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Understanding Sedimentary Systems and Processes of the Hikurangi Subduction Margin; from Trench to Back-Arc. Volume 1

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Understanding Sedimentary Systems and Processes of the Hikurangi Subduction Margin; from Trench to Back-Arc. Volume 1.

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ABSTRACT

This is the first of a two-part *New Zealand Journal of Geology and Geophysics* Special Issue that focuses on improving our understanding of sedimentary systems of the Hikurangi Subduction Margin, Aotearoa-New Zealand. It is amongst the world's youngest and most accessible active subduction margins and its sedimentary basins preserve a rich history of inception and ongoing evolution, spanning trench to back-arc positions. These sediments and sedimentary rocks provide a record of surface processes from the latest Paleogene to today, and reflect the spatio-temporal variability of the effects of subduction, seismicity, volcanism, evolving sediment sources, routing systems and processes, all imprinted upon by glacio-eustatic sea-level changes. The papers in this volume focus on the interplay between controlling mechanisms and the dynamics of these systems, from both onshore and offshore sedimentary environments. This issue is divided into two themes, distinguished by geological age: 1. Miocene Sedimentary Systems and intra-slope basin evolution, and 2. Insights from Quaternary Sedimentary Systems from the trench to the inner margin. Collectively, these papers represent significant advances into our understanding of sedimentary systems within the Hikurangi Subduction Margin, with innovative results that may find applications to other convergent settings.

Keywords

Hikurangi Subduction Margin, Basins, Forearc; Subduction Wedge, Trench; Miocene, Quaternary, Sedimentary Systems, New Zealand

Introduction

This is the first of two special issue volumes dedicated to the understanding of sedimentary systems of the Hikurangi Subduction Margin (HSM), located to the east of the North Island, Aotearoa-New Zealand (Fig. 1). The HSM forms the southern part of the Tonga-Kermadec-Hikurangi subduction system, where the oceanic Pacific plate is obliquely subducting beneath the continental Australian plate (Fig. 1; (Ballance 1976, 1993; Spörli 1980; Cole and Lewis 1981; Pettinga 1982; Chanier and Ferrière 1991; Lewis & Pettinga 1993; Field et al. 1997; Lewis et al. 1998; Nicol et al. 2007; Barnes et al. 2010). Subduction is interpreted to have initiated ~25 Ma and continues today (Rait et al. 1991; Nicol et al. 2007; Jiao et al. 2014). For the purposes of this special issue, the HSM region encompasses a broad deformation zone, at least 200 km across, stretching from the offshore Hikurangi Trough to the onshore Taupō Volcanic Zone (Ballance 1993; Lewis & Pettinga, 1993; Nicol et al. 2007; Pedley et al., 2010) (Fig. 2). It contains many of the tectono-geomorphic elements of an idealised subduction system (e.g., Ballance 1993; Bailleul et al. 2013) (Fig. 3).

To the east of the sea-floor expression of the subduction deformation front, the Hikurangi Trough forms an elongate, trench-parallel depocentre infilled with gravity flow, contourite, and mass-wasting deposits (Lewis 1994; Lewis et al. 1998; Lewis and Barnes 1999; Lewis and Pantin 2002; Barnes et al. 2010; Bland et al. 2015; McArthur and Tek 2021; Tek et al. 2021, this volume; Fig. 3). Moving westward, the upper (Australian) plate comprises a submerged subduction (accretionary) wedge (Lewis and Pettinga 1993), that incorporates (1) an outer accretionary prism close to the Hikurangi Trough, formed from accreted trench-fill sediments and overlain by Quaternary trench-slope basins (e.g. Davey et al. 1986; Lewis and Pettinga 1993; Collot et al. 1996; Barnes and Mercier de Lépinay 1997; Lewis et al. 1999), and (2) an inner imbricated wedge cored by pre-subduction rocks that have been deformed by Neogene–Quaternary folds and thrusts (Barnes et al. 2002; Bailleul et al. 2013; Barnes et al. 2010; Bland et al. 2015).

Small sedimentary basins within the imbricated wedge are often filled with thick successions of syn-subduction sedimentary rocks (Fig. 3) (e.g. Lewis 1980; Cole and Lewis 1981; Pettinga 1982; Davey et al. 1986; Lewis and Pettinga 1993; Collot et al. 1996; Barnes et al. 2010; Bailleul et al. 2007, 2013; Paquet et al. 2009; Bland et al. 2015; Strogen et al. 2018; McArthur et al. 2019; Griffin et al. 2021, this volume). The offshore margin displays extensive evidence of intense fluid migration (e.g. Katz 1981; Lewis and Marshall 1996; Barnes et al. 2010; Crutchley et al. 2010, 2011; Faure et al. 2010; Greinert et al. 2010 ; Pecher et al. 2010; Plaza-Faverola et al. 2012; Kroeger et al. 2015, 2019; Watson et al. 2020a; Hillman et al. 2020), mass-wasting occurrences (Collot et al. 2001; Lamarche et al. 2008; Mountjoy et al. 2009; Joanne et al. 2010, 2013; Watson et al. 2020b), frequent downslope turbidity currents (e.g. Orpin et al. 2006, Pouderoux et al., 2012a, 2012b, 2014; Crisóstomo-Figueroa et al. 2020) and contourite deposition (Carter et al. 2002; Lewis and Pantin, 2002; Fernandes et al. 2018; Bailey et al. 2020). To the west, an exhumed emergent part of the subduction wedge, within the North Island's Coastal Ranges, allows for careful outcrop-based approaches to understand the origins and architecture of the margin's many trench-slope basins and depositional processes within gravity-driven systems (e.g. Van der Lingen and Pettinga 1980; Pettinga 1982; Van der Lingen 1982; Neef 1992, 1999; Lewis and Pettinga 1993; Reid 1998; Field 2005; Bailleul et al. 2007, 2013; Burgreen and Graham 2014; Buckeridge et al. 2018; McArthur and McCaffrey 2019; Caron et al. this volume; Claussmann et al. 2021b, this volume; McArthur et al. 2021a, this volume). In addition to active onland mud volcanoes and oil and gas seeps (Field et al. 1997; Pettinga 2003; Hollis et al. 2005; Sykes et al. 2012; Malié et al. 2022), that part of the margin displays outcropping paleo-methane seeps and expressions of their plumbing systems (tubular carbonate concretions) hosted by Cretaceous to Miocene rocks (Ledésert et al., 2003; Campbell et al., 2008; Nyman et al., 2010; Kiel et al., 2013; Malié et al., 2017, 2022). Inboard of the Coastal Ranges lies a comparatively little-deformed partially exhumed forearc basin, in places containing >5 km of Neogene–Quaternary mixed clastic-carbonate sedimentary fill (e.g., Lillie 1953; Kingma 1971; Beu and Edwards 1984; Harmsen 1985; Haywick et al. 1991; Ballance 1993; Beu 1995; Field et al. 1997; Begg and Johnston 2000; Mazengarb and Speden 2000; Lee and Begg 2002; Nelson et al. 2003; Bland et al. 2004, 2013; Caron et al. 2004a, 2004b, 2005; Lee et al. 2011; Bertaud-Gandar et al. 2017). The forearc basin is back-stopped by uplifted by fault-bounded Mesozoic metasedimentary basement rocks of North Island's Axial Ranges, which are closely associated with many active crustal-scale strike-slip faults (North Island fault system) (e.g., Spörli 1980; Browne 1986, 2004; Cashman et al. 1992; Erdman and Kelsey 1992; Beanland et al. 1998; Lee and Begg 2002; Mouslopoulou et al. 2007; Nicol et al. 2007; Lee et al. 2011; Jiao et al. 2014; Bland et al. 2019; Ninis, this volume). The active back-arc Taupō Volcanic Zone, incorporating voluminous rhyolitic, andesitic, and basaltic eruptive centres, defines the western extent of the region of interest for this volume (e.g., Ballance 1976, 1988; Ballance et al. 1985; Cole 1986; Wilson et al. 1995; Kear 2004; Leonard et al. 2010; Lee et al. 2011; Mortimer and Scott 2020; Stagpoole et al. 2021; Pittari et al. 2021) (Fig. 3).

This volume includes nine original research papers that represent a diversity of topics, approaches, geological ages, and research groups from around the globe, including both emerging and established researchers (Table 1). They are linked by the significance of the HSM as an accessible global laboratory for tectonic, sedimentological, and paleontological research. Many of these studies build on a legacy of several decades of outcrop and marine geology research, requiring cumulative months of fieldwork and numerous voyages (e.g., Lillie 1953; Kingma 1971; Van der Lingen and Pettinga 1980; Pettinga 1982; Harmsen 1985; Rait et al. 1991; Chanier and Ferrière 1991; Neef 1992; Lewis et al. 1993, 1999; Lewis and Pettinga 1993; Van der Lingen and Pettinga 1993; Beu 1995; Delteil et al. 1996; Barnes et al. 2010, 2019; Pecher et al. 2019; Wallace et al. 2019). In addition, several authors have utilised freely available petroleum exploration (2D seismic-reflection and drillhole) data sets (e.g. Barnes et al. 2002; Barker et al. 2009; Sutherland et al. 2009; Plaza-Faverola et al. 2012; Bland et al. 2015; Griffin et al. 2021, this volume) and proprietary 3D seismic data volumes (e.g. McArthur et al. 2019, this volume; Tek et al. 2021b this volume) to provide broader-scale context to understanding sedimentary system scale processes.

The overarching theme of this volume is subduction and its profound influence on the spatio-temporal evolution of sedimentary systems. The papers span some of the earliest preserved records of subduction within the HSM (e.g. Caron et al., Griffin et al., McArthur et al.) through to expressions of Late Pleistocene–Holocene upper-plate fault mechanics within southern parts of the margin (Ninis et al.). A staggering array of depositional sequences from Early Miocene to

Holocene age are encompassed, including indurated to unconsolidated clastic successions deposited in paleo-lakes through to shelf and deep-marine environments, and a diversity of lithofacies that includes mixed carbonate-clastic, reworked carbonates, siliciclastic-dominated, and volcaniclastic successions.

The authors have employed a wide range of methodologies, from fundamental field-based stratigraphic logging (McArthur et al., Caron et al.) to cutting-edge structure-from-motion photogrammetry (Claussmann et al.), optically stimulated luminescence dating (Ninis et al.) and paleontologically based dating techniques (Caron et al., Griffin et al.), permeability (Dutilleul et al.), 2D and 3D seismic-reflection interpretation (McArthur et al., Tek et al.), petrophysical well-log analysis (Griffin et al.), taphonomy (Claussmann et al.), palynology (Marden et al.), and International Ocean Discovery Program (IODP) drilling of deep-water sites (Allen et al., Dutilleul et al.).

The volume is divided into two themes, distinguished by geological age. The papers of theme 1 focus on Miocene sedimentary systems and basin evolution within the early history of the HSM; they are ordered here in terms of scale, moving from discrete sedimentary systems (Claussmann et al., Caron et al.) to integrated basin-scale syntheses focussed on longer-term system evolution (Griffin et al., McArthur et al.). The papers of theme 2 focus on Quaternary sedimentary systems. They are ordered here in terms of position within the HSM (Fig. 3) moving from the offshore Hikurangi Trough (Tek et al., Allen et al.), outer subduction wedge (Dutilleul et al.), to the inner subduction wedge (Marden et al.) and North Island forearc basin and Axial Ranges (Ninis et al.).

Theme 1 Miocene sedimentary systems and basin evolution

Special Issue Volume 1 and Theme 1 opens with Claussmann et al. who integrate mapping (3D outcrop models from drone acquisitions), high-resolution photography, sedimentology, paleontology, and taphonomy to unravel the spatio-temporal distribution of outcropping Early to Middle Miocene mass-transport deposits (MTDs) along the central Wairarapa coast (Fig. 2). The paper includes amazing images focussing on outcropping shelf-derived MTDs deposited in trench-slope basins (Fig. 4). The authors describe a range of distinct MTD textures, and link them to variable MTD transport processes and distance from the contemporaneous shelf, resulting in the identification of complex slope stratigraphies consisting of multi-scaled coalescing deposits. The authors invoke ongoing fold-thrust belt deformation associated with evolving subduction as the principle MTD trigger.

Although the sedimentary succession of the HSM is overwhelmingly siliciclastic strata, distinctive carbonate-rich intervals form prominent landscape and seafloor features throughout the region. Addressing such rocks, is the second paper in Theme 1 by Caron et al., who take an outcrop-based approach at Akaroa Peak quarry, northern Wairarapa, where a shallowing-upward carbonate succession is overlain by turbidite lobes. Through detailed field-based and petrographic analyses (Fig. 5), a series of biofacies and lithofacies are defined and used to understand the palaeoecological and tectono-eustatic depositional conditions that allowed these unusual carbonates to form within a lower trench-slope setting. The authors conclude that the succession is explainable within a tectono-eustatic based framework.

The volume's third paper, by Griffin et al., explores an offshore part of the Miocene subduction wedge. The authors reappraise multiple data-sets from the petroleum exploration drillhole Titihaoa-1, one of only three within the entire offshore HSM. The authors utilise digital image- and wireline-log and new foraminiferal-based biostratigraphic data to refine the age, lithologies, sedimentary structures, faults and fractures, and *in-situ* stress within the drillhole's ~2740 m-thick Holocene to early-Middle Miocene sedimentary succession (Fig. 6). They identify a new unconformity based on biostratigraphy, and refine the previous age model. Through comparison with nearby onshore outcrops, the geological evolution within the Titihaoa-1 area is framed within the context of the evolving HSM imbricated wedge.

This theme's fourth paper, by McArthur et al., presents a comprehensive reconstruction of the Early to Middle Miocene geological history of the onshore Akitio sub-basin. The outcrop-based study uses detailed lithofacies and stratigraphic analyses integrated with micropaleontological, and geological mapping data, to build realistic architectural models for trench-slope basins. Results also provide insights for the more proximal parts of the sedimentary system. Moreover, by using proprietary seismic reflection data, the authors compare the onshore outcrop stratigraphy to the offshore, actively filling Akitio Trough, highlighting controls on trench-slope basin fill. Using these case studies together, they present a schematic model of the evolution of Neogene–Quaternary trench-slope basins within the Hikurangi Margin (Fig. 7). Although the offshore area represents a subtly different setting with no shallow-marine incursions, a similar evolution is proposed, from confined to semi- to unconfined basin filling.

Theme 2 - Quaternary Sedimentary Systems - from trench to inner margin

The opening paper of Theme 2 is by Tek et al., who provide a comprehensive, detailed quantitative study of Quaternary sediment waves on the outer and inner bends of the submarine Hikurangi Channel (Fig. 8). The authors employ quantitative geomorphic techniques to both bathymetric and subsurface 3D seismic-reflection data-sets to obtain detailed statistical extractions of sediment-waves fields with the aim to help understand what controls their formation. The paper presents nine controls, many of which have been cited in similar overbank studies from different locations. However, a novel and significant outcome from this paper is the recognition that overbank flows and their deposits can interact, being sourced from different locations within the same system. This does not produce the typical decay in bed thickness away from thalwegs, as might be expected. Of perhaps more importance is the recognition of inner-channel wave-fields and the identification of at least two modes of formation depending upon orientation.

The second paper in Theme 2 is by Allen et al. They present a volcaniclastic sedimentological and petrological study of two IODP Expedition 375 core-sites (U1520 and U1526) associated with Tūranganui Knoll, a Cretaceous-aged seamount located in the northern part of the Hikurangi Trough, east of the subduction interface (Fig. 2). The study aims to offer insights into fluid-flow, paleoenvironmental conditions, and diagenetic processes within this part of the HSM, providing analogues for other margins. Strata within the studied interval at U1520 were found to be composed of volcaniclastic debris transported downslope, whereas strata at U1526 are thought to be subaerial eruption products reworked by wave action. This study provides useful insights into what some of the dozens of seamounts within the wider HSM and associated subducting Hikurangi Plateau (Pacific plate) are likely to be composed of and their potential impact on the subduction process itself.

Datasets from recent IODP drilling are also used to explore active sea-floor processes off the Hawke Bay coast, by Dutilleul et al. in the third paper in Theme 2. Using data from IODP Expeditions 372 and 375 (sites U1517 and U1519) (Fig. 9), the authors assess changes in porosity, pore structure, and permeability between the two drill sites to determine potential links between excess pore-pressure, gas hydrates, and creeping of the large submarine Tuaheni Landslide Complex (TLC). The authors combine shipboard data including logging-while-drilling (LWD) data with physical core-sample analyses to determine interstitial porosity, pore-size distribution, and permeability. Despite evidence for variations in porosity and pore-pressures within and between sites, the authors conclude that there is no obvious evidence of the involvement of gas hydrate in active creeping at the TLC, which is more likely induced by hydro-geomechanical processes. Further, they suggest that their results support studying other mechanisms of creeping at the TLC and at other analogous locations where gas-hydrates and submarine landslides co-exist.

The penultimate paper in the Special Issue Volume 1 and in Theme 2 is by Marden et al., who use a well-preserved stratigraphic record from 26, shallow (up to 20 m long) sediment cores from an upland paleolake — Redpath Lake — that is thought to have existed for c. 12 kyr (17.3–5.5 cal ka BP). Redpath Lake is located in the Waipaoa River sedimentary system (Fig. 2), and interpreted to be a transient landslide-dammed lake. The authors integrate sedimentological and stratigraphic analyses, with radiometric ^{14}C, tephrochronology and palynology to provide an interpretive window into Late Pleistocene paleoclimate, paleovegetation and paleoecological changes in the region. They reveal a mean storm frequency of c. 226 years and a counterintuitive absence of seismic-shaking related sedimentary structures. Pollen analyses focus on a shorter, but significant period between c. 16.3–14.1 cal ka BP (Fig. 10). Although perhaps representing a snap-shot of paleo-ecological conditions, this comprehensive study shows the complex nature of the latter part of the climatically variable Last Glacial-Interglacial Transition.

The concluding paper of Volume 1 and Theme 2 is a key study by Ninis et al., that aims to understand the distribution of permanent upper-plate tectonic uplift across the southern HSM. This superb paper reassesses the age, elevation, and distribution of a spectacular flight of Late Pleistocene wave-cut marine terraces (Fig. 11) along the southernmost coast of the North Island by integrating sedimentology, stratigraphy, numerical dating techniques (Optically Stimulated

Luminescence, OSL dating) with differential Global Navigation Satellite System (GNSS) measurements. The authors correlate the marine terraces by age along the coast, enabling the identification of uplift patterns associated with active faulting and subduction at this plate margin. They provide the first numerical ages for most of these terraces, allowing the first regional-scale correlations to be made, with some surprising temporal clustering of tectonic uplift. We chose to conclude the volume with this paper as it encapsulates the interplay between the sedimentary, climatic, and tectonic processes highlighted in the volume's papers, and which have resulted in the spectacular landscapes and seascapes of today's HSM (Fig. 2).

Conclusion

This is the first of two *NZJGG* special issue volumes dedicated to the understanding of sedimentary systems of the Hikurangi Subduction Margin (HSM). Volume 1 includes nine research papers from a diverse group of international researchers. This points to a very vibrant and exciting period of intense research into the HSM that builds upon many decades of work. Two themes of Volume 1 reveal two sides of HSM evolution, with the papers that focus on Miocene Sedimentary Systems revealing details of a very different continental margin to today, but one that would lay the foundation for the Quaternary Sedimentary System(s) that were to follow. Tantalising results from these papers also reveal a margin rattled by frequent storms, floods, landslides, earthquakes and volcanic eruptions that may have some temporal ordering to them. Collectively, these papers represent significant advances into our understanding of the geology of the HSM, with innovative results that may find applications to other convergent settings.

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Figures

Figure 1. New Zealand and the Hikurangi Subduction Margin (HSM) in the South-West Pacific. Background map from Google Earth Pro V 7.3.4.8248 (July 16, 2021), -31.38°S, 163.61°E, Eye altitude 7211 km, February 15, 2022).

Figure 2. Bathymetric and topographic map of North Island, New Zealand showing: 1) The main morpho-structural and morpho-sedimentary elements of the HSM; 2) The study areas of the papers contained within this special issue, and 3) The location of the geological cross-section of Figure 3. Mapping data come from the 250 m resolution gridded bathymetric data set 2016 from NIWA (Mitchell et al., 2012).

Figure 3. Schematic cross-section of the Hikurangi subduction margin showing: 1) The main subduction-related morpho-structural features; and 2) The relative distribution across the margin of the studies published within the special issue. Modified from Chanier et al. (1999) by Bailleul et al. (2007) and Claussmann et al. (2021, this volume). Subdivisions of the subduction wedge follows McArthur et al. (2019). C.R. – Coastal Ranges, corresponding roughly to the trench-slope break of the margin; A.P. – Accretionary prism and protothrust zone (Barnes et al., 2018).

Figure 4. This figure, from Claussmann et al. (this volume), shows impressive coastal exposures of Middle Miocene shelf-derived MTDs infilling syn-subduction intra-slope basins (image provided courtesy of Claussmann et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.1918729).

Figure 5. This figure, from Caron et al. (this volume), outlines the high diversity of microfacies that can be found in the Early Miocene limestones of the Coastal Ranges, pointing out contrasted and tectonically-controlled shallow water depositional settings on top of the early Hikurangi subduction wedge (image provided courtesy of Caron et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.1960865).

Figure 6. This figure, from Griffin et al. (this volume), illustrates comparisons between spectacular outcropping thin-bedded Miocene turbidites along the central Wairarapa coastline, and similar strata that were imaged by a FMI(™) resistivity image-log within the nearby, offshore Titihaoa-1 drillhole. Such rocks and sedimentary lithofacies are widespread within trench-slope basins in the

HSM (image provided courtesy of Griffin et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.1932527).

Figure 7. This figure, from McArthur et al. (this volume), is a schematic reconstruction of the evolution of a trench-slope basin based on a detailed sedimentological analysis and systematic mapping of a Miocene field analogue outcropping within the Coastal Ranges (image provided courtesy of McArthur et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.1977343).

Figure 8. This figure, from Tek et al. (this volume), displays several maps showing the seafloor expression of an overbank sediment wave field for a part of the deep-water Hikurangi Channel covered by 3D seismic data (image provided courtesy of Tek et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.1978509).

Figure 9. This figure, from Dutilleul et al. (this volume), locates IODP sites of Expeditions 372/375 and the Tuaheni submarine landslide Complex on a bathymetric map of the northern part of the HSM (image provided courtesy of Dutilleul et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.1990088).

Figure 10. This figure, from Marden et al. (this volume), corresponds to the pollen spectra identified from a Late Pleistocene upland paleolake recently discovered onshore the HSM (image provided courtesy of Marden et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.1947327).

Figure 11. This figure, from Ninis et al. (this volume), shows spectacular flights of Late Pleistocene wave-cut marine terraces along North Island's southern coastline, products of ongoing subduction and upper-plate faulting within the HSM (image provided courtesy of Ninis et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.2011329).

Tables

Table 1. Summary of the main themes covered by the scientific contributions to the *New Zealand Journal of Geology and Geophysics* Special Issue: Understanding Sedimentary Systems and Processes of the Hikurangi Subduction Margin; from Trench to Back-Arc, Volume 1**.**

References

Allen, SM, Marsaglia KM, Morgan J, Franco A. 2021 (this volume). Origin and diagenetic priming of a potential slow-slip trigger zone in volcaniclastic deposits flanking a seamount on the subducting plate, Hikurangi margin, New Zealand. In Strachan LJ, Bailleul J, Bland KJ, Orpin AR, McArthur AD, (Eds); Understanding sedimentary systems and processes of the Hikurangi Subduction Margin - from trench to back-arc (Volume 1); New Zealand Journal of Geology and Geophysics Special Issue. https://doi.org/10.1080/00288306.2021.1975776.

Bailey WS, McArthur AD, McCaffrey WD. 2020. Distribution of contourite drifts on convergent margins: examples from the Hikurangi subduction margin of New Zealand. Sedimentology. 68(1):296–323.

Bailleul J, Robin C, Chanier F, Guillocheau F, Field B, Ferrière J. 2007. Turbidite systems in the inner forearc domain of the Hikurangi convergent margin (New Zealand): new constraints on the development of trench-slope basins. Journal of Sedimentary Research. 77: 263-283.

Bailleul J, Chanier F, Ferrière J, Robin C, Nicol A, Mahieux G, Gorini C, Caron V. 2013. Neogene evolution of lower trench-slope basins and wedge dynamics in the central Hikurangi subduction margin, New Zealand. In Gaullier V, Basile C, Roure F, Scheck-Wenderoth M (Eds.); Basin dynamics; Tectonophysics Special Issue. 591:152-174. https://dx.doi.org/10.1016/j.tecto.2013.01.003.

Ballance PF. 1976. Evolution of the Upper Cenozoic Magmatic Arc and plate boundary in northern New Zealand. Earth and Planetary Science Letters. 28(3):356–370. https://doi.org/10.1016/0012-821X(76)90197-7.

Ballance PF. 1988. Late Cenozoic time-lines and calc-alkaline volcanic arcs in northern New Zealand — further discussion. Journal of the Royal Society of New Zealand. 18:347–358.

Ballance PF. 1993. The New Zealand Neogene forearc basins. In Hsü KJ (Ed.); South Pacific Sedimentary Basins. Sedimentary Basins of the World. 2:177–193.

Ballance PF, Hayward BW, Brook FJ. 1985. Subduction regression of volcanism in New Zealand. Nature. 313:820.

Barker DHN, Sutherland R, Henrys S, Bannister S. 2009. Geometry of the Hikurangi subduction thrust and upper plate, North Island, New Zealand. Geochemistry Geophysics Geosystems.

10(2):23 p. https://doi.org/10.1029/2008GC002153.

Barnes PM, Mercier de Lépinay B. 1997. Rates and mechanics of rapid frontal accretion along the very obliquely convergent southern Hikurangi margin, New Zealand Journal of Geophysical Research. 102:24931–24952.

Barnes PM, Nicol A, Harrison T. 2002. Late Cenozoic evolution and earthquake potential of an active listric thrust complex above the Hikurangi subduction zone, New Zealand. Geological Society of America Bulletin. 114:1379–1405.

Barnes PM, Lamarche G, Bialas J, Henrys S, Pecher I, Netzeband GL, Greinert J, Mountjoy JJ, Pedley K, Crutchley G. 2010. Tectonic and geological framework for gas hydrates and cold seeps on the Hikurangi subduction margin, New Zealand. Marine Geology. 272(1–4):26–48. https://doi.org/10.1016/j.margeo.2009.03.012.

Barnes PM, Ghisetti FC, Ellis S, Morgan JK. 2018. The role of protothrusts in frontal accretion and accommodation of plate convergence, Hikurangi subduction margin, New Zealand. Geosphere. 14:440–468.

Barnes PM, Pecher IA, LeVay LJ, Bourlange SM, Brunet MMY, Cardona S, Clennell MB, Cook AE, Crundwell MP, Dugan B, Elger J, Gamboa D, Georgiopoulou A, Greve A, Han S, Heeschen KU, Hu G, Kim GY, Kitajima H, Koge H, Li X, Machado KS, McNamara DD, Moore GF, Mountjoy JJ, Nole MA, Owari S, Paganoni M, Petronotis KE, Rose PS, Screaton EJ, Shankar U, Shepherd CL, Torres ME, Underwood MB, Wang X, Woodhouse AD, Wu, H-Y. 2019. Expedition 372A summary. In Pecher, I.A., Barnes, P.M., LeVay, L.J., and the Expedition 372A Scientists *Proceedings of the International Ocean Discovery Program* Volume 372A publications.iodp.org.

Beanland S, Melhuish A, Nicol A, Ravens J. 1998. Structure and deformational history of the inner forearc region, Hikurangi subduction margin, New Zealand. New Zealand Journal of Geology and Geophysics. 41:325–342.

Begg JG, Johnston MR. 2000 (compilers). Geology of the Wellington area. Institute of Geological and Nuclear Sciences 1:250 000 geological map 10. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences Ltd. 64 p. + 1 folded map.

Bertaud-Gandar TLB, Atkins CB, Hannah MJ. 2017. New stratigraphic constraints on the late Miocene–early Pliocene tectonic development of the Aorangi range, Wairarapa. New Zealand

Journal of Geology and Geophysics. 61:26–43.

Beu AG. 1995. Pliocene limestones and their scallops: lithostratigraphy, pectinid biostratigraphy and paleogeography of eastern North Island late Neogene limestone. Institute of Geological & Nuclear Sciences monograph, Institute of Geological & Nuclear Sciences, Lower Hutt. 10:243 p.

Beu AG, Edwards AR. 1984. New Zealand Pleistocene and Late Pliocene glacio-eustatic cycles. Palaeogeography, Palaeoclimatology, Palaeoecology. 46:119–142.

Bland KJ, Kamp PJJ, Pallentin A, Graafhuis RB, Nelson CS, Caron V. 2004. The early Pliocene Titiokura Formation: stratigraphy of a thick mixed carbonate-siliciclastic shelf succession in Hawke's Bay basin, New Zealand. New Zealand Journal of Geology and Geophysics. 47:675–695.

Bland KJ, Hendy AJW, Kamp PJJ, Nelson CS. 2013. Macrofossil biofacies in the late Neogene of central Hawke's Bay: applications to palaeogeography. New Zealand Journal of Geology and Geophysics. 56:200–222.

Bland KJ, Uruski CI, Isaac MJ. 2015. Pegasus Basin, eastern New Zealand: A stratigraphic record of subsidence and subduction, ancient and modern. New Zealand Journal of Geology and Geophysics. 58(4):319-343.

Bland KJ, Nicol A, Kamp PJJ, Nelson CS. 2019. Stratigraphic constraints on the late Miocene–Pleistocene evolution of the North Island fault system and axial ranges in the central Hikurangi subduction margin, New Zealand. New Zealand Journal of Geology and Geophysics. 62(2):248–272. https://doi.org/10.1080/00288306.2018.1545675.

Browne GH. 1986. Basement-cover relationships and tectonic significance of Mt Miroroa, western Hawke's Bay. Journal of the Royal Society of New Zealand. 16:381–402.

Browne GH. 2004. Late Neogene sedimentation adjacent to the tectonically evolving North Island axial ranges: insights from Kuripapango, western Hawke's Bay. New Zealand Journal of Geology and Geophysics. 47:663–674.

Buckeridge JS, Beu AG, Gordon DP. 2018. Depositional environments of the Early Pleistocene Castlepoint Formation, New Zealand: a canyon fill in situ. New Zealand Journal of Geology and Geophysics. 61(4):524–542.

Burgreen B, Graham S. 2014. Evolution of a deep-water lobe system in the Neogene trench-slope setting of the East Coast Basin, New Zealand: Lobe stratigraphy and architecture in a weakly confined basin configuration. Marine and Petroleum Geology. 54:1–22. https://doi.org/10.1016/j.marpetgeo.2014.02.011.

Campbell KA, Francis DA, Collins M, Gregory MR, Nelson CS, Greinert J, Aharon J. 2008. Hydrocarbon seep-carbonates of a Miocene forearc (East Coast Basin), North Island, New Zealand. Sedimentary Geology. 204:83–105.

Caron V, Nelson CS, Kamp PJJ. 2004a. Contrasting carbonate depositional systems for Pliocene cool-water limestones cropping out in central Hawke's Bay, New Zealand. New Zealand Journal of Geology and Geophysics. 47:697-617.

Caron V, Nelson CS, Kamp PJJ. 2004b. Transgressive surfaces of erosion as sequence boundary markers in cool-water shelf carbonates. Sedimentary Geology. 164:179–189.

Caron V, Nelson CS, Kamp PJJ. 2005. Sequence stratigraphic context of syndepositional diagenesis in cool-water shelf carbonates: Pliocene limestones, New Zealand. *Journal of Sedimentary Research 75*, 231-250.

Caron J, Bailleul J, Chanier F, Mahieux G. 2021 (this volume). Episodes of seabed rise and rapid drowning as primary controls for the development of regressive and transgressive heterozoan carbonates and rhodolithic limestones in a tectonically-active setting (Early Miocene, Wairarapa region, New Zealand). In Strachan LJ, Bailleul J, Bland KJ, Orpin AR, McArthur AD (Eds); Understanding sedimentary systems and processes of the Hikurangi Subduction Margin - from trench to back-arc (Volume 1); New Zealand Journal of Geology and Geophysics Special Issue. https://doi.org/10.1080/00288306.2021.1960865.

Carter L, Manighetti B, Elliot M, Trustrum N, Gomez B. 2002. Source, sea level and circulation effects on the sediment flux to the deep ocean over the past 15 ka off eastern New Zealand. Global and Planetary Change. 33(3–4):339–355.

Cashman SM, Kelsey HM, Erdman CF, Cutten HNC, Berryman KR, 1992, Strain partitioning between structural domains in the forearc of the Hikurangi subduction zone, New Zealand. Tectonics. 11:242–257.

Chanier F, Ferrières J. 1991. From a passive to an active margin: tectonic and sedimentary processes linked to the birth of an accretionary prism (Hikurangi Margin, New Zealand). Earth Science Bulletin (Bulletin de la Société Géologique de France). 162: 649–660.

Chanier F, Ferrière J, Angelier J. 1999. Extensional deformation across an active margin, relations with subsidence, uplift, and rotations: The Hikurangi subduction, New Zealand. Tectonics. 18(5):862–876. https://doi.org/10.1029/1999TC900028.

Claussmann B, Bailleul J, Chanier F, Mahieux G, Caron V, McArthur AD, Chaptal C, Morgans HEG, Vendeville BC. 2021a (this volume). Shelf-derived mass-transport deposits: origin and significance in the stratigraphic development of trench-slope basins. In Strachan LJ, Bailleul J, Bland KJ, Orpin AR, McArthur AD (Eds); Understanding sedimentary systems and processes of the Hikurangi Subduction Margin - from trench to back-arc (Volume 1); New Zealand Journal of Geology and Geophysics Special Issue. https://doi.org/10.1080/00288306.2021.1918729.

Claussmann B, Bailleul J, Chanier F, Caron V, McArthur AD, Mahieux G, Chaptal C, Vendeville BC. 2021b. Contrasting mixed siliciclastic-carbonate shelf-derived gravity-driven systems in compressional intra-slope basins (southern Hikurangi margin, New Zealand). Marine and Petroleum Geology. 134: 31 p. https://doi.org/10.1016/j.marpetgeo.2021.105252.

Cole JW, Lewis KB. 1981. Evolution of the Taupo-Hikurangi subduction system. Tectonophysics. 72:1-21.

Cole JW. 1986. Distribution and tectonic setting of late Cenozoic volcanism in New Zealand. In: Smith IEM, editor. Late Cenozoic volcanism in New Zealand. Royal Society of New Zealand bulletin 23:7–20.

Collot JY, Delteil J, Lewis KB, Davy B, Lamarche G, Audru JC, Barnes P, Chanier F, Chaumillon E, Lallemand S, Mercier de Lépinay B, Orpin A, Pelletier B, Sosson M, Toussaint B, Uruski C. 1996. From oblique subduction to intracontinental transpression: structures of the southern Kermadec–Hikurangi margin from multibeam bathymetry, side-scan sonar and seismic reflection. Marine Geophysical Researches. 18:357–381.

Collot J-Y, Lewis KB, Lamarche G, Lallemand S. 2001. The giant Ruatoria debris avalanche on the northern Hikurangi margin, New Zealand: result of oblique seamount subduction. Journal of Geophysical Research. 106:271–297.

Crisóstomo-Figueroa A, McArthur AD, Dorrell RM, Amy L, McCaffrey WD. 2020. A new modelling approach to sediment bypass prediction applied to the East Coast Basin, New Zealand. GSA Bulletin. 133(7-8):1734–1748.

Crutchley GJ, Pecher IA, Gorman AR, Henrys SA, Greinert J. 2010. Seismic imaging of gas conduits beneath seafloor vent sites in a shallow marine gas hydrate province, Hikurangi Margin, New Zealand. Marine Geology. 272(1-4):114-126.

Crutchley GJ, Gorman AR, Pecher IA, Toulmin S, Henrys SA. 2011. Geological controls on focused fluid flow through the gas hydrate stability zone on the southern Hikurangi Margin of New Zealand, evidenced from multi-channel seismic data. Marine and Petroleum Geology. 28(10):1915-1931.

Davey FJ, Hampton M, Childs J, Fisher MA, Lewis KB, Pettinga JR. 1986. Structure of a growing accretionary prism, Hikurangi margin, New Zealand. Geology. 14:663-666.

Delteil J, Morgans HEG, Raine JI, Field BD, Cutten HNC. 1996. Early Miocene thin-skinned tectonics and wrench faulting in the Pongaroa district, Hikurangi margin, North Island, New Zealand. New Zealand Journal of Geology and Geophysics. 39 :271–282.

Dutilleul J, Bourlange S, Géraud Y, Reuschlé T. 2021 (this volume). Porosity and permeability evolution in the Tuaheni Landslide Complex at Hikurangi margin from IODP sites U1517 and 1519. In Strachan LJ, Bailleul J, Bland KJ, Orpin AR, McArthur AD (Eds); Understanding sedimentary systems and processes of the Hikurangi Subduction Margin - from trench to back-arc (Volume 1); New Zealand Journal of Geology and Geophysics Special Issue. https://doi.org/10.1080/00288306.2021.1990088.

Erdman CF, Kelsey HM. 1992. Pliocene and Pleistocene stratigraphy and tectonics, Ohara depression and Wakarara range, North Island, New Zealand. New Zealand Journal of Geology and Geophysics. 35:177–192.

Faure K, Greinert J, Von Deimling JS, McGinnis DF, Kipfer R, Linke P. 2010. Methane seepage along the Hikurangi Margin of New Zealand: geochemical and physical data from the water column, sea surface and atmosphere. Marine Geology. 272:170-188.

Fernandez D, Bowen MM, Sutton PJH. 2018. Variability, coherence and forcing mechanisms in the New Zealand ocean boundary currents. Progress in Oceanography. 165:168–188.

Field BD, Uruski CI, Beu AG, Browne GH, Crampton JS, Funnell R, Killops S, Laird MG, Mazengarb, C, Morgans HEG, Rait GJ, Smale D, Strong CP. 1997. Cretaceous–Cenozoic geology and petroleum systems of the East Coast region, New Zealand. New Zealand Institute of Geological and Nuclear Sciences Monograph. 19:301 p.

Field BD. 2005. Cyclicity in turbidites of the Miocene Whakataki Formation, Castlepoint, North Island, and implications for hydrocarbon reservoir modelling. New Zealand Journal of Geology and Geophysics. 48:135-146.

Greinert J, Lewis KB, Bialas J, Pecher IA, Rowden A, Bowden DA, Debatist M, Linke P. 2010. Methane seepage along the Hikurangi Margin, New Zealand: Overview of studies in 2006 and 2007 and new evidence from visual, bathymetric and hydroacoustic investigations. Marine Geology. 272:6-25.

Griffin, B, Bland KJ, Morgans HEG, Strogen DP. 2021 (this volume). A multifaceted study of the offshore Titihaoa-1 drillhole and a Neogene accretionary slope basin, Hikurangi subduction margin. In Strachan LJ, Bailleul J, Bland KJ, Orpin AR, McArthur AD, (Eds); Understanding sedimentary systems and processes of the Hikurangi Subduction Margin - from trench to back-arc (Volume 1); New Zealand Journal of Geology and Geophysics Special Issue. https://doi.org/10.1080/00288306.2021.1932527.

Harmsen FJ. 1985. Lithostratigraphy of Pliocene strata, central and southern Hawke's Bay, New Zealand. New Zealand Journal of Geology and Geophysics. 28(3):413–433.

Hillman JIT, Crutchley GJ, Kroeger KF. 2020. Investigating the role of faults in fluid migration and gas hydrate formation along the southern Hikurangi Margin, New Zealand. Marine Geophysical Research. 41(1): article 8. https://doi.org/10.1007/s11001-020-09400-2.

Hollis CJ, Manzano-Kareah K, Crampton C, Field B, Funnel R, Morgans H, Rogers K. 2005. Source rock potential of the East Coast Basin (central and northern regions). Institute of Geological and Nuclear Sciences Client Report. 118:156 p.

Jiao R, Seward D, Little TA, Kohn BP. 2014. Thermal history and exhumation of basement rocks from Mesozoic to Cenozoic subduction cycles, central North Island, New Zealand. Tectonics. 33:1920–1935.

Joanne C, Collot J-Y, Lamarche G, Migeon S. 2010. Continental slope reconstruction after a giant mass failure, the example of the Matakaoa Margin, New Zealand. Marine Geology. 268(1-

4):67-84. https://doi.org/10.1016/j.margeo.2009.10.013.

Joanne C, Lamarche G, Collot J-Y. 2013. Dynamic of giant mass transport in deep submarine environments: the Matakaoa Debris Flow, New Zealand. Basin Research. 25(4):491-488. https://doi.org/10.1111/bre.12006.

Haywick DW, Lowe DA, Beu AG, Henderson RA, Carter RM. 1991. Pliocene-Pleistocene (Nukumaruan) lithostratigraphy of the Tangoio block, and origin of sedimentary cyclicity, central Hawke's Bay, New Zealand. New Zealand Journal of Geology and Geophysics. 34:213–225.

Katz H. 1981. Probable gas hydrate in continental slope east of the North Island, New Zealand. Journal of Petroleum Geology. 3 :315-324.

Kear D. 2004. Reassessment of Neogene tectonism and volcanism in North Island, New Zealand. New Zealand Journal of Geology and Geophysics. 47(3):361-374. https://doi.org/10.1080/00288306.2004.9515062.

Kiel S, Birgel D, Campbell K.A, Crampton JS, Schioler P, Eckmann J. 2013. Cretaceous methane-seep deposits from New Zealand and their fauna. Palaeogeography Palaeoclimatology Palaeoecology. 390:17-34.

Kingma JT. 1971. Geology of the Te Aute subdivision. Lower Hutt: New Zealand Geological Survey, Department of Scientific Industrial Research. New Zealand Geological Survey bulletin. 70.

Kroeger KF, Plaza-Faverola A, Barnes PM, Pecher IA. 2015. Thermal evolution of the New Zealand Hikurangi subduction margin: Impact on natural gas generation and methane hydrate formation – A model study. Marine and Petroleum Geology. 63:97-114.

Kroeger KF, Crutchley GJ, Kellett R, Barnes PM. 2019. A 3-D model of gas generation, migration, and gas hydrate formation at a yong convergent margin (Hikurangi margin, New Zealand). Geochemistry Geophysics Geosystems. 20:5126-5147. https://doi.org/10.1029/2019GC008275.

Lamarche G, Joanne C, Collot J-Y. 2008. Successive, large mass-transport deposits in the south Kermadec fore-arc basin, New Zealand: The Matakaoa Submarine Instability Complex. Geochemistry Geophysics Geosystems. 9(4): 30 p. https://doi.org/10.1029/2007GC001843.

Ledésert B, Buret C, Chanier F, Fèrriere J, Recourt P. 2003. Tubular structures of northern

Wairarapa (New Zealand) as possible examples of ancient fluid expulsion in an accretionary prism: evidence from field and petrographical observations. Geological Society of London Special Publication. 216: 95–107.

Lee JM, Begg JG, (compilers) 2002. Geology of the Wairarapa area. Institute of Geological & Nuclear Sciences 1:250 000 geological map 11. Lower Hutt, GNS Science. 66 p. + 1 folded map.

Lee JM, Bland KJ, Townsend DB, Kamp PJJ, (compilers). 2011. Geology of the Hawke's Bay area. Lower Hutt: Institute of Geological & Nuclear Sciences. Institute of Geological & Nuclear Sciences 1:250 000 geological map 8. 93 p. + 1 folded map.

Leonard GS, Begg JG, Wilson CJN, (compilers). 2010. Geology of the Rotorua area: scale 1:250,000. Lower Hutt: GNS Science. Institute of Geological & Nuclear Sciences 1:250,000 geological map 5. 102 p. + 1 folded map.

Lewis KB. 1994. The 1500-km-long Hikurangi Channel: trench-axis channel that escapes its trench, crosses a plateau, and feeds a fan drift. Geo-Marine Letters. 14:19–28.

Lewis KB. 1980. Quaternary sedimentation of the Hikurangi oblique subduction and transform margin. In Ballance PF, Reading HG (Eds.); Sedimentation in Oblique-slip Mobile Zones; International Association of Sedimentologists Special Publication. 4:171–189.

Lewis KB; Pettinga, JR. 1993. The emerging, imbricate frontal wedge of the Hikurangi margin. In Ballance PF (Ed.); South Pacific Sedimentary Basins; Sedimentary Basins of the World. 2:225-250.

Lewis KB, Marshall BA. 1996. Seep faunas and other indicators of methane rich dewatering on New Zealand convergent margin. New Zealand Journal of Geology and Geophysics. 39:181–200.

Lewis KB, Collot JY, Lallemand SE. 1998. The dammed Hikurangi Trough: a channel-fed trench blocked by subducting seamounts and their wake avalanches (New Zealand-France GeodyNZ Project). Basin Research. 10:441–468.

Lewis KB, Barnes PM. 1999. Kaikoura Canyon, New Zealand: active conduit from near-shore sediment zones to trench-axis channel. Marine Geology. 162:39–69.

Lewis KB, Barnes PM, Collot JY, Mercier de Lépinay B, Delteil J, TEAM GeodyNZ. 1999. Central Hikurangi GeodyNZ swath maps: depths, texture and geological interpretation. NIWA Chart

Miscellaneous Series. 77. National Institute of Water and Atmospheric Research, Wellington.

Lewis KB, Pantin HM. 2002. Channel-axis, overbank and drift sediment waves in the southern Hikurangi Trough, New Zealand. Marine Geology. 192(1-3):123–151.

Lillie AR. 1953. The geology of the Dannevirke subdivision. Lower Hutt: New Zealand Geological Survey. New Zealand Geological Survey Bulletin. 46:156 p.

Malié P, Bailleul J, Chanier F, Toullec R, Mahieux G, Caron V, Field B, Ferreiro Mählmann R, Potel S. 2017. Spatial distribution and tectonic framework of fossil tubular concretions as onshore analogues of cold seep plumbing systems, North Island of New Zealand. Earth Science Bulletin (Bulletin de la Société Géologique de France). 188(4):24 p.

Malié P, Bailleul J, Chanier F, Ferreiro Mählmann R, Toullec R, Mahieux G, Potel S. 2022. Fossil thermogenic hydrocarbon migration within the plumbing system of paleo-cold seeps in the Hikurangi subduction wedge (North Island, New Zealand). Marine and Petroleum Geology. https://doi.org/10.1016/j.marpetgeo.2022.105593.

Marden M, Holt K, Ryan M, Carrasco J, Marsaglia K, Kirby M, Palmer A. 2021 (this volume). Stratigraphy and vegetation signals from an upland, landslide-dammed, paleolake during the last Glacial-Interglacial Transition, Waipaoa Sedimentary System, Hikurangi Margin, eastern North Island, New Zealand. In Strachan LJ, Bailleul J, Bland KJ, Orpin AR, McArthur AD (Eds); Understanding sedimentary systems and processes of the Hikurangi Subduction Margin - from trench to back-arc (Volume 1); New Zealand Journal of Geology and Geophysics Special Issue. https://doi.org/10.1080/00288306.2021.1947327.

Mazengarb C, Speden IG, (compilers). 2000. Geology of the Raukumara area. Institute of Geological & Nuclear Sciences 1:250 000 geological map 6. Lower Hutt, GNS Science. 60 p. + 1 map.

McArthur AD, McCaffrey WD. 2019. Sedimentary architecture of detached deep-marine canyons: Examples from the East Coast Basin of New Zealand. Sedimentology. 66:1067–1101.

McArthur AD, Claussmann B, Bailleul J, Clare A, McCaffrey WD. 2019. Variation in syn-subduction sedimentation patterns from inner to outer portions of deep-water fold and thrust belts: examples from the Hikurangi subduction margin of New Zealand. In Hammerstein JA, DiCuia R, Cottam MA, Zamora G, Butler RWH (Eds); Fold and Thrust Belts: Structural Style, Evolution and Exploration; Geological Society of London, Special Publications. 490:285-310. https://doi.org/10.1144/SP490-2018-95.

McArthur AD, Tek DE. 2021. Controls on the origin and evolution of deep-ocean trench-axial channels. Geology. https://doi.org/10.1130/G48612.1.

McArthur AD, Bailleul J, Mahieux G, Claussmann B, Wunderlich A, McCaffrey WD. 2021a. Deformation-sedimentation feedback and the development of anomalously thick aggradational turbidite lobes: outcrop and subsurface examples from the Hikurangi Margin, New Zealand. Journal of Sedimentary Research. https://doi.org/10.2110/jsr.2020.013.

McArthur AD, Bailleul J, Chanier F, Clare A, McCaffrey WD. 2021b (this volume). Lateral and longitudinal fill variation within trench-slope basins: examples from the Neogene Akitio and Tawhero Basins, Hikurangi Margin, New Zealand. In Strachan LJ, Bailleul J, Bland KJ, Orpin AR, McArthur AD (Eds); Understanding sedimentary systems and processes of the Hikurangi Subduction Margin - from trench to back-arc (Volume 1); New Zealand Journal of Geology and Geophysics Special Issue. https://doi.org/10.1080/00288306.2021.1977343.

Mitchell J, Mackay KA, Neil HL, Mackay EJ, Pallentin A, Notman P. 2012. Undersea New Zealand, 1:5,000,000.

Mortimer N, Scott JM. 2020. Volcanoes of Zealandia and the Southwest Pacific. New Zealand Journal of Geology and Geophysics. 63(4):371–377. https://doi.org/10.1080/00288306.2020.1713824.

Mountjoy JJ, Barnes PM, Pettinga JR. 2009. Morphostructure and evolution of submarine canyons across an active margin: Cook Strait sector of the Hikurangi Margin, New Zealand. Marine Geology. 260(1-4): 45-68.

Mouslopoulou V, Nicol A, Little TA, Walsh JJ. 2007. Terminations of large strike-slip faults: an alternative model from New Zealand. In: Cunningham WD, Mann P, editors. London: Geological Society of London. Tectonics of strike-slip restraining and releasing bends. Geological Society special publication. 290: 387–415.

Nelson CS, Winefield PR, Hood SD, Caron V, Pallentin A, Kamp PJJ. 2003. Pliocene Te Aute limestones, New Zealand: expanding concepts for cool-water shelf carbonates. New Zealand Journal of Geology and Geophysics. 46: 407–424.

Nicol A, Mazengarb C, Chanier F, Rait G, Uruski C, Wallace L. 2007. Tectonic evolution of the active Hikurangi subduction margin, New Zealand, since the Oligocene. Tectonics. 26(4): 24 p. https://doi.org/10.1029/2006TC002090.

Ninis D, Little T, Litchfield N, Wang N, Jacobs K, Henderson CM. 2021 (this volume). Pleistocene marine terraces of the Wellington south coast – their distribution across multiple active faults at the southern Hikurangi subduction margin, Aotearoa New Zealand. In Strachan LJ, Bailleul J, Bland KJ, Orpin AR, McArthur AD (Eds); Understanding sedimentary systems and processes of the Hikurangi Subduction Margin - from trench to back-arc (Volume 1); New Zealand Journal of Geology and Geophysics Special Issue. https://doi.org/10.1080/00288306.2021.2011329.

Neef G. 1992. Turbidite deposition in five Miocene, bathyal formations along an active plate margin, North Island, New Zealand: with notes on styles of deposition at the margins of east coast bathyal basins. Sedimentary Geology. 78: 111–136.

Neef G. 1999. Neogene development of the onland part of the forearc in the northern Wairarapa, North Island, New Zealand: a synthesis. New Zealand Journal of Geology and Geophysics. 42:113-115. https://doi.org/10.1080/00288306.1999.9514835.

Nyman SL, Nelson CS, Campbell KA. 2010. Miocene tubular concretions in East Coast Basin, New Zealand: analogue for the subsurface plumbing of cold seeps. Marine Geology. 272(1–4):319–336.

Orpin AR, Alexander C, Kuehl S, Carter L, Walsh JP. 2006. Temporal and spatial complexity in post-glacial sedimentation on the tectonically-active, Poverty Bay continental margin of New Zealand. Continental Shelf Research. 26:2205-2224.

Paquet F, Proust JN, Barnes PM, Pettinga J. 2009. Inner forearc sequence architecture in response to climate and tectonic forcing since 150 Ka: Hawke's Bay, New Zealand. Journal of Sedimentary Research. 79:97–124.

Pecher IA, Henrys SA, Wood WT, Kukowski N, Crutchley GJ, Forhmann M. 2010. Focused fluid flow on the Hikurangi Margin, New Zealand - Evidence from possible local upwarping of the base of gas hydrate stability. Marine Geology. 272(1-4):99-113. https://doi.org/10.1016/j.margeo.2009.10.006.

Pecher IA, Barnes PM, LeVay LJ, and the Expedition 372A Scientists. 2019. Creeping gas hydrate slides. Proceedings of the International Ocean Discovery Program, 372A; College Station, TX (International Ocean Discovery Program). https://doi.org/10.14379/iodp.proc.372A.2019.

Pedley KL, Barnes PM, Pettinga JR, Lewis KB. 2010. Seafloor structural geomorphic evolution of the accretionary frontal wedge in response to seamount subduction, poverty indentation, New Zealand. Marine Geology. 270(1–4):119–138. https://doi.org/10.1016/j.margeo.2009.11.006.

Pettinga JR. 1982. Upper Cenozoic structural history, coastal Southern Hawke's Bay, New Zealand. New Zealand Journal of Geology and Geophysics. 25(2):149–191. https://doi.org/10.1080/00288306.1982.10421407.

Pettinga JR. 2003. Mud volcano eruption within the emergent accretionary Hikurangi margin, southern Hawke's Bay, New Zealand. New Zealand Journal of Geology and Geophysics. 46:107–121.

Pittari A, Prentice ML, McLeod OE, Yousef Zadeh E, Kamp PJJ, Danišík M, Vincent KA. 2021. Inception of the modern North Island (New Zealand) volcanic setting: spatio-temporal patterns of volcanism between 3.0 to 0.9 Ma. New Zealand Journal of Geology and Geophysics. 64(2/3):250–272. https://doi.org/10.1080/00288306.2021.1915343.

Plaza-Faverola A, Klaeschen D, Barnes PM, Pecher IA, Henrys S, Mountjoy J. 2012. Evolution of fluid expulsion and concentrated hydrate zones across the southern Hikurangi subduction margin, New Zealand: An analysis from depth migrated seismic data. Geochemistry Geophysics Geosystems. 13(8):22 p.

Pouderoux H, Proust JN, Lamarche G. 2012a. Building an 18 000-year-long paleo-earthquake record from the detailed deep-sea turbidite characterization in Poverty Bay, New Zealand. Natural Hazards and Earth System Sciences. 12(6):2077-2101.

Pouderoux H, Proust JN, Lamarche G., Orpin A, Neil H. 2012b. Postglacial (after 18 ka) deep-sea sedimentation along the Hikurangi subduction margin (New Zealand): Characterisation, timing and origin of turbidites. Marine Geology. 295:51-76.

Pouderoux H, Proust JN, Lamarche G. 2014. Submarine paleoseismology of the northern Hikurangi subduction margin of New Zealand as deduced from turbidite record since 16ka. Quaternary Science Reviews. 84:116-131.

Rait G.J, Chanier F, Waters DW. 1991. Landward and seaward directed thrusting accompanying the onset of subduction beneath New Zealand. Geology. 19:230-233.

Reid CM. 1998. Stratigraphy, paleontology, and tectonics of lower Miocene rocks in the

Waipatiki/Mangatuna area, southern Hawke's Bay, New Zealand. New Zealand Journal of Geology and Geophysics. 41:115–131.

Spörli KB. 1980. New Zealand and oblique-slip margins: tectonic development up to and during the Cainozoic. In Ballance PF, Reading HG (Eds.); Sedimentation in Oblique-slip Mobile Zones; International Association of Sedimentologists Special Publication. 4:147-170.

Spörli KB. 1987. Development of the New Zealand micro-continent. In Monger JWH, Francheteau J. (Eds.); Circum Pacific Orogenic Belts and Evolution of the Pacific Ocean Basin; American Geophysical Union Geodynamics Series. 18:115–132.

Stagpoole VM, Miller CA, Caratori Tontini F, Brakenrig T, Macdonald N. 2021. A two million-year history of rifting and caldera volcanism imprinted in new gravity anomaly compilation of the Taupo Volcanic Zone, New Zealand. New Zealand Journal of Geology and Geophysics. 64(2/3):358–371. https://doi.org/10.1080/00288306.2020.1848882.

Strogen DP, Kellett R, Bland KJ, Viskovic GPD, compilers. 2018. Atlas of Petroleum Prospectivity, Northeast Province (Raukumara, East Coast, and Pegasus basins): ArcGIS geodatabase, illustrated seismic transects and technical report. GNS Science Data Series 23d. 1 ArcGIS geodatabase, 4 ArcGIS projects, 12 illustrated seismic transects, 1 technical report. https://data.gns.cri.nz/pbe/

Sutherland R, Stagpoole V, Uruski C, Kennedy C, Bassett D, Henrys S, Scherwath M, Kopp H, Field B, Toulmin S, Barker D, Bannister S, Davey F, Stern T, Flueh ER.. 2009. Reactivation of tectonics, crustal underplating, and uplift after 60 Myr of passive subsidence, Raukumara Basin, Hikurangi-Kermadec fore arc, New Zealand: Implications for global growth and recycling of continents. Tectonics 28: TC5017. 23 p. https://doi.org/10.1029/2008TC002356.

Sykes R, Zink K-G, Rogers KM, Phillips A, Ventura GT. 2012. New and updated geochemical databases for New Zealand petroleum samples, with assessments of genetic oil families, source age, facies and maturity. Ministry of Economic Development New Zealand Unpublished Petroleum Report PR4513. 763 p. https://data.gns.cri.nz/pbe/index.html?content=/mapservice/Content/outputs/Geochem/Report/navigation/index.html

Tek DE, McArthur AD, Poyatos-Moré M, Colombera L, Patacci M, Craven B, McCaffrey WD. 2021a.

Relating seafloor geomorphology to subsurface architecture: how mass-transport deposits and knickpoint-zones build the stratigraphy of the deep-water Hikurangi channel. Sedimentology. Accepted.

Tek DE, McArthur AD, Poyatos-Moré M, Colombera L, Allen C, Patacci M, McCaffrey WD. 2021b (this volume). Controls on the architectural evolution of deep-water channel overbank sediment wave fields: insights from the Hikurangi Channel, offshore New Zealand. In Strachan LJ, Bailleul J, Bland KJ, Orpin AR, McArthur AD (Eds); Understanding sedimentary systems and processes of the Hikurangi Subduction Margin - from trench to back-arc (Volume 1); New Zealand Journal of Geology and Geophysics Special Issue. https://doi.org/10.1080/00288306.2021.1978509.

Van der Lingen GJ, Pettinga JG. 1980. The Makara basin: a Miocene slope basin along the New Zealand sector of the Australian–Pacific obliquely convergent plate boundary. In Ballance PF, Reading HG (Eds.); Sedimentation in Oblique slip Mobile Zones; International Association of Sedimentologists Special Publication. 4:191-215.

Van Der Lingen GJ. 1982. Development of the North Island subduction system, New Zealand. In Leggett JK (Ed.); Trench-forearc geology; Geological Society of London Special Publication. 10:259–274.

Wallace LM, Saffer DM, Barnes PM, Pecher IA, Petronotis KE, LeVay LJ, and the Expedition 372/375 scientists. 2019. Hikurangi subduction margin coring, logging, and observatories. Proceedings of the International Ocean Discovery Program, 372B/375; College Station, TX (International Ocean Discovery Program). https://doi.org/10.14379/iodp.proc.372B375.2019.

Watson, SJ, Mountjoy JJ, Barnes PM, Crutchley GJ, Lamarche G, Higgs B, Hillman J, Orpin AR, Micallef A, Neil H, Mitchell J, Pallentin A, Kane T, Woelz S, Bowden D, Rowden AA, Pecher IA. 2020a. Focused fluid seepage related to variations in accretionary wedge structure, Hikurangi margin, New Zealand. Geology. *48* (1), 56-61.

Watson SJ, Mountjoy JJ, Crutchley GJ. 2020b. Tectonic and geomorphic controls on the distribution of submarine landslides across active and passive margins, eastern New Zealand. In Georgiopoulou A, Amy LA, Benetti S, Chaytor JD, Clare MA, Gamboa D, Haughton PDW, Moernaut J, Mountjoy JJ (Eds.); Subaqueous mass movements and their consequences:

advances in process understanding, monitoring and hazard assessments; Geological Society of London Special Publications. 500:477–494.

Wilson CJN, Houghton BF, McWilliams MO, Lanphere MA, Weaver SD, Briggs RM. 1995. Volcanic and structural evolution of Taupo Volcanic Zone, New Zealand: a review. Journal of Volcanology and Geothermal Research. 68(1–3):1–28. https://doi.org/10.1016/0377-0273(95)00006-G.

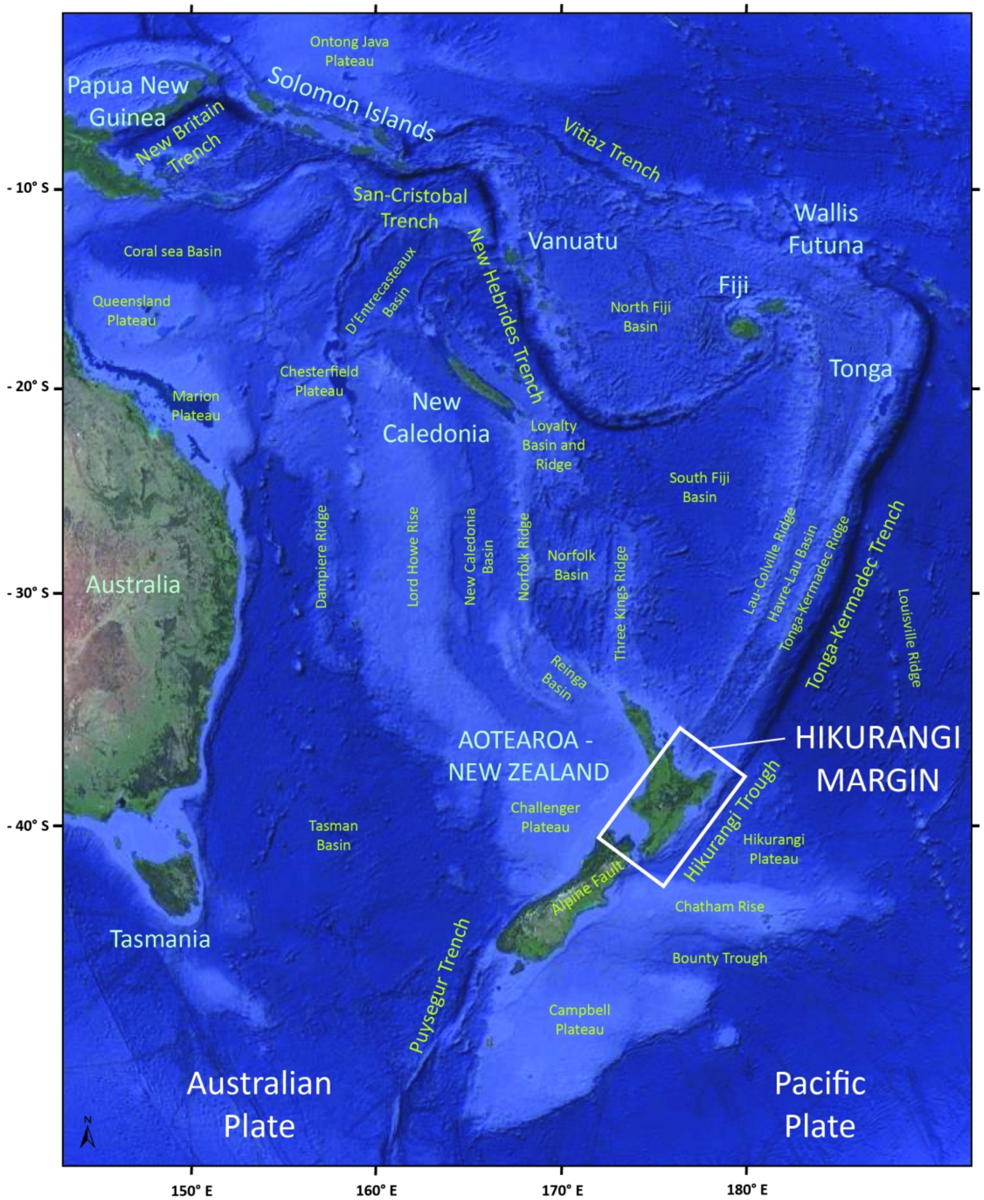

Figure 1. New Zealand and the Hikurangi Subduction Margin (HSM) in the South-West Pacific. Background map from Google Earth Pro V 7.3.4.8248 (July 16, 2021), -31.38°S, 163.61°E, Eye altitude 7211 km, February 15, 2022).

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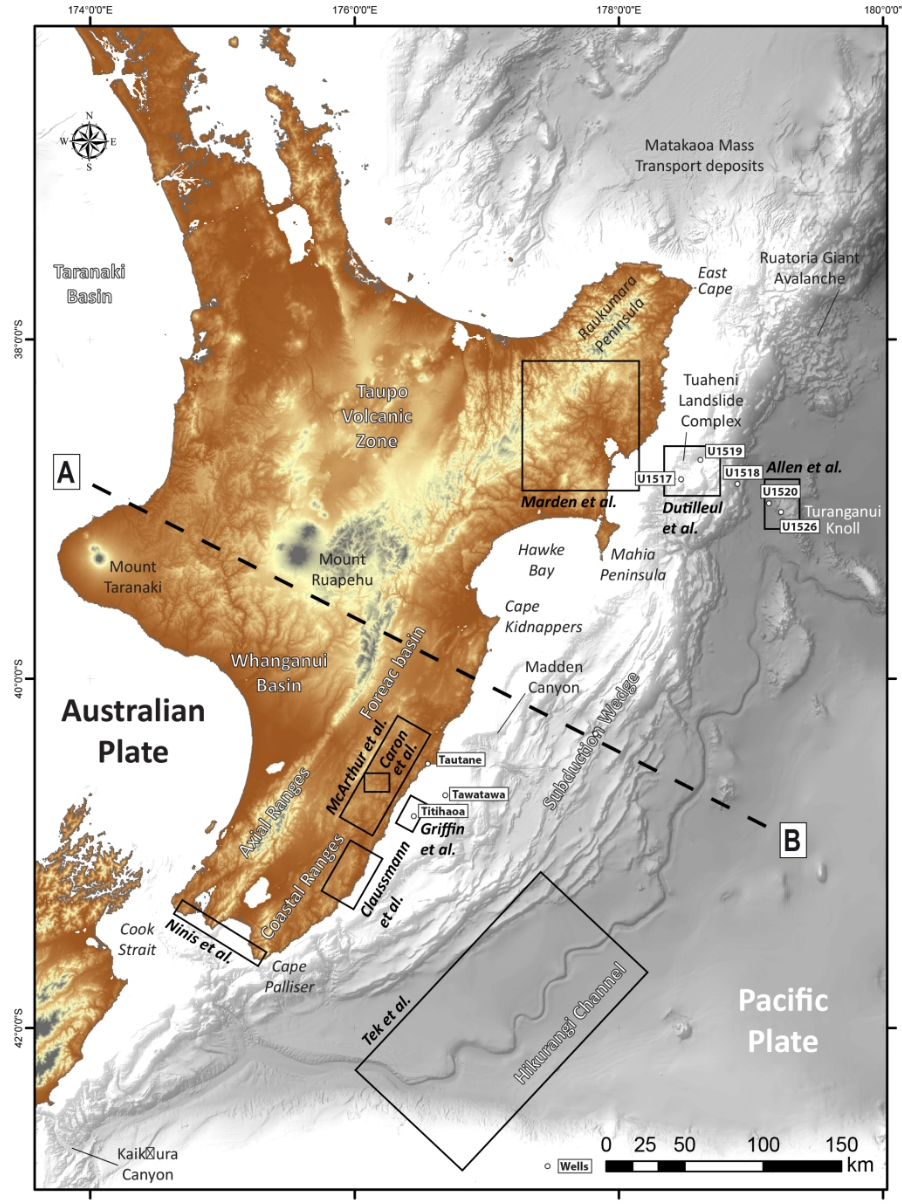

Figure 2. Bathymetric and topographic map of North Island, New Zealand showing: 1) The main morpho-structural and morpho-sedimentary elements of the HSM; 2) The study areas of the papers contained within this special issue, and 3) The location of the geological cross-section of Figure 3. Mapping data come from the 250 m resolution gridded bathymetric data set 2016 from NIWA (Mitchell et al., 2012).

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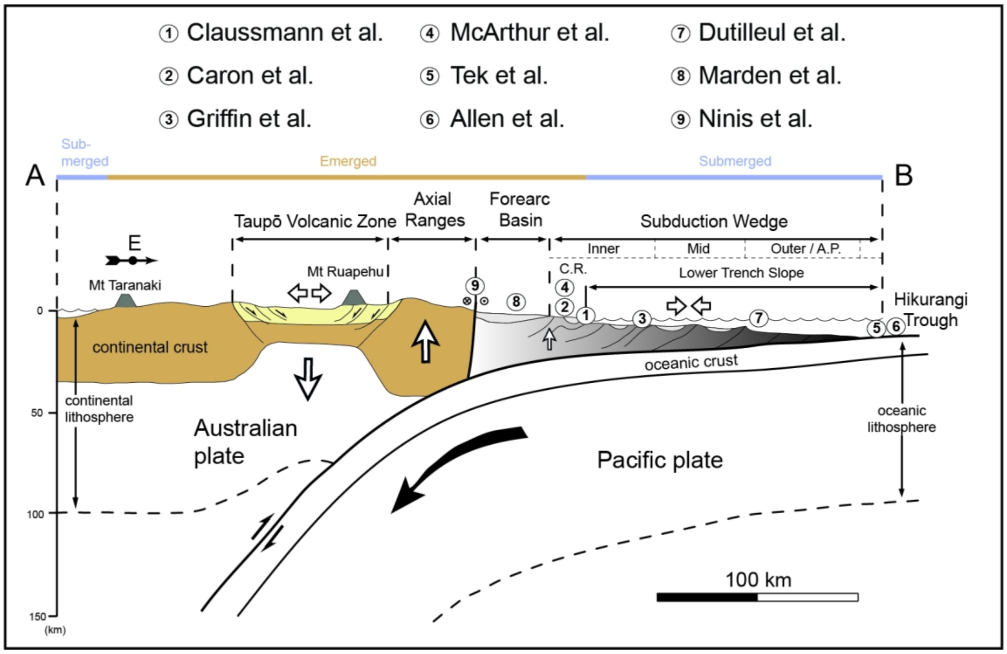

Figure 3. Schematic cross-section of the Hikurangi subduction margin showing: 1) The main subduction-related morpho-structural features; and 2) The relative distribution across the margin of the studies published within the special issue. Modified from Chanier et al. (1999) by Bailleul et al. (2007) and Claussmann et al. (2021, this volume). Subdivisions of the subduction wedge follows McArthur et al. (2019). C.R. – Coastal Ranges, corresponding roughly to the trench-slope break of the margin; A.P. – Accretionary prism and protothrust zone (Barnes et al., 2018).

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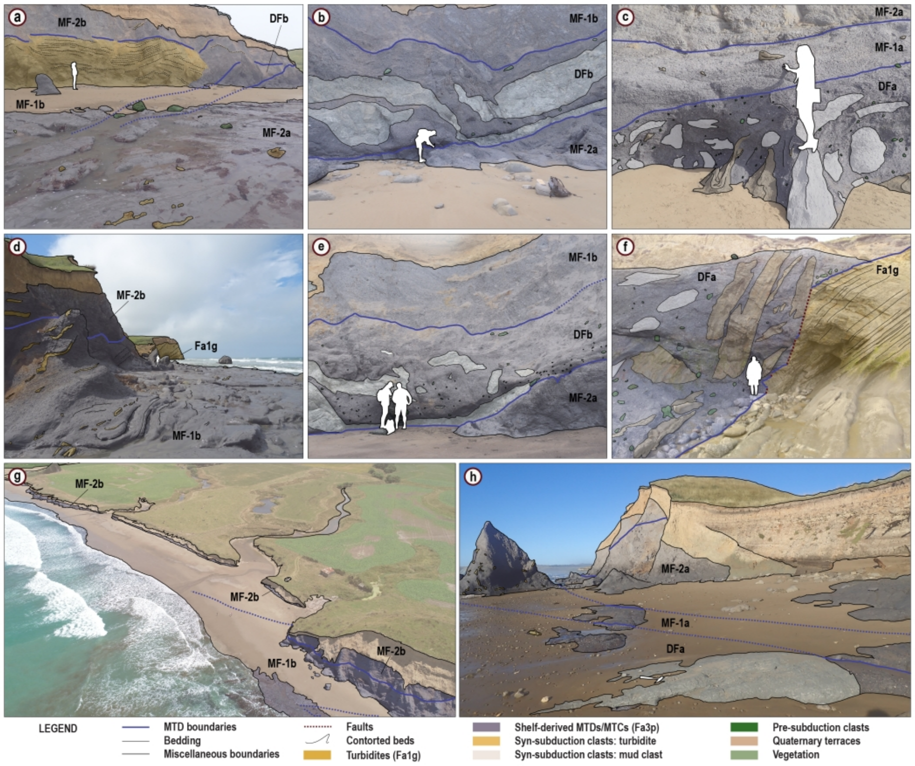

Figure 4. This figure, from Claussmann et al. (this volume), shows impressive coastal exposures of Middle Miocene shelf-derived MTDs infilling syn-subduction intra-slope basins (image provided courtesy of Claussmann et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.1918729).

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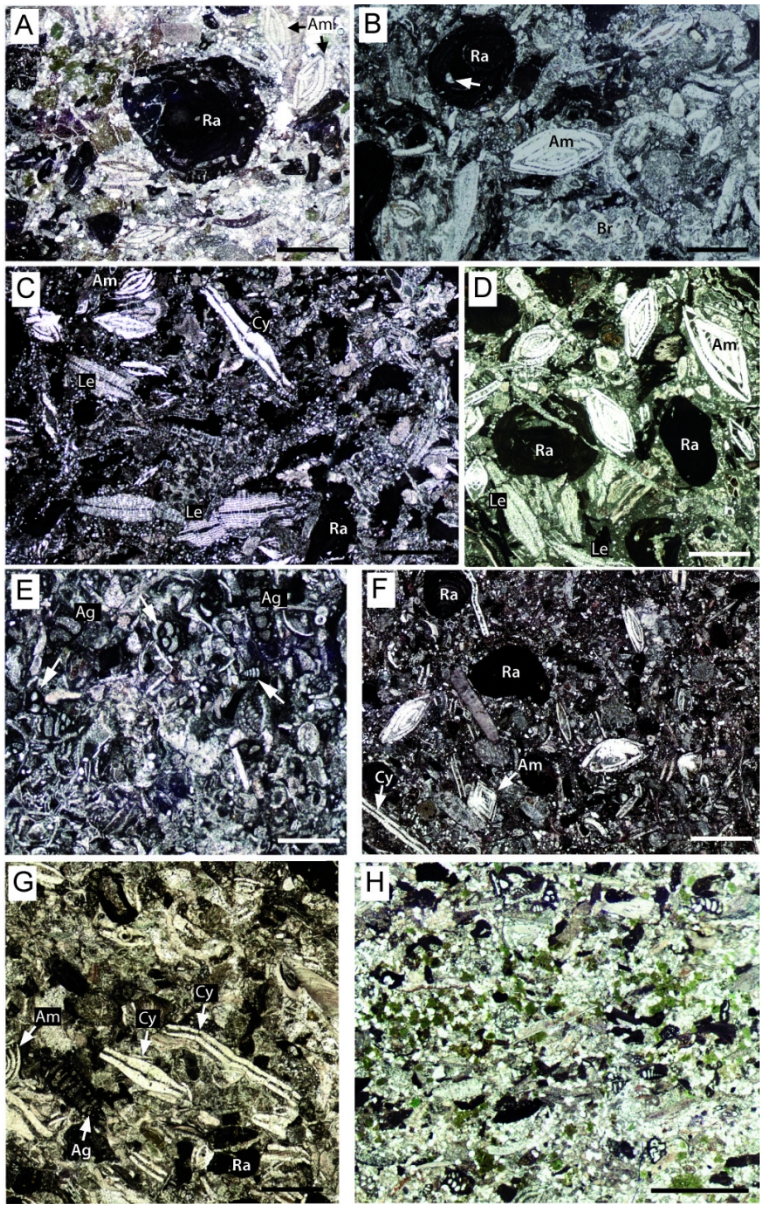

Figure 5. This figure, from Caron et al. (this volume), outlines the high diversity of microfacies that can be found in the Early Miocene limestones of the Coastal Ranges, pointing out contrasted and tectonically-controlled shallow water depositional settings on top of the early Hikurangi subduction wedge (image provided courtesy of Caron et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.1960865).

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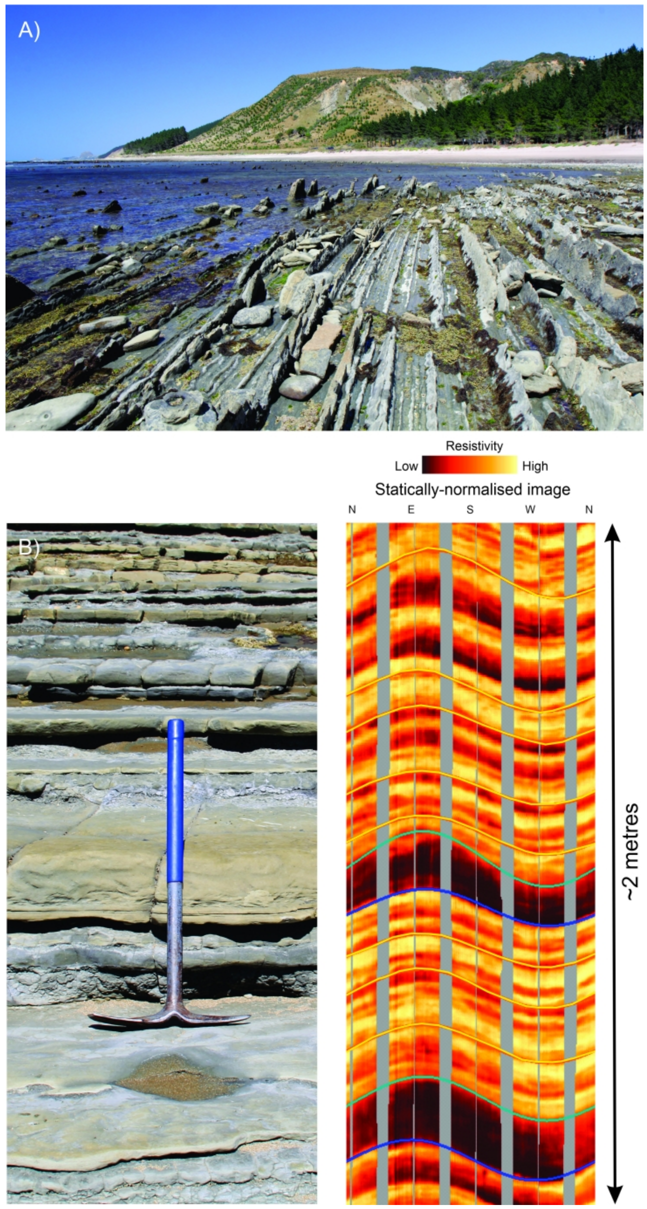

Figure 6. This figure, from Griffin et al. (this volume), illustrates comparisons between spectacular outcropping thin-bedded Miocene turbidites along the central Wairarapa coastline, and similar strata that were imaged by a FMI(™) resistivity image-log within the nearby, offshore Titihaoa-1 drillhole. Such rocks and sedimentary lithofacies are widespread within trench-slope basins in the HSM (image provided courtesy of Griffin et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.1932527).

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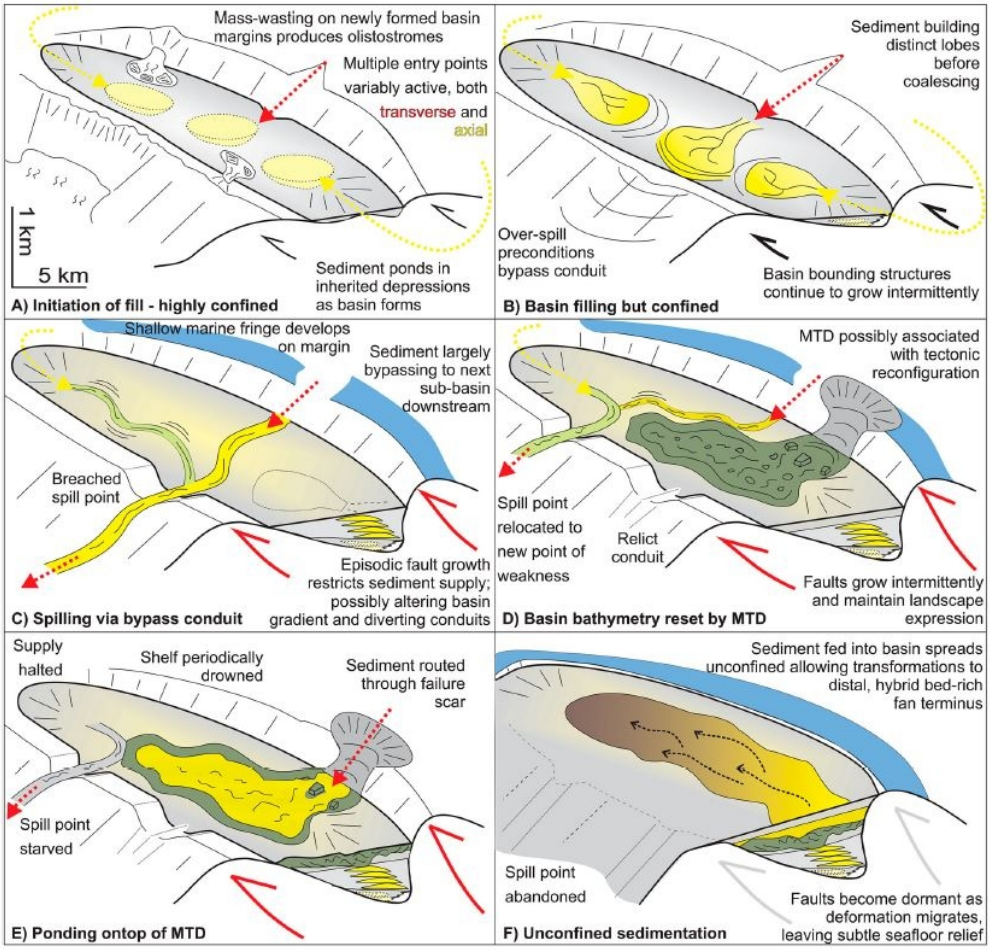

Figure 7. This figure, from McArthur et al. (this volume), is a schematic reconstruction of the evolution of a trench-slope basin based on a detailed sedimentological analysis and systematic mapping of a Miocene field analogue outcropping within the Coastal Ranges (image provided courtesy of McArthur et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.1977343).

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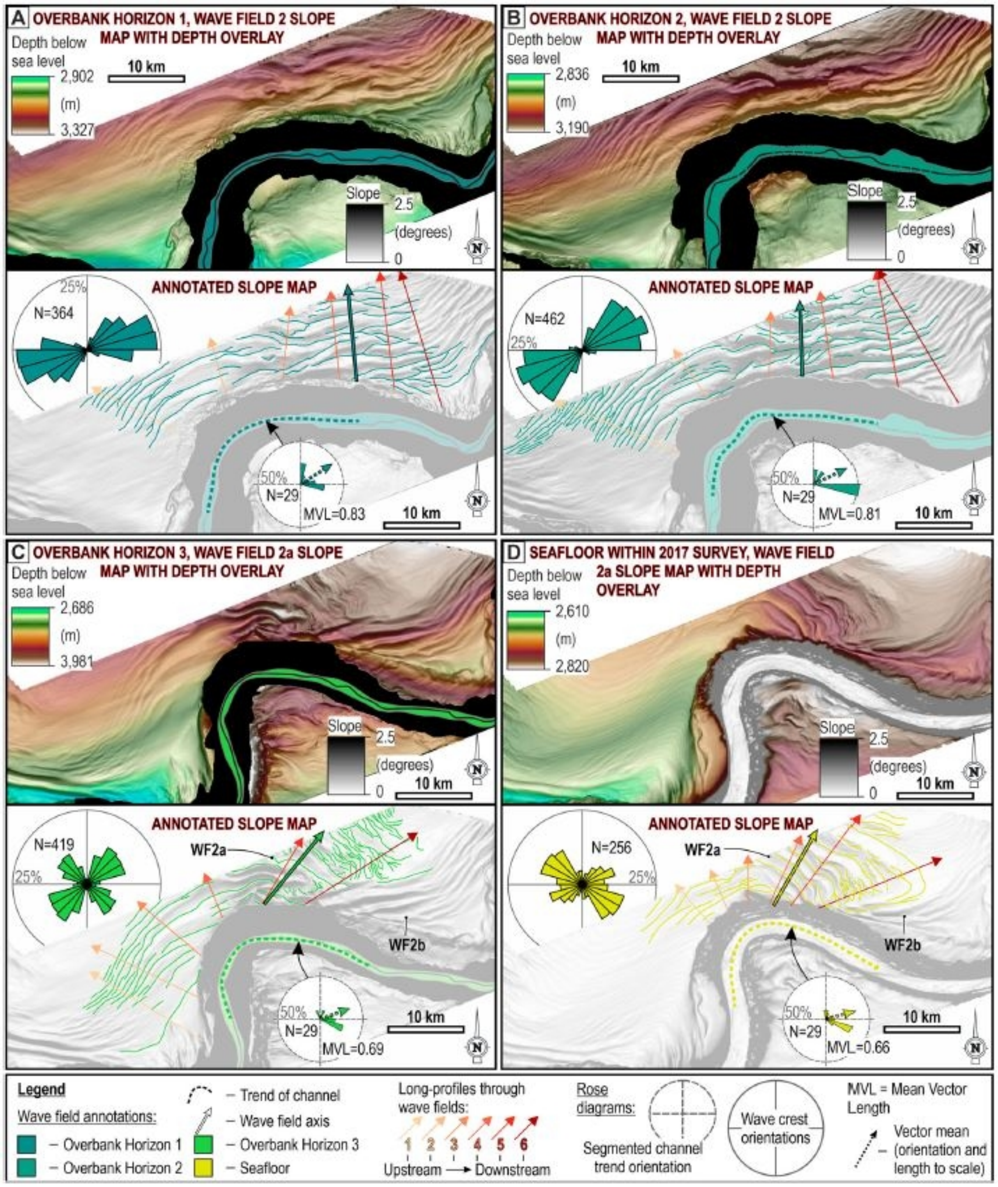

Figure 8. This figure, from Tek et al. (this volume), displays several maps showing the seafloor expression of an overbank sediment wave field for a part of the deep-water Hikurangi Channel covered by 3D seismic data (image provided courtesy of Tek et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.1978509).

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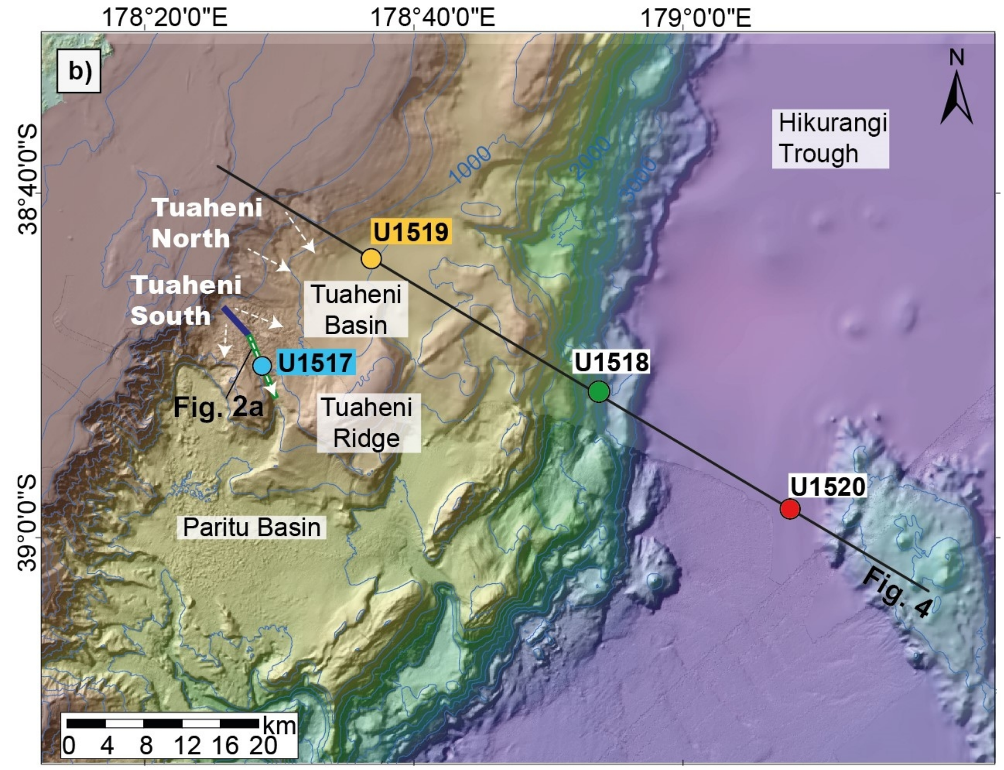

Figure 9. This figure, from Dutilleul et al. (this volume), locates IODP sites of Expeditions 372/375 and the Tuaheni submarine landslide Complex on a bathymetric map of the northern part of the HSM (image provided courtesy of Dutilleul et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.1990088).

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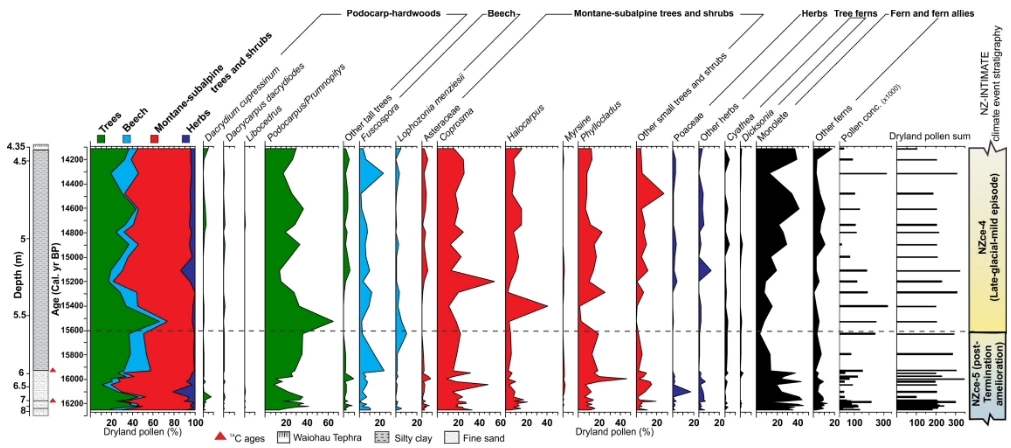

Figure 10. This figure, from Marden et al. (this volume), corresponds to the pollen spectra identified from a Late Pleistocene upland paleolake recently discovered onshore the HSM (image provided courtesy of Marden et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.1947327).

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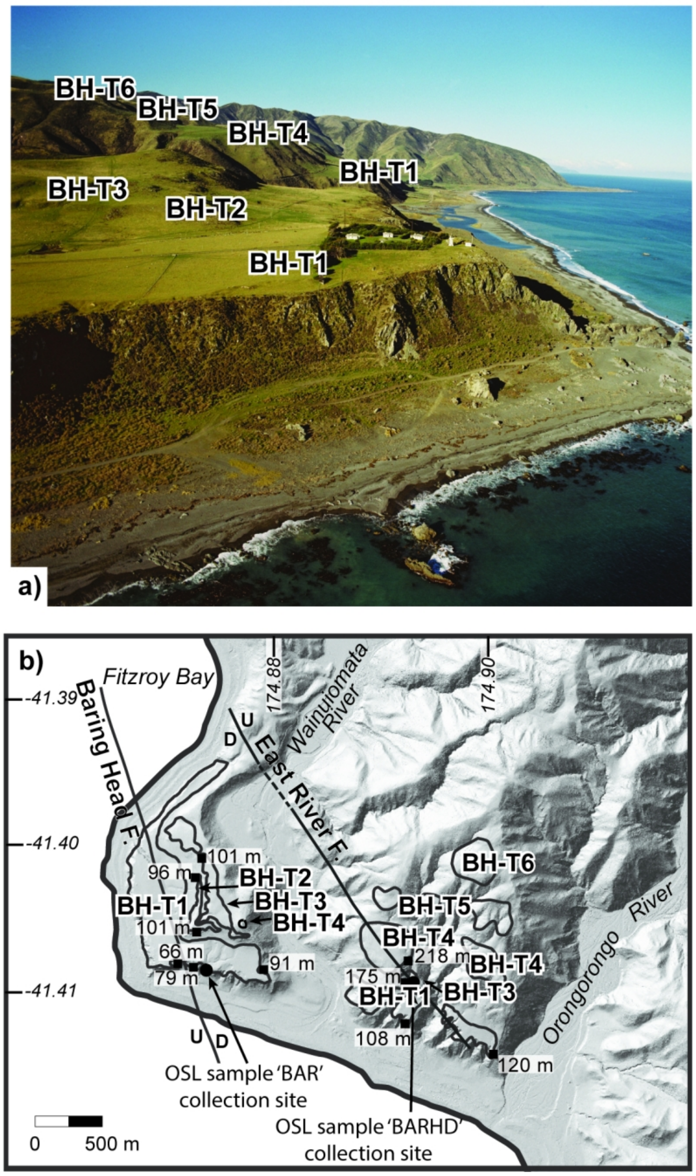

Figure 11. This figure, from Ninis et al. (this volume), shows spectacular flights of Late Pleistocene wave-cut marine terraces along North Island's southern coastline, products of ongoing subduction and upper-plate faulting within the HSM (image provided courtesy of Ninis et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.2011329).

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HIKURANGI SUBDUCTION MARGIN	Stratigraphic Architectures	Dynamics of Sedimentary Systems	Mass-Transport Deposits	Paleogeography / Paleoenvironments / paleoclimates / paleovegetation	Interplays between Tectonics and Sedimentation	Slow-slip Events / Neotectonics / Marine Terraces	Diagenesis / Petrophysics	Gaz Hydrates	IODP Expeditions 372A and 375
Onshore	Caron et al. Marden et al. McArthur et al.	Caron et al. Claussmann et al. Marden et al.	Claussmann et al. McArthur et al.	Caron et al. Claussmann et al. Marden et al.	Caron et al. Claussmann et al. McArthur et al. Ninis et al.	Ninis et al.			
Offshore	Griffin at al. McArthur et al. Tek et al.	Tek et al.	Dutilleul et al.	Griffin at al.	Griffin at al.	Allen et al.	Allen et al. Dutilleul et al.	Dutilleul et al.	Allen et al. Dutilleul et al.