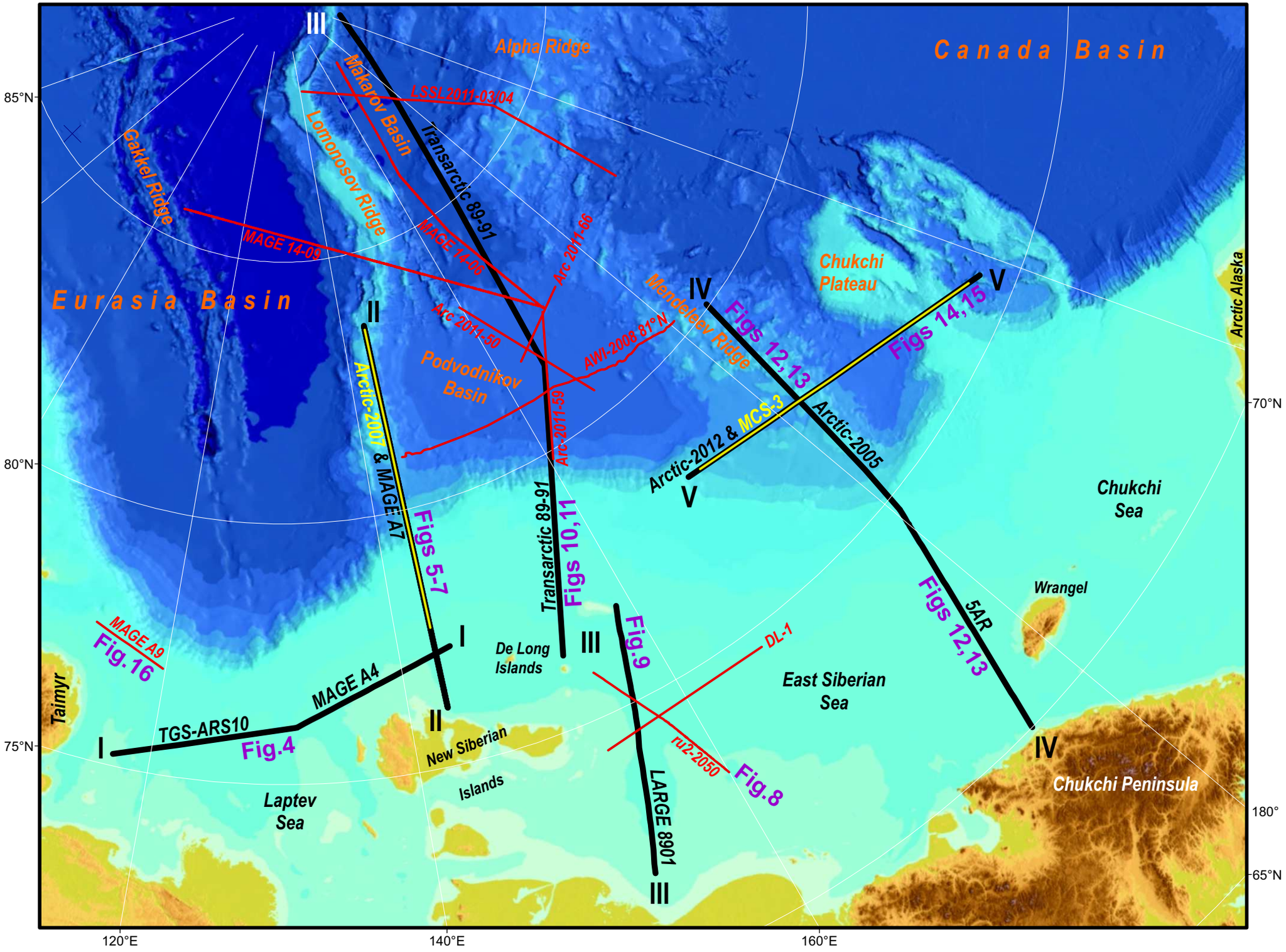
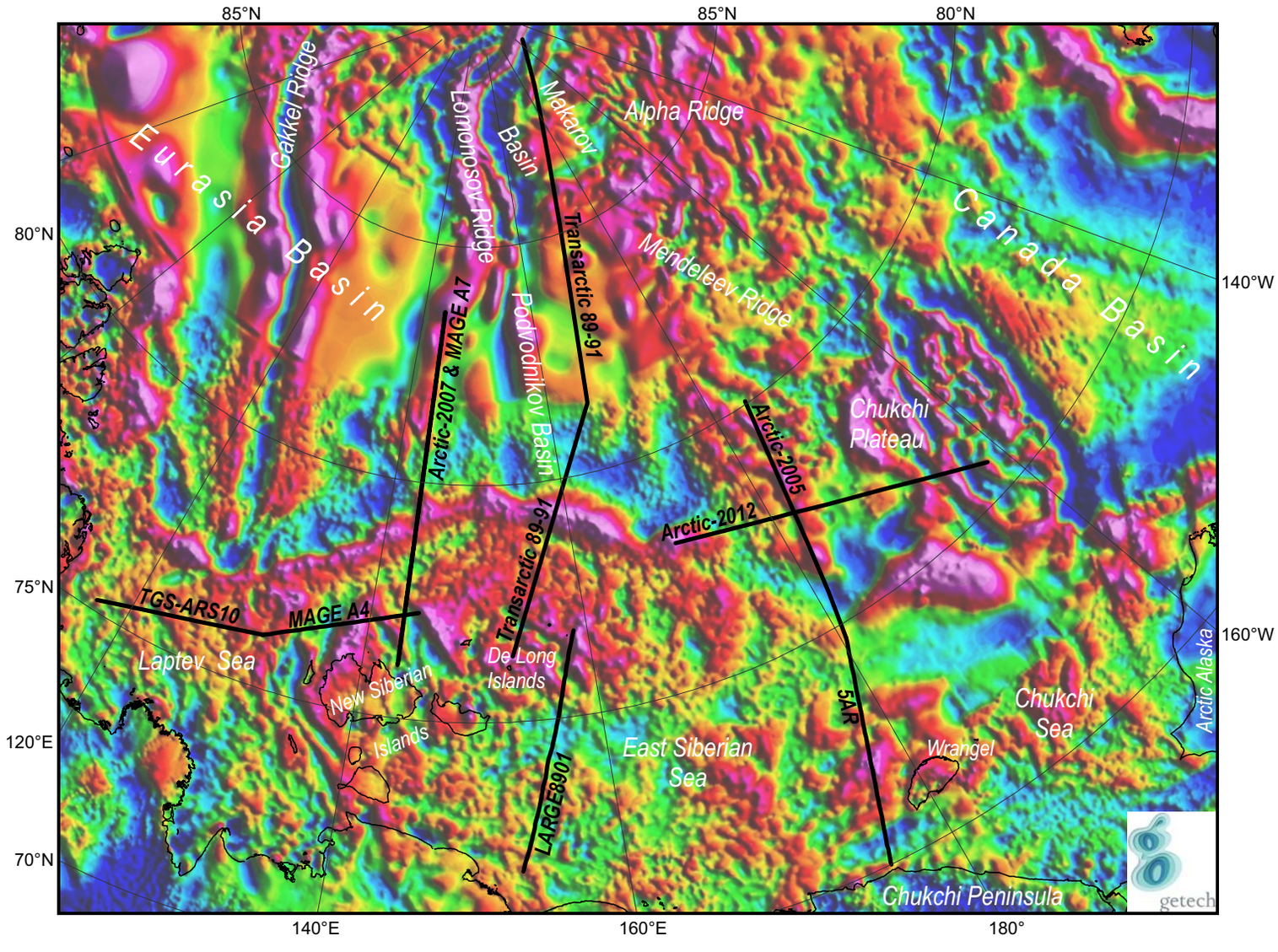
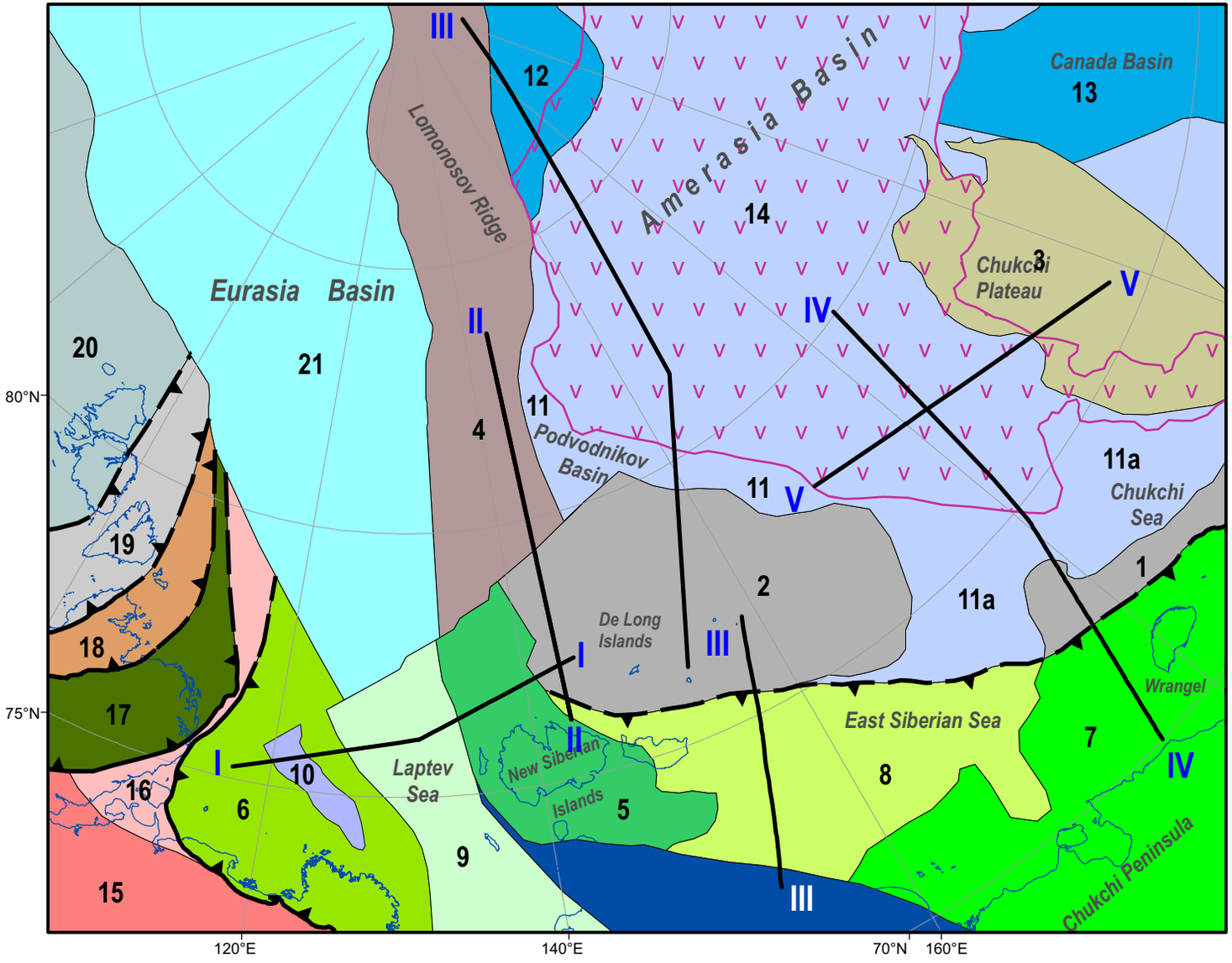

Canada Basin
Eurasia Basin
Alpha Ridge
Makarov Basin
Lomonosov Ridge
Gakkel Ridge
Podvodnikov Basin
Mendeleev Ridge
Chukchi Plateau
Chukchi Sea
East Siberian Sea
Laptev Sea
New Siberian Islands
De Long Islands
Wrangel
Chukchi Peninsula
Arctic Alaska
Taimyr
Transarctic 89-91
LSSL 2011-03/04
MAGE 14-09
MAGE 14-08
Arc 2011-60
Arc 2011-50
Arc-2011-59
AWI-2008 81°N
Arctic-2007 & MAGE A7
Arctic-2012 & MCS-3
Arctic-2005
5AR
TGS-ARS10
MAGE A4
MAGE A9
LARGE 8901
DL-1
ru2-2050
Figs 5-7
Figs 10,11
Figs 12,13
Figs 14,15
Fig.4
Fig.8
Fig.9
Fig.16
I
II
III
IV
V
85°N
80°N
75°N
70°N
65°N
120°E
140°E
160°E
180°


85°N
85°N
80°N
80°N
140°W
75°N
160°W
120°E
70°N
140°E
160°E
180°
Eurasia Basin
Gakkel Ridge
Lomonosov Ridge
Makarov Basin
Alpha Ridge
Canada Basin
Mendeleev Ridge
Podvodnikov Basin
Chukchi Plateau
Arctic-2007 & MAGE A7
Transarctic 89-91
Arctic-2005
Arctic-2012
TGS-ARS10
MAGE A4
Transarctic 89-91
Laptev Sea
New Siberian Islands
De Long Islands
LARGE8901
East Siberian Sea
5AR
Chukchi Sea
Wrangel
Arctic Alaska
Chukchi Peninsula
getech



1&2 North Wrangel (1) and De Long (2) blocks: inferred fragments of Neoproterozoic fold belt

3 Chukchi Borderland: inferred fragment of Arctic mid-PZ fold belt

4 Lomonosov Ridge (incl. its margins): fragments of Neoproterozoic, Late Pz and Mz fold belts

5 New Siberian block: inferred Kotel'nyi cratonic terrane

6 North Verkhoyansk Late Mz Fold Belt developed over Paleo-Siberian margin

7 Chukotka-Wrangel Fold Belt developed over Arctic Alaska – Chukotka Microcontinent

8 Novaya Sibir' Fold Belt developed over hyperextended North Chukchi Basin

9 Kular-Nera-Polousnyi Turbidite Belt developed over distal Paleo-Siberian continental margin

10 West Laptev zone of hyperextension (includ. exhumed mantle)

11 Amerasia Basin margins underlain by hyperextended continental crust and/or exhumed mantle (11a, North Chukchi Basin)

12&13 Makarov (12) and Canada (13) oceanic basins

V14V Alpha-Mendeleev Large Igneous Province (HALIP)

Neoproterozoic and early Paleozoic continental blocks not affected by Late Mesozoic compressional deformation

Blocks of Precambrian continental crust involved in Late Mesozoic compressional deformation

Continental crust of Late Mesozoic fold belts developed over distal passive continental margins and hyperextended rift basins

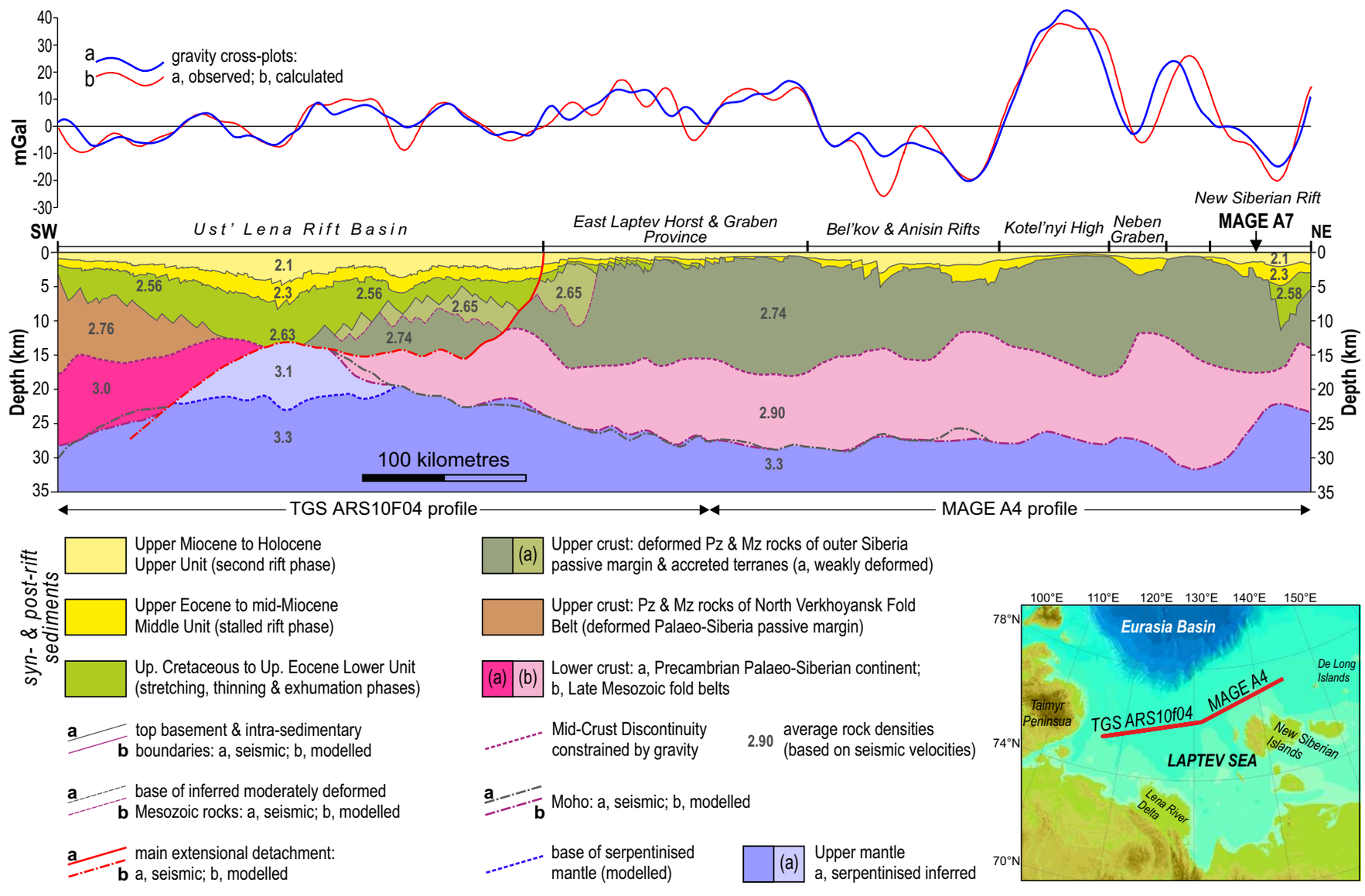
Exhumed serpentinised upper mantle and/or lower continental crust

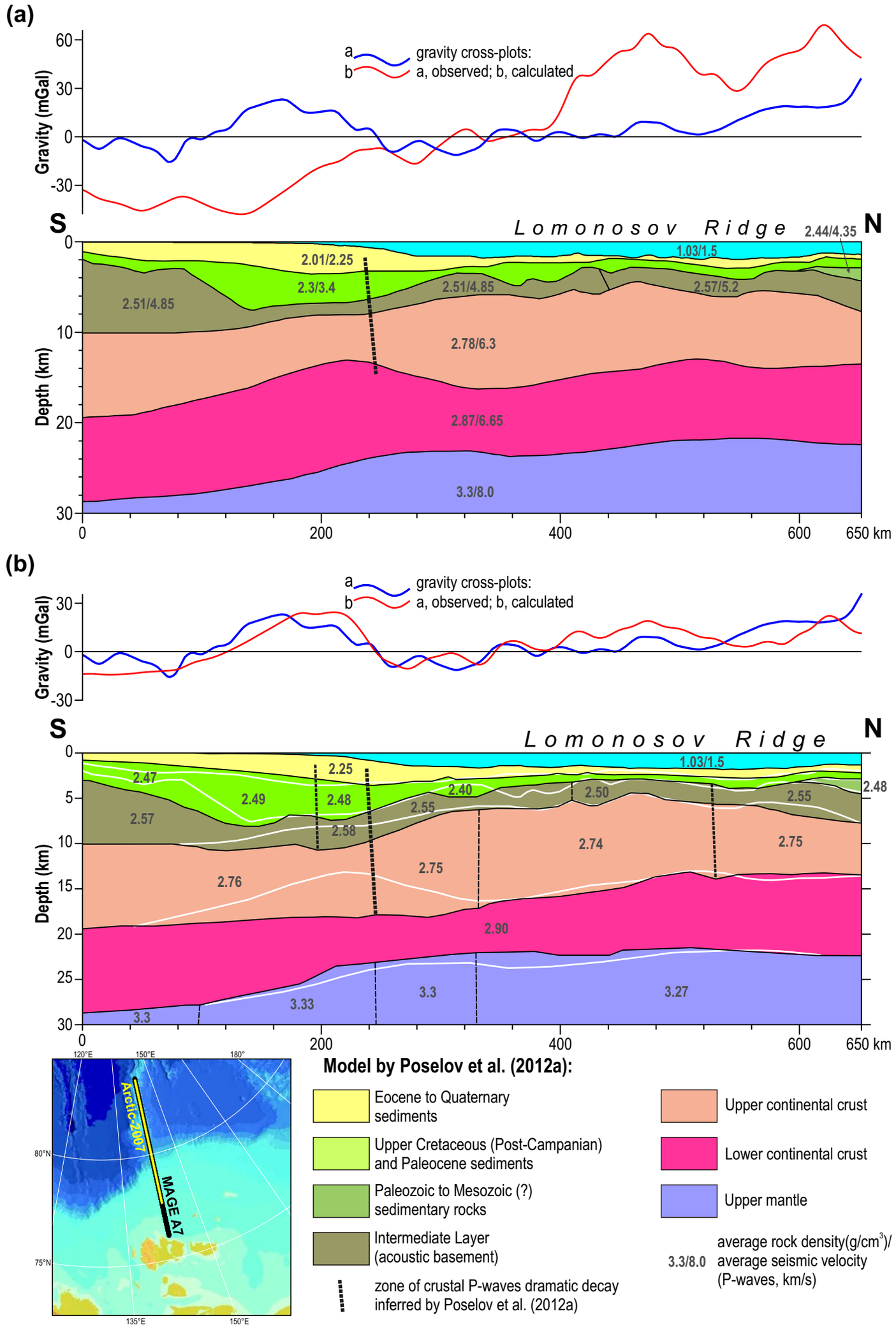
Oceanic crust

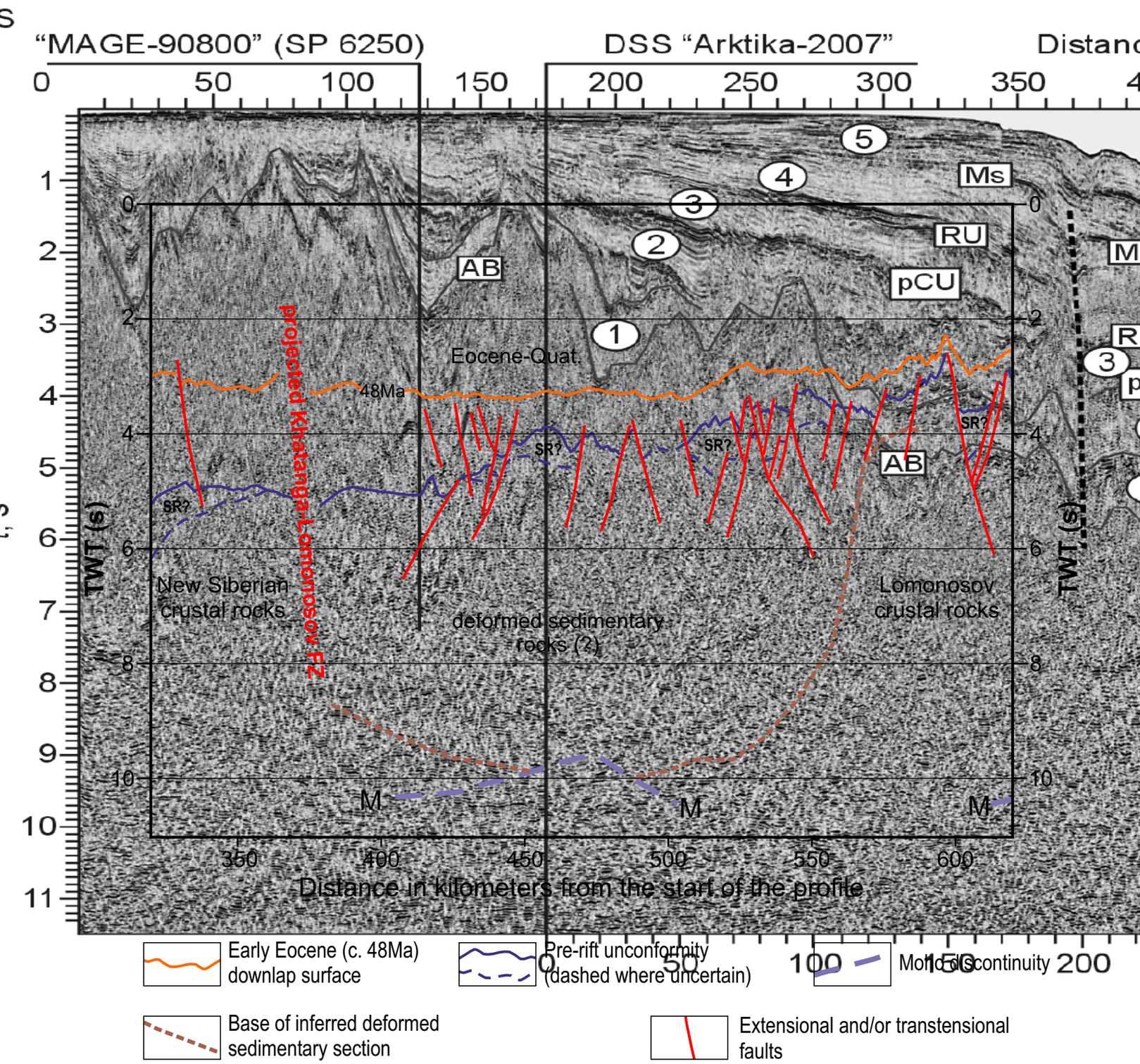
HALIP magmatic crust and/or continental crust heavily intruded by mafic rocks

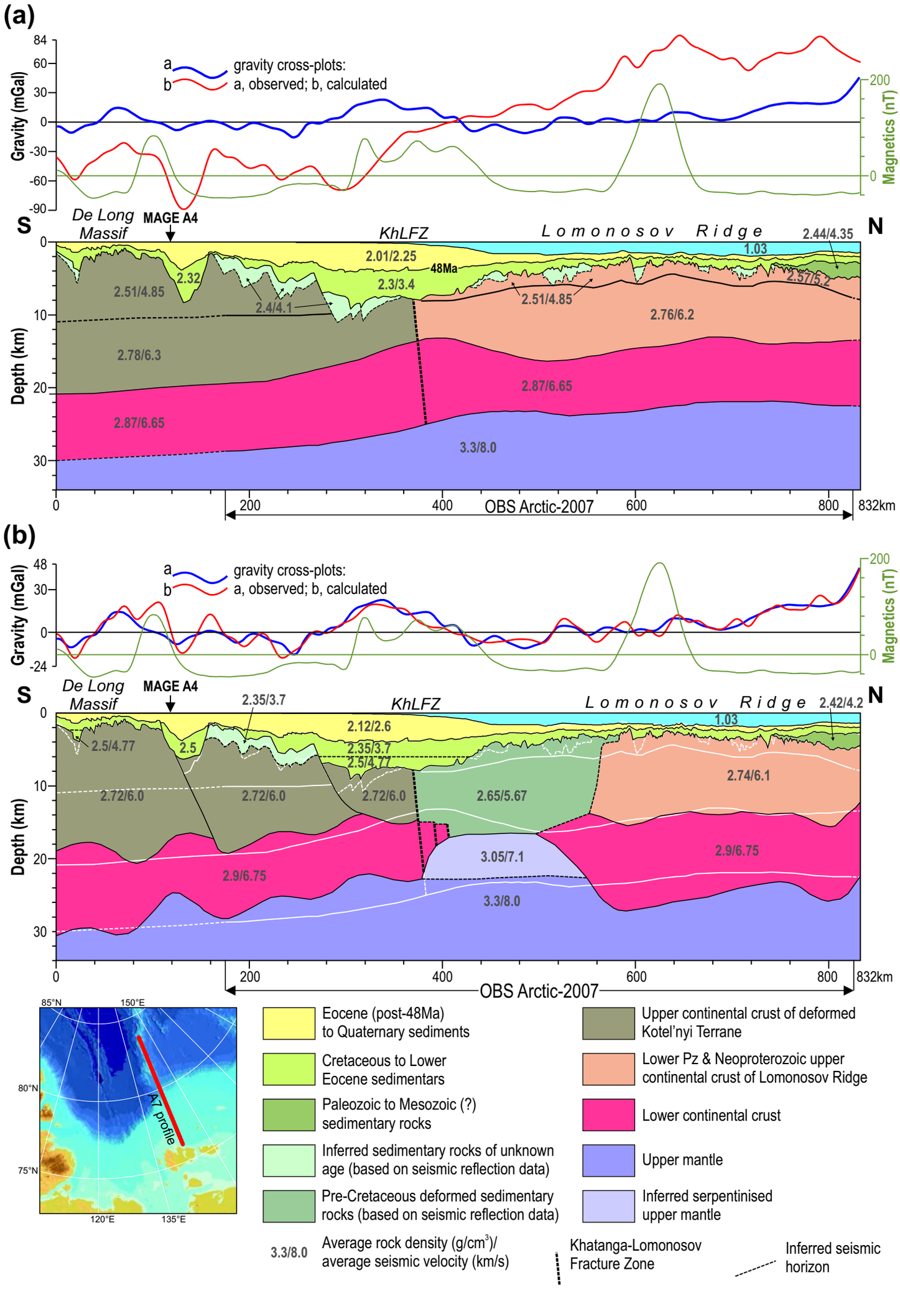
I Location of seismic geotransects and their number (names of the seismic lines are given in Fig.1)

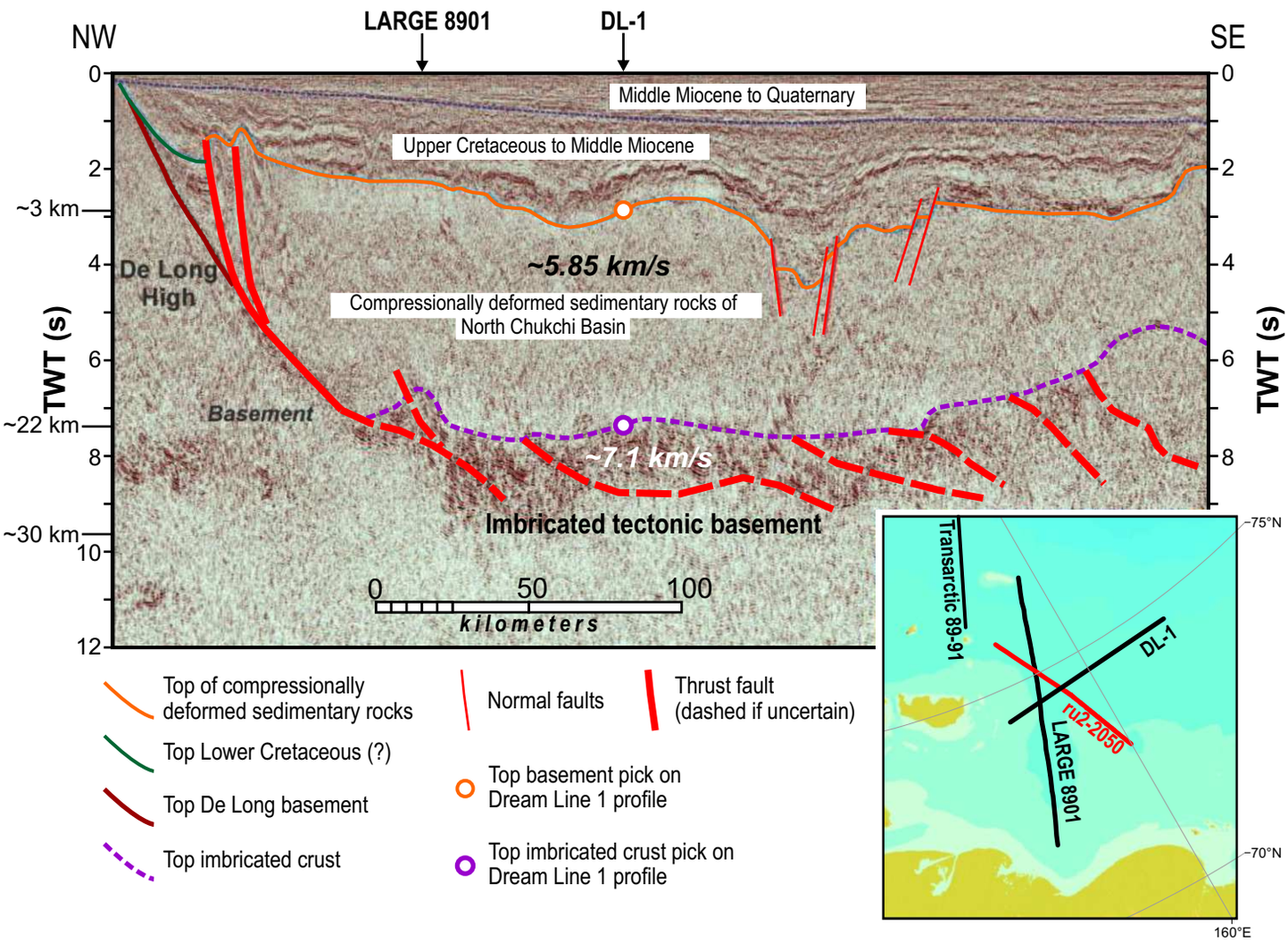
Front of compressional deformation

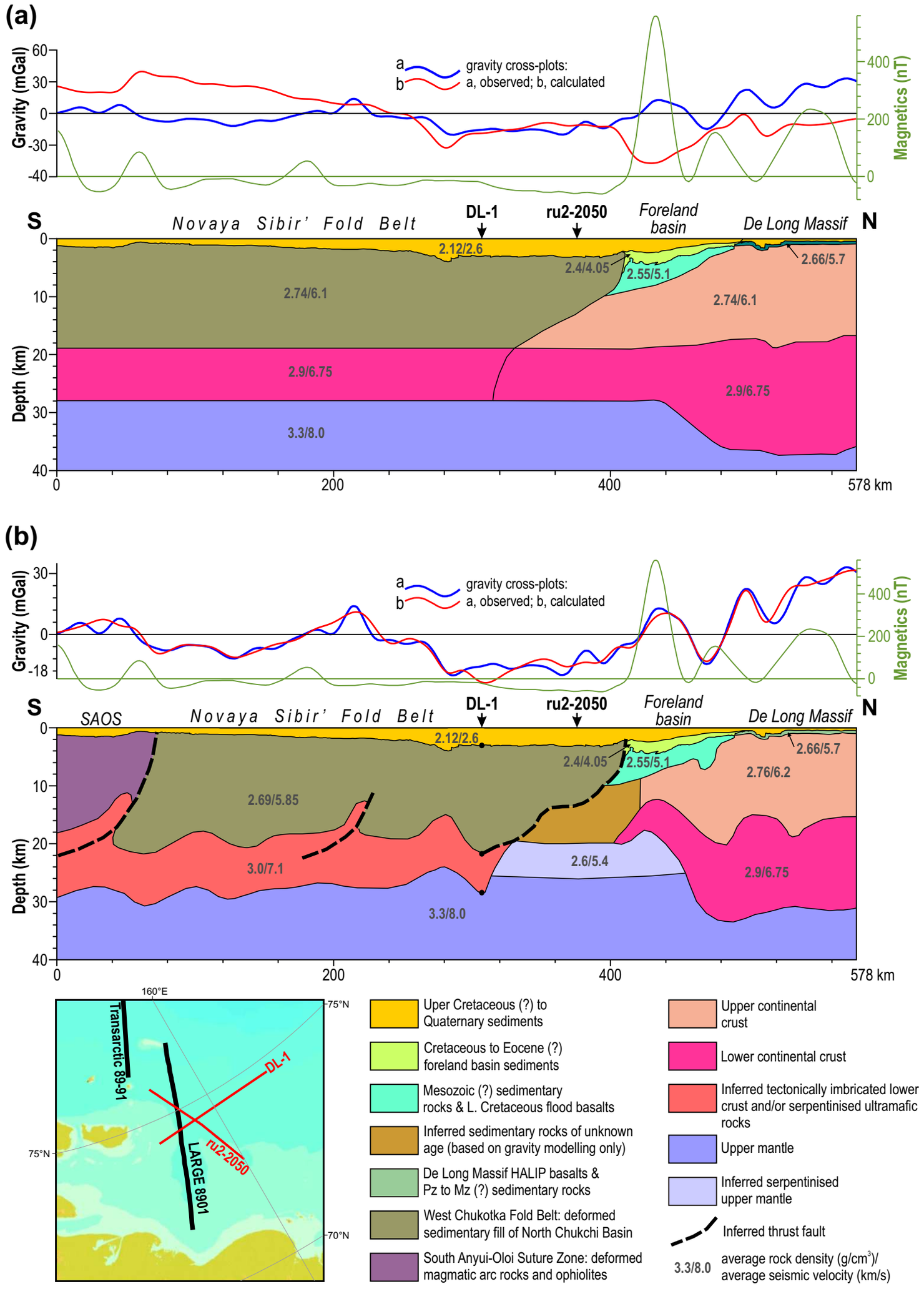

a
b
gravity cross-plots:
a, observed; b, calculated
mGal
40
30
20
10
0
-10
-20
-30
New Siberian Rift
SW
Ust' Lena Rift Basin
East Laptev Horst & Graben Province
Bel'kov & Anisin Rifts
Kotel'nyi High
Neben Graben
MAGE A7
NE
Depth (km)
2.1
2.56
2.3
2.56
2.65
2.65
2.74
2.76
2.63
2.74
3.1
3.0
2.90
3.3
3.3
2.1
2.3
2.58
100 kilometres
TGS ARS10F04 profile
MAGE A4 profile
syn- & post-rift sediments
Upper Miocene to Holocene
Upper Unit (second rift phase)
Upper Eocene to mid-Miocene
Middle Unit (stalled rift phase)
Up. Cretaceous to Up. Eocene Lower Unit
(stretching, thinning & exhumation phases)
a
b
top basement & intra-sedimentary
boundaries: a, seismic; b, modelled
base of inferred moderately deformed
Mesozoic rocks: a, seismic; b, modelled
main extensional detachment:
a, seismic; b, modelled
(a)
Upper crust: deformed Pz & Mz rocks of outer Siberia
passive margin & accreted terranes (a, weakly deformed)
Upper crust: Pz & Mz rocks of North Verkhoyansk Fold
Belt (deformed Palaeo-Siberia passive margin)
(a) (b)
Lower crust: a, Precambrian Palaeo-Siberian continent;
b, Late Mesozoic fold belts
Mid-Crust Discontinuity
constrained by gravity
2.90
average rock densities
(based on seismic velocities)
Moho: a, seismic; b, modelled
base of serpentinised
mantle (modelled)
(a)
Upper mantle
a, serpentinised inferred
100°E
110°E
120°E
130°E
140°E
150°E
78°N
74°N
70°N
Eurasia Basin
De Long Islands
Taimyr Peninsua
TGS ARS10f04
MAGE A4
New Siberian Islands
LAPTEV SEA
Lena River Delta

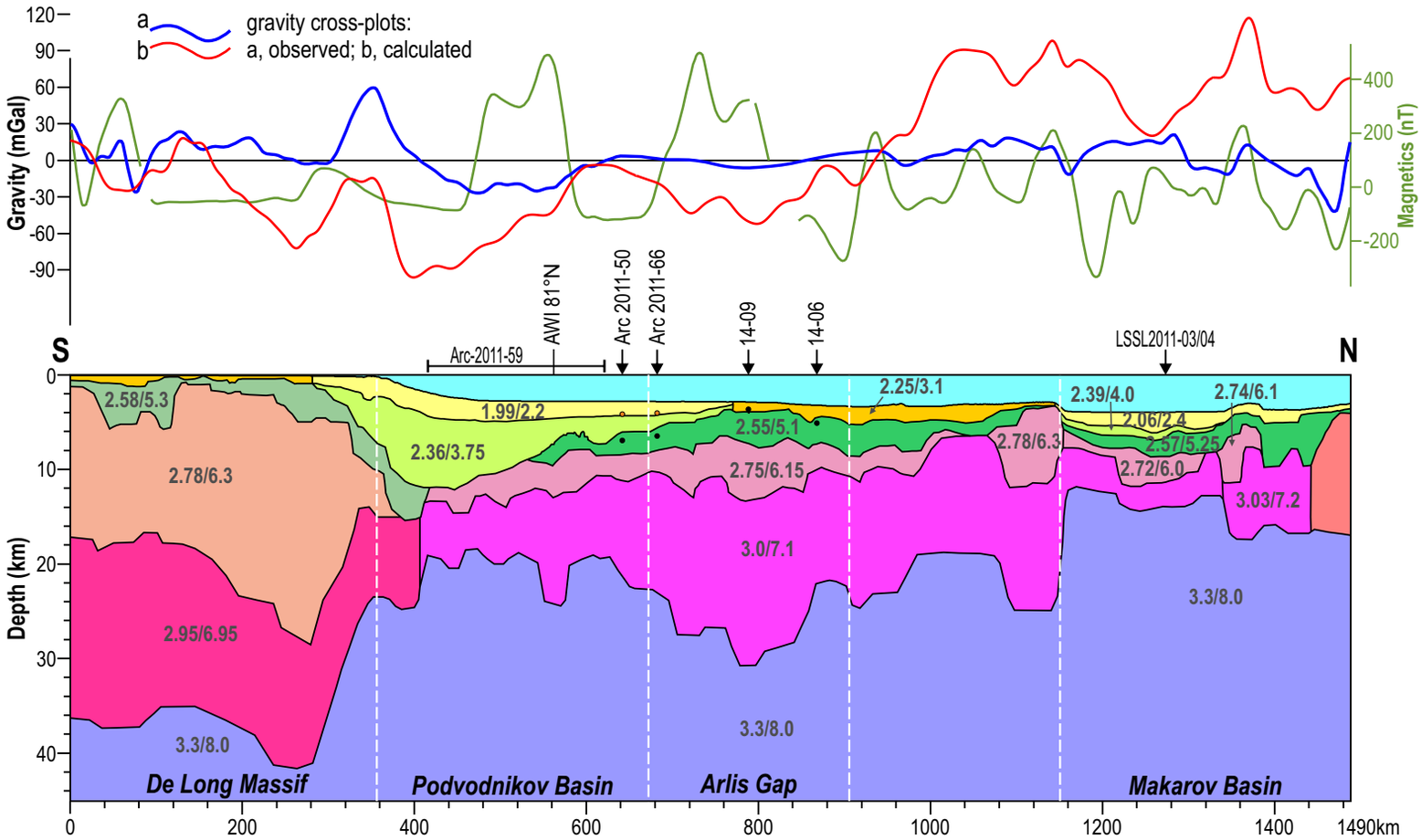

(a)
Gravity (mGal)
60
30
0
-30
a
b
gravity cross-plots:
a, observed; b, calculated
S
Lomonosov Ridge
N
2.44/4.35
1.03/1.5
2.01/2.25
2.3/3.4
2.51/4.85
2.51/4.85
2.57/5.2
2.78/6.3
2.87/6.65
3.3/8.0
Depth (km)
0
10
20
30
0
200
400
600
650 km
(b)
Gravity (mGal)
30
0
-30
a
b
gravity cross-plots:
a, observed; b, calculated
S
Lomonosov Ridge
N
1.03/1.5
2.47
2.49
2.25
2.48
2.40
2.50
2.55
2.48
2.57
2.58
2.55
2.74
2.75
2.76
2.75
2.90
3.3
3.33
3.3
3.27
Depth (km)
0
5
10
15
20
25
30
0
200
400
600
650 km
120°E
150°E
180°
80°N
75°N
135°E
150°E
Arctic-2007
MAGE A7
Model by Poselov et al. (2012a):
Eocene to Quaternary sediments
Upper Cretaceous (Post-Campanian) and Paleocene sediments
Paleozoic to Mesozoic (?) sedimentary rocks
Intermediate Layer (acoustic basement)
zone of crustal P-waves dramatic decay inferred by Poselov et al. (2012a)
Upper continental crust
Lower continental crust
Upper mantle
3.3/8.0
average rock density(g/cm3)/ average seismic velocity (P-waves, km/s)

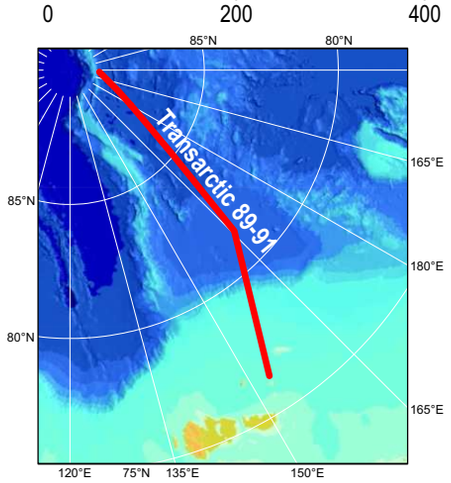

"MAGE-90800" (SP 6250)
DSS "Arktika-2007"
Distanc
0
50
100
150
200
250
300
350
5
4
3
2
1
Ms
RU
pCU
AB
M
R
p
Eocene-Quat.
48Ma
projected Khatanga-Lomonosov FZ
SR?
New Siberian
crustal rocks
deformed sedimentary
rocks (?)
Lomonosov
crustal rocks
TWT (s)
M
350
400
450
500
550
600
Distance in kilometers from the start of the profile
Early Eocene (c. 48Ma)
downlap surface
Pre-rift unconformity
(dashed where uncertain)
Mohorovicic discontinuity
Base of inferred deformed
sedimentary section
Extensional and/or transtensional
faults


(a)
Gravity (mGal)
84
60
30
0
-30
-60
-90
a
b
gravity cross-plots:
a, observed; b, calculated
200
0
Magnetics (nT)
S
De Long Massif
MAGE A4
KhLFZ
Lomonosov Ridge
N
2.44/4.35
1.03
2.01/2.25
48Ma
2.32
2.51/4.85
2.3/3.4
2.4/4.1
2.51/4.85
2.57/5.2
2.76/6.2
2.78/6.3
2.87/6.65
2.87/6.65
3.3/8.0
Depth (km)
0
10
20
30
0
200
400
OBS Arctic-2007
600
800
832km
(b)
Gravity (mGal)
48
30
0
-24
a
b
gravity cross-plots:
a, observed; b, calculated
200
0
Magnetics (nT)
S
De Long Massif
MAGE A4
2.35/3.7
KhLFZ
Lomonosov Ridge
2.42/4.2
N
1.03
2.12/2.6
2.5/4.77
2.5
2.35/3.7
2.5/4.77
2.74/6.1
2.72/6.0
2.72/6.0
2.72/6.0
2.65/5.67
3.05/7.1
2.9/6.75
2.9/6.75
3.3/8.0
Depth (km)
0
10
20
30
0
200
400
OBS Arctic-2007
600
800
832km
85°N
150°E
80°N
75°N
120°E
135°E
A7 profile
Eocene (post-48Ma) to Quaternary sediments
Cretaceous to Lower Eocene sedimentars
Paleozoic to Mesozoic (?) sedimentary rocks
Inferred sedimentary rocks of unknown age (based on seismic reflection data)
Pre-Cretaceous deformed sedimentary rocks (based on seismic reflection data)
Upper continental crust of deformed Kotel'nyi Terrane
Lower Pz & Neoproterozoic upper continental crust of Lomonosov Ridge
Lower continental crust
Upper mantle
Inferred serpentinised upper mantle
3.3/8.0
Average rock density (g/cm3)/ average seismic velocity (km/s)
Khatanga-Lomonosov Fracture Zone
Inferred seismic horizon


NW
SE
LARGE 8901
DL-1
TWT (s)
0
2
4
6
8
10
12
~3 km
~22 km
~30 km
Middle Miocene to Quaternary
Upper Cretaceous to Middle Miocene
~5.85 km/s
Compressionally deformed sedimentary rocks of North Chukchi Basin
De Long High
Basement
~7.1 km/s
Imbricated tectonic basement
0
50
100
kilometers
Top of compressionally deformed sedimentary rocks
Top Lower Cretaceous (?)
Top De Long basement
Top imbricated crust
Normal faults
Thrust fault (dashed if uncertain)
Top basement pick on Dream Line 1 profile
Top imbricated crust pick on Dream Line 1 profile
Transarctic 89-91
DL-1
TuZ-2050
LARGE 8901
75°N
70°N
160°E


(a)
Gravity (mGal)
60
30
0
-30
-40
a
b
gravity cross-plots:
a, observed; b, calculated
400
200
0
Magnetics (nT)
S
Novaya Sibir' Fold Belt
DL-1
ru2-2050
Foreland basin
De Long Massif
N
Depth (km)
0
10
20
30
40
2.12/2.6
2.4/4.05
2.55/5.1
2.66/5.7
2.74/6.1
2.74/6.1
2.9/6.75
2.9/6.75
3.3/8.0
0
200
400
578 km
(b)
Gravity (mGal)
30
0
-18
a
b
gravity cross-plots:
a, observed; b, calculated
400
200
0
Magnetics (nT)
S
SAOS
Novaya Sibir' Fold Belt
DL-1
ru2-2050
Foreland basin
De Long Massif
N
Depth (km)
0
10
20
30
40
2.12/2.6
2.4/4.05
2.55/5.1
2.66/5.7
2.76/6.2
2.69/5.85
3.0/7.1
2.6/5.4
2.9/6.75
3.3/8.0
0
200
400
578 km
160°E
75°N
70°N
75°N
Transarctic 89-91
DL-1
ru2-2050
LARGE 8901
Uper Cretaceous (?) to Quaternary sediments
Cretaceous to Eocene (?) foreland basin sediments
Mesozoic (?) sedimentary rocks & L. Cretaceous flood basalts
Inferred sedimentary rocks of unknown age (based on gravity modelling only)
De Long Massif HALIP basalts & Pz to Mz (?) sedimentary rocks
West Chukotka Fold Belt: deformed sedimentary fill of North Chukchi Basin
South Anyui-Oloi Suture Zone: deformed magmatic arc rocks and ophiolites
Upper continental crust
Lower continental crust
Inferred tectonically imbricated lower crust and/or serpentinised ultramafic rocks
Upper mantle
Inferred serpentinised upper mantle
Inferred thrust fault
3.3/8.0
average rock density (g/cm3)/ average seismic velocity (km/s)





Eocene to Quaternary sediments

Cretaceous to Lower Eocene sediments

Cretaceous (?) Quaternary sediments undivided

De Long Massif HALIP basalts & Pz to Mz (?) sedimentary rocks

Upper continental crust

Lower continental crust

Lomonosov Ridge continental crust undivided

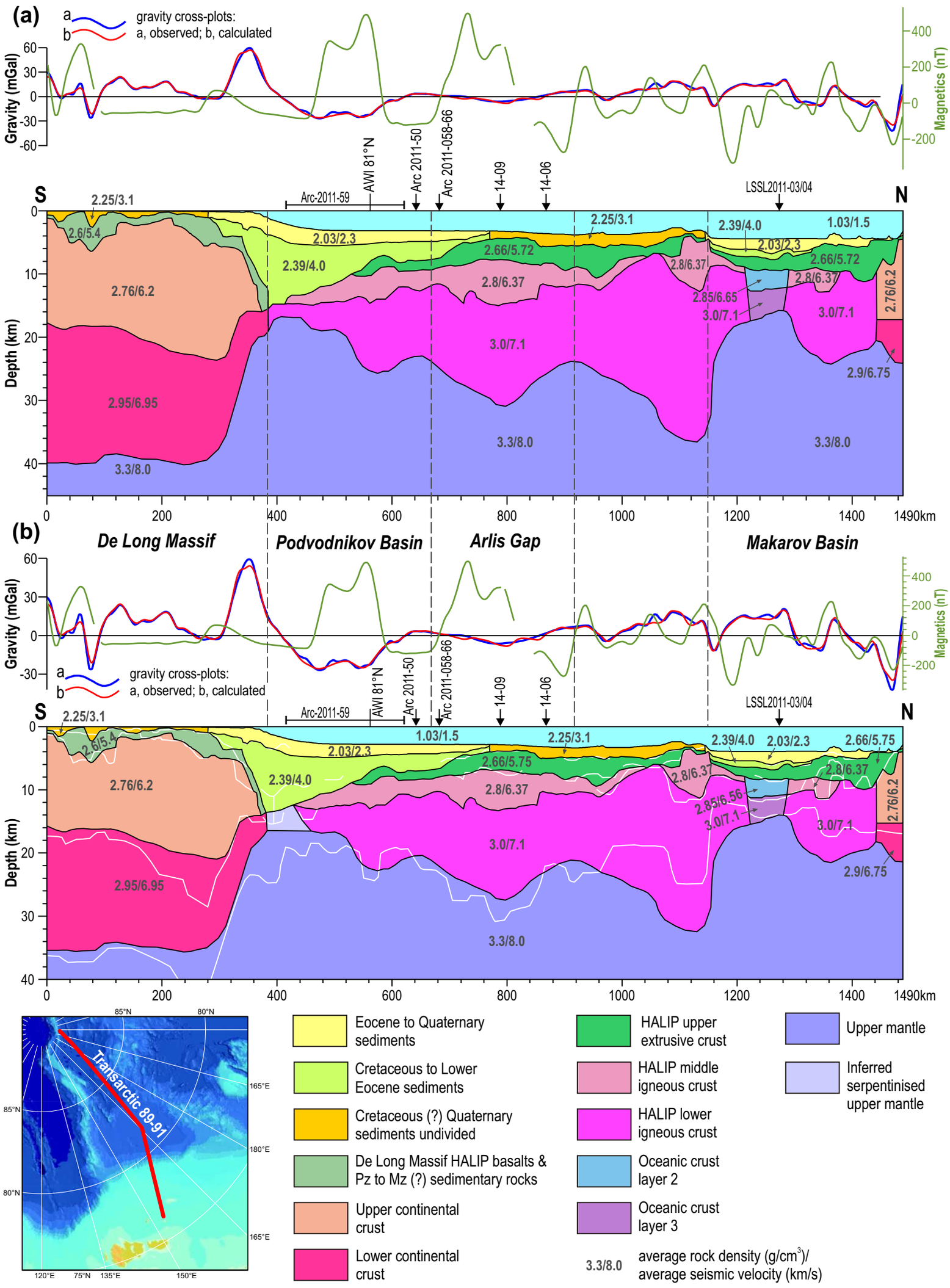
HALIP upper extrusive crust

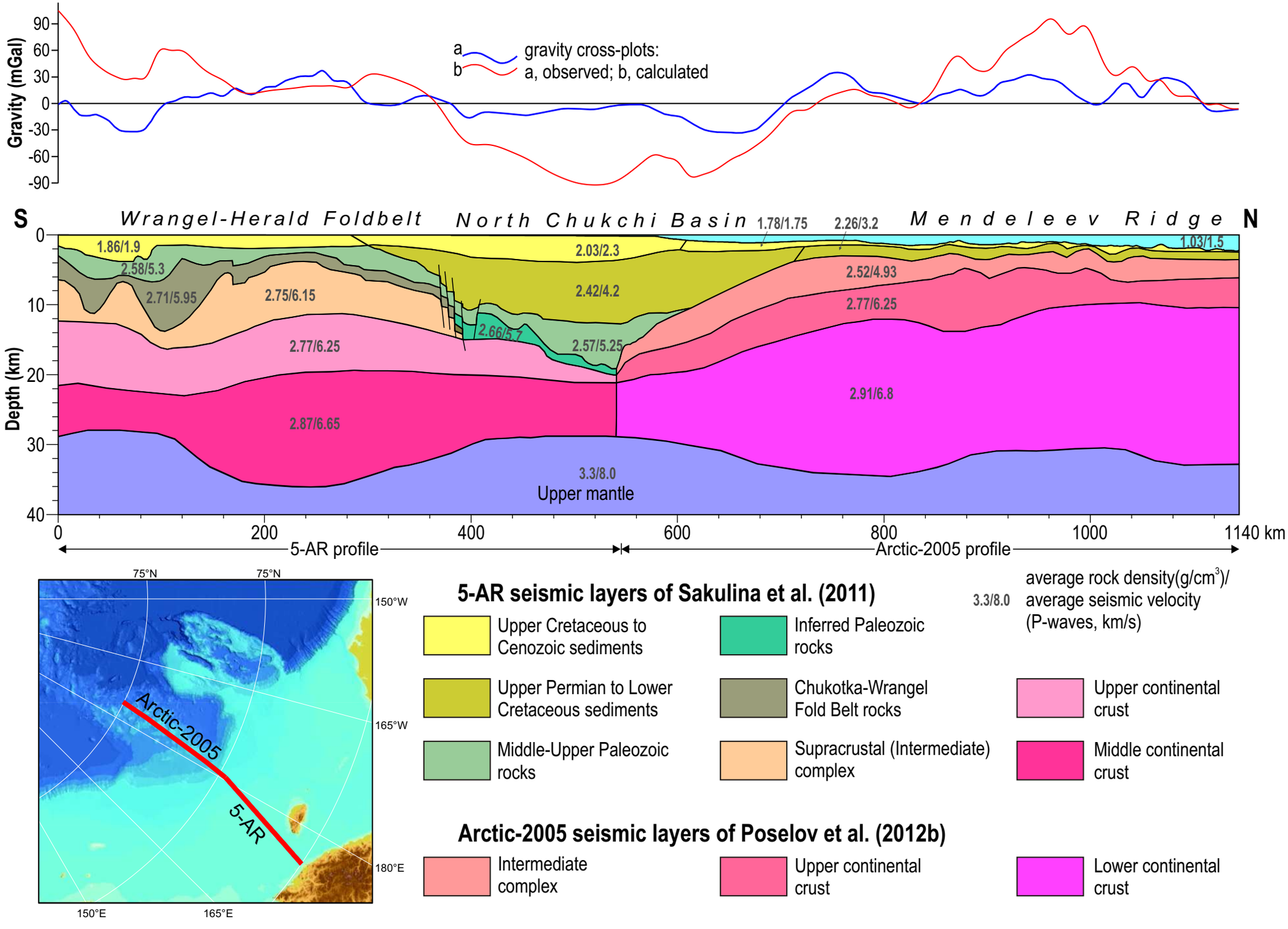
HALIP middle igneous crust

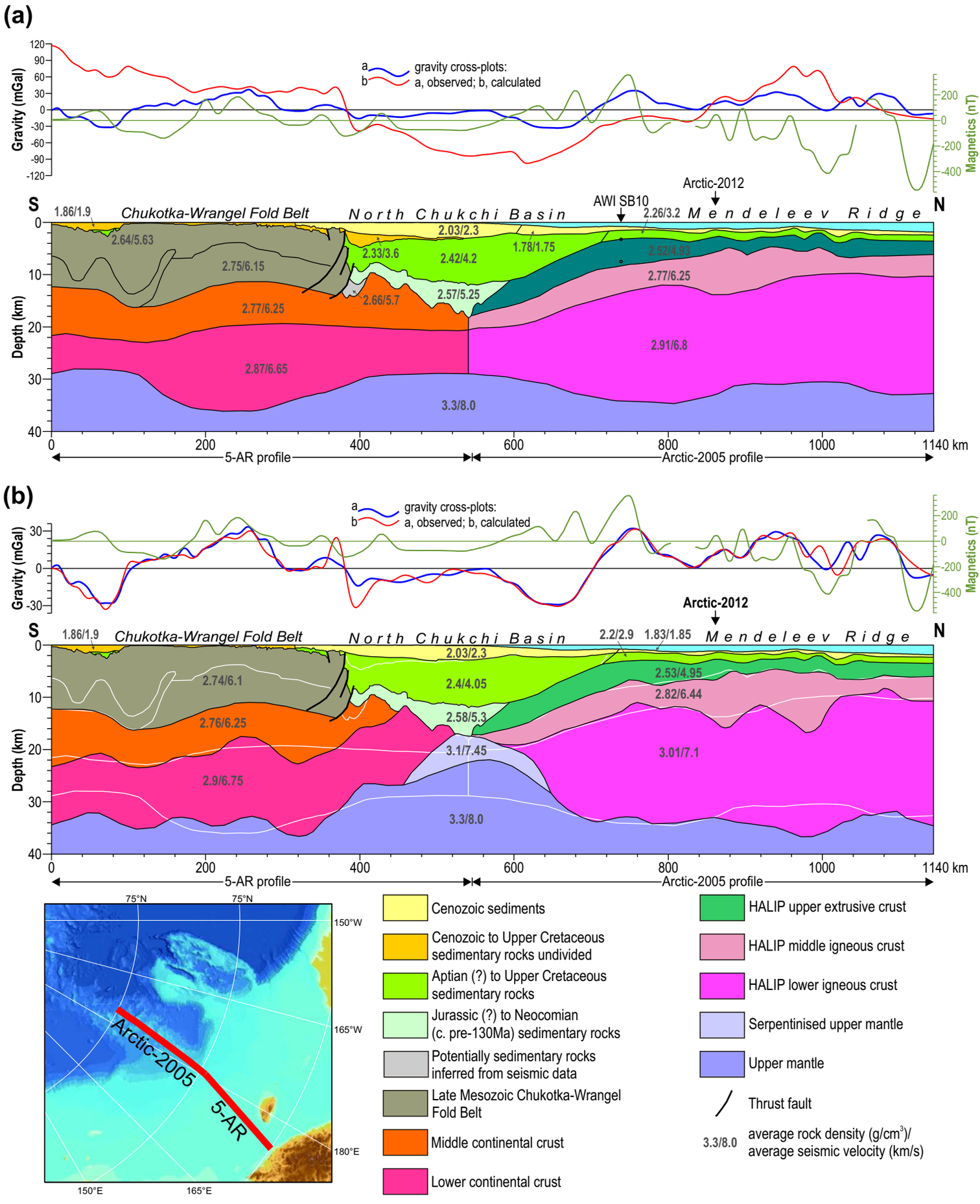
HALIP lower igneous crust

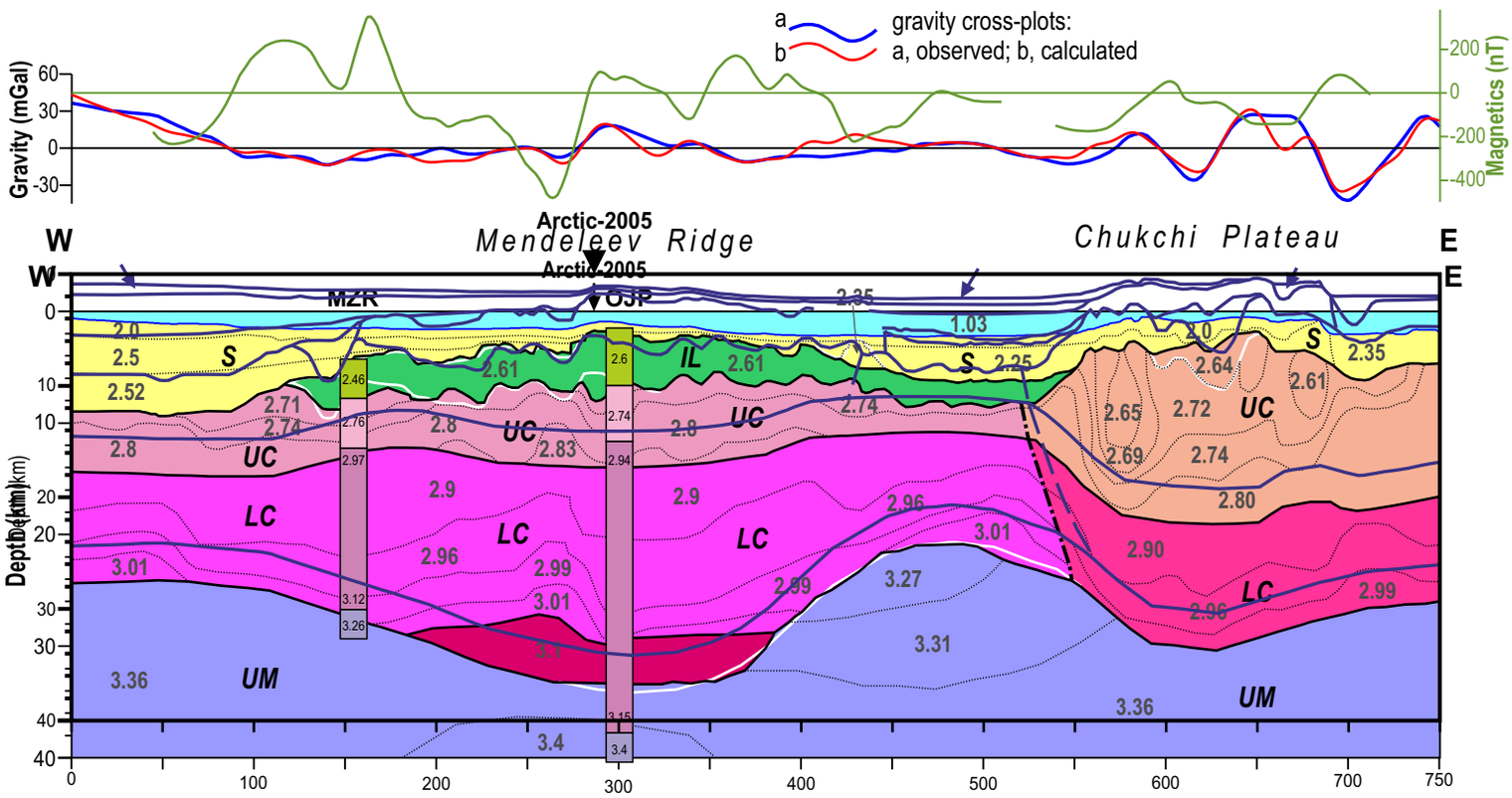
Upper mantle

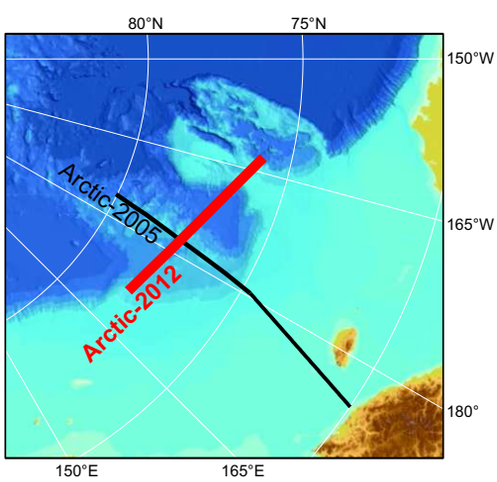
3.3/8.0 average rock density (g/cm^3)/ average seismic velocity (km/s)


(a)
a
b
gravity cross-plots:
a, observed; b, calculated
Gravity (mGal)
Magnetics (nT)
AWI 81°N
Arc 2011-50
Arc 2011-058-66
14-09
14-06
Arc-2011-59
LSSL2011-03/04
S
N
Depth (km)
2.25/3.1
2.6/5.4
2.03/2.3
2.39/4.0
2.66/5.72
2.8/6.37
2.76/6.2
2.85/6.65
3.0/7.1
2.9/6.75
2.95/6.95
3.3/8.0
1.03/1.5
0
200
400
600
800
1000
1200
1400
1490km
(b)
De Long Massif
Podvodnikov Basin
Arlis Gap
Makarov Basin
2.85/6.56
Transarctic 89-91
85°N
80°N
165°E
180°E
120°E
75°N
135°E
150°E
Eocene to Quaternary sediments
Cretaceous to Lower Eocene sediments
Cretaceous (?) Quaternary sediments undivided
De Long Massif HALIP basalts & Pz to Mz (?) sedimentary rocks
Upper continental crust
Lower continental crust
HALIP upper extrusive crust
HALIP middle igneous crust
HALIP lower igneous crust
Oceanic crust layer 2
Oceanic crust layer 3
Upper mantle
Inferred serpentinised upper mantle
3.3/8.0
average rock density (g/cm3)/ average seismic velocity (km/s)


Gravity (mGal)
90
60
30
0
-30
-60
-90
a
b
gravity cross-plots:
a, observed; b, calculated
S
Wrangel-Herald Foldbelt
North Chukchi Basin
Mendeleev Ridge
N
Depth (km)
0
10
20
30
40
1.86/1.9
2.58/5.3
2.71/5.95
2.75/6.15
2.77/6.25
2.87/6.65
2.03/2.3
2.42/4.2
2.66/5.7
2.57/5.25
1.78/1.75
2.26/3.2
1.03/1.5
2.52/4.93
2.77/6.25
2.91/6.8
3.3/8.0
Upper mantle
0
200
400
600
800
1000
1140 km
5-AR profile
Arctic-2005 profile
75°N
75°N
150°W
165°W
180°E
150°E
165°E
Arctic-2005
5-AR
5-AR seismic layers of Sakulina et al. (2011)
Upper Cretaceous to Cenozoic sediments
Upper Permian to Lower Cretaceous sediments
Middle-Upper Paleozoic rocks
Inferred Paleozoic rocks
Chukotka-Wrangel Fold Belt rocks
Supracrustal (Intermediate) complex
Upper continental crust
Middle continental crust
3.3/8.0
average rock density(g/cm3)/
average seismic velocity
(P-waves, km/s)
Arctic-2005 seismic layers of Poselov et al. (2012b)
Intermediate complex
Upper continental crust
Lower continental crust


(a)
Gravity (mGal)
Magnetics (nT)
a gravity cross-plots:
b a, observed; b, calculated
Arctic-2012
AWI SB10
S
N
1.86/1.9
Chukotka-Wrangel Fold Belt
North Chukchi Basin
2.26/3.2
Mendeleev Ridge
2.64/5.63
2.03/2.3
2.33/3.6
2.42/4.2
1.78/1.75
2.52/4.93
2.75/6.15
2.77/6.25
2.66/5.7
2.57/5.25
2.91/6.8
2.87/6.65
3.3/8.0
Depth (km)
1140 km
5-AR profile
Arctic-2005 profile
(b)
Gravity (mGal)
Magnetics (nT)
a gravity cross-plots:
b a, observed; b, calculated
Arctic-2012
S
N
1.86/1.9
Chukotka-Wrangel Fold Belt
North Chukchi Basin
2.2/2.9
1.83/1.85
Mendeleev Ridge
2.03/2.3
2.74/6.1
2.4/4.05
2.53/4.95
2.82/6.44
2.76/6.25
2.58/5.3
3.1/7.45
3.01/7.1
2.9/6.75
3.3/8.0
Depth (km)
1140 km
5-AR profile
Arctic-2005 profile
75°N
150°W
165°W
180°E
150°E
165°E
Arctic-2005
5-AR
Cenozoic sediments
Cenozoic to Upper Cretaceous sedimentary rocks undivided
Aptian (?) to Upper Cretaceous sedimentary rocks
Jurassic (?) to Neocomian (c. pre-130Ma) sedimentary rocks
Potentially sedimentary rocks inferred from seismic data
Late Mesozoic Chukotka-Wrangel Fold Belt
Middle continental crust
Lower continental crust
HALIP upper extrusive crust
HALIP middle igneous crust
HALIP lower igneous crust
Serpentinised upper mantle
Upper mantle
Thrust fault
3.3/8.0 average rock density (g/cm3)/ average seismic velocity (km/s)



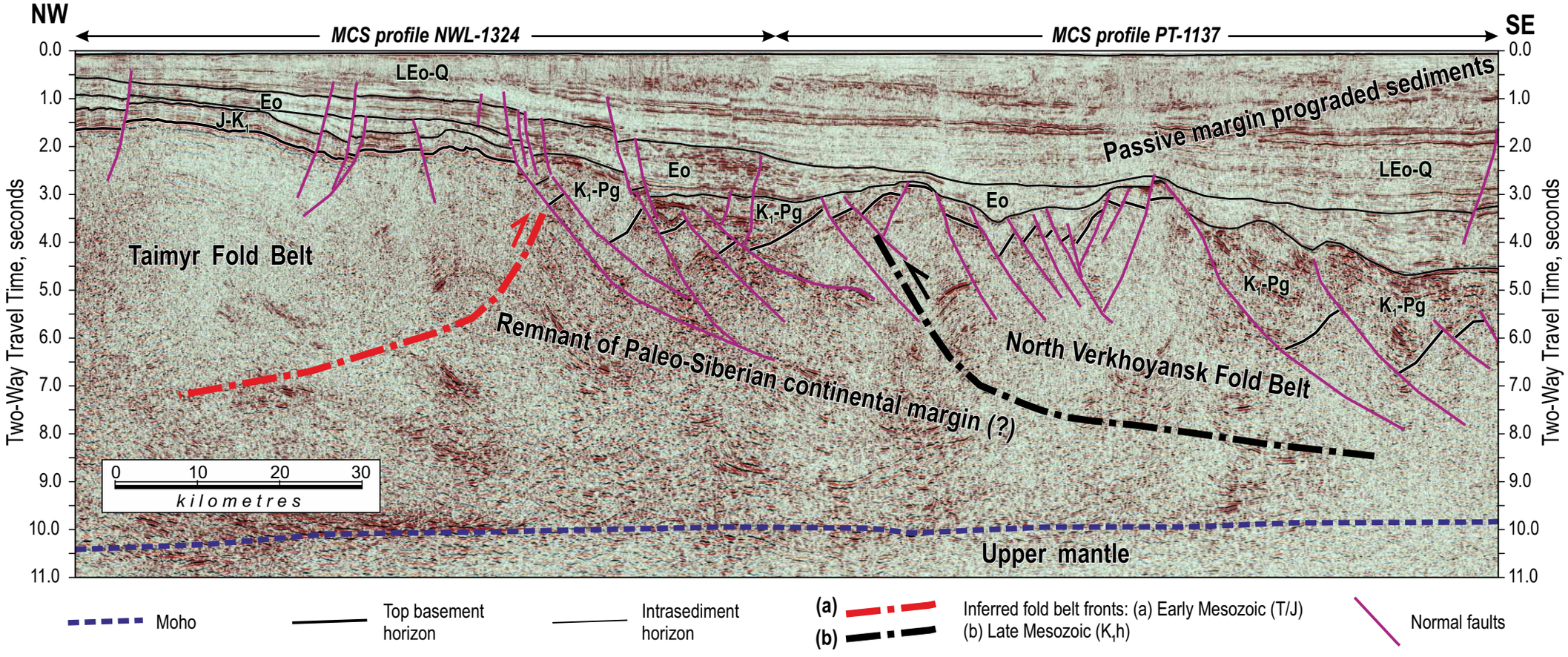


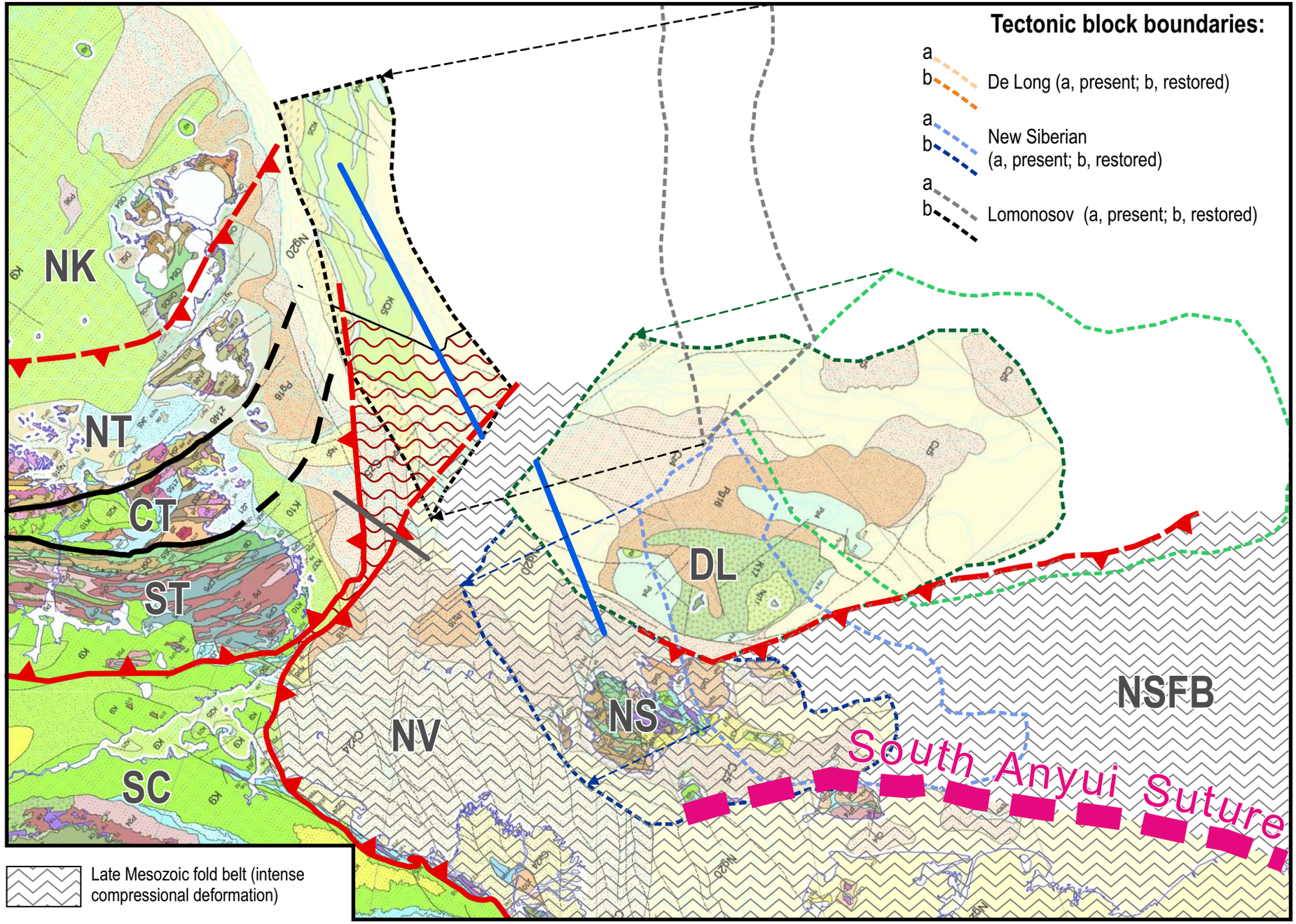
Modelled layers according to Kashubin et al. (2016):

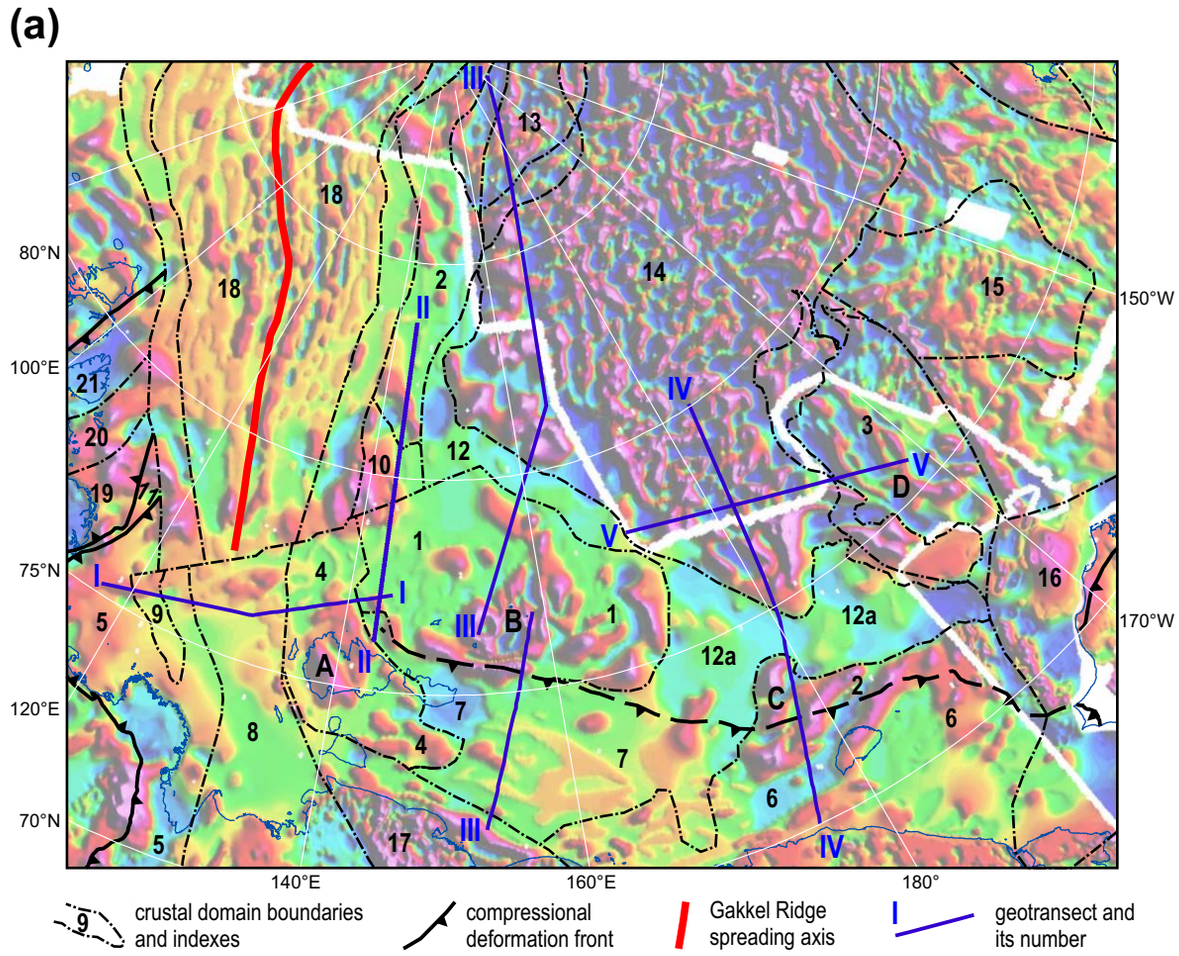
- ***S*** Sediments
- ***IL*** Metasediments (Intermediate Layer)
- ***UC*** Upper crust
- ***LC*** Lower crust
- ***UM*** Upper mantle
- **2.94** rock density: a, according to Kashubin et al. 2016 model

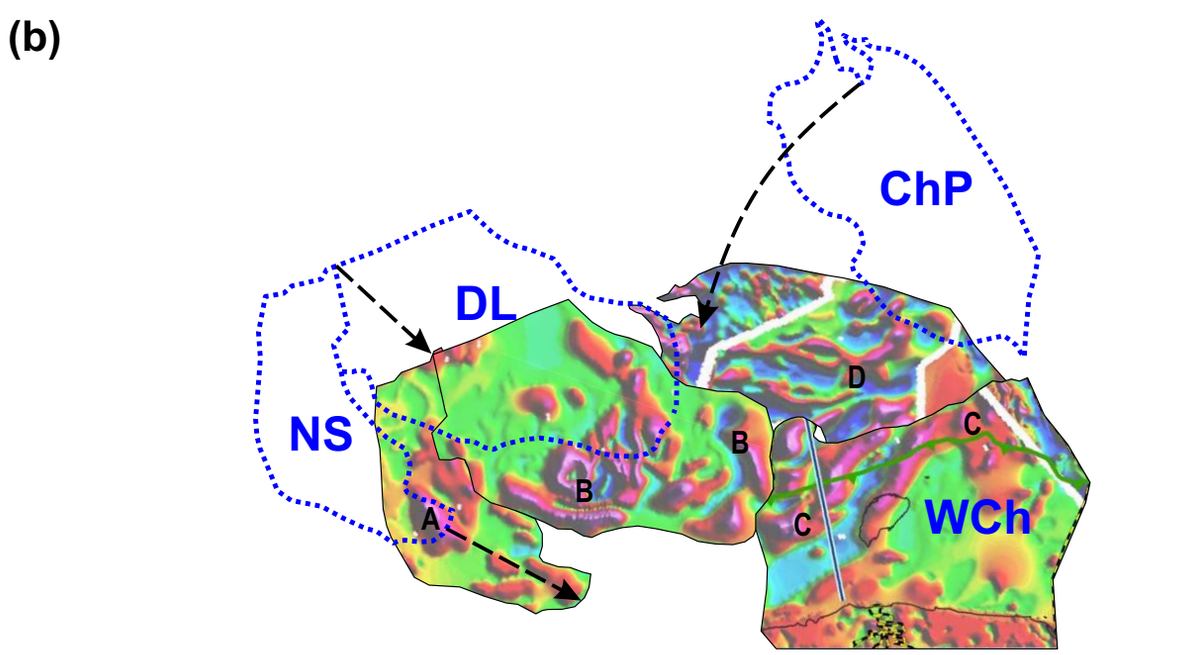
This study:

- Cretaceous (?) to Cenozoic sediments undivided
- HALIP upper extrusive crust
- HALIP middle igneous crust
- HALIP lower igneous crust
- Inferred magmatc underplating body
- Upper continental crust
- Lower continental crust
- Upper mantle
- Inferred boundary between continental and igneous crusts


NW
SE
MCS profile NWL-1324
MCS profile PT-1137
Two-Way Travel Time, seconds
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
LEo-Q
Eo
J-K1
K1-Pg
Passive margin prograded sediments
Taimyr Fold Belt
Remnant of Paleo-Siberian continental margin (?)
North Verkhoyansk Fold Belt
Upper mantle
0 10 20 30
kilometres
Moho
Top basement horizon
Intrasediment horizon
(a)
(b)
Inferred fold belt fronts: (a) Early Mesozoic (T/J)
(b) Late Mesozoic (K1h)
Normal faults


Tectonic block boundaries:
a
b
De Long (a, present; b, restored)
a
b
New Siberian
(a, present; b, restored)
a
b
Lomonosov (a, present; b, restored)
NK
NT
CT
ST
SC
NV
NS
DL
NSFB
South Anyui Suture
Late Mesozoic fold belt (intense compressional deformation)
Inferred remnant of Paleo-Siberian passive continental margin (moderately deformed Late Paleozoic-Mesozoic clastic succession)
front of compressional deformation
a
b
Restored location of Geotransect II (a) and MCS composite profile MAGE A9 (b)


(a)
80°N
100°E
75°N
120°E
70°N
140°E
160°E
180°
150°W
170°W
I
II
III
IV
V
A
B
C
D
1
2
3
4
5
6
7
8
9
10
12
12a
13
14
15
16
17
18
19
20
21
crustal domain boundaries and indexes
compressional deformation front
Gakkel Ridge spreading axis
geotransect and its number


(b)
ChP
DL
NS
WCh
A
B
C
D