⁴ (5), Pb ²⁰⁶ (30), Pb ²⁰⁷ (45), Pb ²⁰⁸ (15), Th ²³² (10), U ²³⁸ (10).
Total integration time per output datapoint (secs)	~0.4secs for monazite; ~0.3secs for titanite (N.B. this should represent the time resolution of the data)
'Sensitivity'	9000 cps of Th on NIST612
IC Dead time (ns)	
Data Processing	
Gas blank	30 second before and after ablation
Calibration strategy	MOACIR and MKED-1 were used as primary reference materials for monazite and titanite dating, respectively. 44069 monazite (Aleinikoff et al., 2006; Liu et al., 2012) was analysed as secondary/validation standard.
	Titanite trace elements: NIST610 was used as primary reference materials for titanite trace element characterization MKED-1 and TTN150 (Klemme et al., 2008) were analysed as secondaries/validation
Reference Material info	MOACIR monazite: Cruz et al. 1996; Seydoux-Guillaume et al. (2002a, b); considering the values, re-calibrated for isotopic disequilibrium, reported by Gasquet et al. (2010). 44069 monazite: Aleinikoff et al. (2006) with the ²⁰⁸ Pb/ ²³² Th values after Liu et al. (2012);
	MKED-1 titanite: Spandler et al. (2016); Bear Lake and Khan River titanite: Mazoz et al. (2022).
Data processing package used / Correction for LIEF	GLITTER
Mass discrimination	Standard-sample bracketing with ²⁰⁷ Pb/ ²⁰⁶ Pb, ²⁰⁶ Pb/ ²³⁸ U and ²⁰⁸ Pb/ ²³² Th normalized to reference material
Common-Pb correction,	No common-Pb correction applied to the data.

composition and uncertainty	
composition and uncertainty Uncertainty level & propagation Quality control / Validation	Ages are quoted at 2sigma absolute, propagation is by quadratic addition according to Horstwood et al. (2003). Reproducibility and age uncertainty of reference material are propagated. 44069 monazite (Aleinikoff et al., 2006): average ratio \pm 1sigma; precision(%); accuracy(%) ²⁰⁷ Pb/ ²⁰⁶ Pb: 0,0538±0,0014; 2.2%; ²⁰⁷ Pb/ ²³⁵ U: 0,5070±0,0132; 2.1%; 2.45% ^(a) ²⁰⁶ Pb/ ²³⁸ U: 0,0683±0,0007; 1.4%; 0.33% ^(a) ²⁰⁸ Pb/ ²³² Th: 0,0219±0,0002; 3.6%; 4.88% ^(b) Data for the accuracy are from Aleinikoff et al. (2006) for ^(a) and Liu et al. (2012) for ^(b) . Precision: 2.2% Wtd ave ²⁰⁶ Pb/ ²³⁸ U age = 338 ± 3 (2s, MSWD = 0.9, n=8) GJ-1 – Wtd ave ²⁰⁶ Pb/ ²³⁸ U age = 602 ± 5 (2s, MSWD = 1.1, n=7)
	n=7) Systematic uncertainty for propagation is 2% (2 <i>s</i>). Bear Lake titanite: average ratio \pm 1sigma; precision (%); accuracy (%). Accuracy is measured with respect to the reference value proposed by Mazoz et al. (2022). ²⁰⁷ Pb/ ²⁰⁶ Pb: 0.11314 \pm 0.00148; 1.31%; 1.19%; ²⁰⁷ Pb/ ²³⁵ U: 3.08732 \pm 0.08049; 2.61%; -3.57% ²⁰⁶ Pb/ ²³⁸ U: 0.19792 \pm 0,00434; 2.19%; -4.94% Khan River titanite: average ratio \pm 1sigma; precision (%); accuracy (%). Accuracy is measured with respect to the reference value proposed by Mazoz et al. (2022). ²⁰⁷ Pb/ ²⁰⁶ Pb: 0.06118 \pm 0.005255; 8.59%; -1.28%; ²⁰⁷ Pb/ ²³⁵ U: 0.73966 \pm 0.087656; 11.85%; -6.24% ²⁰⁶ Pb/ ²³⁸ U: 0.08752 \pm 0.003556; 4.06%; -4.69%
Other information	

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Table S4 - U-Th-Pb d	data of monazite
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RUN# Date Identifier	Mnz#	Textural position
RUN1 11/18/2021 007SMPL	4	foliation
RUN1 11/18/2021 008SMPL	4	foliation
RUN1 11/18/2021 009SMPL	4	foliation
RUN1 11/18/2021 010SMPL	4	foliation
RUN1 11/18/2021 011SMPL	4	foliation
RUN1 11/18/2021 012SMPL	4	foliation
RUN1 11/18/2021 013SMPL	6	*
RUN1 11/18/2021 014SMPL	6	*
RUN1 11/18/2021 015SMPL	5	foliation
RUN1 11/18/2021 016SMPL	5	foliation
RUN1 11/18/2021 017SMPL	5	foliation
RUN1 11/18/2021 018SMPL	12	foliation
RUN1 11/18/2021 019SMPL	12	foliation
RUN1 11/18/2021 020SMPL	12	foliation
RUN1 11/18/2021 021SMPL	12	foliation
RUN1 11/18/2021 022SMPL	12	foliation
RUN1 11/18/2021 023SMPL	11	foliation
RUN1 11/18/2021 024SMPL	11	foliation
RUN1 11/18/2021 025SMPL	11	foliation
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RUN1 11/18/2021 028SMPL	8	foliation
RUN1 11/18/2021 029SMPL	8	foliation
RUN1 11/18/2021 030SMPL	10	foliation
RUN1 11/18/2021 031SMPL	10	foliation
RUN1 11/18/2021 032SMPL	10	foliation
RUN1 11/18/2021 0335MPL	10	tollation
DUN2 11/18/2021 006SMD	0	foliation
RUN2 11/18/2021 0000001 E	9	foliation
RUNZ 11/18/2021 007 SMPL RUN2 11/18/2021 008 SMPL	9	foliation
RUN2 11/18/2021 0005MPL	9	foliation
RUN2 11/18/2021 0000000000000000000000000000000000	14	*
RUN2 11/18/2021 0100MFL	14	*
RUN2 11/18/2021 0110MIL	14	*
RUN2 11/18/2021 0125MPL	14	*
RUN2 11/18/2021 014SMPI	14	*
RUN2 11/18/2021 015SMPI	14	*
RUN2 11/18/2021 016SMPI	14	*
RUN2 11/18/2021 017SMPI	14	*
RUN2 11/18/2021 018SMPI	15	within garnet
RUN2 11/18/2021 019SMPL	15	within darnet
RUN2 11/18/2021 020SMPL	15	within garnet

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2 3	RUN2	11/18/2021	021SMPI	15	within garnet
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				Data f	
-content (wt%)	²⁰⁷ Pb/ ²⁰⁶ Pb	1s abs	²⁰⁷ Pb/ ²³⁵ U	1s abs	
1.96	0.05418	0.00213	0.25779	0.00966	
1.97	0.05280	0.00142	0.26163	0.00675	
2.07	0.05348	0.00149	0.27783	0.00742	
1.8	0.05233	0.00206	0.23278	0.00874	
2.12	0.05019	0.00180	0.23807	0.00816	
2.81	0.05327	0.00150	0.27146	0.00731	
0.47	0.05262	0.00168	0.29873	0.00910	
0.15	0.05196	0.00184	0.31983	0.01084	
0.67	0.05723	0.00161	0.29683	0.00795	
2.06	0.05217	0.00146	0.27061	0.00723	
2.61	0.05273	0.00175	0.27289	0.00863	
0.84	0.05091	0.00187	0.23576	0.00828	
0.84	0.05384 🤇	0.00186	0.26130	0.00859	
1.34	0.05599	0.00296	0.26619	0.01348	
1.34	0.05473	0.00231	0.26012	0.01050	
1.05	0.05212	0.00261	0.22862	0.01096	
0.8	0.05148	0.00163	0.24747	0.00749	
2.43	0.05081	0.00166	0.26715	0.00834	
0.4	0.05222	0.00200	0.25667	0.00936	
0 19	0.05211	0 00220	0 20061	0.01100	
0.10	0.05511	0.00220	0.30001	0.01190	
0.43	0.05555	0.00222	0.20205	0.01074	
0.31	0.05110	0.00280	0.24409	0.01263	
2.0	0.05052	0.00195	0.20420	0.00909	
2.0	0.05088	0.00271	0.27445	0.01401	
0.4	0.03403	0.00200	0.27020	0.00980	
1	0.05094	0.00177	0.22522	0.00672	
1.01	0.05189	0.00169	0.29033	0.00801	
1.59	0.06209	0.00207	0.43109	0.01216	
1.21	0.05064	0.00221	0.20652	0.00806	
0.98	0.05114	0.00185	0.26459	0.00832	
0.32	0.06123	0.00198	0.38276	0.01040	
0.32	0.07197	0.00356	0.36102	0.01603	
0.32	0.05988	0.00273	0.28744	0.01176	
0.32	0.05336	0.00196	0.25346	0.00809	
0.25	0.05767	0.00183	0.37943	0.01006	
0.22	0.05389	0.00182	0.29287	0.00840	
0.98	0.05398	0.00192	0.24703	0.00755	
2.82	0.04875	0.00166	0.23581	0.00685	
0.52	0.05211	0.00174	0.33443	0.00948	
1.46	0.05464	0.00175	0.34525	0.00924	

1 2 3 4		
5 6	or Wetherill plot	3
7	²⁰⁶ Pb/ ²³⁸ U	1s al
8 0	0.03460	0.000
9 10	0.03594	0.000
11	0.03768	0.000
12	0.03230	0.000
13 14	0.03442	0.000
15	0.03697	0.000
16	0.04118	0.000
17 19	0.04465	0.000
18	0.03762	0.000
20	0.03763	0.000
21	0.03754	0.000
22	0.03360	0.000
23 24	0.03521	0.000
25	0.03449	0.000
26	0.03448	0.000
27	0.03185	0.000
28 29	0.03487	0.000
30	0.03814	0.000
31	0.03565	0.000
32		
33 34	0.04106	0 000
35	0.04100	0.000
36	0.03062	0.000
37	0.03400	0.000
38 39	0.03734	0.000
40	0.03629	0.000
41	0.00020	0.000
42	0.03208	0.000
43 44	0.04060	0.000
45	0.05038	0.000
46	0.02958	0.000
47	0.03754	0.000
48 49	0.04536	0.000
50	0.03640	0.000
51	0.03483	0.000
52	0.03448	0.000
53 54	0.04774	0.000
55	0.03944	0.000
56	0.03321	0.000
57	0.03510	0.000
58 59	0.04658	0.000
60	0.04584	0.000

or Wetherill plot	3				
²⁰⁶ Pb/ ²³⁸ U	1s abs	Rho	²⁰⁸ Pb/ ²³² Th	1s abs	²⁰⁷ Pb/ ²⁰⁶ Pb
0.03460	0.00047	0.0	0.01080	0.00013	379
0.03594	0.00036	0.1	0.01112	0.00013	320
0.03768	0.00039	0.1	0.01116	0.00013	349
0.03230	0.00043	0.0	0.00995	0.00012	300
0.03442	0.00043	0.1	0.01107	0.00013	204
0.03697	0.00039	0.1	0.01173	0.00014	340
0.04118	0.00047	0.1	0.01291	0.00015	312
0.04465	0.00056	0.1	0.01386	0.00016	284
0.03762	0.00040	0.1	0.01176	0.00014	500
0.03763	0.00039	0.1	0.01184	0.00014	293
0.03754	0.00045	0.1	0.01138	0.00014	317
0.03360	0.00042	0.1	0.01130	0.00014	237
0.03521	0.00044	0.1	0.01148	0.00014	364
0.03449	0.00062	0.0	0.01112	0.00013	452
0.03448	0.00050	0.0	0.01084	0.00013	401
0.03185	0.00054	0.0	0.00999	0.00012	291
0.03487	0.00040	0.1	0.01105	0.00013	262
0.03814	0.00045	0.1	0.01167	0.00014	232
0.03565	0.00048	0.1	0.01105	0.00013	295
0.04106	0.00061	0.1	0.01362	0.00017	333
0.03682	0.00052	0.0	0.01116	0.00013	434
0.03466	0.00065	0.1	0.01156	0.00015	245
0.03794	0.00052	0.1	0.01216	0.00015	219
0.03914	0.00071	0.1	0.01181	0.00015	235
0.03629	0.00049	0.1	0.01156	0.00014	372
			0.04007		
0.03208	0.00033	0.0	0.01037	0.00010	238
0.04060	0.00039	0.0	0.01279	0.00012	281
0.05038	0.00051	0.0	0.01459	0.00014	677
0.02958	0.00040	0.0	0.00957	0.00010	224
0.03754	0.00041	0.0	0.01141	0.00011	247
0.04550	0.00044	0.0	0.01440	0.00014	047
0.03040	0.00001	0.0	0.01127	0.00011	500
0.03403	0.00030	0.0	0.01007	0.00010	344
0.03440	0.00045	0.0	0.01499	0.00014	517
0 03944	0 00040	0.0	0 01233	0 00012	366
0.03321	0.00035	0.0	0.01028	0.00010	370
0.03510	0.00035	0.1	0.01102	0.00011	136
0.04658	0.00046	0.0	0.01457	0.00014	290
0.04584	0.00043	0.0	0.01450	0.00014	398

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4	0.03629	0.00044	0.1	0.01138	0.00011	187
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1s abs	²⁰⁷ Pb/ ²³⁵ U	1s abs	²⁰⁶ Pb/ ²³⁸ U	1s abs	
15	233	9	219	3	
9	236	6	228	2	
10	249	7	238	2	
12	212	8	205	3	
7	217	7	218	3	
10	244	7	234	2	
10	265	8	260	3	
10	282	10	282	4	
14	264	7	238	3	
8	243	6	238	2	
11	245	8	238	3	
9	215	8	213	3	
13	236	8	223	3	
24	240	12	219	4	
17	235	9	219	3	
15	209	10	202	3	
8	225	7	221	3	
8	240	8	241	3	
11	232	8	226	3	
14	267	11	259	4	
17	252	10	233	3	
13	222	12	220	4	
8	238	9	240	3	
13	246	13	248	4	
14	243	9	230	3	
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8	206	6	204	2	
9	259	7	257	2	
23	364	10	317	3	
10	191	7	188	3	
9	238	7	238	3	
21	329	9	286	3	
49	313	14	230	4	
27	257	10	221	3	
13	229	7	219	2	
16	327	9	301	3	
12	261	7	249	3	
13	224	7	211	2	
5	215	6	222	2	
10	293	8	293	3	
13	301	8	289	3	

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	²⁰⁸ Pb/ ²³² Th	1s abs	% U-Pb disc ¹	I-Pb vs Th-Pb disc ²
_	217	3	5.8	1.0
	224	3	3.5	1.8
	224	3	4.2	5.9
	200	2	3.6	2.3
	223	3	-0.6	-2.0
	236	3	4.0	-0.7
	259	3	2.0	0.3
	278	3	0.1	1.2
	236	3	9.8	0.7
	238	3	2.1	0.1
	229	3	3.0	3.7
	227	3	0.9	-6.6
	231	3 🤇	5.4	-3.4
	224	3	8.8	-2.3
	218	3	6.9	0.3
	201	2	3.3	0.6
	222	3	1.6	-0.5
	235	3	-0.4	2.8
	222	3	2.7	1.6
	273	3	2.8	-5.4
	224	3	7.6	3.8
	232	3	1.0	-5.8
	244	3	-0.8	-1.8
	237	3	-0.5	4.1
	232	3	5.4	-1.1
			4.0	
	209	2	1.3	-2.4
	257	2	0.9	-0.1
	293	3	12.9	7.6
	193	2	1.4	-2.4
	229	2	0.3	3.5
	289	3	13.1	-1.1
	227	2	26.4	1.7
	213	2	14.0	3.7
	220	2	4.7	-0.5
	301	3	8.0	0.0
	248	2	4.4	0.7
	207	2	6.0	1.8
	222	2	-3.4	0.4
	292	3	-0.2	0.4
	291	3	4.1	-0.7

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3	229	2	-1.7	0.5
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Table S4 - U-Th-Pb data of monazite

RUN#	Date	Identifier	Mnz#	Textural position
RUN1	11/30/2021	006SMPL	10	foliation
RUN1	11/30/2021	007SMPL	10	foliation
RUN1	11/30/2021	008SMPL	10	foliation
RUN1	11/30/2021	009SMPL	10	foliation
RUN1	11/30/2021	010SMPL	10	foliation
RUN1	11/30/2021	011SMPL	11	foliation
RUN1	11/30/2021	012SMPL	11	foliation
RUN1	11/30/2021	013SMPL	11	foliation
RUN1	11/30/2021	014SMPL	11	foliation
RUN1	11/30/2021	015SMPL	11	foliation
RUN1	11/30/2021	016SMPL	11	foliation
RUN1	11/30/2021	017SMPL	11	foliation
RUN1	11/30/2021	018SMPL	11	foliation
RUN1	11/30/2021	019SMPL	15	foliation
RUN1	11/30/2021	020SMPL	15	foliation
RUN1	11/30/2021	021SMPL	15	foliation
RUN1	11/30/2021	022SMPL	7	foliation
RUN1	11/30/2021	023SMPL	7	foliation
RUN1	11/30/2021	024SMPL	7	foliation
RUN1	11/30/2021	025SMPL	7	foliation
RUN1	11/30/2021	026SMPL	7	foliation

			Data	a for Wetherill
Y-content (wt%)	²⁰⁷ Pb/ ²⁰⁶ Pb	1s abs	²⁰⁷ Pb/ ²³⁵ U	1s abs
1.09	0.05415	0.00110	0.27734	0.00570
3.01	0.05143	0.00122	0.27030	0.00642
3.01	0.04999	0.00116	0.26450	0.00613
1.05	0.05046	0.00112	0.25774	0.00572
1.32	0.05075	0.00102	0.24976	0.00507
1.13	0.05148	0.00122	0.26543	0.00628
0.71	0.05347	0.00144	0.27498	0.00729
0.71	0.05029	0.00132	0.26143	0.00678
2.28	0.05006	0.00098	0.25675	0.00512
2.6	0.05102	0.00101	0.26215	0.00525
2.88	0.04892	0.00107	0.25538	0.00556
2.88	0.05117	0.00103	0.26447	0.00538
1.13	0.05994	0.00136	0.31257	0.00707
0.63	0.04989 🧹	0.00106	0.25333	0.00542
1.97	0.05421	0.00140	0.29559	0.00753
1.08	0.05087	0.00173	0.25288	0.00839
0.71	0.05393	0.00170	0.28448	0.00875
0.34	0.04880	0.00141	0.25918	0.00738
0.16	0.05035	0.00115	0.25981	0.00593
1.92	0.05207	0.00146	0.27781	0.00763
0.63	0.05206	0.00183	0.28017	0.00957

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²⁰⁶ Pb/ ²³⁸ U	1s abs	Rho	²⁰⁸ Pb/ ²³² Th	1s abs	²⁰⁷ Pb/ ²⁰⁶ Pt
0.03715	0.00040	0.1	0.01155	0.00009	377
0.03812	0.00043	0.1	0.01198	0.00009	260
0.03837	0.00043	0.1	0.01172	0.00009	195
0.03705	0.00041	0.1	0.01185	0.00009	216
0.03569	0.00038	0.1	0.01134	0.00008	229
0.03740	0.00042	0.1	0.01158	0.00009	262
0.03730	0.00045	0.1	0.01181	0.00009	349
0.03770	0.00045	0.1	0.01183	0.00009	208
0.03720	0.00039	0.1	0.01152	0.00009	198
0.03727	0.00039	0.1	0.01191	0.00009	242
0.03786	0.00041	0.1	0.01188	0.00009	144
0.03749	0.00040	0.1	0.01206	0.00009	248
0.03783	0.00043	0.1	0.01150	0.00009	601
0.03683	0.00040	0.1	0.01168	0.00009	190
0.03955	0.00047	0.1	0.01175	0.00009	380
0.03606	0.00050	0.1	0.01147	0.00009	235
0.03826	0.00051	0.1	0.01166	0.00009	368
0.03852	0.00047	0.1	0.01187	0.00009	138
0.03743	0.00041	0.1	0.01194	0.00009	211
0.03869	0.00048	0.1	0.01224	0.00009	288
0.03903	0.00054	0.1	0.01194	0.00009	288

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Ages ³				
1s abs	²⁰⁷ Pb/ ²³⁵ U	1s abs	²⁰⁶ Pb/ ²³⁸ U	1s abs
8	249	5	235	3
6	243	6	241	3
5	238	6	243	3
5	233	5	235	3
5	226	5	226	2
6	239	6	237	3
9	247	7	236	3
5	236	6	239	3
4	232	5	235	2
5	236	5	236	2
3	231	5	240	3
5	238	5	237	3
14	276	6	239	3
4	229	5	233	3
10	263	7	250	3
8	200	8	228	3
12	254	8	220	3
4	234	7	242	3
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²⁰⁸ Pb/ ²³² Th	1s abs	% U-Pb disc ¹	-Pb vs Th-Pb d	isc ²
 232	2	5.4	1.3	
241	2	0.7	0.2	
236	2	-1.9	3.0	
238	2	-0.7	-1.5	
228	2	0.1	-0.8	
233	2	1.0	1.7	
237	2	4.3	-0.5	
238	2	-1.2	0.4	
232	2	-1.5	1.7	
239	2	0.2	-1.4	
239	2	-3.7	0.4	
242	2	0.4	-2.1	
231	2	13.3	3.4	
235	2	-1.7	-0.7	
236	2	4.9	5.6	
231	2	0.2	-0.9	
234	2	4.8	3.2	
239	2	-4.1	2.1	
240	2	-1.0	-1.3	
246	2	1.7	-0.5	
240	2	1.6	2.8	

1 Discordance calculated as (1-(206Pb/238U a 2 Discordance calculated as (1-(206Pb/238U a

2 Discordance calculated as (1-(206Pb/238U a

Page 159 of 235

Geological Magazine

Age/207Pb/235U age))*100 age/208Pb/232Th age))*100

Cambridge University Press

Table S4 - U-Th-Pb data of monazite

		й		
RUN#	Date	Identifier	Mnz#	Fextural positior
RUN2	11/17/2021	006SMPL	2	Foliation
RUN2	11/17/2021	007SMPL	2	Foliation
RUN2	11/17/2021	008SMPL	2	Foliation
RUN2	11/17/2021	009SMPL	1	Foliation
RUN2	11/17/2021	010SMPL	1	Foliation
RUN2	11/17/2021	011SMPL	7	Foliation
RUN2	11/17/2021	012SMPL	7	Foliation
RUN2	11/17/2021	013SMPL	7	Foliation
RUN2	11/17/2021	014SMPL	7	Foliation
RUN2	11/17/2021	015SMPL	8	Foliation
RUN2	11/17/2021	016SMPL	8	Foliation
RUN2	11/17/2021	017SMPL	8	Foliation
RUN2	11/17/2021 🔇	018SMPL	8	Foliation
RUN2	11/17/2021	019SMPL	9	Foliation
RUN2	11/17/2021	020SMPL	9	Foliation
RUN2	11/17/2021	021SMPL	9	Foliation
RUN2	11/17/2021	022SMPL	9	Foliation
RUN2	11/17/2021	026SMPL	6	Foliation
RUN2	11/17/2021	027SMPL	6	Foliation
RUN2	11/17/2021	028SMPL	6	Foliation
RUN2	11/17/2021	029SMPL <	6	Foliation
RUN2	11/17/2021	030SMPL	6	Foliation
RUN2	11/17/2021	031SMPL	6	Foliation
RUN2	11/17/2021	036SMPL	5	Foliation
RUN2	11/17/2021	037SMPL	5	Foliation
RUN2	11/17/2021	038SMPL	5	Foliation
RUN2	11/17/2021	039SMPL	4	Foliation
RUN2	11/17/2021	040SMPL	4	Foliation
RUN2	11/17/2021	041SMPL	10	Foliation
RUN2	11/17/2021	032SMPL	3	Within garnet
RUN2	11/17/2021	033SMPL	3	Within garnet
RUN2	11/17/2021	034SMPL	3	Within garnet
RUN2	11/17/2021	035SMPL	3	Within garnet

				Data f
Y-content (wt%)	²⁰⁷ Pb/ ²⁰⁶ Pb	1s abs	²⁰⁷ Pb/ ²³⁵ U	1s abs
0.25	0.04986	0.00136	0.21866	0.00565
0.74	0.04667	0.00145	0.23615	0.00694
0.38	0.05027	0.00148	0.22041	0.00613
0.5	0.04859	0.00137	0.23176	0.00618
0.22	0.05164	0.00146	0.30736	0.00817
0.6	0.04855	0.00231	0.20901	0.00934
0.34	0.04954	0.00201	0.28629	0.01085
0.18	0.05197	0.00213	0.28739	0.01098
0.41	0.05064	0.00182	0.24529	0.00824
0.43	0.08558	0.00565	0.37535	0.02290
0.43	0.04975	0.00271	0.21720	0.01097
0.92	0.04968	0.00288	0.21557	0.01164
2.15	0.05137 🤇	0.00328	0.24898	0.01480
1.86	0.04816	0.00254	0.21773	0.01068
0.15	0.05029	0.00254	0.21374	0.01003
0.36	0.05584	0.00284	0.22231	0.01050
0.27	0.05579	0.00366	0.24103	0.01472
0.13	0.05068	0.00359	0.32194	0.02112
0.12	0.06742	0.00460	0.42125	0.02659
1.37	0.05225	0.00390	0.22983	0.01596
0.67	0.05063	0.00291 <	0.22906	0.01225
1.07	0.05100	0.00342	0.23904	0.01492
2.52	0.05029	0.00345	0.24963	0.01593
0.65	0.04915	0.00437	0.25845	0.02159
2.08	0.05842	0.00537	0.37491	0.03258
0.33	0.05952	0.00462	0.31570	0.02331
no data	0.04930	0.00539	0.28452	0.02972
no data	0.05023	0.00590	0.35336	0.03991
no data	0.05031	0.00543	0.28300	0.02936
no data	0.05085	0.00408	0.25693	0.01922
no data	0.06235	0.00483	0.39903	0.02892
no data	0.05244	0.00451	0.31339	0.02525
no data	0.04797	0.00440	0.23779	0.02050
2.52 0.65 2.08 0.33 10 data 10 data 10 data 10 data 10 data 10 data 10 data 10 data	0.05029 0.04915 0.05842 0.05952 0.04930 0.05023 0.05031 0.05085 0.06235 0.05244 0.04797	0.00345 0.00437 0.00537 0.00462 0.00539 0.00590 0.00543 0.00408 0.00483 0.00451 0.00440	0.24963 0.25845 0.37491 0.31570 0.28452 0.35336 0.28300 0.25693 0.39903 0.31339 0.23779	0.01593 0.02159 0.03258 0.02331 0.02972 0.03991 0.02936 0.01922 0.02892 0.02525 0.02050

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²⁰⁶ Ph/ ²³⁸ II	1e ahe	Rho	²⁰⁸ Ph/ ²³² Th	1e ahe	207 Dh /206r
FD/ 0					100
0.03180	0.00034	0.1	0.01020	0.00008	100
0.03007	0.00043	0.1	0.01112	0.00009	32
0.03179	0.00036	0.1	0.01028	0.00008	207
0.03458	0.00037	0.1	0.01075	0.00008	128
0.04315	0.00047	0.1	0.01330	0.00010	270
0.03118	0.00052	0.1	0.00975	0.00008	120
0.04187	0.00061	0.1	0.01292	0.00011	173
0.04008	0.00059	0.1	0.01222	0.00010	284
0.03511	0.00046	0.1	0.01145	0.00009	224
0.03175	0.00074	0.0	0.00836	0.00008	1329
0.03163	0.00059	0.1	0.01011	0.00008	183
0.03146	0.00062	0.1	0.00975	0.00008	180
0.03514	0.00076	0.1	0.01118	0.00010	257
0.03278	0.00060	0.1	0.01002	0.00008	107
0.03082	0.00054	0.1	0.00971	0.00008	208
0.02887	0.00051	0.0	0.00901	0.00007	446
0.03133	0.00070	0.0	0.01005	0.00009	444
0.04608	0.00110	0.1	0.01403	0.00012	226
0.04532	0.00105	0.0	0.01165	0.00010	851
0.03191	0.00080	0.1	0.01038	0.00009	296
0.03283	0.00065	0.1	0.01010	0.00008	224
0.03400	0.00077	0.1	0.01035	0.00009	241
0.03602	0.00083	0.1	0.01131	0.00010	208
0.03815	0.00114	0.1	0.01092	0.00011	155
0.04655	0.00145	0.0	0.01255	0.00012	546
0.03848	0.00103	0.0	0.01173	0.00011	586
0.04186	0.00157	0.1	0.01290	0.00014	162
0.05103	0.00207	0.1	0.01486	0.00017	206
0.04080	0.00148	0.1	0.01399	0.00019	209
0.03666	0.00099	0.1	0.01109	0.00010	234
0.04642	0.00122	0.0	0.01386	0.00013	686
0.04335	0.00126	0.0	0.01208	0.00012	305
0.03596	0.00112	0.1	0.01037	0.00011	98

- 59 60

Page 163 of 235

5 6	Ages ³						
7	1s abs	²⁰⁷ Pb/ ²³⁵ U	1s abs	²⁰⁶ Pb/ ²³⁸ U	1s abs		
9	5	201	5	202	2		
10	1	215	6	232	3		
11	6	202	6	202	2		
12	4	212	6	219	2		
13	8	272	3 7	272	<u>-</u> 3		
14	6	103	0	108	3		
15	0	195	9 10	190	3		
10 17	1	200	10	204	4		
17	12	257	10	253	4		
19	8	223	7	222	3		
20	88	324	20	201	5		
21	10	200	10	201	4		
22	10	198	11	200	4		
23	16	226	13	223	5		
24	6	200	10	208	4		
25	11	197	9	196	3		
20	23	204	10	183	3		
28	29	219	13	199	4		
29	16	283	10	290	7		
30	58	200	23	286	7		
31	00	337	23	200	í E		
32	22	210	ID 44	202	5		
33	13	209	11	208	4		
34 35	16	218	14	216	5		
36	14	226	14	228	5		
37	14	233	20	241	7		
38	50	323	28	293	9		
39	46	279	21	243	7		
40	18	254	27	264	10		
41	24	307	35	321	13		
42	23	253	26	258	9		
43 11	19	232	17	232	6		
45	53	2/1	25	202	2 2		
46	33	0 1 1 077	20 00	233	0		
47	20	211	<u> </u>	2/4	0		
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²⁰⁸ Pb/ ²³² Th	1s abs	% U-Pb disc ¹	-Pb vs Th-Pb disc ²
205	2	-0.5	-1.6
224	2	-7.8	3.7
207	2	0.3	-2.5
216	2	-3.5	1.4
268	2	-0.1	1.5
196	2	-2.7	0.9
259	2	-3.4	1.9
245	2	1.2	3.1
230	2	0.1	-3.4
168	2	37.7	16.5
203	2	-0.6	-1.3
196	2	-0.7	1.8
225	2	1.4	-0.9
202	2	-4.0	3.1
195	2	0.5	0.2
181	1	10.0	1.2
202	2	9.3	-1.6
282	2	-2.5	3.0
234	2	20.0	18.1
209	2	3.6	-3.1
203	2	0.6	2.5
208	2	1.0	3.4
227	2	-0.8	0.4
220	2	-3.4	9.0
252	2	9.3	14.1
236	2	12.6	3.2
259	3	-4.0	2.0
298	3	-4.4	7.1
281	4	-1.9	-8.9
223	2	0.0	4.0
278	3	14.2	4.9
243	2	1.2	11.3
209	2	-5.1	8.4

1 Discordance calculated as (1-(206Pb/238U a 2 Discordance calculated as (1-(206Pb/238U a

Page 165 of 235

1 2 4 5 6 7 8 9 10 11	
12 13 14 15 16 17 18 19 20 21 22 23	
24 25 26 27 28 29 30 31 32 33 34 35 26	
30 37 38 39 40 41 42 43 44 45 46 47	
48 49 50 51 52 53 54 55 56 57 58	age/207Pb/235U age))*100 age/208Pb/232Th age))*100

59 60 to per peries

Table S4 - U-Th-Pb data of monazite

		1	•	
RUN#	Date	Identifier	Mnz#	Textural position
RUN2	16/11721	006SMPL	1a	Foliation
RUN2	16/11721	007SMPL	1a	Foliation
RUN2	16/11721	008SMPL	1a	Foliation
RUN2	16/11721	009SMPL	1a	Foliation
RUN2	16/11721	010SMPL	1a	Foliation
RUN2	16/11721	011SMPL	1a	Foliation
RUN2	16/11721	012SMPL	1a	Foliation
RUN2	16/11721	013SMPL	1a	Foliation
RUN2	16/11721	014SMPL	1a	Foliation
RUN2	16/11721	015SMPL	4a	Foliation
RUN2	16/11721	016SMPL	4a	Foliation
RUN2	16/11721	017SMPL	4a	Foliation
RUN2	16/11721	018SMPL	4a	Foliation
RUN2	16/11721	019SMPL	4a	Foliation
RUN2	16/11721	020SMPL	4a	Foliation
RUN2	16/11721	021SMPL	4a	Foliation
RUN2	16/11721	022SMPL	6a	Foliation
RUN2	16/11721	023SMPL	6a	Foliation
RUN2	16/11721	024SMPL	6a	Foliation
RUN2	16/11721	025SMPL	6a	Foliation
RUN2	16/11721	026SMPL <	6a	Foliation
RUN2	16/11721	027SMPL	6b	Foliation
RUN2	16/11721	028SMPL	6b	Foliation
RUN2	16/11721	029SMPL	6b	Foliation
RUN2	16/11721	030SMPL	6b	Foliation

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			Data	for Weth
Y-content (wt%)	²⁰⁷ Pb/ ²⁰⁶ Pb	1s abs	²⁰⁷ Pb/ ²³⁵ U	1s ab
0.39	0.05241	0.00142	0.31872	0.0099
0.21	0.06196	0.00200	0.37836	0.0133
0.15	0.05406	0.00148	0.31008	0.0097
0.15	0.05869	0.00171	0.34893	0.0114
0.08	0.05051	0.00153	0.29493	0.0099
0.02	0.05251	0.00148	0.32251	0.0103
0.13	0.05119	0.00145	0.30553	0.0098
0.06	0.05246	0.00167	0.31356	0.0110
0.13	0.05503	0.00169	0.31342	0.0106
0.79	0.05326	0.00170	0.33351	0.0116
0.82	0.05297	0.00137	0.26020	0.0078
0.36	0.05235	0.00206	0.20887	0.0086
1.14	0.05658 🤇	0.00250	0.22864	0.0104
0.25	0.06165	0.00196	0.25367	0.0088
0.05	0.05587	0.00168	0.27799	0.0093
0.61	0.05759	0.00162	0.34405	0.0110
0.38	0.05435	0.00168	0.32358	0.0111
0.38	0.05314	0.00161	0.31472	0.0106
0.12	0.05216	0.00154	0.29152	0.0096
0.05	0.05752	0.00179	0.34049	0.0116
0.15	0.05074	0.00161	0.29863	0.0104
0.11	0.04895	0.00149	0.29822	0.0100
0.13	0.05290	0.00176	0.30743	0.0111
0.15	0.05072	0.00162	0.28341	0.0099
0.17	0.05249	0.00173	0.28847	0.0103
		Combridge	niversity Press	
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²⁰⁶ Pb/ ²³⁸ U	1s abs	Rho	²⁰⁸ Pb/ ²³² Th	1s abs	²⁰⁷ Pb/ ²⁰⁶ Pb
0.04412	0.00047	0.0	0.01406	0.00027	303
0.04429	0.00056	0.0	0.01367	0.00027	673
0.04161	0.00045	0.0	0.01279	0.00025	374
0.04312	0.00049	0.0	0.01303	0.00025	556
0.04235	0.00049	0.0	0.01304	0.00025	219
0.04455	0.00050	0.0	0.01386	0.00027	308
0.04329	0.00048	0.0	0.01362	0.00026	249
0.04336	0.00052	0.0	0.01375	0.00027	306
0.04131	0.00049	0.0	0.01266	0.00025	413
0.04538	0.00056	0.0	0.01366	0.00027	340
0.03562	0.00038	0.0	0.01111	0.00022	328
0.02892	0.00041	0.0	0.00897	0.00018	301
0.02930	0.00046 🤇	0.0	0.00904	0.00018	475
0.02984	0.00037	0.0	0.00944	0.00018	662
0.03609	0.00042	0.0	0.01084	0.00021	447
0.04333	0.00048	0.0	0.01362	0.00026	514
0.04319	0.00052	0.0	0.01338	0.00026	386
0.04296	0.00050	0.0	0.01348	0.00026	335
0.04054	0.00047	0.0	0.01252	0.00024	292
0.04294	0.00051	0.0	0.01324	0.00026	512
0.04270	0.00051	0.0	0.01383	0.00027	229
0.04419	0.00051	0.1	0.01332	0.00026	145
0.04215	0.00052	0.0	0.01365	0.00027	325
0.04053	0.00049	0.0	0.01264	0.00024	228
0.03986	0.00049	0.0	0.01179	0.00023	307

Page 169 of 235

6	Ages ³				
7	1s abs	²⁰⁷ Pb/ ²³⁵ U	1s abs	²⁰⁶ Pb/ ²³⁸ U	1s abs
8 9	8	281	9	278	3
10	22	326	12	279	4
11	10	274	9	263	3
12	16	304	10	272	3
13	7	262	9	267	3
14 15	9	284	9	281	3
15 16	7	271	9	273	3
17	, 10	277	10	270	3
18	10	277	0	261	3
19	13	211	9 10	201	3
20	0	292	10	200	4
21	0	230	1	220	2
22	12	193	8	184	3
25 24	21	209	10	186	3
2 4 25	21	230	8	190	2
26	13	249	8	229	3
27	14	300	10	273	3
28	12	285	10	273	3
29	10	278	9	271	3
30	9	260	9	256	3
31	16	298	10	271	3
32 33	7	265	q	270	3
33 34	1	205	0	270	3
35	4	200	9	219	3
36	-	272	10	200	3
37	1	253	9	256	3
38	10	257	9	252	3
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²⁰⁸ Pb/ ²³² Th	1s abs	% U-Pb disc ¹	I-Pb vs Th-Pb disc ²
282	5	0.9	-1.4
274	5	14.3	1.8
257	5	4.2	2.3
262	5	10.5	3.9
262	5	-1.9	2.1
278	5	1.0	1.0
273	5	-0.9	-0.1
276	5	1.2	-0.9
254	5	5.7	2.6
274	5	2.1	4.1
223	4	3.9	1.0
180	4	4.6	1.8
182	4	11.0	2.3
190	4	17.4	-0.2
218	4	8.2	4.7
273	5	8.9	0.0
269	5	4.2	1.4
271	5	2.4	0.2
251	5	1.4	1.8
266	5	8.9	1.9
278	5	-1.6	-3.0
267	5	-5.2	4.1
274	5	2.2	-3.0
254	5	-1.1	0.9
237	5	2.1	6.0

1 Discordance calculated as (1-(206Pb/238U a 2 Discordance calculated as (1-(206Pb/238U a Page 171 of 235

35U age))*100 32Th age))*100

age/207Pb/235U age))*100 age/208Pb/232Th age))*100

Table S4 - U-Th-Pb d	lata of monazite
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RUN#	Date	Identifier	Mnz#	Textural position
Run1	11/16/2021	006SMPL	8a	Foliation
Run1	11/16/2021	007SMPL	8a	Foliation
Run1	11/16/2021	008SMPL	8a	Foliation
Run1	11/16/2021	009SMPL	8a	Foliation
Run1	11/16/2021	010SMPL	8a	Foliation
Run1	11/16/2021	011SMPL	8c	Foliation
Run1	11/16/2021	012SMPL	8c	Foliation
Run1	11/16/2021	013SMPL	8c	Foliation
Run1	11/16/2021	014SMPL	8b	Foliation
Run1	11/16/2021	015SMPL	8b	Foliation
Run1	11/16/2021	016SMPL	8b	Foliation
Run1	11/16/2021	017SMPL	8b	Foliation
Run1	11/16/2021 🤇	018SMPL	8b	Foliation
Run1	11/16/2021	019SMPL	8b	Foliation
Run1	11/16/2021	020SMPL	8b	Foliation
Run1	11/16/2021	021SMPL	8b	Foliation
Run1	11/16/2021	022SMPL	8b	Foliation
Run1	11/16/2021	023SMPL	8b	Foliation
Run1	11/16/2021	024SMPL	8b	Foliation
Run1	11/16/2021	025SMPL	8b	Foliation

			007 005	Data f
'-content (wt%)	²⁰⁷ Pb/ ²⁰⁶ Pb	1s abs	²⁰⁷ Pb/ ²³⁵ U	1s abs
0.62	0.05130	0.00143	0.28492	0.00826
0.09	0.05131	0.00104	0.33697	0.00756
1.42	0.05360	0.00166	0.33589	0.01069
0.01	0.05135	0.00090	0.34711	0.00705
0.04	0.05175	0.00115	0.28371	0.00684
0.46	0.04733	0.00117	0.23495	0.00620
0.73	0.04801	0.00104	0.22439	0.00531
0.58	0.05049	0.00112	0.26405	0.00638
0.07	0.05113	0.00107	0.35195	0.00810
0.36	0.05035	0.00115	0.24426	0.00599
0.5	0.05110	0.00088	0.34474	0.00691
0.63	0.05103	0.00089	0.34878	0.00701
0.5	0.05010 🤇	0.00088	0.34296	0.00693
0.47	0.04973	0.00117	0.23660	0.00595
0	0.05052	0.00253	0.34112	0.01681
0	0.05303	0.00263	0.35187	0.01708
0.18	0.05241	0.00113	0.32803	0.00771
0.18	0.05114	0.00095	0.32702	0.00688
0.64	0.05175	0.00136	0.30210	0.00827
0.44	0.05134	0.00107	0.32546	0.00743

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or Wetherill plot	3				
²⁰⁶ Pb/ ²³⁸ U	1s abs	Rho	²⁰⁸ Pb/ ²³² Th	1s abs	²⁰⁷ Pb/ ²⁰⁶ Pb
0.04027	0.00048	0.1	0.01248	0.00014	254
0.04762	0.00049	0.1	0.01484	0.00017	255
0.04544	0.00058	0.1	0.01396	0.00016	354
0.04902	0.00048	0.1	0.01502	0.00017	257
0.03975	0.00043	0.1	0.01242	0.00014	274
0.03599	0.00040	0.1	0.01112	0.00013	66
0.03390	0.00035	0.1	0.01046	0.00012	100
0.03792	0.00040	0.1	0.01156	0.00013	218
0.04989	0.00052	0.1	0.01536	0.00018	247
0.03518	0.00037	0.1	0.01084	0.00012	211
0.04892	0.00047	0.1	0.01486	0.00017	245
0.04956	0.00048	0.1	0.01530	0.00017	242
0.04964	0.00048	0.1	0.01465	0.00017	200
0.03449	0.00038	0.1	0.01056	0.00012	182
0.04894	0.00087	0.1	0.01421	0.00017	219
0.04810	0.00086	0.1	0.01347	0.00016	330
0.04539	0.00048	0.1	0.01378	0.00016	303
0.04637	0.00046	0.1	0.01426	0.00016	247
0.04234	0.00049	0.1	0.01062	0.00013	274
0.04597	0.00047	0.1	0.01326	0.00015	256

Page 175 of 2	235		Geological	Magazine				
1 2 3 4								
6	Ages ³							
7	1s abs	²⁰⁷ Pb/ ²³⁵ U	1s abs	²⁰⁶ Pb/ ²³⁸ U	1s abs			
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51	1s abs 7 5 11 5 6 2 5 5 5 5 5 7 5 7 5 7 5 7 5	20 ⁷ Pb/ ²³⁵ U 255 295 294 303 254 214 206 238 306 222 301 304 299 216 298 306 288 287 268 287 268 286	1s abs 7 9 6 6 7 5 6 7 5 6 7 7 7 6 7 7 6 7 7 7	206Pb/238U 255 300 286 309 251 228 215 240 314 223 308 312 312 219 308 303 286 292 267 290	1s abs 3 4 3 2 3 2 3 2 3 2 3 3 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3			
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²⁰⁸ Pb/ ²³² Th	1s abs	% U-Pb disc ¹	-Pb vs Th-Pb d	isc ²
251	3	0.0	1.5	
298	3	-1.7	0.7	
280	3	2.6	2.2	
301	3	-2.0	2.3	
249	3	0.9	0.7	
224	3	-6.4	1.9	
210	2	-4.6	2.1	
232	3	-0.8	3.2	
308	4	-2.5	1.8	
218	3	-0.4	2.2	
298	3	-2.4	3.2	
307	3	-2.6	1.6	
294	3	-4.3	5.9	
212	2	-1.4	2.9	
285	3	-3.4	7.4	
270	3	1.1	10.7	
277	3	0.7	3.3	
286	3	-1.7	2.1	
214	3	0.3	20.1	
266	3	-1.3	8.1	

1 Discordance calculated as (1-(206Pb/238U a 2 Discordance calculated as (1-(206Pb/238U a

Page 177 of 235

Geological Magazine

J age))*100 'h age))*100 age/208Pb/232Th age))*100

age/207Pb/235U age))*100

Table S4 - U-Th-Pb data of monazite

RUN#	Date	Identifier	Mnz#	Fextural positior
RUN1	11/17/2021	006SMPL	6c	Foliation
RUN1	11/17/2021	007SMPL	6c	Foliation
RUN1	11/17/2021	008SMPL	6c	Foliation
RUN1	11/17/2021	009SMPL	6c	Foliation
RUN1	11/17/2021	010SMPL	6c	Foliation
RUN1	11/17/2021	011SMPL	6c	Foliation
RUN1	11/17/2021	012SMPL	6c	Foliation
RUN1	11/17/2021	013SMPL	6c	Foliation
RUN1	11/17/2021	014SMPL	6c	Foliation
RUN1	11/17/2021	015SMPL	6c	Foliation
RUN1	11/17/2021	▶ 016SMPL	6c	Foliation
RUN1	11/17/2021	017SMPL	6c	Foliation
RUN1	11/17/2021 🔇	018SMPL	6c	Foliation
RUN1	11/17/2021	019SMPL	6b	Foliation
RUN1	11/17/2021	020SMPL	6b	Foliation
RUN1	11/17/2021	021SMPL	6b	Foliation
RUN1	11/17/2021	022SMPL	6b	Foliation
RUN1	11/17/2021	026SMPL	6b	Foliation
RUN1	11/17/2021	027SMPL	6b	Foliation
RUN1	11/17/2021	028SMPL	6b	Foliation
RUN1	11/17/2021	029SMPL 🔹	6b	Foliation
RUN1	11/17/2021	030SMPL	6b	Foliation
RUN1	11/17/2021	031SMPL	6b	Foliation
RUN1	11/17/2021	032SMPL	6b	Foliation
RUN1	11/17/2021	033SMPL	6a	Foliation
RUN1	11/17/2021	034SMPL	6a	Foliation
RUN1	11/17/2021	035SMPL	6a	Foliation
RUN1	11/17/2021	036SMPL	6a 🧹	Foliation
RUN1	11/17/2021	037SMPL	6a	Foliation
RUN1	11/17/2021	038SMPL	6a	Foliation
RUN1	11/17/2021	039SMPL	6a	Foliation
RUN1	11/17/2021	040SMPL	6a	Foliation
RUN1	11/17/2021	041SMPL	6a	Foliation
RUN1	11/17/2021	042SMPL	6a	Foliation
RUN1	11/17/2021	043SMPL	7a	within garnet
RUN1	11/17/2021	044SMPL	7a	within garnet
RUN1	11/17/2021	045SMPL	7a	within garnet
RUN1	11/17/2021	046SMPL	7a	within garnet
RUN1	11/17/2021	047SMPL	7a	within garnet
RUN1	11/17/2021	048SMPL	7a	within garnet
RUN1	11/17/2021	049SMPL	7a	within garnet
RUN1	11/17/2021	055SMPL	7b	Foliation
RUN1	11/17/2021	056SMPL	7b	Foliation

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3	RUN1	11/17/2021	057SMPL	7b	Foliation
4	RUN1	11/17/2021	058SMPL	7b	Foliation
5	RUN1	11/17/2021	059SMPL	7b	Foliation
7	RUN1	11/17/2021	060SMPL	7b	Foliation
8	RUN1	11/17/2021	061SMPL	7b	Foliation
9	RUN1	11/17/2021	062SMPL	2a	Foliation
10	RUN1	11/17/2021	063SMPL	2a	Foliation
 12	RUN1	11/17/2021	065SMPL	2a	Foliation
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				Data f
<pre>/-content (wt%)</pre>	²⁰⁷ Pb/ ²⁰⁶ Pb	1s abs	²⁰⁷ Pb/ ²³⁵ U	1s abs
0.03	0.05367	0.00168	0.24465	0.00740
0.06	0.05832	0.00188	0.34918	0.01086
0.11	0.05105	0.00161	0.27536	0.00840
0.11	0.05174	0.00234	0.28623	0.01252
0.54	0.05028	0.00159	0.23120	0.00711
0.54	0.05053	0.00151	0.26667	0.00774
0.23	0.05647	0.00218	0.28990	0.01075
0.54	0.05362	0.00198	0.24409	0.00873
0.46	0.05107	0.00171	0.26080	0.00847
0.28	0.05379	0.00203	0.24987	0.00912
no data	0.05322	0.00198	0.22203	0.00799
no data	0.05260	0.00186	0.21400	0.00730
no data	0.05423 🤇	0.00192	0.22419	0.00769
0.37	0.05123	0.00161	0.24631	0.00751
0.37	0.05252	0.00162	0.25961	0.00773
0.09	0.05248	0.00174	0.31893	0.01025
0.00	0.05392	0.00244	0.32469	0.01412
0.18	0.05018	0.00197	0.31012	0.01169
0.13	0.05485	0.00220	0.32811	0.01267
0.38	0.05292	0.00193	0.25327	0.00888
0.38	0.05130	0.00196	0.23394	0.00862
0.36	0.05232	0.00209	0.25113	0.00964
1.75	0.05087	0.00190	0.25119	0.00904
0.32	0.05009	0.00203	0.23559	0.00916
0.34	0.05267	0.00338	0.20056	0.01223
0.34	0.05122	0.00199	0.24519	0.00911
0.00	0.05183	0.00246	0.28732	0.01309
0.06	0.05707	0.00316	0.32042	0.01689
0.28	0.05193	0.00224	0.24684	0.01016
0.13	0.05245	0.00251	0.31603	0.01440
0.00	0.05167	0.00273	0.30592	0.01543
0.00	0.05082	0.00281	0.31330	0.01648
0.27	0.05001	0.00263	0.24824	0.01235
0.49	0.05342	0.00316	0.25480	0.01420
1.43	0.05159	0.00264	0.32872	0.01581
0.46	0.05551	0.00292	0.34824	0.01717
0.40	0.05185	0.00231	0.34187	0.01436
0.88	0.05290	0.00238	0.35162	0.01487
0.68	0.05178	0.00238	0.34031	0.01467
0.33	0.05124	0.00253	0.31879	0.01477
0.02	0.05135	0.00249	0.31876	0.01452
1.60	0.04969	0.00311	0.20545	0.01196
1.88	0.05107	0.00283	0.28540	0.01464

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3	0.94	0.05118	0.00314	0.34789	0.01974
4	0.31	0.05161	0.00294	0.34196	0.01801
5	0.75	0.05210	0.00298	0.33892	0.01792
7	0.15	0.05197	0.00452	0.28236	0.02257
8	1.60	0.05119	0.00310	0.33258	0.01856
9	0.28	0.05809	0.00521	0.25111	0.02082
10	0.23	0.05369	0.00539	0.25725	0.02386
11	0.06	0.05118	0.00654	0.26810	0.03127
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²⁰⁶ Pb/ ²³⁸ U	1s abs	Rho	²⁰⁸ Pb/ ²³² Th	1s abs	²⁰⁷ Pb/ ²⁰⁶ Pb
0.03306	0.00048	0.1	0.01058	0.00008	357
0.04343	0.00065	0.1	0.01325	0.00010	542
0.03912	0.00057	0.1	0.01248	0.00009	243
0.04013	0.00071	0.1	0.01234	0.00009	274
0.03336	0.00049	0.1	0.01065	0.00008	208
0.03828	0.00054	0.1	0.01165	0.00008	219
0.03724	0.00061	0.1	0.01147	0.00008	471
0.03301	0.00053	0.1	0.01117	0.00008	355
0.03705	0.00056	0.1	0.01159	0.00008	244
0.03369	0.00055	0.1	0.01056	0.00008	362
0.03026	0.00048	0.1	0.00925	0.00007	338
0.02951	0.00046	0.1	0.00904	0.00007	312
0.02999	0.00047	0.1	0.00940	0.00007	381
0.03487	0.00051	0.1	0.01077	0.00008	251
0.03584	0.00052	0.1	0.01214	0.00009	308
0.04408	0.00067	0.1	0.01350	0.00010	306
0.04369	0.00079	0.1	0.01351	0.00010	368
0.04485	0.00074	0.1	0.01340	0.00010	203
0.04339	0.00073	0.1	0.01331	0.00010	406
0.03473	0.00055	0.1	0.01092	0.00008	325
0.03309	0.00053	0.1	0.01043	0.00008	254
0.03483	0.00058	0.1	0.01061	0.00008	299
0.03583	0.00058	0.1	0.01085	0.00008	235
0.03413	0.00057	0.1	0.01056	0.00008	199
0.02763	0.00064	0.1	0.00855	0.00007	315
0.03473	0.00057	0.1	0.01092	0.00008	251
0.04023	0.00075	0.1	0.01216	0.00009	278
0.04075	0.00086	0.1	0.01282	0.00010	494
0.03449	0.00061	0.1	0.01123	0.00009	282
0.04373	0.00083	0.1	0.01332	0.00010	305
0.04296	0.00086	0.1	0.01372	0.00011	271
0.04475	0.00092	0.1	0.01322	0.00010	233
0.03602	0.00072	0.1	0.01171	0.00010	195
0.03461	0.00076	0.1	0.01094	0.00009	347
0.04624	0.00091	0.1	0.01435	0.00012	267
0.04552	0.00092	0.1	0.01467	0.00012	433
0.04784	0.00085	0.1	0.01476	0.00012	279
0.04824	0.00087	0.1	0.01583	0.00012	325
0.04769	0.00087	0.1	0.01508	0.00012	276
0.04515	0.00087	0.1	0.01462	0.00012	252
0.04505	0.00085	0.1	0.01415	0.00011	257
0.03000	0.00069	0.1	0.01027	0.00009	181
0.04055	0.00084	0.1	0.01322	0.00011	244

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3	0.04934	0.00111	0.1	0.01625	0.00014	249
4	0.04808	0.00102	0.1	0.01574	0.00014	268
5	0.04720	0.00101	0.1	0.01569	0.00013	290
7	0.03942	0.00118	0.1	0.01292	0.00013	284
8	0.04715	0.00105	0.1	0.01521	0.00013	249
9	0.03137	0.00096	0.0	0.01044	0.00011	533
10	0.03477	0.00116	0.0	0.01392	0.00014	358
12	0.03800	0.00159	0.1	0.01274	0.00015	249
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	1s abs	²⁰⁷ Pb/ ²³⁵ U	1s abs	²⁰⁶ Pb/ ²³⁸ U	1s abs		
-	11	222	7	210	3		
	17	304	9	274	4		
	8	247	8	247	4		
	12	256	11	254	5		
	7	211	6	212	3		
	7	240	7	242	3		
	18	258	10	236	4		
	13	222	8	209	3		
	8	235	8	235	4		
	14	226	8	214	3		
	13	204	7	192	3		
	11	197	7	187	3		
	14	205	7	190	3		
	8	224	7	221	3		
	9	234	7	227	3		
	10	281	9	278	4		
	17	286	12	276	5		
	8	274	10	283	5		
	16	288	11	274	5		
	12	229	8	220	4		
	10	213	8 🗸	210	3		
	12	227	9	221	4		
	9	228	8	227	4		
	8	215	8	216	4		
	20	186	11	176	4		
	10	223	8	220	4		
	13	256	12	254	5		
	27	282	15	257 🧹	5		
	12	224	9	219	4		
	15	279	13	276	5		
	14	271	14	271	5		
	13	277	15	282	6		
	10	225	11	228	5		
	21	230	13	219	5		
	14	289	14	291	6		
	23	303	15	287	6		
	12	299	13	301	5		
	15	306	13	304	5		
	13	297	13	300	5		
	12	281	13	285	5		
	12	281	13	284	5		
	11	190	11	191	4		
	14	255	13	256	5		

Geological Magazine

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3	15	303	17	310	7
4	15	299	16	303	6
5	17	200	16	207	6
6	17	290	10	297	0
7	25	253	20	249	7
8	15	292	16	297	7
9	48	227	19	199	6
10	26	222	22	220	7
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208	³ Pb/ ²³² Th	1s abs	% U-Pb disc ¹	I-Pb vs Th-Pb disc ²
	213	2	5.6	-1.5
	266	2	9.9	2.9
	251	2	-0.2	-1.3
	248	2	0.8	2.3
	214	2	-0.2	-1.2
	234	2	-0.9	3.3
	231	2	8.8	2.2
	225	2	5.6	-7.2
	233	2	0.3	0.7
	212	2	5.7	0.6
	186	1	5.6	3.2
	182	1	4.8	3.0
	189	1	7.3	0.7
	217	2	1.2	2.0
	244	2	3.1	-7.4
	271	2	1.1	2.5
	271	2	3.4	1.6
	269	2	-3.1	4.9
	267	2	5.0	2.4
	220	2	4.0	0.3
	210	2	1.7	0.1
	213	2	3.0	3.3
	218	2	0.3	3.9
	212	2	-0.7	1.9
	172	1	5.3	2.1
	220	2	1.2	0.3
	244	2	0.9	3.9
	257	2	8.8	0.0
	226	2	2.4	-3.3
	267	2	1.1	3.1
	275	2	-0.1	-1.6
	265	2	-2.0	5.9
	235	2	-1.3	-3.2
	220	2	4.8	-0.3
	288	2	-1.0	1.2
	294	2	5.4	-2.6
	296	2	-0.9	1.7
	317	2	0.7	-4.5
	303	2	-1.0	-0.7
	293	2	-1.3	-3.1
	284	2	-1.1	0.0
	207	2	-0.4	-8.4
	265	2	-0.5	-3.6

Z				
3	326	3	-24	-4 9
4	316	3	1 /	1.0
5	510	5	-1.4	-4.5
6	315	3	-0.3	-5.8
7	259	3	1.3	-4.1
8	305	3	-1.9	-2.7
9	210	2	12.5	-5.4
10	270	_		0.1
11	279	3	5.2	-26.8
12	256	3	0.3	-6.4
13				

1 Discordance calculated as (1-(206Pb/238U a 2 Discordance calculated as (1-(206Pb/238U a

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race elements and U-Pb

Titanite type	Run name	Spot dimension (microns)	Identifier
Type Z	RUN2	35	006SMPL
Type Z	RUN2	35	007SMPL
Type Z	RUN2	35	008SMPL
Type Z	RUN2	35	009SMPL
Type Z	RUN2	35	010SMPL
Type Z	RUN2	35	011SMPL
Type Z	RUN2	35	012SMPL
Type Z	RUN2	35	013SMPL
Type Z	RUN2	35	014SMPL
Type Z	RUN2	35	015SMPL
Type Z	RUN2	35	016SMPL
Type Z	RUN2	35	017SMPL
Type Z	RUN2	35	018SMPL
Type Z	RUN2	35	019SMPL
Type Z	RUN2	35	020SMPL
Type Z	RUN2	35	021SMPL
Type Z	RUN2	35	022SMPL
Type Z	RUN2	35	029SMPL
Type Z	RUN2	35	030SMPL
Type Z	RUN2	35	031SMPL
Type Z	RUN2	35	032SMPL
Type Z	RUN2	35	033SMPL
Type Z	RUN2	35	034SMPL
Type Z	RUN2	35	035SMPL
Type Z	RUN1	25	006SMPL
Type Z	RUN1	25	007SMPL
Type Z	RUN1	25	008SMPL
Type Z	RUN1	25	009SMPL
Type Z	RUN1	25	010SMPL
Type Z	RUN1	25	011SMPL
Type Z	RUN1	25	012SMPL
Type Z	RUN1	25	013SMPL
Type Z	RUN1	25	014SMPL
Type Z	RUN1	25	015SMPL
Type Z	RUN1	25	016SMPL
Type Z	RUN1	25	017SMPL

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	position	feature	(ppm)
Ttn2	rim	dark	3197.87
Ttn2	rim	dark	6495 5
Ttn2	core	bright	26738 61
Ttn2	core	bright	26425.26
Ttn2	core	bright	25490 92
Ttn2	core	bright	21784 52
Ttn2	core	bright	30554.8
Ttn2	core	bright	27431 51
Ttn2	rim	dark/bright	25744 34
Ttn7	rim	dark	3446 25
Ttn7	rim	dark/bright	21737 94
Ttn7	rim	dark	3654 21
Ttn7	core	bright	23372 63
Ttn7	core	bright	22746 63
Ttn7	core	bright	20533.66
Ttn7	core	bright	20091 69
Ttn7	rim	dark	7483 53
Ttn10	rim	dark	12436 62
Ttn10	core	bright	29877 02
Ttn10	core	bright	27505 22
Ttn10	core	bright	28236 41
Ttn10	core	bright	25624 22
Ttn10	core	bright	25304 42
Ttn10	core	bright	19011 8
Ttn3a	core	bright	22608 57
Ttn3a	core	bright	29196.06
Ttn3a	rim	dark	10862 15
Ttn4b	rim	dark	10308.28
Ttn4b	core	bright	11701.61
Ttn4b	core	bright	8323.18
Ttn4b	core	bright	13253.08
Ttn4b	core	bright	11846.44
Ttn5c	rim	dark	3909.82
Ttn5c	core	briaht	14385.07
Ttn5c	core	briaht	12695.78
Ttn5c	rim	dark	1835 54

1s

0.11699

0.13103

0.03807

0.03137

0.02697

0.06108

0.02964

0.04128

0.10423

0.38547

0.13205

0.07647

0.03466

0.09117

0.04319

0.04074

0.24046

0.05677

0.03020

0.02885

0.02855

0.02860

0.02976

0.03865

0.04296

0.04085

0.07308

0.06924

0.03582

0.06640

0.03729

0.16468

0.16751

0.04464

0.12344

0.20424

Data for Wetherill plot

206Pb/238U

0.04923

0.05702

0.04356

0.04243

0.04134

0.05022

0.03998

0.04367

0.05858

0.11568

0.06272

0.03950

0.03844

0.04799

0.04115

0.04326

0.08354

0.03637

0.03988

0.03903

0.03835

0.04167

0.04148

0.04034

0.03601

0.03653

0.04562

0.03650

0.04131

0.04092

0.04125

0.06471

0.05811

0.04101

0.05771

0.05803

1s

0.00163

0.00160

0.00106

0.00103 0.00100

0.00122

0.00103

0.00107

0.00148

0.00316

0.00161

0.00140

0.00110

0.00141 0.00118

0.00112

0.00259

0.00127

0.00107

0.00102

0.00102

0.00109

0.00106

0.00111

0.00104

0.00081

0.00107

0.00143

0.00087

0.00126

0.00086 0.00189

0.00212

0.00101

0.00132

0.00208

3 4			
5			
6 7			
8	²⁰⁷ Pb/ ²⁰⁶ Pb	1s	²⁰⁷ Pb/ ²³⁵ U
9 10	0.36702	0.01738	2.48979
11	0.41303	0.01564	3.24608
12	0.16405	0.00562	0.98495
13 14	0.13926	0.00473	0.81421
15	0.12032	0.00421	0.68522
16	0.23752	0.00770	1.64362
17 19	0.12358	0.00498	0.68086
18	0.17822	0.00608	1.07253
20	0.34263	0.01145	2.76385
21	0.63396	0.02176	10.10473
22 23	0.40537	0.01363	3.50418
24	0.25446	0.01447	1.38472
25	0.12966	0.00634	0.68635
26 27	0.31265	0.01329	2.06660
27	0.15558	0.00738	0.88122
29	0.16339	0.00628	0.97400
30	0.48959	0.02018	5.62497
31 22	0.19182	0.01162	0.95945
33	0.11533	0.00522	0.63294
34	0.12057	0.00500	0.64814
35	0.11643	0.00509	0.61535
36 37	0.10899	0.00466	0.62554
38	0.11982	0.00481	0.68442
39	0.14965	0.00662	0.83133
40	0.13209	0.00907	0.65590
41 42	0.16873	0.00843	0.84959
43	0.25826	0.01224	1.62456
44	0.17532	0.01482	0.88225
45 46	0.12634	0.00647	0.71960
40 47	0.19496	0.01258	1.09911
48	0.13552	0.00676	0.77073
49	0.38270	0.01985	3.41415
50 51	0.37306	0.02315	2.98868
52	0.14473	0.00824	0.81828
53	0.37604	0.01627	2.99150
54 55	0.50083	0.02876	4.00373
55 56			
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MICROSTRUCTURES (EBSI

7			
8 9	Rho	comment	observation
) 10	0.0	High-distortion	twins
11	0.0	no-distortion	twins
12	0.0	no-distortion	twins
13	0.0	no-distortion	twins
14 15	0.0	no-distortion	twins
16	0.0	low-distortion	twins
17	0.0	no-distortion	twins
18	0.0	no-distortion	twins
19 20	0.0	moderate-distortion	twine
20 21	0.0		twins
22	0.0		twins
23	0.0		twins
24	0.0	IOW-distortion	twins
25 26	0.0	no-distortion	twins
20 27	0.0	no-distortion	twins
28	0.0	no-distortion	twins
29	0.0	no-distortion	twins
30	0.0	low-distortion	twins
31	0.0	moderate-distortion	twins
32 33	0.0	no-distortion	twins
34	0.0	no-distortion	twins
35	0.0	no-distortion	twins
36	0.0	low-distortion	twins
37 38	0.0	low-distortion	twins
39	0.0	High-distortion	twins
40	0.0	High-distortion	
41	0.0	moderate-distortion	
42 43	0.0	moderate-distortion	
44	0.0	low-distortion	
45	0.0	low-distortion	
46	0.0	low-distortion	
47	0.0	low-distortion	
48 49	0.0	low-distortion	
50	0.0	moderate-distortion	
51	0.0	low-distortion	
52	0.0	no distortion	
53 54	0.0		
54 55	0.0	IOW-UISIOI IION	
56			
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5	D DATA)
7	WBV magnitude
8	microns_1
9	0.001601
10	0.001001
12	0.000100
13	0.000304
14	0.000184
15	0.000110
16 17	0.000551
17	0.000428
19	0.000045
20	0.000691
21	0.000968
22	0.000561
23 24	0.000273
25	0.000078
26	0.000512
27	0.003977
28 29	0.00017
30	0 002525
31	0.002682
32	0.006775
33	0.000770
34 35	0.004124
36	0.003040
37	0.004009
38	0.001035
39 40	0.008995
40 41	0.000608
42	0.001308
43	0.000328
44	0.036794
45 46	0.040976
40 47	0.001919
48	0.037729
49	0.000392
50	0.004823
51 52	0.001567
53	0.003892
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(microns) position Type H RUN2 35 036SMPL Tm18 core Type H RUN2 35 037SMPL Tm18 core Type H RUN2 35 037SMPL Tm18 core Type H RUN2 35 040SMPL Tm18 core Type H RUN2 35 040SMPL Tm19 rim Type H RUN2 35 041SMPL Tm19 core Type H RUN2 35 042SMPL Tm19 core Type H RUN2 35 043SMPL Tm16 rim Type H RUN2 35 051SMPL Tm16 rim Type H RUN2 35 053SMPL Tm16 core Type H RUN2 35 053SMPL Tm16 core Type H RUN2 35 055SMPL Tm24 rim Type H RUN2 35 055SMPL Tm24	Titanite type	Run name	Spot dimension	Identifier	Ttn#	Textural
Type HRUN235036SMPLThn18core $Type H$ RUN235037SMPLTin18core $Type H$ RUN235039SMPLTin18core $Type H$ RUN235040SMPLTin19rim $Type H$ RUN235041SMPLTin19core $Type H$ RUN235042SMPLTin19core $Type H$ RUN235043SMPLTin19core $Type H$ RUN235043SMPLTin19core $Type H$ RUN235050SMPLTin16core $Type H$ RUN235051SMPLTin16core $Type H$ RUN235053SMPLTin16core $Type H$ RUN235055SMPLTin16core $Type H$ RUN235055SMPLTin16core $Type H$ RUN235055SMPLTin24core $Type H$ RUN235055SMPLTin24core $Type H$ RUN23505SSMPLTin34core $Type H$ RUN23506SSMPLTin34core </th <th></th> <th></th> <th>(microns)</th> <th></th> <th></th> <th>position</th>			(microns)			position
Type HRUN235037SMPLTm18coreType HRUN235038SMPLTim18coreType HRUN235040SMPLTim18coreType HRUN235040SMPLTim19rimType HRUN235042SMPLTim19coreType HRUN235043SMPLTim19coreType HRUN235043SMPLTim19coreType HRUN235050SMPLTim16rimType HRUN235052SMPLTim16coreType HRUN235053SMPLTim16coreType HRUN235053SMPLTim16coreType HRUN235055SMPLTim16coreType HRUN235056SMPLTim24rimType HRUN235055SMPLTim24coreType HRUN235058SMPLTim24coreType HRUN235065SMPLTim34coreType HRUN235065SMPLTim34coreType HRUN235065SMPLTim34coreType HRUN235065SMPLTim34coreType HRUN235065SMPLTim34coreType HRUN235065SMPLTim34coreType HRUN235065SMPLTim34coreType HRUN235<	Туре Н	RUN2	35	036SMPL	Ttn18	core
Type H RUN2 35 038SMPL Ttn18 core Type H RUN2 35 040SMPL Ttn18 core Type H RUN2 35 040SMPL Ttn19 rim Type H RUN2 35 041SMPL Ttn19 core Type H RUN2 35 043SMPL Ttn19 core Type H RUN2 35 043SMPL Ttn19 rim Type H RUN2 35 050SMPL Ttn16 core Type H RUN2 35 051SMPL Ttn16 core Type H RUN2 35 053SMPL Ttn16 core Type H RUN2 35 055SMPL Ttn24 rim Type H RUN2 35 058SMPL Ttn24 core Type H RUN2 35 058SMPL Ttn24 core Type H RUN2 35 063SMPL Ttn34 core Type H	Туре Н	RUN2	35	037SMPL	Ttn18	core
Type H RUN2 35 039SMPL Th18 core Type H RUN2 35 040SMPL Th19 rim Type H RUN2 35 041SMPL Th19 core Type H RUN2 35 042SMPL Th19 core Type H RUN2 35 043SMPL Th16 rim Type H RUN2 35 050SMPL Th16 core Type H RUN2 35 052SMPL Th16 core Type H RUN2 35 053SMPL Th16 core Type H RUN2 35 054SMPL Th16 core Type H RUN2 35 055SMPL Th24 rim Type H RUN2 35 056SMPL Th24 core Type H RUN2 35 058SMPL Th24 core Type H RUN2 35 060SMPL Th34 core Type H	Туре Н	RUN2	35	038SMPL	Ttn18	core
Type H RUN2 35 040SMPL Thn19 rim Type H RUN2 35 041SMPL Thn19 core Type H RUN2 35 042SMPL Thn19 core Type H RUN2 35 043SMPL Thn19 rim Type H RUN2 35 050SMPL Thn16 rim Type H RUN2 35 052SMPL Thn16 core Type H RUN2 35 053SMPL Thn16 core Type H RUN2 35 055SMPL Thn16 core Type H RUN2 35 056SMPL Thn24 rim Type H RUN2 35 057SMPL Th24 core Type H RUN2 35 058SMPL Th174 core Type H RUN2 35 058SMPL Th24 core Type H RUN2 35 063SMPL Th34 core Type H	Туре Н	RUN2	35	039SMPL	Ttn18	core
Type H RUN2 35 041SMPL Ttn19 core Type H RUN2 35 042SMPL Ttn19 rim Type H RUN2 35 043SMPL Ttn19 rim Type H RUN2 35 050SMPL Ttn16 rim Type H RUN2 35 052SMPL Ttn16 core Type H RUN2 35 053SMPL Ttn16 core Type H RUN2 35 053SMPL Ttn16 core Type H RUN2 35 054SMPL Ttn16 core Type H RUN2 35 055SMPL Ttn24 core Type H RUN2 35 055SMPL Ttn24 core Type H RUN2 35 058SMPL Ttn24 core Type H RUN2 35 058SMPL Ttn34 core Type H RUN2 35 061SMPL Ttn34 core Type H	Type H	RUN2	35	040SMPL	Ttn19	rim
Type H RUN2 35 042SMPL Ttn19 core Type H RUN2 35 043SMPL Ttn19 rim Type H RUN2 35 050SMPL Ttn16 core Type H RUN2 35 051SMPL Ttn16 core Type H RUN2 35 052SMPL Ttn16 core Type H RUN2 35 053SMPL Ttn16 core Type H RUN2 35 054SMPL Ttn16 core Type H RUN2 35 055SMPL Ttn24 rim Type H RUN2 35 056SMPL Ttn24 core Type H RUN2 35 059SMPL Ttn24 core Type H RUN2 35 060SMPL Ttn34 core Type H RUN2 35 061SMPL Ttn34 core Type H RUN2 35 064SMPL Ttn34 core Type H <td>Tvpe H</td> <td>RUN2</td> <td>35</td> <td>041SMPL</td> <td>Ttn19</td> <td>core</td>	Tvpe H	RUN2	35	041SMPL	Ttn19	core
Type HRUN235043SMPLTin 19rimType HRUN235050SMPLTin 16rimType HRUN235051SMPLTin 16coreType HRUN235052SMPLTin 16coreType HRUN235053SMPLTin 16coreType HRUN235054SMPLTin 16coreType HRUN235055SMPLTin 16coreType HRUN235056SMPLTin 24rimType HRUN235056SMPLTin 24coreType HRUN235058SMPLTin 24coreType HRUN235059SMPLTin 34rimType HRUN235060SMPLTin 34rimType HRUN235063SMPLTin 34coreType HRUN235063SMPLTin 34coreType HRUN235063SMPLTin 34coreType HRUN235065SMPLTin 34coreType HRUN235066SMPLTin 34coreType HRUN125024SMPLTin 28arimType HRUN125025SMPLTin 28arimType HRUN12503SMPLTin 29acoreType HRUN12503SMPLTin 29arimType HRUN12503SMPLTin 23acoreType H	Type H	RUN2	35	042SMPL	Ttn19	core
Type H RUN2 35 OSOSMPL Th16 rim Type H RUN2 35 OSOSMPL Th16 core Type H RUN2 35 OSOSMPL Th24 core Type H RUN2 35 OSOSMPL Th34 core Type H RUN2 35 OGSSMPL Th34 core Type H RUN2 35 OGSSMPL Th34 core Type H RUN2 </td <td>Type H</td> <td>RUN2</td> <td>35</td> <td>043SMPI</td> <td>Ttn19</td> <td>rim</td>	Type H	RUN2	35	043SMPI	Ttn19	rim
Type H RUN2 35 OSISMPL Tuni6 core Type H RUN2 35 OSISMPL Tuni6 core Type H RUN2 35 OSSSMPL Tuni4 rim Type H RUN2 35 OSSSMPL Tun24 rim Type H RUN2 35 OSSSMPL Tun24 core Type H RUN2 35 OSSSMPL Tun24 core Type H RUN2 35 OSSSMPL Tun34 core Type H RUN2 35 O6SSMPL Tun34 core Type H RUN2 35 O6SSMPL Tun34 core Type H RUN2 35 O6SSMPL Tun34 core Type H <td>Type H</td> <td>RUN2</td> <td>35</td> <td>050SMPI</td> <td>Ttn16</td> <td>rim</td>	Type H	RUN2	35	050SMPI	Ttn16	rim
Type H RUN2 35 0515MPL Th16 core Type H RUN2 35 052SMPL Th16 core Type H RUN2 35 054SMPL Th16 core Type H RUN2 35 055SMPL Th16 core Type H RUN2 35 055SMPL Th124 rim Type H RUN2 35 056SMPL Th24 core Type H RUN2 35 057SMPL Th24 core Type H RUN2 35 058SMPL Th24 core Type H RUN2 35 060SMPL Th34 core Type H RUN2 35 061SMPL Th34 core Type H RUN2 35 062SMPL Th34 core Type H RUN2 35 063SMPL Th34 core Type H RUN2 35 065SMPL Th34 core Type H <	Type H	RUN2	35	051SMPI	Ttn16	core
Type H RUN2 35 0525MPL Tm16 core Type H RUN2 35 053SMPL Tm16 core Type H RUN2 35 055SMPL Tm16 core Type H RUN2 35 055SMPL Tm16 core Type H RUN2 35 056SMPL Tm24 rim Type H RUN2 35 057SMPL Tm24 core Type H RUN2 35 058SMPL Tm24 core Type H RUN2 35 059SMPL Tm24 core Type H RUN2 35 060SMPL Tm34 core Type H RUN2 35 061SMPL Tm34 core Type H RUN2 35 062SMPL Tm34 core Type H RUN2 35 063SMPL Tm34 core Type H RUN2 35 066SMPL Tm34 core Type H <t< td=""><td>Type H</td><td>RUN2</td><td>35</td><td>052SMPI</td><td>Ttn16</td><td>core</td></t<>	Type H	RUN2	35	052SMPI	Ttn16	core
Type H RUN2 35 O035MPL Tin16 Core Type H RUN2 35 054SMPL Tin16 core Type H RUN2 35 055SMPL Tin24 rim Type H RUN2 35 056SMPL Tin24 core Type H RUN2 35 057SMPL Tin24 core Type H RUN2 35 058SMPL Tin24 core Type H RUN2 35 059SMPL Tin24 core Type H RUN2 35 060SMPL Tin34 core Type H RUN2 35 061SMPL Tin34 core Type H RUN2 35 063SMPL Tin34 core Type H RUN2 35 064SMPL Tin34 core Type H RUN2 35 066SMPL Tin34 core Type H RUN2 35 066SMPL Tin34 core Type H RUN1 25 024SMPL Tin28a rim Type H	Туре П		35	0525MDI	Ttn16	core
Type H RUN2 35 034 SMPL TIn16 Core Type H RUN2 35 055SMPL Ttn24 rim Type H RUN2 35 056SMPL Ttn24 core Type H RUN2 35 057SMPL Ttn24 core Type H RUN2 35 058SMPL Ttn24 core Type H RUN2 35 059SMPL Ttn24 core Type H RUN2 35 060SMPL Ttn24 rim Type H RUN2 35 061SMPL Ttn34 core Type H RUN2 35 061SMPL Ttn34 core Type H RUN2 35 063SMPL Ttn34 core Type H RUN2 35 064SMPL Ttn34 core Type H RUN2 35 065SMPL Ttn34 core Type H RUN1 25 024SMPL Ttn28a rim Type H RUN1 25 026SMPL Ttn28a rim Type H	Туре П Тура Н		25		Ttn16	core
Type H RUN2 35 055SMPL TIn24 Inff Type H RUN2 35 057SMPL Tin24 core Type H RUN2 35 057SMPL Tin24 core Type H RUN2 35 058SMPL Tin24 core Type H RUN2 35 059SMPL Tin24 core Type H RUN2 35 060SMPL Tin34 rim Type H RUN2 35 061SMPL Tin34 core Type H RUN2 35 063SMPL Tin34 core Type H RUN2 35 063SMPL Tin34 core Type H RUN2 35 063SMPL Tin34 core Type H RUN2 35 066SMPL Tin34 core Type H RUN2 35 066SMPL Tin34 core Type H RUN1 25 024SMPL Tin34 core Type H RUN1 25 025SMPL Tin28a rim Type H	Турен	RUNZ	35			core
Type H RUN2 35 058SMPL TIn24 core Type H RUN2 35 057SMPL Tin24 core Type H RUN2 35 058SMPL Tin24 core Type H RUN2 35 059SMPL Tin24 core Type H RUN2 35 060SMPL Tin34 rim Type H RUN2 35 061SMPL Tin34 core Type H RUN2 35 062SMPL Tin34 core Type H RUN2 35 063SMPL Tin34 core Type H RUN2 35 064SMPL Tin34 core Type H RUN2 35 066SMPL Tin34 core Type H RUN2 35 066SMPL Tin34 core Type H RUN1 25 024SMPL Tin34 core Type H RUN1 25 024SMPL Tin28a core Type H RUN1 25 026SMPL Tin28a core Type H	Type H	RUNZ	35	0555MPL	The O.4	rim
Type H RUN2 35 05/SMPL Ttn24 core Type H RUN2 35 058SMPL Ttn24 core Type H RUN2 35 059SMPL Ttn24 rim Type H RUN2 35 060SMPL Ttn24 rim Type H RUN2 35 060SMPL Ttn34 rim Type H RUN2 35 061SMPL Ttn34 core Type H RUN2 35 063SMPL Ttn34 core Type H RUN2 35 063SMPL Ttn34 core Type H RUN2 35 064SMPL Ttn34 core Type H RUN2 35 066SMPL Ttn34 core Type H RUN1 25 024SMPL Ttn34 core Type H RUN1 25 025SMPL Ttn28a core Type H RUN1 25 026SMPL Ttn28a core Type H RUN1 25 027SMPL Ttn29a rim Type H	Туре Н	RUN2	35	056SMPL		core
Type H RUN2 35 058SMPL Ttn24 core Type H RUN2 35 059SMPL Ttn24 rim Type H RUN2 35 060SMPL Ttn34 rim Type H RUN2 35 061SMPL Ttn34 core Type H RUN2 35 061SMPL Ttn34 core Type H RUN2 35 062SMPL Ttn34 core Type H RUN2 35 063SMPL Ttn34 core Type H RUN2 35 064SMPL Ttn34 core Type H RUN2 35 066SMPL Ttn34 core Type H RUN1 25 024SMPL Ttn28a rim Type H RUN1 25 026SMPL Ttn28a core Type H RUN1 25 026SMPL Ttn29a rim Type H RUN1 25 027SMPL Ttn29a core Type H </td <td>Type H</td> <td>RUN2</td> <td>35</td> <td>057SMPL</td> <td>Ttn24</td> <td>core</td>	Type H	RUN2	35	057SMPL	Ttn24	core
Type H RUN2 35 059SMPL Ttn24 rim Type H RUN2 35 060SMPL Ttn34 rim Type H RUN2 35 061SMPL Ttn34 rim Type H RUN2 35 061SMPL Ttn34 core Type H RUN2 35 062SMPL Ttn34 core Type H RUN2 35 063SMPL Ttn34 core Type H RUN2 35 064SMPL Ttn34 core Type H RUN2 35 066SMPL Ttn34 core Type H RUN2 35 066SMPL Ttn34 core Type H RUN1 25 024SMPL Ttn28a rim Type H RUN1 25 026SMPL Ttn28a core Type H RUN1 25 026SMPL Ttn29a rim Type H RUN1 25 028SMPL Ttn29a rim Type H <td>Type H</td> <td>RUN2</td> <td>35</td> <td>058SMPL</td> <td>Itn24</td> <td>core</td>	Type H	RUN2	35	058SMPL	Itn24	core
Type H RUN2 35 060SMPL Ttn34 rim Type H RUN2 35 061SMPL Ttn34 core Type H RUN2 35 062SMPL Ttn34 core Type H RUN2 35 062SMPL Ttn34 core Type H RUN2 35 063SMPL Ttn34 core Type H RUN2 35 064SMPL Ttn34 core Type H RUN2 35 065SMPL Ttn34 core Type H RUN2 35 066SMPL Ttn34 core Type H RUN1 25 024SMPL Ttn28a rim Type H RUN1 25 025SMPL Ttn28a rim Type H RUN1 25 026SMPL Ttn28a rim Type H RUN1 25 027SMPL Ttn29a rim Type H RUN1 25 030SMPL Ttn29a core Type H </td <td>Туре Н</td> <td>RUN2</td> <td>35</td> <td>059SMPL</td> <td>Ttn24</td> <td>rim</td>	Туре Н	RUN2	35	059SMPL	Ttn24	rim
Type H RUN2 35 061SMPL Ttn34 core Type H RUN2 35 062SMPL Ttn34 core Type H RUN2 35 063SMPL Ttn34 core Type H RUN2 35 063SMPL Ttn34 core Type H RUN2 35 064SMPL Ttn34 core Type H RUN2 35 065SMPL Ttn34 core Type H RUN2 35 066SMPL Ttn34 core Type H RUN1 25 024SMPL Ttn28a rim Type H RUN1 25 025SMPL Ttn28a core Type H RUN1 25 026SMPL Ttn28a rim Type H RUN1 25 027SMPL Ttn29a rim Type H RUN1 25 028SMPL Ttn29a rim Type H RUN1 25 030SMPL Ttn29a rim Type H<	Туре Н	RUN2	35	060SMPL	Ttn34	rim
Type H RUN2 35 062SMPL Ttn34 core Type H RUN2 35 063SMPL Ttn34 core Type H RUN2 35 064SMPL Ttn34 core Type H RUN2 35 064SMPL Ttn34 core Type H RUN2 35 066SMPL Ttn34 core Type H RUN2 35 066SMPL Ttn34 core Type H RUN1 25 024SMPL Ttn28a rim Type H RUN1 25 025SMPL Ttn28a core Type H RUN1 25 026SMPL Ttn28a rim Type H RUN1 25 026SMPL Ttn29a core Type H RUN1 25 028SMPL Ttn29a core Type H RUN1 25 030SMPL Ttn29a core Type H RUN1 25 031SMPL Ttn23a core Typ	Туре Н	RUN2	35	061SMPL	Ttn34	core
Type H RUN2 35 063SMPL Ttn34 core Type H RUN2 35 064SMPL Ttn34 core Type H RUN2 35 065SMPL Ttn34 core Type H RUN2 35 066SMPL Ttn34 core Type H RUN1 25 024SMPL Ttn28a rim Type H RUN1 25 025SMPL Ttn28a core Type H RUN1 25 026SMPL Ttn28a core Type H RUN1 25 026SMPL Ttn28a core Type H RUN1 25 026SMPL Ttn28a rim Type H RUN1 25 027SMPL Ttn29a core Type H RUN1 25 028SMPL Ttn29a core Type H RUN1 25 030SMPL Ttn29a rim Type H RUN1 25 031SMPL Ttn23a core Ty	Туре Н	RUN2	35	062SMPL	Ttn34	core
Type H RUN2 35 064SMPL Ttn34 core Type H RUN2 35 065SMPL Ttn34 core Type H RUN2 35 066SMPL Ttn34 rim Type H RUN1 25 024SMPL Ttn28a rim Type H RUN1 25 025SMPL Ttn28a core Type H RUN1 25 026SMPL Ttn28a core Type H RUN1 25 026SMPL Ttn28a rim Type H RUN1 25 026SMPL Ttn29a rim Type H RUN1 25 027SMPL Ttn29a rim Type H RUN1 25 028SMPL Ttn29a core Type H RUN1 25 030SMPL Ttn29a rim Type H RUN1 25 031SMPL Ttn23a core Type H RUN1 25 032SMPL Ttn23a core Type	Туре Н	RUN2	35	063SMPL	Ttn34	core
Type H RUN2 35 065SMPL Ttn34 core Type H RUN2 35 066SMPL Ttn34 rim Type H RUN1 25 024SMPL Ttn28a rim Type H RUN1 25 025SMPL Ttn28a core Type H RUN1 25 026SMPL Ttn28a core Type H RUN1 25 026SMPL Ttn28a rim Type H RUN1 25 026SMPL Ttn28a rim Type H RUN1 25 026SMPL Ttn29a rim Type H RUN1 25 027SMPL Ttn29a core Type H RUN1 25 028SMPL Ttn29a core Type H RUN1 25 030SMPL Ttn29a rim Type H RUN1 25 031SMPL Ttn23a core Type H RUN1 25 032SMPL Ttn23a core Typ	Туре Н	RUN2	35	064SMPL	Ttn34	core
Type H RUN2 35 066SMPL Ttn34 rim Type H RUN1 25 024SMPL Ttn28a rim Type H RUN1 25 025SMPL Ttn28a core Type H RUN1 25 025SMPL Ttn28a core Type H RUN1 25 026SMPL Ttn28a rim Type H RUN1 25 027SMPL Ttn29a rim Type H RUN1 25 027SMPL Ttn29a core Type H RUN1 25 028SMPL Ttn29a core Type H RUN1 25 030SMPL Ttn29a core Type H RUN1 25 031SMPL Ttn29a rim Type H RUN1 25 032SMPL Ttn23a core Type H RUN1 25 033SMPL Ttn23a core Type H RUN1 25 034SMPL Ttn23a core T	Туре Н	RUN2	35	065SMPL	Ttn34	core
Type HRUN125024SMPLTtn28arimType HRUN125025SMPLTtn28acoreType HRUN125026SMPLTtn28arimType HRUN125027SMPLTtn29arimType HRUN125028SMPLTtn29acoreType HRUN125029SMPLTtn29acoreType HRUN125030SMPLTtn29acoreType HRUN125031SMPLTtn29arimType HRUN125032SMPLTtn23acoreType HRUN125033SMPLTtn23acoreType HRUN125034SMPLTtn23acoreType HRUN125035SMPLTtn23acoreType HRUN125035SMPLTtn23acoreType HRUN125035SMPLTtn23acore	Туре Н	RUN2	35	066SMPL	Ttn34	rim
Type HRUN125025SMPLTtn28acoreType HRUN125026SMPLTtn28arimType HRUN125027SMPLTtn29arimType HRUN125028SMPLTtn29acoreType HRUN125029SMPLTtn29acoreType HRUN125030SMPLTtn29acoreType HRUN125030SMPLTtn29arimType HRUN125031SMPLTtn29arimType HRUN125032SMPLTtn23acoreType HRUN125033SMPLTtn23acoreType HRUN125034SMPLTtn23acoreType HRUN125035SMPLTtn23acoreType HRUN125035SMPLTtn23acore	Type H	RUN1	25	024SMPL	Ttn28a	rim
Type HRUN125026SMPLTtn28arimType HRUN125027SMPLTtn29arimType HRUN125028SMPLTtn29acoreType HRUN125029SMPLTtn29acoreType HRUN125030SMPLTtn29arimType HRUN125031SMPLTtn29arimType HRUN125031SMPLTtn29arimType HRUN125032SMPLTtn23acoreType HRUN125033SMPLTtn23acoreType HRUN125034SMPLTtn23acoreType HRUN125035SMPLTtn23acoreType HRUN125035SMPLTtn23acore	Type H	RUN1	25	025SMPL	Ttn28a	core
Type HRUN125027SMPLTtn29arimType HRUN125028SMPLTtn29acoreType HRUN125029SMPLTtn29acoreType HRUN125030SMPLTtn29arimType HRUN125031SMPLTtn29arimType HRUN125031SMPLTtn29arimType HRUN125032SMPLTtn23acoreType HRUN125033SMPLTtn23acoreType HRUN125034SMPLTtn23acoreType HRUN125035SMPLTtn23acore	Type H	RUN1	25	026SMPL	Ttn28a	rim
Type HRUN125028SMPLTtn29acoreType HRUN125029SMPLTtn29acoreType HRUN125030SMPLTtn29arimType HRUN125031SMPLTtn29arimType HRUN125032SMPLTtn23acoreType HRUN125033SMPLTtn23acoreType HRUN125034SMPLTtn23acoreType HRUN125034SMPLTtn23acoreType HRUN125035SMPLTtn23acore	Tvpe H	RUN1	25	027SMPL	Ttn29a	rim
Type HRUN125029SMPLTtn29acoreType HRUN125030SMPLTtn29arimType HRUN125031SMPLTtn29arimType HRUN125032SMPLTtn23acoreType HRUN125033SMPLTtn23acoreType HRUN125034SMPLTtn23acoreType HRUN125034SMPLTtn23acoreType HRUN125035SMPLTtn23acore	Type H	RUN1	25	028SMPI	Ttn29a	core
Type HRUN1250100 MPLTtm20dooreType HRUN125030SMPLTtm29arimType HRUN125031SMPLTtm23acoreType HRUN125033SMPLTtm23acoreType HRUN125034SMPLTtm23acoreType HRUN125034SMPLTtm23acoreType HRUN125035SMPLTtm23acore	Type H	RUN1	25	029SMPI	Ttn29a	core
Type HRUN125000000000000000000000000000000000	Type H	RUN1	25	030SMPI	Ttn29a	rim
Type HRUN12503150MFLTth23dImmType HRUN125032SMPLTth23acoreType HRUN125033SMPLTth23acoreType HRUN125034SMPLTth23acoreType HRUN125035SMPLTth23acore	Type H	RUN1	25	031SMPI	Ttn20a	rim
Type HRUN125032SMPLTtn23acoreType HRUN125034SMPLTtn23acoreType HRUN125035SMPLTtn23acoreType HRUN125035SMPLTtn23acore	Type H		25		Ttn23a	core
Type HRUN1250335MPLTth23acoreType HRUN125034SMPLTth23acoreType HRUN125035SMPLTth23acore	Type II		25	0320101FL	Tto220	
Type H RUN1 25 0345MPL Ttn23a core	туре п Тура Ц		20		Tto220	
iypen kuni 25 U35SMPL itn23a core	туре п		20 05		1 UIZ38	core
	туре Н	RUNT	25	UJJSNIPL	110238	core

3			
4	Zoning		
5	footuro	(nnm)	207ph/206ph
0 7	leature	(ppiii)	
8	nomogeneous	4650.51	0.07710
9	homogeneous	4271.46	0.08845
10	homogeneous	3910.71	0.08008
11	homogeneous	4455.07	0.06956
12	homogeneous	1413.26	0.06427
13	homogeneous	1657.19	0.06396
15	homogeneous	1352.36	0.06357
16	homogeneous	2038.4	0.06780
17	homogeneous	1434.58	0.11737
18	homogeneous	2353.54	0.10728
20	homogeneous	2719.76	0.13312
21	homogeneous	2503.05	0 65903
22	homogeneous	2299 72	0.07996
23	homogeneous	2511 15	0.07000
24 25	homogeneous	3840.43	0.10012
25	homogonoouo	2410.49	0.00109
27	homogeneous	34 19.40	0.11300
28	nomogeneous	2703.82	0.10311
29	nomogeneous	1804.08	0.16289
30	homogeneous	1354.86	0.12216
32	homogeneous	1328.53	0.14322
33	homogeneous	2307.89	0.07771
34	homogeneous	2340.5	0.07569
35	homogeneous	1199.14	0.17902
36 27	homogeneous	889.28	0.13878
38	homogeneous	1761.97	0.09290
39	homogeneous	2590.68	0.08005
40	homogeneous	2139.4	0.06272
41	homogeneous	2074.09	0.08920
42	homogeneous	2405.85	0.14563
43	homogeneous	2126.65	0.14093
45	homogeneous	1978.32	0 06546
46	homogeneous	1788.8	0 12784
47	homogeneous	1374.85	0.12704
48 40	homogeneous	3153 15	0.51000
49 50	homogonacus	100.10 1700 0E	0.01090
51	homogonacus	4700.00	0.01004
52	nomogeneous	3487.29 2001 20	0.35077
53	nomogeneous	3261.63	0.36099

1s

0.00095

0.00093

0.00101

0.00112

0.00092

0.00104

0.00093

0.00102

0.00156

0.00102

0.00111

0.00327

0.00091

0.00112

0.00110

0.00107

0.00110

0.00117

0.00088

0.00124

0.00090

0.00089

0.00136

0.00117

0.00088

0.00085

0.00074

0.00082

0.00095

0.00095

0.00076

0.00078

0.00106

0.00432

0.00203

0.00298

0.00216

Rho 0.0

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2				
3			Data for	r Wetherill plot
4 5				
6	1s	²⁰⁷ Pb/ ²³⁵ U	1s	²⁰⁶ Pb/ ²³⁸ U
7	0.00362	0.38483	0.01908	0.03625
8	0.00407	0.42914	0.02090	0.03522
9 10	0.00381	0.42173	0.02109	0.03823
11	0.00469	0.35066	0.02383	0.03673
12	0.00258	0.32956	0.01449	0.03723
13	0.00418	0.30597	0.02033	0.03473
14	0.00278	0.32239	0.01518	0.03685
16	0.00299	0.37695	0.01783	0.04035
17	0.01086	0.58735	0.05243	0.03642
18 10	0.00578	0.51514	0.02839	0.03492
20	0.00673	0.70210	0.03643	0.03830
21	0.02084	11.99885	0.43972	0.13217
22	0.00384	0.37695	0.01905	0.03424
23 24	0.00554	0.55206	0.03040	0.03890
25	0.00394	0.46117	0.02347	0.04112
26	0.00502	0.62255	0.02928	0.04000
27	0.00527	0.55128	0.02914	0.03889
28 29	0.00830	0.86936	0.04511	0.03879
30	0.00605	0.52715	0.02696	0.03132
31	0.00908	0.71958	0.04505	0.03644
32	0.00328	0.38075	0.01733	0.03556
34	0.00332	0.36238	0.01703	0.03475
35	0.01134	0.94792	0.05869	0.03840
36	0.00891	0.66056	0.04185	0.03460
37 38	0.00464	0.41142	0.02137	0.03213
39	0.00509	0.41294	0.02556	0.03742
40	0.00392	0.31128	0.01914	0.03600
41	0.00518	0.46753	0.02650	0.03802
42 43	0.00850	0.75805	0.04244	0.03776
44	0.00794	0.76378	0.04159	0.03929
45	0.00432	0.30748	0.01989	0.03407
46 47	0.00767	0.55730	0.03217	0.03162
47	0.01129	0.77932	0.05042	0.03434
49	0.04888	4.67814	0.38143	0.06638
50	0.02370	2.06074	0.14010	0.04768
51	0.03076	2.70288	0.20754	0.05595
53	0.02906	2.25146	0.15935	0.04523
54				
55 56				
50 57				

- 58
- 59 60

MICROS	STRUCTURES (EBSD DA	AIA)
		WBV magnitude
comment	observation	microns-1
no-distortion	twins	0.000461
moderate-distortion	twins	0.001064
low-distortion	twins	0.000675
moderate-distortion	twins	0.002613
moderate-distortion	twins	0.000989
low-distortion	twins	0.00063
low-distortion	twins	0.000449
moderate-distortion	twins	0.014736
moderate-distortion	deformation bands	0.000445
moderate-distortion	deformation bands	0.000245
low-distortion	deformation bands	0.000573
moderate-distortion	deformation bands	0.001216
High-distortion	deformation bands	0.002981
moderate-distortion	twins	0.000252
low-distortion	twins	0.000508
moderate-distortion	twins	0.000419
low-distortion	twins	0.000129
High-distortion	twins	0.000388
moderate-distortion	twins-2set	0.001027
moderate-distortion	twins-2set	0.000208
moderate-distortion	twins-2set	0.002913
moderate-distortion	twins-2set	0.001198
moderate-distortion	twins-2set	0.000337
moderate-distortion	twins-2set	0.003467
moderate-distortion	twins-2set	0.008543
n.a.		
High-distortion	twins	0.003463
moderate-distortion	twins	0.001542
moderate-distortion	twins	0.001954
moderate-distortion	twins	0.001441

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2		1	2	2	٨
4					
5					
6		35 microns	35 microns	35 microns	35 microns
7		Itn2	Itn2	Itn2	Itn2
8 0	spot name	A1	A2	A3	A4
10	identifier	006SMPL	007SMPL	008SMPL	009SMPL
11	zoning				
12	Spot position	rim	rim	core	core
13	zoning	dark	dark	bright	bright
14	EBDS data	ligh-distortio	no-distortion	no-distortion	no-distortion
16					
17	AI27	9234.4	10133.03	10446.28	10538.22
18	P31	354.61	488.44	516.88	587.63
19	Ca44	238080.28	222387.02	221840.47	220033.95
20	Ti49	285773.06	307488 38	278869 44	281372 25
22	V51	980 67	1373 54	1194 76	1234 54
23	Mn55	847 07	1069 17	826.3	764 17
24	Fe57	3131 64	3792 56	4136 78	3771 6
25	V80	1151 76	1737 70	2660.08	2632 16
20 27	7 r00	101.70	250.85	974 59	2032.10 969 5
28		1206 24	1914 55	1420 G	1270.20
29		64.24	1014.00	1429.0	2750.29
30	La139	04.31	107.10		2750.15
31	Ce140	605.08	15/1.8	11/40.50	11958.27
32 33	Pr141	187.01	406.19	1660.65	1665.87
34	Nd146	1537.33	2860.3	8319.14	/888.15
35	Sm149	804.14	1470.03	2361.38	2162.82
36	Eu151	104.26	147.93	130.5	126.06
3/	Gd157	679.6	1138.07	1551.55	1369.83
30 39	Tb159	95.42	147.75	194.43	176.79
40	Dy163	380.74	611.85	823.82	748.28
41	Ho165	48.31	80.54	121.69	112.92
42	Er167	95.61	151.16	249.09	249.33
43 44	Tm169	10.87	16.15	29.03	30.7
45	Yb173	61.74	83.84	153.93	170.24
46	Lu175	5.43	6.71	15.21	18.42
47	Hf177	18.76	28.75	53.95	51.56
48	Pb208	6.3	16.77	28.04	27.92
49 50	Th232	15.69	47.77	946.12	982.72
51	U238	88.06	139.39	390.08	391.8
52		0.18	0.34	2.43	2.51
53	Al/Fe	2.95	2.67	2.53	2.79
54 55	LREE=(La-Sm)	3197.87	6495.50	26738.61	26425.26
56	Zr/Y	0.17	0.14	0.37	0.37
57	Y/(Dv/Yh)	186.77	238.12	497.03	598.84
58	Dv/Yb Normalizzati	6.17	7.30	5.35	4_40
59 60	HRFF	1377 72	2236.07	3138 75	2876 51
00	T°C.	741 32	755 91	835.69	835 36
		1 7 1.04	100.01	000.00	000.00

3	5	6	7	8	9	10
4	RUN2	RUN2	RUN2	RUN2	RUN2	RUN1
5	35 microns	35 microns	35 microns	35 microns	35 microns	25 microns
6 7	Ttn2	Ttn2	Ttn2	Ttn2	Ttn2	Ttn3
8	Δ5	Δ6	Δ7	Δ <u>8</u>	Δ9	Δ1
9		0119MDI	0129MDI	0139MDI		
10	0103WIFL		UTZOWIP L			
11						
12	core					
14	bright	bright	bright	bright	dark/bright	bright
15	no-distortion	low-distortion	no-distortion	no-distortion	derate-distor	ign-distortio
16			44000.00		0700.04	
17	10211.05	11316.55	11633.38	11028.02	9766.91	11487.42
10 19	791.23	585.37	681.62	511.48	495.32	847.54
20	222006.75	213626.17	220451.06	207278.98	213091	236926.94
21	298257.72	295914.28	300791.75	279367.66	269298.16	250366.7
22	1125.91	1132.49	1248.54	1161.05	1228.61	993.84
23 24	800.8	903.73	884.81	787.19	801.67	733.19
24	3976.06	4200.83	4282.25	4477.2	3978.56	3409.04
26	2683.62	2580.27	2787.58	2628.84	2548.7	2423.76
27	1040.44	973.66	1002.32	990.01	932.02	893
28	1387.89	1319.45	1698.66	1490.74	1532.22	1754.02
29 30	2815.67	2687.12	3031.96	2729.99	2621.41	2088.08
31	11893.46	10351.87	13756.15	12033.09	11240.46	9342.72
32	1554.85	1299.43	1791.11	1722.62	1614.2	1419.51
33	7314	5910.3	9398.74	8552.03	8094.71	7456.37
34 25	1912.94	1535.8	2576.84	2393.78	2173.56	2301.89
35 36	125 27	116 46	145 1	135 12	130.6	113 18
37	1246.57	1035 91	1651 54	1584 74	1452 63	1502.96
38	165.09	143 29	206.82	191 91	179 25	186 95
39	720 50	657.7	821.27	816.22	773 10	760.00
40 41	115.05	104 58	122 1.27	117.8/	114 27	106.47
41	254.09	104.00	122.13	254 10	114.27	225.29
43	204.00	230.20	203.04	204.19	202.04	220.20
44	31.79 104 E4	30.72	29.40	20.33	29.13	23.39
45	184.94	CO. 161	102.51	160.27	155.45	127.98
46 47	19.71	20.89	16.81	17.25	16.86	13.76
48	51	39.17	60.36	53.55	52.48	49.69
49	26.73	38.51	29	29.95	40.57	16.83
50	982.17	889.18	1058.73	942.27	919.71	666.09
51 52	425.48	452.02	410.3	393.78	381.74	275.85
52 53	2.31	1.97	2.58	2.39	2.41	2.41
54	2.57	2.69	2.72	2.46	2.45	3.37
55	25490.92	21784.52	30554.80	27431.51	25744.34	22608.57
56	0.39	0.38	0.36	0.38	0.37	0.37
57 58	678.79	736.18	551.60	516.19	512.42	402.87
59	3.95	3.50	5.05	5.09	4.97	6.02
60	2747.32	2417.02	3264.43	3170.75	2953.12	2956.94
	839.85	835.63	837.47	836.69	832.87	830.18

3	11	12	13	14	15	16
4	RUN1	RUN1	RUN1	RUN1	RUN1	RUN1
5	25 microns	25 microns	25 microns	25 microns	25 microns	25 microns
7	Ttn3	Ttn3	Ttn4	Ttn4	Ttn4	Ttn4
8	A2	A3	B1	B2	B 3	B4
9	007SMPL	008SMPL	009SMPL	010SMPL	011SMPL	012SMPL
10 11						
12	core	rim	rim	core	core	core
13	bright	dark	dark	bright	bright	bright
14	Jerate-distor	derate-distor	ow-distortio	ow-distortion	ow-distortion	ow-distortion
15 16						
17	12086.68	9749.03	11212.75	12456.6	10992.92	10398.16
18	1024.84	<681.25	<489.14	<657.97	829.47	1046.01
19	261188.91	266499	288121.19	254615.08	251573.42	239842.44
20 21	277219.97	251568.91	290089.94	241944.48	239923.58	236940.22
22	1113.18	1178.31	1437.36	1618.39	1432.77	1324.4
23	762.46	818.31	793.1	1591.25	1445.1	1317.07
24 25	4123.41	2986.74	3274.01	3057.7	3033.65	3158.69
25 26	2701.97	1725.89	1434.15	1891.53	1603.72	1783.33
27	1031.52	392.51	453.41	456.27	416.16	514.89
28	1920.2	2327.95	1140.69	259.92	530.18	661.97
29	2643.57	504.64	953.81	1115.83	657.01	1320.74
31	11942.26	3066.13	3547.98	4170.53	2748.76	4849.36
32	1880.04	766.58	703.42	770.01	555.7	876.67
33	9861.63	4795.94	3820.47	4298.73	3211.58	4706.34
34	2868.56	1728.86	1282.6	1346.51	1150.13	1499.97
35 36	136.29	134.18	170.53	155.2	168.45	154.15
37	1959.86	1286.51	955.05	983.88	888.74	1035.78
38	221.3	150.07	113.51	125.77	110.31	122.63
39 40	913.37	581.4	445.03	526.28	449.2	509.52
41	127.01	77.78	62.12	78.89	66.59	74.03
42	262.9	148.65	120.35	177.07	138.68	162.49
43	25.56	16.4	14.69	21.87	18.38	19.39
44 45	133.78	87.9	75.61	138.46	109.01	122.2
46	14.37	8.83	9.4	16.69	12.86	13.24
47	62.97	37.01	38.82	47	32.16	40.65
48	24.1	10.5	5.46	5.36	7.8	5.84
49 50	878.66	104.47	99.01	94.59	42.33	109.68
51	331.47	152.03	168.36	183.68	167.81	200.22
52	2.65	0.69	0.59	0.51	0.25	0.55
53 54	2.93	3.26	3.42	4.07	3.62	3.29
55	29196.06	10862.15	10308.28	11701.61	8323.18	13253.08
56	0.38	0.23	0.32	0.24	0.26	0.29
57	395.75	260.93	243.66	497.65	389.18	427.70
со 59	6.83	6.61	5.89	3.80	4.12	4.17
60	3658.15	2357.54	1795.76	2068.91	1793.77	2059.28
	839.30	780.93	789.25	789.62	784.29	796.70

17	18	19	20	21	22
RUN1	RUN1	RUN1	RUN1	RUN1	RUN2
25 microne	25 microns	25 microns	25 microns	25 microns	35 micror
Ttn4	Ttn5	Ttn5	Ttn5	Ttn5	Ttn7
B5	C1	C2	C3	C4	Δ1
013SMPI	014SMPI	015SMPI	016SMPI	017SMPI	015SMP
core	rim	core	core	rim	rim
bright	dark	bright	bright	dark	dark
ow-distortic	prow-distortio	row-distortio	row-distortio	derate-distor	High-distor
0040 70	10000 70	10001 11	40040.04	07457	44074.04
9912.72	13299.73	12201.41	10843.64	9745.7	11974.8
1028.68	<434.80	694.59	<445.94	428.71	614.07
249244.73	261036.31	259246.09	231807.3	279687.31	255547.3
248076.61	252343.72	258294.3	235937.45	250364.23	310932.0
1430.23	1480.58	1192.27	1104.42	2222.51	1516.56
962.47	828.28	677.12	634.8	776.46	865.81
3169.9	4037.24	3540.34	3413.48	3790.1	3775.79
1510.02	1032.16	2013.35	1778.94	1177.68	1217.41
450.67	379.67	1549.17	1381.62	224.26	337.49
717.86	1030.94	980.71	974.32	716.22	1289.96
1163.07	283.06	2418.39	2060.79	66.01	156.56
4175.55	1293.23	6564.04	5628.66	452.78	958.78
794.52	265.21	839.02	760.11	121.07	225.73
4355.12	1525.75	3679.5	3443.01	790.3	1495.94
1358.18	542.57	884.12	803.21	405.38	609.24
172.79	112.53	104.89	96.87	87.77	133.99
988.69	444.17	655	616.97	383.06	520.23
114.57	59.89	92.86	83.68	56.09	72.68
470.7	274.3	497.15	424.84	283.36	330.8
67.13	42.79	81.46	73.86	47.53	48.97
134 87	89 78	202.98	173.93	102 76	104 41
15 87	10.69	25.24	22.39	13.7	11 54
90.85	56	161 29	132.26	68 78	67.28
10.20	5 97	18 44	15 01	6 78	7 09
40.91	28 34	59 38	62.6	20.53	34 51
21 01	0.31	16.64	26.81	20.00 8 16	30.24
109.83	10/ 17	721 26	622 83	12 22	59.24 59.37
168.67	03.46	106 7	160 56	67.47	122.15
0.65	1 12	3.67	3.67	01.47	0.40
2 12	1.12 2.20	3.07 3 / F	3.07 3.12	9 57	2 17
J. 13 11976 77	3.23 3000 93	J.40 1/285 07	J. 10 12605 70	2.07 1825 57	3.11 2116 75
1 1040.44 0 20	3909.02 0 27	14303.07	12033.70 0 70	1033.34 0 40	3440.20 0 20
0.30 204 4E	0.37	U.11 652 40	U./O	U. 13 205 00	U.20
291.40 E 40	210.72	2 003.13	000.01 2 04	20J.00 1 1 2	247.00
J.10	4.30	J.UO	J.2 1		4.92
1092.97	903.59 770.00	1/34.42	1542.94	902.UO	770.00
788.90	119.03	865.84	858.25	749.84	//2.36

23	24	25	26	27	28
RUN2	RUN2	RUN2	RUN2	RUN2	RUN2
35 microns	35 micron				
Ttn7	Ttn7	Ttn7	Ttn7	Ttn7	Ttn7
A2	A3	A4	A5	A6	A7
016SMPL	017SMPL	018SMPL	019SMPL	020SMPL	021SMPL
rim/core	rim	core	core	core	core
dark/bright	dark	bright	bright	bright	bright
igh-distortio	ow-distortion	no-distortion	no-distortion	no-distortior	no-distorti
12394.9	10262.87	12130.84	12405.19	11389.96	11300.41
772.42	490.3	764.09	576.72	733.78	752.13
222377.94	222820.59	238947.05	222711.91	207998.19	212146.1
293319.06	318812.69	311782.28	310296.5	269722.31	277068.8
1196.03	1521.07	1306.79	1220.57	1062.42	1096.44
674.99	742.45	716.55	697.48	633.98	674.88
4468.28	3011.14	4304.83	3847.16	3883.03	3761.11
1763.38	918.86	2065.62	1919.64	1957.5	1868.59
1223.29	344.6	1407.26	1260.83	1236.26	1166.94
2165.09	1279.7	1454.27	1692.83	1233.6	1657.88
3110.28	201.74	3389.26	3212.28	2900.29	2989.08
10326.42	1030.26	11033.68	10924.53	9838.46	9418.46
1238.44	235.06	1352.91	1304.22	1166.45	1161.16
5768.95	1542.88	6141.06	5960.54	5411.5	5296.12
1293.85	644.27	1455.72	1345.06	1216.96	1226.87
113.2	147.61	122.93	119.26	110.2	104.26
905.28	535.69	1008.44	951.74	856.87	866.18
113.28	68.92	127.8	121.67	116.09	114.4
506.21	279.94	567.55	535.71	544.49	519.18
78.07	38.35	94.72	87.4	88.69	85.24
161.45	68.3	199.26	173.47	184.89	175.32
16.3	8.09	20.88	19.67	20.32	19.83
78.42	41.88	109.18	94.08	108.22	100.95
7.22	4.11	10.23	9.42	10.39	9.68
73.52	37.49	70.97	73.22	67.85	70.33
49.2	7 13	30.56	42.86	29.86	26.6
1160	52.2	1359.85	1212.89	1157.93	996.76
271 37	141 34	357 89	328 53	313 53	279 63
4.27	0.37	3.80	3.69	3.69	3.56
2.77	3.41	2.82	3.22	2.93	3.00
21737.94	3654.21	23372.63	22746.63	20533.66	20091.6
0.69	0.38	0.68	0.66	0.63	0.62
273 18	137 46	397 36	337 12	389.06	363.33
6.46	6.68	5.20	5.69	5.03	5.14
1866 23	1045 28	2138.06	1993 16	1929 96	1890 78
850 28	773 53	859 46	852 24	850.96	847 22
000.20	110.00	000.40	004.47	000.00	UT1.44

2						
3	29	30	31	32	33	34
4	RUN2	RUN2	RUN2	RUN2	RUN2	RUN2
6	35 microns	35 microns	35 microns	35 microns	35 microns	35 microns
7	Ttn7	Ttn10	Ttn10	Ttn10	Ttn10	Ttn10
8	A 8	A1	A2	A3	A4	A5
9	022SMPL	029SMPL	030SMPL	031SMPL	032SMPL	033SMPL
10						
12	rim	rim	core	core	core	core
13	dark	dark	bright	bright	bright	bright
14 15	ow-distortio	derate-distor	no-distortion	no-distortion	no-distortion	ow-distortio
16						
17	12327.72	11880.15	11998	11766.89	11937.18	11687.51
18	583.5	930.79	1355.04	1177.26	1183.48	1350.91
19 20	234709.58	212950.55	203445.27	208881.03	220107.33	207994.69
20	300795.72	270572.59	265847.69	250140.59	262082.88	247918.17
22	1163.08	1453.93	1147.28	1078.71	1092.4	996.77
23	717.39	739.05	782.94	767.43	736.49	855.74
24	2938.28	2823.9	4108.63	3938.36	3762.28	3963.38
26	771.52	2614.92	2802.11	2669.56	2741.91	2515.18
27	438.74	375.76	1008.51	999.46	983.25	1067.69
28	1123.13	2422.93	2697.33	2173.37	2224.73	1853.45
29	776.56	325.23	2711.98	2509.83	2491.63	2563.68
31	2762.92	2873.51	12428.1	11260	11689.17	10888.01
32	498.68	848.53	1918.79	1764.88	1810	1607.27
33	2642.17	5915.98	9995.77	9286.98	9507.15	8260.78
34 35	803.2	2473.37	2822.38	2683.53	2738.46	2304.48
36	154.51	124.38	121.89	117.37	121.53	106.16
37	520.8	1733.22	1868.25	1711.39	1805.83	1542.31
38	61.26	206.91	216.34	202.64	210.48	181.17
39	257.62	801.15	799.69	797.29	822.54	734.86
41	34.22	113.48	114.94	116.86	119.44	105.46
42	56.51	223.41	241.28	241.64	242.57	224.22
43	6.08	24.82	28.29	28.78	29.32	27.27
44 45	33.5	137.35	157.16	163.48	166.9	156.47
46	3.1	13.36	17.7	18.1	18.31	18.09
47	37.74	40.58	61.45	59.99	54.82	55.2
48	27.23	5.87	20.99	21.19	18.31	20.86
49 50	125.22	119.19	899.41	875.97	770.87	828.32
51	148.56	150.43	349.26	330.85	344.47	348.13
52	0.84	0.79	2.58	2.65	2.24	2.38
53	4.20	4.21	2.92	2.99	3.17	2.95
54 55	7483.53	12436.62	29877.02	27505.22	28236.41	25624.22
56	0.57	0.14	0.36	0.37	0.36	0.42
57	100.33	448.30	550.69	547.38	556.36	535.54
58 50	7.69	5.83	5.09	4.88	4.93	4.70
60	973.09	3253.70	3443.65	3280.18	3415.39	2989.85
-	787.34	778.44	837.86	837.29	836.25	841.50

(

3	35	36				
4	RUN2	RUN2				
5	35 microns	35 microns				
7	Ttn10	Ttn10				
8	A6	A7				
9	034SMPI	035SMPI				
10						
11 12	core	core				
13	bright	bright	Bright	inner dom	aine	Dark
14	ow-distortion	diah_distortio	n		unio	Dark
15		ingri-distortio	Δνοτασο	St dov	RSD	Average
16 17	11705 67	113/3 05	11305 1	828 6	7.3%	10082 0
18	1222 77	1103 52	840.6	281.0	23.2%	555.8
19	205771.05	21/260.07	225207 6	17579.2	7 90/	2/2122 0
20	200771.00	214300.97	223207.0	22521.6	7.0/0 9.10/	240103.9
21	240755.09	203741.09	200909.2	22321.0	0.4 %	203074.1
22	992.07	700.60	042.0	144.3	12.2%	1432.0
24	010.72	729.01	043.0 2025 0	235.0	27.9%	019.7
25	3838.11	3963.12	3635.6	408.4	10.0%	3330.1
26	2421.27	2418.68	2293.3	414.0	18.1%	1378.2
27 28	951.34	/45./2	983.6	282.8	28.7%	338.9
29	2310.25	1941.37	1513.5	578.0	38.2%	1445.2
30	2330.94	1569.73	2413.2	687.1	28.5%	351.9
31	10379.98	/183.12	9593.0	2981.8	31.1%	1816.2
32 33	1611.42	1207.72	1369.0	394.4	28.8%	425.7
34	8528.79	6866.51	6874.4	2085.9	30.3%	2692.7
35	2453.29	2184.72	1897.4	633.5	33.4%	1076.4
36	106.01	105.52	125.6	19.7	15.7%	131.8
3/	1576.3	1548.96	1282.2	385.8	30.1%	819.6
39	181.51	183.08	157.9	41.7	26.4%	103.3
40	705.25	717.61	665.0	145.5	21.9%	424.6
41	104.37	104.48	100.0	18.8	18.8%	59.4
42	223.67	214.81	211.9	38.2	18.0%	116.1
43 44	26.34	24.9	24.9	4.8	19.1%	13.3
45	156.83	140.38	139.9	29.5	21.1%	71.4
46	18.26	15.88	15.2	3.6	23.9%	7.1
47	50.14	47.76	55.4	10.7	19.2%	32.3
48 49	17.6	13.42	25.1	11.0	44.0%	13.6
50	632.96	486.86	787.7	351.8	44.7%	74.0
51	334.44	242.59	311.9	85.7	27.5%	127.1
52	1.89	2.01	2.4	1.1	43.0%	0.6
53 54	3.07	2.85	3.0	0.4	12.7%	3.3
55	25304.42	19011.80	22146.9	6283.0	28.4%	6363.0
56	0.39	0.31	0.4	0.2	36.3%	0.3
57	538.43	473.15	488.0	113.6	23.3%	236.0
58 50	4.50	5.11	4.8	0.9	18.3%	6.0
60	2992.53	2950.10	2597.0	639.0	24.6%	1614.8
	834,16	818.99	833.5	21.1	2.5%	770.8

14			
15	01.1		
16	St.dev.	R.S.D.	
17	1348.6	12%	
18	187.2	34%	
19	25768.4	10%	
20 21	26197 3	9%	
21	331.1	23%	
23	100 /	10%	
24	100.4	1 Z /0	
25	445.9	13%	
26	537.4	39%	
27	89.3	26%	
28	561.9	39%	
29	302.5	86%	
30 31	1134 7	62%	
32	264.5	62%	
33	204.0	02 /0 600/	
34	1072.8	02%	
35	655.2	61%	
36	25.1	19%	
37	445.1	54%	
38	50.6	49%	
39 40	183.8	43%	
40 41	24.6	41%	
42	19 A	470/	
43	40.4	42 /0 200/	
44	5.2	39%	
45	28.8	40%	
46	2.9	41%	
47	7.8	24%	
48	11.2	82%	
49 50	41.8	57%	
51	33.2	26%	
52	03	55%	
53	0.5	170/	
54	0.5	17%	
55	3/46.8	59%	
56	0.1	48%	
5/	94.0	40%	
50 59	1.1	19%	
60	780.1	48%	
	16.3	2%	

	Geological Magazine						
	RUN2	RUN2	RUN2	RUN2			
	35 microns	35 microns	35 microns	35 micron			
	Ttn16	Ttn16	Ttn16	Ttn16			
spot name	A1	A2	A3	A4			
identifier	050SMPL	051SMPL	052SMPL	053SMPL			
zoning							
Spot position	rim	core	core	core			
zoning	dark	bright	bright	bright			
EBDS data	derate-distor	derate-distor	ow-distortion	derate-dist			
AI27	11954.2	13668.06	11358.77	13654.32			
P31	343.4	<234.95	346.66	<228.89			
Ca44	215954.19	208734.53	192974.23	192856.88			
Ti49	245509	223439.22	215476.64	205249.34			
V51	871.88	1096.45	1268.86	1112.81			
Mn55	399.55	458	364.47	565.96			
Fe57	3201.13	7526.35	3079.11	11306.66			
Y89	477.69	675.76	943.24	824.54			
Zr90	308.2	803.91	523.5	482.31			
Nb93	615.15	639.77	592.95	575.06			
La139	91.07	227.31	241.02	223.5			
Ce140	448.27	906.16	987.63	894.25			
Pr141	94.7	154.51	188.29	169.72			
Nd146	595.59	824.15	1003.61	945.63			
Sm149	204.95	241.41	299.21	269.95			
Eu151	50.76	48.36	56.49	53.55			
Gd157	182.76	203.21	248.87	230.26			
Tb159	27.23	32.07	39.89	35.27			
Dy163	129.62	166.43	220.5	195.76			
Ho165	19.07	27.5	40.78	35.44			
Er167	38.94	62.1	99.09	81.51			
Tm169	4.19	8.57	12.72	10.26			
Yb173	22.43	43.54	73.01	61.99			
Lu175	2.24	4.8	7.25	6.26			
Hf177	22.81	42.18	34.77	31.8			
Pb208	1.85	6.58	2.64	64.26			
Th232	16.35	257.05	22.27	24.92			
U238	123	194.76	170.02	174.89			
	0.13	1.32	0.13	0.14			
Al/Fe	3.73	1.82	3.69	1.21			
LREE=(La-Sm)	1434.58	2353.54	2719.76	2503.05			
Zr/Y	0.65	1.19	0.56	0.58			
Y/(Dy/Yb)	82.66	176.79	312.32	261.10			
Dy/Yb Normalizzati	5.78	3.82	3.02	3.16			
HREE	426.48	548.22	742.11	656.75			
	767 27	823.63	797 68	792 86			

3	RUN2	RUN2	RUN2	RUN2	RUN2	RUN2
4	35 microns	35 microns	35 microns	35 microns	35 microns	35 microns
5	Ttn16	Ttn18	Ttn18	Ttn18	Ttn18	Ttn19
7	Α5	A1	A2	A3	Α4	A1
8	054SMPI	036SMPI	037SMPI	038SMPI	039SMPI	040SMPI
9						
10	core	core	core	core	core	rim
11 12	bright					
12	ligh distortio	no distortion	dorato distor	low distortion	dorato distori	dorato distort
14	iigii-uistortio					
15	14249 00	15020.01	14170 60	14140 00	14201 04	14601 66
16	14340.09	<020.01	14172.00	14140.02	750 4	F20 40
17	277.03	<230.1U	407.51	273.00	107000 44	539.49
19	211801.44	225120.88	203790.89	216064.53	197908.14	202106.44
20	216074.34	227391.58	214479.3	215277.02	221071.3	213581.41
21	1093.45	1330.77	1085.45	1088.01	1105.79	884.28
22	417.22	402.57	412.75	466.5	409.13	405.14
25 24	2329.73	2600.09	3104.73	3352.57	2625.22	2663.02
25	773	1330.85	1282.78	1248.63	1273.1	683.47
26	2837.63	2623.61	2489.64	2155.51	2257.24	2932.38
27	582.93	800.66	812.3	716.26	790.62	754.98
28 20	262.75	688.75	607.29	547.13	654.96	166.65
30	930.89	2031.72	1846.52	1706.25	1956.45	552.5
31	153.23	295.92	270.91	250.37	284.07	96.75
32	757.54	1327.75	1253.02	1135.59	1257.84	460
33	195.31	306.37	293.72	271.37	301.75	137.36
34 35	38.21	53.14	49.27	48.7	51.24	32.83
36	165.1	272.86	255.75	243.76	255.44	124.5
37	28.5	44.45	45.79	41.5	44.3	23.19
38	162.47	267.88	251.67	249.46	252.98	140.58
39 40	32.33	51.87	52.25	49.66	49.47	26.6
41	78.25	136.25	134.77	132.85	130.09	66.37
42	11.44	18.77	18.92	18.39	18.25	9.33
43	66 42	118 65	115 91	121 1	115.8	57 59
44 45	7 37	14 52	13 73	13 69	13.4	6 29
45 46	97 7	78.94	77.08	69.25	63.98	119 45
47	12 15	13 77	12.31	10.92	13 27	12.32
48	608.26	675.04	568 1	469.93	612 61	563 17
49	288 37	283 92	284 52	264 14	272.48	553 44
50 51	200.07	200.02	204.52	1 78	272.40	1 02
52	6.16	5 78	2.00	1.70	5 11	5.48
53	2200 72	4650 51	4.50	4.22	J.44 4455 07	1/12 26
54	2299.12	4050.51	4271.40	1 72	4455.07	1413.20
55 56	3.07	1.97	1.94	1.73		4.29
57	310.01	209.40			JOZ./J	219.99
58	2.45	2.20	2.17	2.00	2.18 070 70	2.44
59	551.88	925.25	888.79	8/0.41	8/9./3	454.45
60	907.78	902.18	898.46	888.36	891.57	910.15

3	RUN2	RUN2	RUN2	RUN1	RUN1	RUN1
4	35 microns	35 microns	35 microns	25 microns	25 microns	25 microns
5	Ttn19	Ttn19	Ttn19	Ttn23	Ttn23	Ttn23
6 7	Δ2	Δ3	Δ4	Δ1	Δ2	Δ3
8	041SMPL	042SMPL	043SMPL	032SMPL	033SMPL	034SMPL
9		•				
10 11	core	core	rim	rim	core	core
12	nomogeneou	າomogeneou	nomogeneou	weakly zoned	weakly zoned	weakly zoned
13	ow-distortio	ow-distortion	derate-distor	ligh-distortio	derate-distor	derate-distor
14 15				-		
15	16222.86	16581.17	12952.1	10702	10486.46	9561.1
17	260.04	379.34	<233.29	<367.34	587.87	<366.22
18	234574.63	208134.5	203796.03	186216.5	194251.72	192231.91
19	255583.77	231072.66	218408.8	207840.75	203469.61	210087.3
20 21	1029.54	955.53	1006.6	339.36	390.63	377.41
22	474.41	453.56	421.24	610.22	621.11	667.42
23	3172 86	3006.2	3170 5	2120 5	2375 17	2062 04
24	698.3	565.92	674 28	153 94	330.46	124 97
25	2479 97	1986 45	2654 48	473 37	284 09	310.63
20	820.82	778.08	862.47	863.43	856.85	576.48
28	100 12	161.6	221.63	266.83	3324	408.05
29	685.05	538.67	784 07	1028.23	1552.4	1440.38
30	110 14	20.07	140.00	210.20	226.99	227.07
31	F11 09	09.0	140.09	210.20	320.00	237.07
33	511.00	434.72	004.71	1203.07	1956.54	1130.13
34	160.8	127.77	207.9	382.14	013.84	205.00
35	37.7	32.97	40.47	33.75	97.3	52.04
36	143.9	110.11	1/3.29	209.58	375.58	134.97
37 38	24.18	20.91	29.65	20.16	37.39	11.84
39	139.41	118.26	162.57	65.64	127.29	41.69
40	27.1	22.26	27.83	6.27	14.3	4.53
41	66	58.97	67.33	10.67	20.07	7.9
42	9.05	7.72	8.62	1.15	1.94	0.83
44	56.33	48.98	49.64	7.97	9.16	4.44
45	6.25	5.52	5.12	0.71	0.76	0.402
46	92.25	75	119.01	16.62	15.28	10.96
47	13.62	12.41	9.63	3.19	3.78	4.38
48 49	600.65	556.67	410.84	35.88	63.93	83.3
50	628.31	607.87	379.11	21.3	45.57	26.86
51	0.96	0.92	1.08	1.68	1.40	3.10
52	5.11	5.52	4.09	5.05	4.42	4.64
53 54	1657.19	1352.36	2038.40	3153.15	4783.85	3487.29
55	3.55	3.51	3.94	3.08	0.86	2.49
56	282.16	234.39	205.89	18.69	23.78	13.31
57	2.47	2.41	3.27	8.24	13.90	9.39
58	472.22	392.73	524.05	322.15	586.49	206.60
60	898.18	882.71	903.01	791.76	762.75	767.71

RUN1	RUN2	RUN2	RUN2	RUN2	RUN2
25 microns	35 microns	35 microns	35 microns	35 microns	35 microns
Ttn23	Ttn24	Ttn24	Ttn24	Ttn24	Ttn24
A4	A1	A2	A3	A4	A5
035SMPL	055SMPL	056SMPL	057SMPL	058SMPL	059SMPL
core	rim	core	core	core	rim
weakly zoned	dark	bright	bright	bright	dark
derate-distor	derate-distor	low-distortior	derate-distor	ow-distortion	ligh-distortio
					-
8287.3	12116.3	13771.71	14134.35	12621.64	10228.78
<328.62	409.15	305.64	227.07	468.26	489.25
177352.11	204825.25	198003.06	195890.73	195638.36	188386.97
189886.75	214982.72	204510.63	194742.8	206921.28	203590.83
355.34	1267.24	1331.82	986.81	1386.58	1271.78
532.53	434.78	331.21	338.14	341.31	366.99
1612.73	3496.35	2649.22	3607.76	2576.85	2560.06
239.1	870.08	858.48	885.76	890.12	782.69
208.77	558.66	3312.09	1562.02	915.66	416.64
632.04	616.64	632.86	621.89	619.69	615.76
278.64	237.77	539.04	494.44	292.08	130.26
1120.19	949.51	1675.73	1492.78	1098.36	622.98
226.9	172.48	244.34	213.24	183.86	123
1245.93	904.41	1131.12	983.88	942.92	706.1
389.97	246.98	250.2	235.14	246.6	221.74
64.59	51.58	40.2	40.78	51.3	49.46
230.97	203.6	203.34	191.59	208.41	190.41
24	34.08	32.71	31.46	34.31	30.97
84.22	194.93	191.82	182.15	191.86	170.17
9.88	36.9	35.74	36	36.45	32.23
14.16	87.55	89.74	93	90.47	82.2
1.73	12.04	12.82	12.75	12.69	10.68
10.42	80.79	81.96	79.67	81.61	69.13
0.86	9.42	9.43	9.29	9.76	8.24
9.52	34 39	109 11	43 97	42 21	28 53
3 49	2 35	15 39	13 38	6.2	3 27
47.2	40 18	634 36	524 85	210.25	25 57
34 96	151 58	219 45	213.08	173.5	143 14
1 35	0 27	2 89	2 46	1 21	0.18
5 14	3 47	5 20	3.92	4 90	4 00
3261 63	2511 15	3840 43	3419 48	2763 82	1804 08
0.87	0.64	3 86	1 76	1 0.3	0.53
29 58	360 61	366 81	387 42	378 62	317.96
8 08	2 41	2 34	2 29	2 35	2 46
376 24	659 31	657 56	635.91	665 56	594 03
745.99	801.53	919.00	866.40	831.75	784.36

3	RUN1	RUN1	RUN1	RUN1	RUN1	RUN1
4	25 microns	25 microns	25 microns	25 microns	25 microns	25 microns
5	Ttn28	Ttn28	Ttn28	Ttn29	Ttn29	Ttn29
7	A1	A2	A3	A1	A2	A3
8 9	024SMPL	025SMPL	026SMPL	027SMPL	028SMPL	029SMPL
10 11	rim	core	core	rim	core	core
12	nomogeneous	nomogeneous	nomogeneou	nomogeneous	nomogeneous	nomogeneous
13	no data	no data	no data	no data	no data	no data
14 15						
15	10285.69	14085.95	12480.23	10379	14669.15	13466.6
17	<456.15	835.12	<494.06	<437.92	<452.91	<458.11
18	212951.98	195954.97	199574.59	199470.48	193914.63	183948.61
19	210816.44	186702.38	193836.67	206611.25	184442.63	182048.3
20 21	1332.61	1248.66	1193.21	1226.57	1142.78	1102.33
22	432.53	397.89	455.28	422.11	432.12	389.68
23	2314.01	2387.94	2630.69	2564.76	3806.86	1985.37
24	978.64	773.09	766.36	905.2	747.65	744.87
25 26	621.54	2692.93	2477.83	575.29	2385.45	2216.84
27	623.5	586.16	620.92	644.68	681.63	616.62
28	237.85	235.21	223.06	223.09	245.67	220.58
29	978 44	852 29	809 71	875.9	835 19	776.34
30 31	179 99	139.87	144 43	166	143 74	134
32	920.07	722.95	701.82	883 55	708.34	670.87
33	274 33	180 08	195.07	257 31	103 71	176 53
34	51 83	31.8	34 31	50.04	34.2	33.05
35	2/2/8	165.02	175 63	23/ 0/	150.61	167 30
30 37	242.40	27.81	20.87	254.54	27.1	27 00
38	217.83	165.28	171 30	207.07	162.48	157 50
39	217.00	34 30	30.78	207.57	31.85	31 13
40	40.05	34.39 84.04	30.70 80.56	40 87 36	78.06	77 30
41	12 52	11 07	11 01	11 26	10.00	10.21
43	12.00	11.07	64.22	71.30	64.24	10.21
44	7 22	7 /	7 20	7 7 22	6.64	604
45	1.22	7. 4 05.72	1.29	7.23	64.2	0.94
40	37.0Z	90.72	91.13	39.1	10	71.10
48	2.49	10.27	12.14	7.03		14.11
49	54.58	813.37	442.29	75.98	671.98	714.29
50	230.31	340.15	264.66	247.58	335.31	313.22
51	0.24	2.39	1.67	0.31	2.00	2.28
52	4.44	5.90	4.74	4.05	3.85	6.78
54	2590.68	2139.40	2074.09	2405.85	2126.65	1978.32
55	0.64	3.48	3.23	0.64	3.19	2.98
56 57	301.55	337.71	287.60	310.12	295.60	317.20
58	3.24538141	2.28919668	2.66	2.92	2.53	2.35
59	724.23	567.21	570.85	695.55	540.85	544.85
60	807.91	904.04	898.12	803.28	895.44	890.31

DUNA		DUNO	DUN2	DUN2	DUN2
25 miorono	25 miorono	25 miorono	RUNZ	25 miorono	RUNZ 25 miorono
25 microns	25 microns	JO INICIONS	35 microns	35 microns	35 microns
10129	1 (1129	10134	10134	10134	10134
				AJ	
0305MPL	USISMPL	0603MPL	UGISIMPL	0625IMPL	0635MPL
rim	rim	rim	core	core	core
no data	no data	derate_distor	Herate-distor	Herate-distor	Herate-distort
no data	no data				
9599.48	11193.62	10518.52	10700.17	10881.15	10548.73
418 98	663 76	509 86	338 25	524 43	413.06
206881.3	233587.34	196380.11	201322.75	197558.09	198558.03
213262 11	246335 63	216838 8	210206 5	198326 89	200104 69
1109.99	990.86	1113.82	1130	1137.52	1156.37
433 36	466 29	410.97	415 87	409 35	404 79
2946 13	2752 39	2747 89	2177 22	2023 11	2027 56
851.05	1183 81	786 32	745 39	713 5	714 56
1229 22	204 72	255.01	286 75	528.3	529.28
749 39	865.86	656 86	655 42	638 17	644 07
145.69	52.49	86.16	93.63	241.16	245.93
626 21	335 44	401 25	413 62	893.9	900.05
122.92	82.86	89.97	88.35	155.58	159.6
680.07	618.54	568.25	533.93	796.5	805.96
213 91	285 52	209 23	199	220 75	228.96
45.96	69.63	47.49	43.17	41.87	41.32
205.31	288.17	199.1	185.85	189.54	187.72
34.03	45.65	35.05	32.36	31.73	30.9
185.82	273.39	197.19	184.16	174.37	172.22
36.44	51.82	35.22	32.72	32.5	31.88
82.44	113.07	79.27	70.43	70.37	70.89
10.97	15.79	9.23	9.04	9.04	8.79
66.82	82.52	50.18	47.79	49.47	47.28
6.24	5.92	4.88	4.61	4.96	4.98
44.86	16.74	19.02	20.85	35.1	35.03
6.84	3.76	2.29	1.45	7.71	7.76
235.46	12.66	18.45	8.21	363.07	352.34
272.13	185.83	174.8	89.19	303.69	308.99
0.87	0.07	0.11	0.09	1.20	1.14
3.26	4.07	3.83	4.91	5.38	5.20
1788.80	1374.85	1354.86	1328.53	2307.89	2340.50
1.44	0.17	0.32	0.38	0.74	0.74
306.03	357.32	200.10	193.43	202.42	196.17
2.78	3.31	3.93	3.85	3.52	3.64
628.07	876.33	610.12	566.96	561.98	554.66
850.59	744.95	756.81	763.26	798.22	798.32

3	RUN2	RUN2	RUN2				
4	35 microns	35 microns	35 microns				
5	Ttn34	Ttn34	Ttn34				
0 7	A5	A 6	Α7				
8	064SMPI	065SMPI	066SMPI				
9							
10	core	core	rim				
11 12	lomodeneou	nonogeneou	nomodeneous	Inn	Inner domains		
13	derate_distor	Horato-distor	derate-distortion				
14							
15	10486 93	10324 72	8722 66	12798 5	2161 1	17%	
16 17	350.87	10524.72	135 71	127 90.0	170 0	10%	
18	200428 5	103050 47	101167 77	200388 3	12073.8	4070 6%	
19	200420.3	202676 22	102726 11	200300.3	16210.2	0 /0 90/	
20	2007 17.73	200070.22	096 15	200231.0	276 1	0 /0	
21	1109.97	990.01 296.64	900.10	1031.0	270.1	20%	
22 23	411.0	300.04	301.97	430.4	02.0	19%	
24	2133.32	2072.13	2299.76	3129.3	2043.7	00%	
25	710.25	045.53	955.29	780.2	295.8	38%	
26	279.42	227.93	262.24	1474.3	1061.1	12%	
27 28	673.85	650.48	697.51	6/2./	86.1	13%	
29	83.77	50.16	113.93	311.5	178.2	57%	
30	374.4	249.71	544.06	1078.7	502.2	47%	
31	79.47	58.79	117.86	180.1	72.1	40%	
32	480.95	371.29	709.45	905.7	354.9	39%	
33 34	180.55	159.33	276.67	248.5	96.1	39%	
35	39.87	37.47	55.97	46.2	13.6	30%	
36	172.3	156.93	252.51	201.4	55.1	27%	
37	30.28	28.58	43.25	31.8	7.8	24%	
38	175.87	158.83	238.38	174.6	51.3	29%	
40	30.63	27.88	41.35	32.4	11.7	36%	
41	69.31	61.9	93.48	78.3	33.5	43%	
42	8.87	7.83	11.43	10.5	4.8	46%	
43	47.23	39.47	59.33	63.5	31.9	50%	
44	4.61	3.86	5.83	7.0	3.9	56%	
46	21.96	17.17	21.91	53.9	30.7	57%	
47	1.14	1.39	1.92	11.6	12.2	105%	
48	2.56	5.7	29.3	373.3	274.5	74%	
49 50	56.42	76.75	217.47	238.8	151.8	64%	
51	0.05	0.07	0.13	1.5	0.9	61%	
52	4 92	4 98	3 79	4 7	12	25%	
53	1199 14	889 28	1761.97	2724 5	1125 1	41%	
54 55	0.39	0 35	0.27	1 9	120.1	66%	
56	100 74	160 42	237 76	202 2	168.0	57%	
57	2 72	4 02	<u>4</u> 02	200.0	2 8	74%	
58	520 10	7.02	7/5 56	5.1 500 5	2.0 167 2	20/_ 200/_	
59	761 00	400.20 750 74	750 24	044 E	61 0	Z070 70/	
υu	101.03	100.11	100.04	0 4 1.J	01.2	1 70	

14%

21%

6%

7%

26%

14%

15%

34%

107%

14%

43%

35%

31%

29%

25%

20%

20%

23%

30%

36%

36%

39%

39%

42%

84%

72%

144%

60%

103%

15%

29%

108%

43%

46%

25%

7%

perien

3 4 5 6 7 8 9 10 11 Outer domains 12 13 14 15 11104.5 1589.9 16 476.2 98.2 17 18 203752.0 12932.6 19 215959.5 15501.2 20 1033.4 267.2 21 22 432.1 61.9 23 2736.4 409.1 24 775.2 263.8 25 874.3 938.1 26 27 713.9 102.6 28 164.5 71.4 29 678.9 238.0 30 41.0 133.1 31 32 749.7 214.8 33 243.2 60.1 34 48.3 9.8 35 42.2 208.9 36 37 33.2 7.6 38 54.3 182.0 39 32.9 11.8 40 75.5 27.4 41 42 9.8 3.9 43 57.1 22.3 44 5.8 2.4 45 46 43.4 36.6 47 4.7 3.4 48 126.5 181.7 49 225.0 135.7 50 51 0.5 0.5 52 4.1 0.6 53 1969.3 580.4 54 1.4 1.5 55 56 248.2 106.5 57 3.7 1.7 58 605.0 153.9 59 806.7 54.7 60
Grain	Size (µm²)	Position
Mnz2a	8000	in foliation
Mnz6a	74000	in foliation
Mnz6b	84000	in foliation
Mnz6c	22000	in foliation
Mnz7b	21000	in sillimanite
Mnz7a	21000	In garnet
Mnz8a	4000	in foliation
Mnz8b	14000	in foliation
Mnz8c	5000	in foliation
Mnz6a	9000	in foliation
Mnz6b	4000	in foliation
Mnz4a	7000	in foliation
Mnz1a	11000	in foliation
Mnz9	6000	contact with garnet
Mnz1	3000	contact with garnet
Mnz2	4000	in foliation
Mnz8	5000	in garnet
Mnz6	8000	in garnet
Mnz7	7000	in foliation
Mnz10	7000	in foliation
Mnz5	3000	in strain shadow
Mnz10	12000	in foliation
Mnz11	11000	in foliation
Mnz15	3000	in foliation
Mnz6	3000	in foliation
Mnz7	17000	in strain shadow
Mnz14	76000	contact with garnet
Mnz5	3000	contact with garnet
Mnz9	7000	in foliation
Mnz8	3000	in foliation
Mnz6	2000	in foliation
Mnz12	6000	in foliation
Mnz4	13000	in foliation
Mnz15	13000	in foliation
Mnz11	4000	in foliation
Mnz10	6000	in foliation

Table S6 - Monazite textural features for the studied sam

2
3
4
5
6

Litology	Fabric	Sample
Bt-rich paragneiss	Protomylonitic	VSDO-13A1
Bt-rich paragneiss	Protomylonitic	VSDO-13A2
Bt-rich paragneiss	Protomylonitic	VSDO-13A2
Bt-rich paragneiss	Protomylonitic	VSDO-13A2
Bt-poor paragneiss	Protomylonitic	VSDO-13B1
paragneiss	Mylonitic	VSDO-13M1
paragneiss	Mylonitic	VSDO-13M2
paragneiss	Mylonitic	VSDO-13M4



270x236mm (300 x 300 DPI)



- 58 59
- 60



201x176mm (300 x 300 DPI)

Calc-silicates



192x281mm (300 x 300 DPI)









173x155mm (300 x 300 DPI)



175x289mm (300 x 300 DPI)



201x166mm (300 x 300 DPI)



203x248mm (300 x 300 DPI)

Ttn.

'TTN7_bis

100µm

TTN10

• 50µm

TTN18 & 19

F

Ø

FTN 11

100µm

500µm

Zrc

Cp





186x271mm (300 x 300 DPI)







207x244mm (300 x 300 DPI)





120x241mm (300 x 300 DPI)



- 46 47 48
- 49 50 51
- 52 53
- 55
- 55
- 56 57
- 58
- 59 60

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A) ,	Prograde and peak mineral assemblages (Grt+Sil+Fsp+Qz±Bt)	Mylonitic and retrogra (Bt+Chl; gar	de mineral assemblages net breakdown)	
Mnz generation	MNZ I	MNZ II	MNZ III	
 Protomylonites 	MNZ I	Y-rich domains	Silimante	
Mylonites	Gamet	MNZ IIa MNZ IIb	Gamet	
Zoning, internal features	patchy zoned large low Y cores	Y-rich high-Y inner rims domains and low Y edges/tips	highly fractured or with interconnected micro-pore	
Textural features	among grains partially or totally enclosed within porphyroclasts	among grains	among grains partially enclosed within porphyroclasts	
U–Th–Pb	© 314-250 Ma	● 222±8 Ma ● 238±8 Ma	O 202±8 - 184±6 Ma	
Period	Carboniferous - Permian	Triassic	Jurassic	
B) Prograde and peak mineral assemblages (Cal+Cpx+Amp+Fsp±Grt±Aln)		Mylonitic and retrograde mineral assemblages (±Czo±Chl)		
TTN generation	TTN I ?	TTN II ?	TTN III	
Zoning, internal features	stage2 Type "Z" TTN (Cal-poor layers)	Deformation twins development	Weak depletion of LREE at the tips. Bending of the twins ocalization of dislocations a tips; pores and fracturing	

179x284mm (300 x 300 DPI)

🔵 240±5 Ma

Triassic

🔵 186±6 Ma

Jurassic

No U–Pb record

Carboniferous - Early Permian

U–Pb

Period





149x201mm (300 x 300 DPI)



149x284mm (300 x 300 DPI)



198x273mm (300 x 300 DPI)







198x273mm (300 x 300 DPI)



159x260mm (300 x 300 DPI)

Ce

9.00

7.88

6.75

TTN30







189x218mm (300 x 300 DPI)