Structural analysis of compactive deformation in the incoming sedimentary section of the Hikurangi Subduction Margin, New Zealand: results from IODP 375 expedition

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The International Ocean Discovery Program (IODP) Expedition 375 carried out ocean scientific drilling at the Hikurangi Subduction Margin, New Zealand, with the purpose of revealing the mechanisms that may control shallow slow slip events. This expedition collected core samples from site U1520 within the incoming subducting plate. Here we report on the structure and evolution of early deformation associated with sedimentary basin compaction on the incoming subducting plate of the Hikurangi Margin. By interpreting a 2D grid of seismic reflection profiles that image the sedimentary basins covering the Hikurangi Trough and analyzing core data, we find widely developed normal faults within specific horizons above the volcanic basement. These normal faults are densely spaced and are usually confined to specific marl horizons, and the offsets of the faults are generally small. The dip angle of the fault planes is generally steep, but a listric normal fault network can also be observed locally. These faults are covered by a Plio-Pleistocene clastic section, generally found in the Miocene and older sections, suggesting that these faults may have developed during the late Miocene when the section was away from the present trench site where turbidites have been deposited. We interpret that these normal faults were caused by basin compaction through possible dehydation reactions between rock and fluid in sedimentary basins and generally formed as compactive structures. The porosity of the section hosting the compactive structures is generally reduced compared to sections above and below, and thus these compactive structures appear to significantly modify the permeability of the sedimentary section, which may have a certain impact on fault slip at subduction zones. These precursory deformation features will eventually be carried into the accretionary wedge and become overridden by later forming structural development in lower parts of the wedge. Thus, we infer that compactive deformation that is found in the incoming sedimentary section of the Hikurangi Subduction Margin will have an important impact on permeability and structural evolution during subsequent subduction processes.