EGU21-10217
https://doi.org/10.5194/egusphere-egu21-10217
EGU General Assembly 2021

The state of stress in the shallow crust of the Hikurangi Subduction Margin hangingwall, New Zealand

Effat Behboudi[1,2], David McNamara[3], Ivan Lokmer[1,2], Laura Wallace[4,5], and Tom Manzocchi[1,2]

[1]Irish Centre for Research in Applied Geoscience, University College Dublin, Dublin, Republic of Ireland
[2]School of Earth Sciences, University College Dublin, Dublin, Republic of Ireland
[3]Department of Earth, Ocean and Ecological Sciences, University of Liverpool, Liverpool, UK
[4]Natural Hazards, GNS Science, Lower Hutt, New Zealand
[5]University of Texas Institute for Geophysics, Austin, USA

Knowledge of in situ stress fields is critical for a better understanding of deformation, faulting regime, and earthquake processes in seismically active margins such as the Hikurangi Subduction Margin (HSM), North Island, New Zealand. In this study, we utilize Leak-off Test (LOTs) data, borehole breakout widths measured from borehole image logs, and rock unconfined compressive strengths (UCS) derived from empirical P-wave velocity log relationships to estimate vertical (Sv), minimum (Shmin), and maximum horizontal stress magnitudes (SHmax) and interpret the likely faulting regime experienced in four boreholes (Kauhauroa-2, Kauhauroa-5, Titihaoa-1, and Tawatawa-1). Using the standard Anderson's stress regime classification, relative stress magnitudes in Kauhauroa-5 at 1200-1700 m depth and Kauhauroa-2 at 1800-2100 m and indicate that the stress state in the shallow crust of the central and northern part of HSM is predominantly strike-slip (SHmax≥Sv≥Shmin) and normal Sv≥SHmax> Shmin respectively. Moving to the offshore, southern HSM a dominant compressional stress regime (SHmax> Shmin >Sv), with some possible strike slip stress states are observed in Titihaoa-1 from 2240-2660 m and Tawatawa-1 from 750-1350 m. The observed normal/strike-slip stress state in Kauhauroa-2 and Kauhauroa-5 is consistent with the average SHmax orientation of 64° ± 18° (NE-SW) determined from borehole breakouts and dominantly NE–SW striking normal faults interpreted from seismic reflection data. The normal/ strike-slip regime in this area suggests that the stress regime here is probably influenced by the effect of the clockwise rotation of the HSM hangingwall associated with oblique Pacific-Australia plate convergence (ENE-WSW). Alternatively, these stress states could be the result of gravitational collapse due to rapid uplift of the subducting plate during the mid-Miocene. The compressional stress regime in the southern HSM in Titihaoa-1 and Tawatawa-1 is in agreement with the SHmax orientations of 148° ± 14° (NW-SE) and 102° ± 16° (WNW-ESE) obtained from image logs and mapped NE–SW striking reverse faults in this region. This observation suggests that the tectonics here are strongly linked to the subduction of Hikurangi plateau under Australian Plate (NW-SE) or active frontal thrusts in the overriding plate.