

Overview and summary of operations of DFDP-2

*Norio Shigematsu¹, Rupert Sutherland², John Townend³, Virginia Toy⁴, Naoki Kato⁵, Yusuke Kometani⁶, Weiren Lin⁷, Osamu Nishikawa⁸, Hiroshi Mori¹, DFDP-2 Science Team

1. Research Institute of Earthquake and Volcano Geology, Geological Survey of Japan, National Institute of Advanced Industrial Science and Technology, 2. GNS Science New Zealand, 3. Victoria University of Wellington, 4. The University of Otago, 5. Osaka University, 6. Yamaguchi University, 7. Japan Agency for Marine-Earth Science and Technology, 8. Akita University

The Alpine Fault is the dextral transpressive fault forming the Australia-Pacific plate boundary in the South Island of New Zealand. New Zealand's Alpine Fault is a site of international scientific importance for the study of active geological faults. The Alpine Fault provides an opportunity to study a major fault late in the cycle of stress accumulation ahead of a future earthquake, to search for precursors to large earthquakes. The hangingwall uplift rate is very rapid ranging between 9-10mm/yr, resulting in the exhumation of mylonitic rocks that was formed in the deep portion of the Alpine Fault. The hangingwall of the Alpine Fault is, therefore, a young proxy for deformation currently occurring at mid-crustal depth.

The goal of the Alpine Fault, Deep Fault Drilling Project (DFDP) is to go beneath the surface, to sample and make observations of the fault rocks and physical conditions at a range of depths, and monitor these over coming decades. To date, no active fault drilling experiment has targeted the mid-crustal roots of a long-lived active fault, or addressed fault zone evolution throughout the seismogenic zone and towards the brittle-ductile transition.

DFDP-2A drilling started in August 2014 and DFDP-2B was completed in January 2015, having reached a maximum depth of 893 m (measured depth). Technical problems, most notably the loss (and recovery) of the bottom-hole assembly on two occasions, caused delays in the drilling schedule, and the failure of a casing string ultimately caused drilling to be terminated at a shallower depth than planned and before the fault had been intersected.

A very extensive data set was collected including geological, geophysical, geochemical and hydraulic measurements extending the length of the DFDP-2B borehole. Samples of rocks and fluids were collected, and a long-term observatory installed. Of particular significance are the observations that the geothermal gradient is extremely high, exceeding 140°C/km in the upper part of the borehole, and that the hangingwall is overpressured, as predicted prior to drilling. This poster documents the technical planning and execution of DFDP-2 drilling, summarizes the scientific methods and types of data collected, and describes the observatory constructed.

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