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## Understanding sedimentary systems and processes of the Hikurangi subduction margin; from Trench to Back-Arc. Volume 2

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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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# 1 **Understanding Sedimentary Systems and Processes of the Hikurangi** 2 **Subduction Margin; from Trench to Back-Arc. Volume 1.**

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10

## 11 **ABSTRACT**

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



## 27 **Keywords**

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

## 30 **Introduction**

31 This is the first of two special issue volumes dedicated to the understanding of sedimentary  
32 systems of the Hikurangi Subduction Margin (HSM), located to the east of the North Island,  
33 Aotearoa-New Zealand (Fig. 1). The HSM forms the southern part of the Tonga-Kermadec-  
34 Hikurangi subduction system, where the oceanic Pacific plate is obliquely subducting beneath the  
35 continental Australian plate (Fig. 1; (Ballance 1976, 1993; Spörli 1980; Cole and Lewis 1981;  
36 Pettinga 1982; Chanier and Ferrière 1991; Lewis & Pettinga 1993; Field et al. 1997; Lewis et al.  
37 1998; Nicol et al. 2007; Barnes et al. 2010). Subduction is interpreted to have initiated ~25 Ma  
38 and continues today (Rait et al. 1991; Nicol et al. 2007; Jiao et al. 2014). For the purposes of this  
39 special issue, the HSM region encompasses a broad deformation zone, at least 200 km across,  
40 stretching from the offshore Hikurangi Trough to the onshore Taupō Volcanic Zone (Ballance  
41 1993; Lewis & Pettinga, 1993; Nicol et al. 2007; Pedley et al., 2010) (Fig. 2). It contains many of  
42 the tectono-geomorphic elements of an idealised subduction system (e.g., Ballance 1993; Bailleul  
43 et al. 2013) (Fig. 3).

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

55 Small sedimentary basins within the imbricated wedge are often filled with thick successions of  
56 syn-subduction sedimentary rocks (Fig. 3) (e.g. Lewis 1980; Cole and Lewis 1981; Pettinga 1982;  
57 Davey et al. 1986; Lewis and Pettinga 1993; Collot et al. 1996; Barnes et al. 2010; Bailleul et al.  
58 2007, 2013; Paquet et al. 2009; Bland et al. 2015; Strogon et al. 2018; McArthur et al. 2019; Griffin  
59 et al. 2021, this volume). The offshore margin displays extensive evidence of intense fluid  
60 migration (e.g. Katz 1981; Lewis and Marshall 1996; Barnes et al. 2010; Crutchley et al. 2010,  
61 2011; Faure et al. 2010; Greinert et al. 2010; Pecher et al. 2010; Plaza-Faverola et al. 2012;  
62 Kroeger et al. 2015, 2019; Watson et al. 2020a; Hillman et al. 2020), mass-wasting occurrences  
63 (Collot et al. 2001; Lamarche et al. 2008; Mountjoy et al. 2009; Joanne et al. 2010, 2013; Watson  
64 et al. 2020b), frequent downslope turbidity currents (e.g. Orpin et al. 2006, Pouderoux et al.,  
65 2012a, 2012b, 2014; Crisóstomo-Figueroa et al. 2020) and contourite deposition (Carter et al.  
66 2002; Lewis and Pantin, 2002; Fernandes et al. 2018; Bailey et al. 2020). To the west, an exhumed  
67 emergent part of the subduction wedge, within the North Island's Coastal Ranges, allows for  
68 careful outcrop-based approaches to understand the origins and architecture of the margin's  
69 many trench-slope basins and depositional processes within gravity-driven systems (e.g. Van der  
70 Lingen and Pettinga 1980; Pettinga 1982; Van der Lingen 1982; Neef 1992, 1999; Lewis and  
71 Pettinga 1993; Reid 1998; Field 2005; Bailleul et al. 2007, 2013; Burgreen and Graham 2014;  
72 Buckeridge et al. 2018; McArthur and McCaffrey 2019; Caron et al. this volume; Claussmann et  
73 al. 2021b, this volume; McArthur et al. 2021a, this volume). In addition to active onland mud  
74 volcanoes and oil and gas seeps (Field et al. 1997; Pettinga 2003; Hollis et al. 2005; Sykes et al.  
75 2012; Malié et al. 2022), that part of the margin displays outcropping paleo-methane seeps and  
76 expressions of their plumbing systems (tubular carbonate concretions) hosted by Cretaceous to  
77 Miocene rocks (Ledéseret et al., 2003; Campbell et al., 2008; Nyman et al., 2010; Kiel et al., 2013;  
78 Malié et al., 2017, 2022). Inboard of the Coastal Ranges lies a comparatively little-deformed  
79 partially exhumed forearc basin, in places containing >5 km of Neogene–Quaternary mixed  
80 clastic-carbonate sedimentary fill (e.g., Lillie 1953; Kingma 1971; Beu and Edwards 1984; Harmsen  
81 1985; Haywick et al. 1991; Ballance 1993; Beu 1995; Field et al. 1997; Begg and Johnston 2000;  
82 Mazengarb and Speden 2000; Lee and Begg 2002; Nelson et al. 2003; Bland et al. 2004, 2013;  
83 Caron et al. 2004a, 2004b, 2005; Lee et al. 2011; Bertaud-Gandar et al. 2017). The forearc basin

84 is back-stopped by uplifted by fault-bounded Mesozoic metasedimentary basement rocks of  
85 North Island's Axial Ranges, which are closely associated with many active crustal-scale strike-slip  
86 faults (North Island fault system) (e.g., Spörli 1980; Browne 1986, 2004; Cashman et al. 1992;  
87 Erdman and Kelsey 1992; Beanland et al. 1998; Lee and Begg 2002; Mouslopoulou et al. 2007;  
88 Nicol et al. 2007; Lee et al. 2011; Jiao et al. 2014; Bland et al. 2019; Ninis, this volume). The active  
89 back-arc Taupō Volcanic Zone, incorporating voluminous rhyolitic, andesitic, and basaltic eruptive  
90 centres, defines the western extent of the region of interest for this volume (e.g., Ballance 1976,  
91 1988; Ballance et al. 1985; Cole 1986; Wilson et al. 1995; Kear 2004; Leonard et al. 2010; Lee et  
92 al. 2011; Mortimer and Scott 2020; Stagpoole et al. 2021; Pittari et al. 2021) (Fig. 3).

93 This volume includes nine original research papers that represent a diversity of topics,  
94 approaches, geological ages, and research groups from around the globe, including both  
95 emerging and established researchers (Table 1). They are linked by the significance of the HSM  
96 as an accessible global laboratory for tectonic, sedimentological, and paleontological research.  
97 Many of these studies build on a legacy of several decades of outcrop and marine geology  
98 research, requiring cumulative months of fieldwork and numerous voyages (e.g., Lillie 1953;  
99 Kingma 1971; Van der Lingen and Pettinga 1980; Pettinga 1982; Harmsen 1985; Rait et al. 1991;  
100 Chanier and Ferrière 1991; Neef 1992; Lewis et al. 1993, 1999; Lewis and Pettinga 1993; Van der  
101 Lingen and Pettinga 1993; Beu 1995; Delteil et al. 1996; Barnes et al. 2010, 2019; Pecher et al.  
102 2019; Wallace et al. 2019). In addition, several authors have utilised freely available petroleum  
103 exploration (2D seismic-reflection and drillhole) data sets (e.g. Barnes et al. 2002; Barker et al.  
104 2009; Sutherland et al. 2009; Plaza-Faverola et al. 2012; Bland et al. 2015; Griffin et al. 2021, this  
105 volume) and proprietary 3D seismic data volumes (e.g. McArthur et al. 2019, this volume; Tek et  
106 al. 2021b this volume) to provide broader-scale context to understanding sedimentary system  
107 scale processes.

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

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

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

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

### 133 **Theme 1 Miocene sedimentary systems and basin evolution**

134 Special Issue Volume 1 and Theme 1 opens with Claussmann et al. who integrate mapping (3D  
135 outcrop models from drone acquisitions), high-resolution photography, sedimentology,  
136 paleontology, and taphonomy to unravel the spatio-temporal distribution of outcropping Early to  
137 Middle Miocene mass-transport deposits (MTDs) along the central Wairarapa coast (Fig. 2). The  
138 paper includes amazing images focussing on outcropping shelf-derived MTDs deposited in trench-  
139 slope basins (Fig. 4). The authors describe a range of distinct MTD textures, and link them to  
140 variable MTD transport processes and distance from the contemporaneous shelf, resulting in the

141 identification of complex slope stratigraphies consisting of multi-scaled coalescing deposits. The  
142 authors invoke ongoing fold-thrust belt deformation associated with evolving subduction as the  
143 principle MTD trigger.

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

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

162 This theme's fourth paper, by McArthur et al., presents a comprehensive reconstruction of the  
163 Early to Middle Miocene geological history of the onshore Akitio sub-basin. The outcrop-based  
164 study uses detailed lithofacies and stratigraphic analyses integrated with micropaleontological,  
165 and geological mapping data, to build realistic architectural models for trench-slope basins.  
166 Results also provide insights for the more proximal parts of the sedimentary system. Moreover,  
167 by using proprietary seismic reflection data, the authors compare the onshore outcrop  
168 stratigraphy to the offshore, actively filling Akitio Trough, highlighting controls on trench-slope

169 basin fill. Using these case studies together, they present a schematic model of the evolution of  
170 Neogene–Quaternary trench-slope basins within the Hikurangi Margin (Fig. 7). Although the  
171 offshore area represents a subtly different setting with no shallow-marine incursions, a similar  
172 evolution is proposed, from confined to semi- to unconfined basin filling.

## 173 **Theme 2 - Quaternary Sedimentary Systems - from trench to inner margin**

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

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

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

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

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



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

## 234 **Conclusion**

235 This is the first of two *NZJGG* special issue volumes dedicated to the understanding of sedimentary  
236 systems of the Hikurangi Subduction Margin (HSM). Volume 1 includes nine research papers from  
237 a diverse group of international researchers. This points to a very vibrant and exciting period of  
238 intense research into the HSM that builds upon many decades of work. Two themes of Volume  
239 1 reveal two sides of HSM evolution, with the papers that focus on Miocene Sedimentary Systems  
240 revealing details of a very different continental margin to today, but one that would lay the  
241 foundation for the Quaternary Sedimentary System(s) that were to follow. Tantalising results  
242 from these papers also reveal a margin rattled by frequent storms, floods, landslides, earthquakes  
243 and volcanic eruptions that may have some temporal ordering to them. Collectively, these papers  
244 represent significant advances into our understanding of the geology of the HSM, with innovative  
245 results that may find applications to other convergent settings.

## 246 **Acknowledgements**

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248 a success. We would also like to warmly acknowledge all the reviewers who willingly shared their  
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251 managing teams both at the New Zealand Royal Society and from Taylor & Francis. A special  
252 thanks to Yolaine Rubert for her help in constructing the topographic and bathymetric maps from  
253 the NIWA data set.



## 254 **Figures**

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

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

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

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

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

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

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

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

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

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

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

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

## 305 **Tables**

306 **Table 1.** Summary of the main themes covered by the scientific contributions to the *New Zealand*  
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308 Processes of the Hikurangi Subduction Margin; from Trench to Back-Arc, Volume 1.

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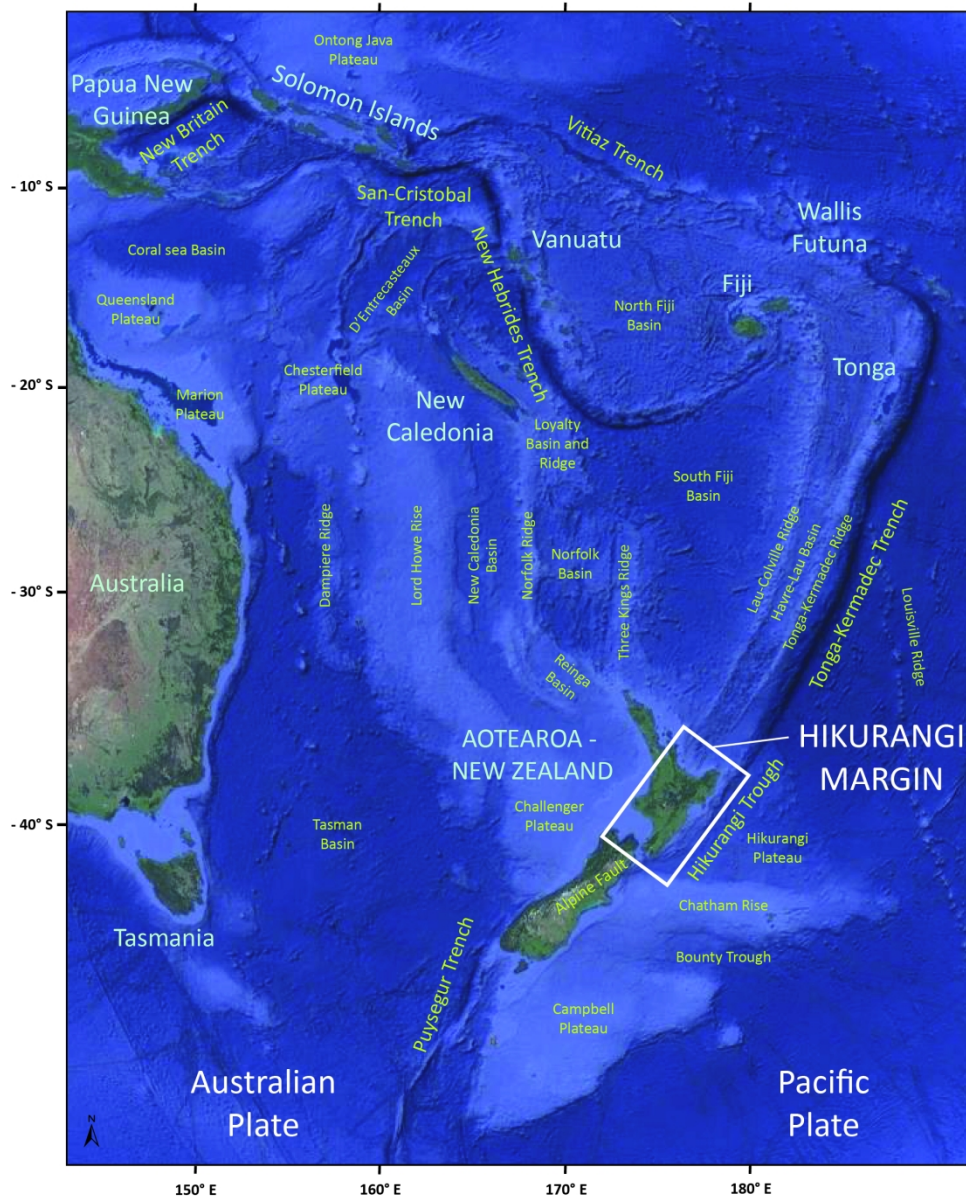


Figure 1. New Zealand and the Hikurangi Subduction Margin (HSM) in the South-West Pacific. Background map from Google Earth Pro V 7.3.4.8248 (July 16, 2021), -31.38°S, 163.61°E, Eye altitude 7211 km, February 15, 2022).

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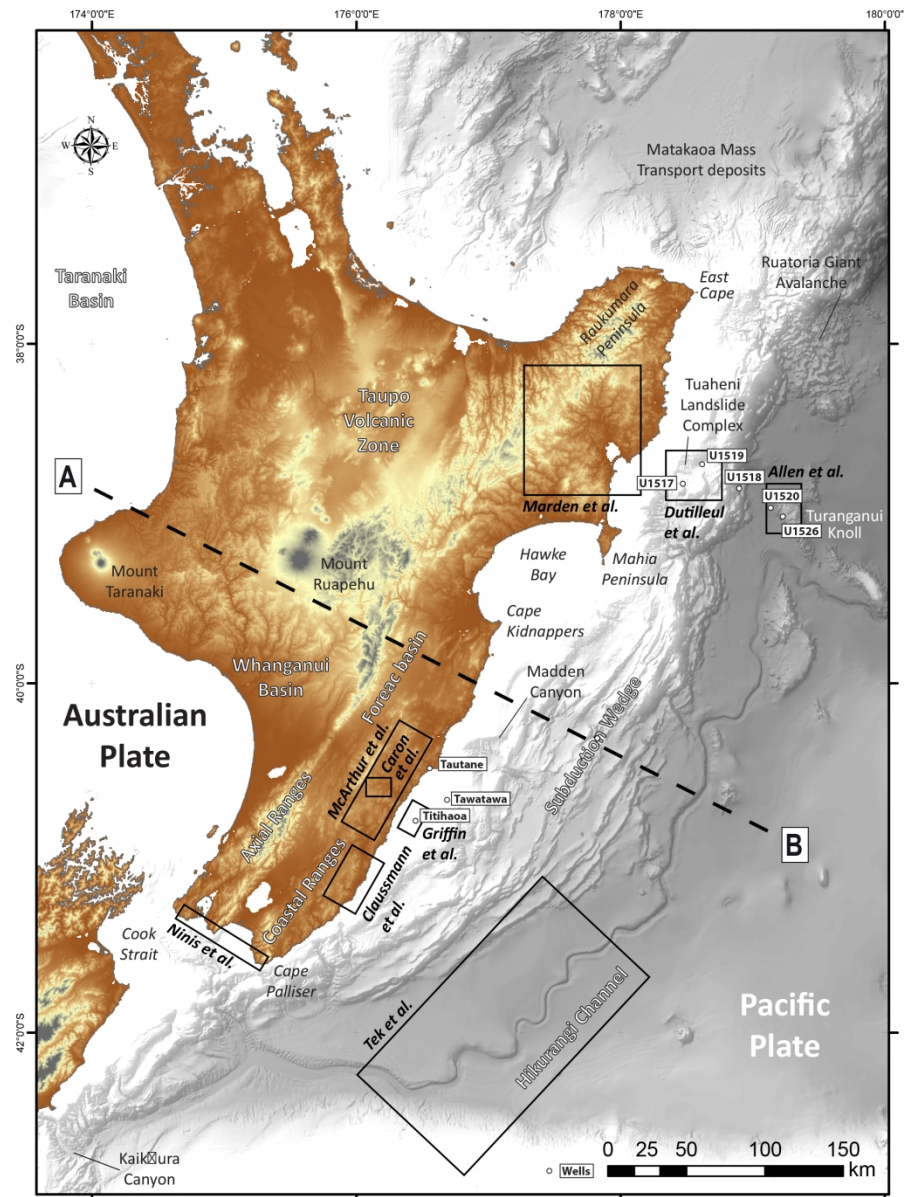


Figure 2. Bathymetric and topographic map of North Island, New Zealand showing: 1) The main morpho-structural and morpho-sedimentary elements of the HSM; 2) The study areas of the papers contained within this special issue, and 3) The location of the geological cross-section of Figure 3. Mapping data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

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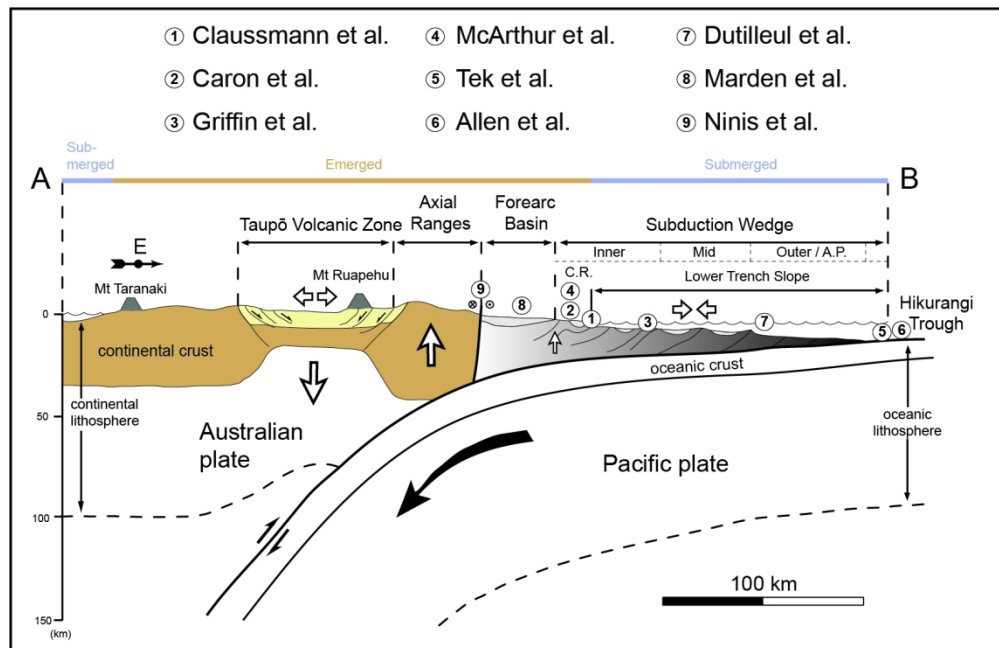


Figure 3. Schematic cross-section of the Hikurangi subduction margin showing: 1) The main subduction-related morpho-structural features; and 2) The relative distribution across the margin of the studies published within the special issue. Modified from Chanier et al. (1999) by Bailleul et al. (2007) 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).

143x92mm (300 x 300 DPI)



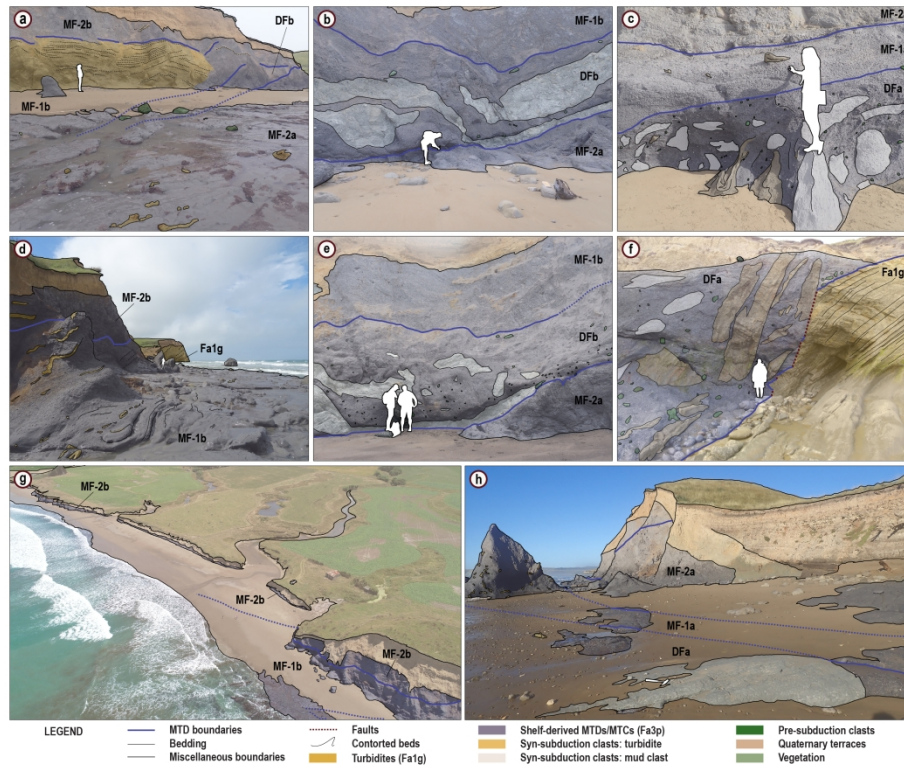


Figure 4. This figure, from Claussmann et al. (this volume), shows impressive coastal exposures of Middle Miocene shelf-derived MTDs infilling syn-subduction intra-slope basins (image provided courtesy of Claussmann et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.1918729).

297x230mm (300 x 300 DPI)

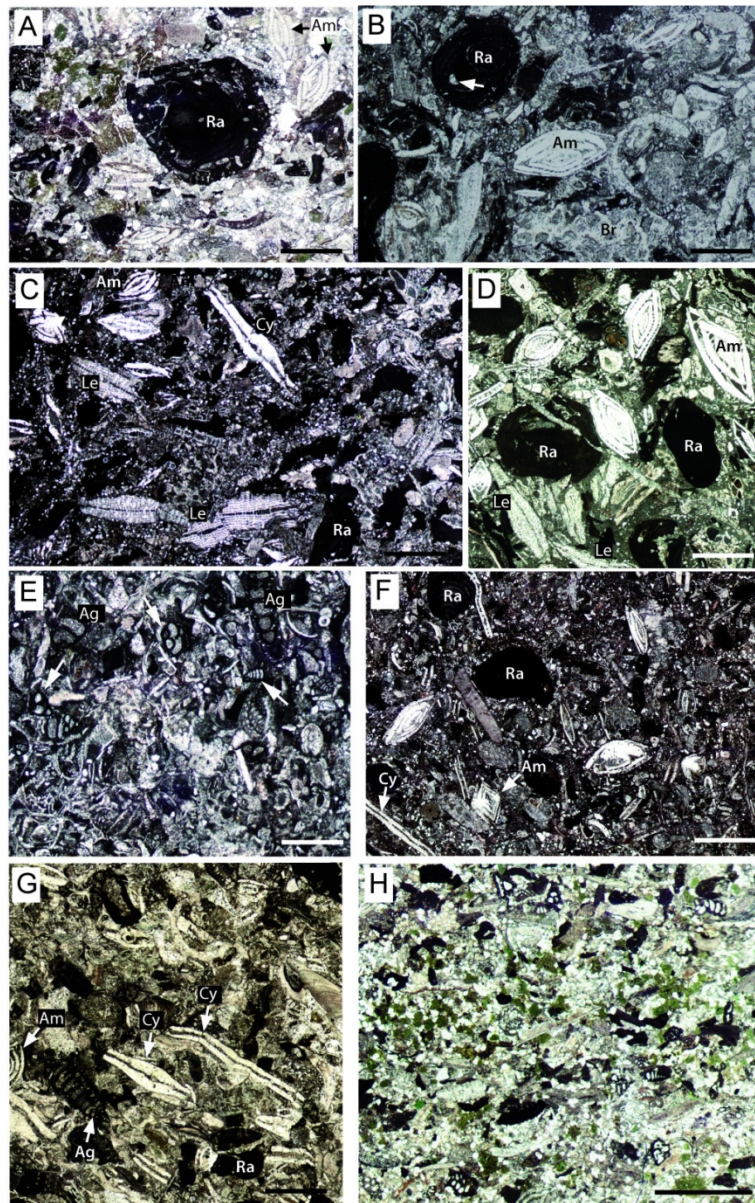


Figure 5. This figure, from Caron et al. (this volume), outlines the high diversity of microfacies that can be found in the Early Miocene limestones of the Coastal Ranges, pointing out contrasted and tectonically-controlled shallow water depositional settings on top of the early Hikurangi subduction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

197x274mm (150 x 150 DPI)



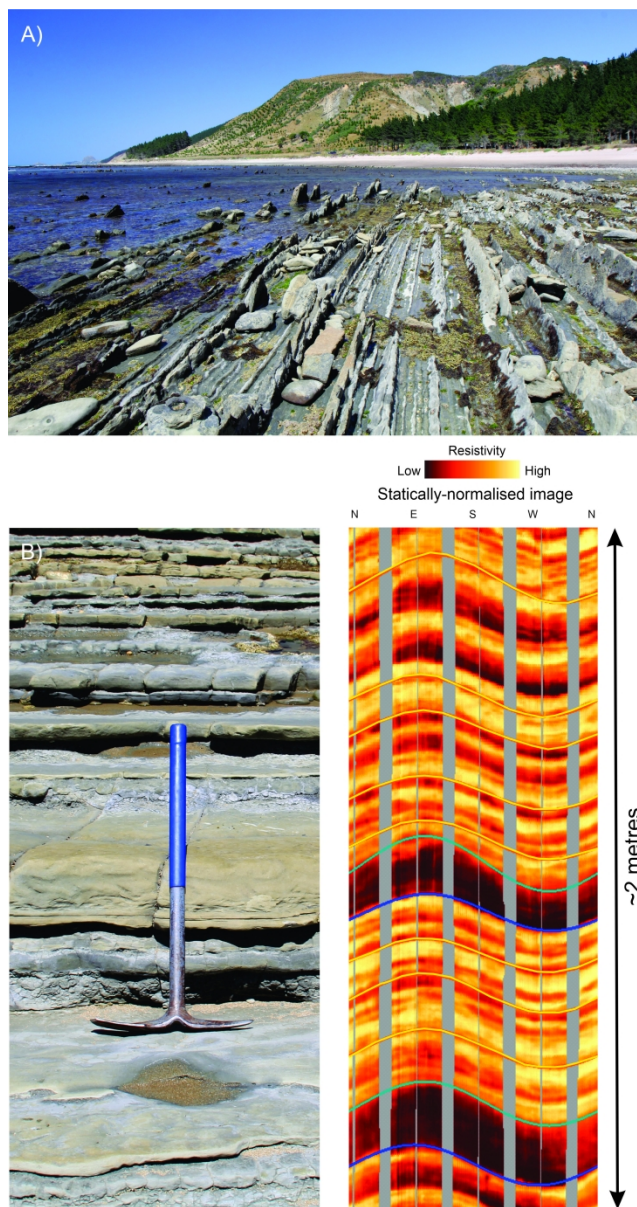


Figure 6. This figure, from Griffin et al. (this volume), illustrates comparisons between spectacular outcropping thin-bedded Miocene turbidites along the central Wairarapa coastline, and similar strata that were imaged by a FMI<sup>™</sup> resistivity image-log within the nearby, offshore Titihaoa-1 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).

246x463mm (300 x 300 DPI)



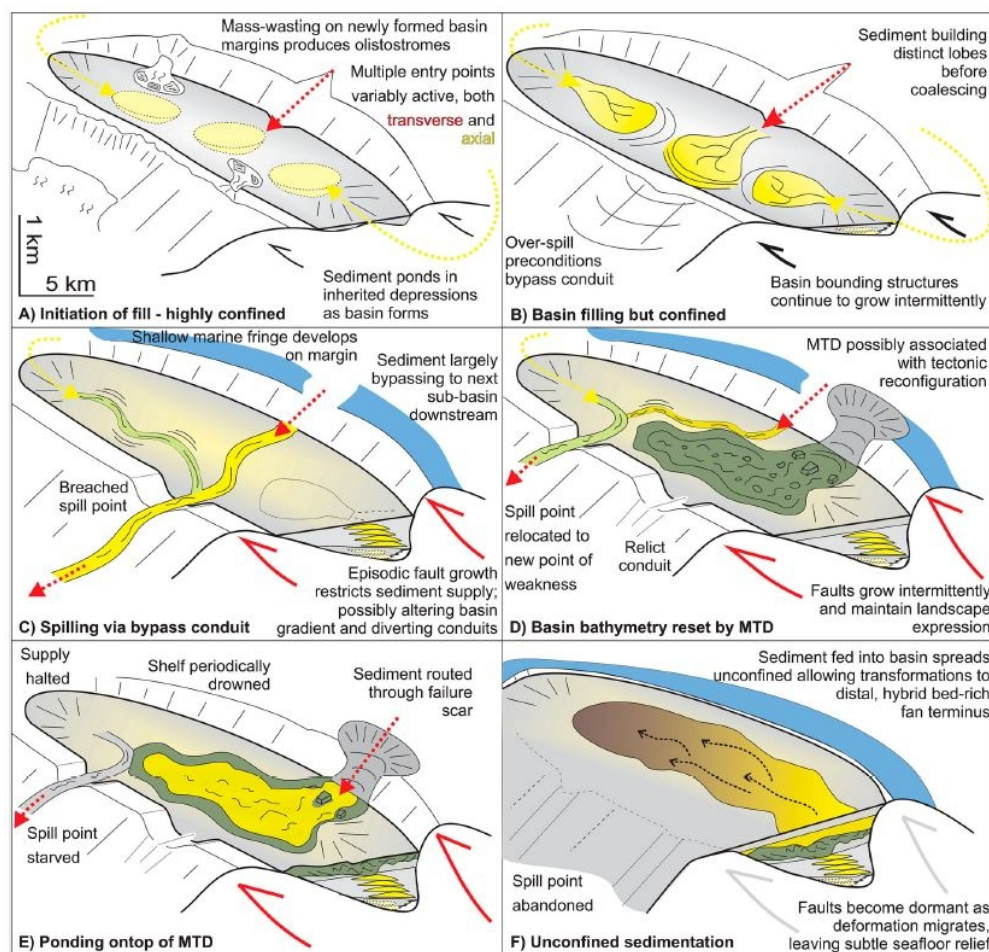


Figure 7. This figure, from McArthur et al. (this volume), is a schematic reconstruction of the evolution of a trench-slope basin based on a detailed sedimentological analysis and systematic mapping of a Miocene field analogue outcropping within the Coastal Ranges (image provided courtesy of McArthur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

175x167mm (120 x 120 DPI)

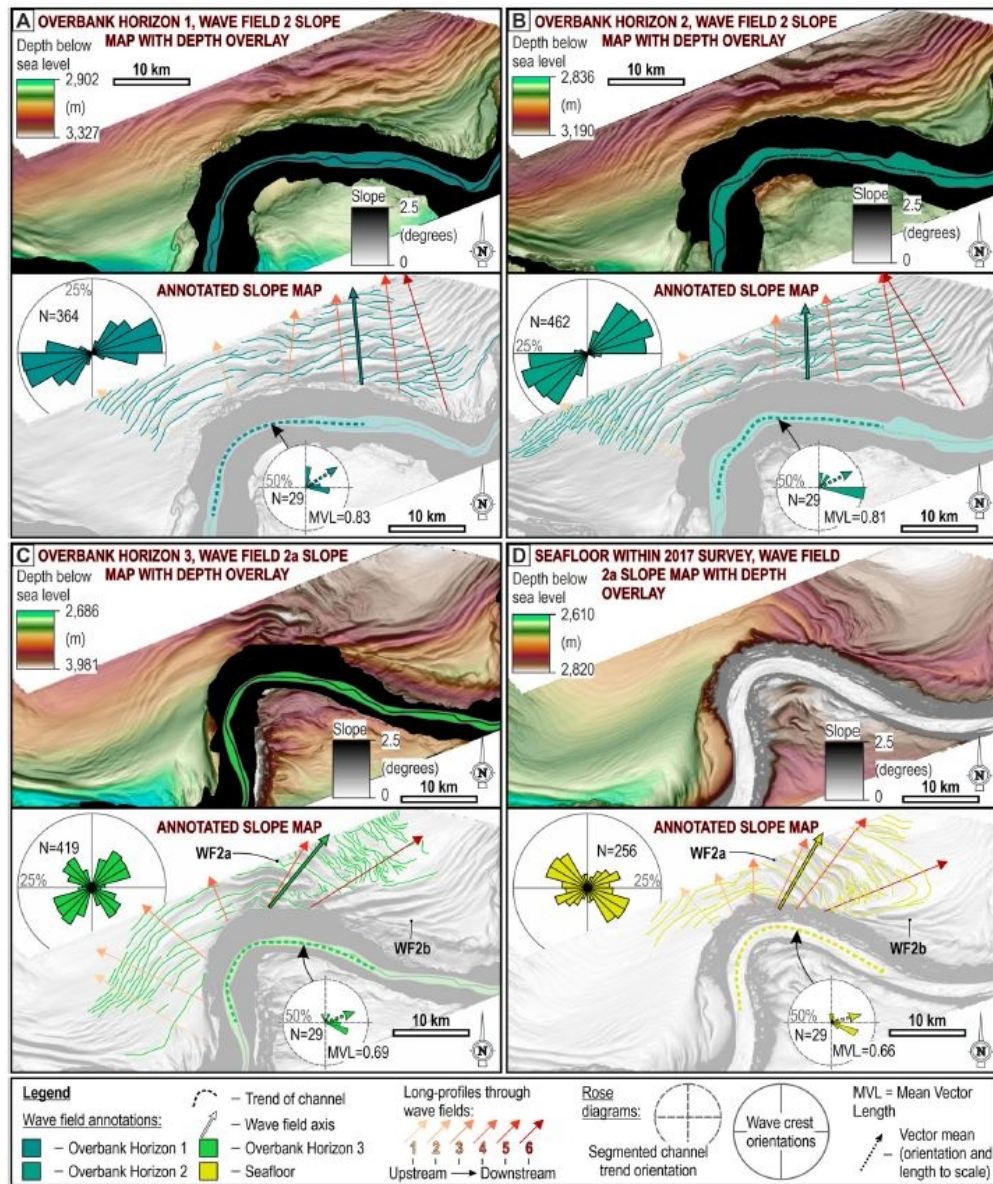


Figure 8. This figure, from Tek et al. (this volume), displays several maps showing the seafloor expression of an overbank sediment wave field for a part of the deep-water Hikurangi Channel covered by 3D seismic data (image provided courtesy of Tek et al. and with permission from the Royal Society of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

151x180mm (120 x 120 DPI)

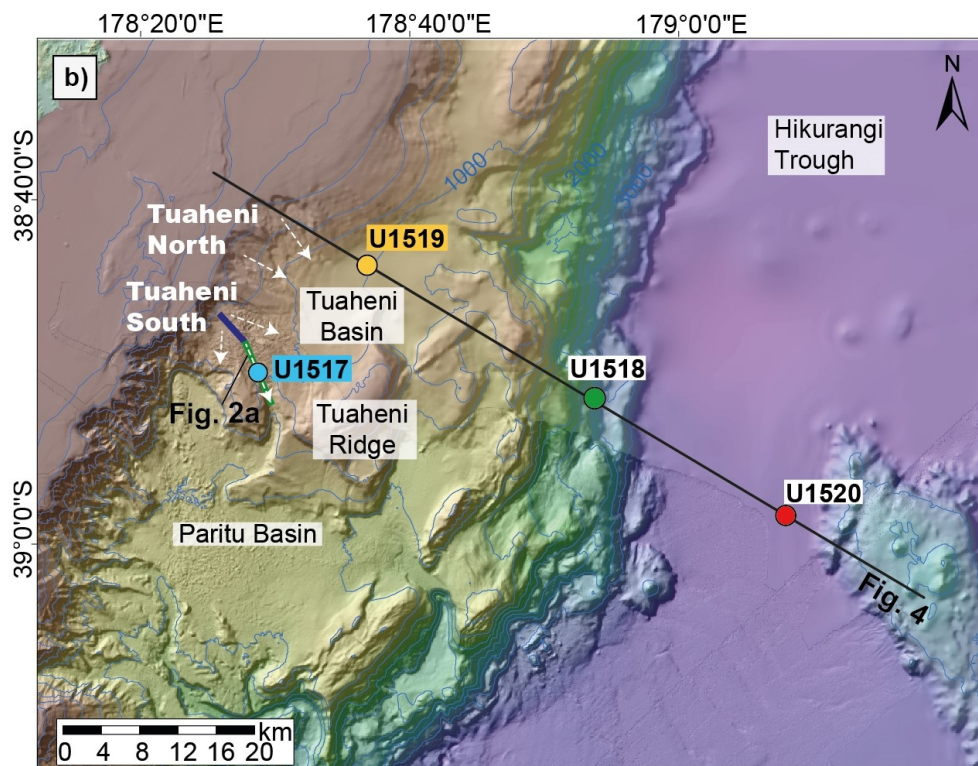


Figure 9. This figure, from Dutilleul et al. (this volume), locates IODP sites of Expeditions 372/375 and the Tuaheni submarine landslide Complex on a bathymetric map of the northern part of the HSM (image provided courtesy of Dutilleul et al. and with permission from the Royal Society of New Zealand.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

109x83mm (300 x 300 DPI)



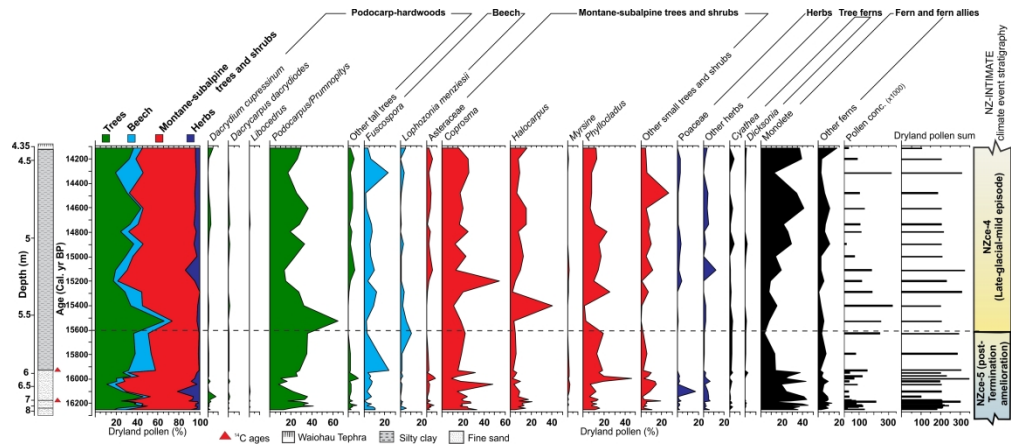


Figure 10. This figure, from Marden et al. (this volume), corresponds to the pollen spectra identified from a Late Pleistocene upland paleolake recently discovered onshore the HSM (image provided courtesy of Marden et al. and with permission from the Royal Society of New Zealand. doi:10.1080/00288306.2021.1947327).

347x150mm (300 x 300 DPI)

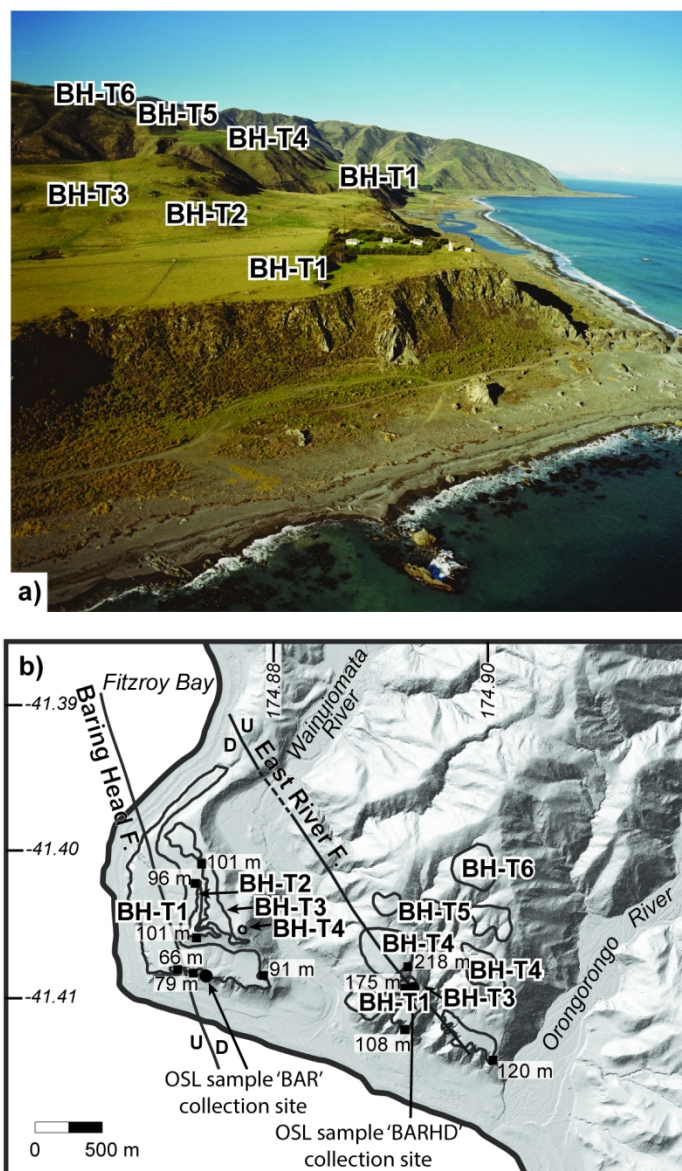


Figure 11. This figure, from Ninis et al. (this volume), shows spectacular flights of Late Pleistocene wave-cut marine terraces along North Island's southern coastline, products of ongoing subduction and upper-plate faulting within the HSM (image provided courtesy of Ninis et al. and with permission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

121x171mm (300 x 300 DPI)

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
<b>Onshore</b>	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.			
<b>Offshore</b>	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.