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Drilling the Alpine Fault: Preliminary project report

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The Alpine Fault, which is dextral-reverse delineates at the Australia-Pacific plate boundary on the west side of the south island, New Zealand. It causes large earthquakes at every 200-400 years (most recently 1717, with expected Mw <7.9). Quaternary fault motions have been determined from landscape features and the deformed rocks around the fault have been investigated in numerous exposures (e.g., Norris and Cooper, 2007, AGU). Recently, microstructures and deformation mechanisms of deformed rocks around the fault have been discussed based on the fabric analyses of quartz (Toy et al., 2008, JSG). It has been proposed that anomalous seismic wave speeds apparent in large-scale seismic transects result from fluid presence within the fault rocks (Stern et al., 2001, Geology). Exhumation occurs rapidly (6-9 mm/yr) from depths of as much as 20-30 km (Little et al., 2005, GJI), yielding young samples.

The drilling project of the Alpine Fault (Deep Fault Drilling Project; DFDP) mainly focus on (1) evolution of a orogenic system, (2) transition between brittle and plastic deformation mechanisms, and (3) seismogenesis and the habitat of earthquakes. The following themes have been identified on which to focus; (a) stresses, fluid pressures, permeabilities, and temperatures adjacent to the Alpine fault, (b) strain localization within the fault core and surrounding damage zone, and the deformation mechanisms related to these, (c) the seismic velocity structure at centimeter to kilometer scales, (d) the deformation mechanisms of minerals (developments of crystallographic preferred orientation; CPO) and reactions (e.g, chloritic alteration), (e) interactions between metamorphic fluids and fault rocks, (f) the thickness of the active slip zone and accompanying damage zone, (g) possibility of episodic slow slip or low-frequency tremor, and (h) developments of pseudotachylyte and element motilities. The Japanese team are involved in (c), (d), and (h) in detail.

The Alpine Fault drilling project has been in planning since 2008, and the drilling started in January 2011. The first phase (DFDP-1), which targeted to drill to 150 m, finished in February 2011, and the samples have already been provided to scientists. Work has now begin on DFDP-2, during which it is planed to drill to 1500 m through the Alpine Fault. DFDP-2 has financial support from the as International Continental Scientific Drilling Program (ICDP). In this presentation, we outline this drilling project.

Keywords: ICPD, J-DESC, contributions of Japanese team