Newsletter 1, December 2009 http://drill.gns.cri.nz/nzcdp/dfdp/index.html

Deep Fault Drilling Project

Alpine Fault, New Zealand

Image courtesy of NASA/JPL/NGA

Quick updates:

- Workshop reports published in *Scientific Drilling* and *EOS*
- New Zealand joins the International Continental Scientific Drilling Program (ICDP)
- Funding received for site characterization and allied research commencing early 2010
- Hydrological and seismological responses to the M_W 7.6 Dusky Sound earthquake observed at Welcome Flat and Whataroa

In this issue:

What is the Deep Fault Drilling Project?

The Alpine Fault in the western South Island is thought to rupture every 200–400 years in a magnitude ~7.9 earthquake, and to have last ruptured in 1717 AD. Rapid uplift and mountain building has exhumed fault rocks from depths of 20–30 km, yielding a young (<~1 Ma), well- preserved sample of structures currently active at depth. The Alpine Fault therefore affords a rare opportunity to study, via scientific drilling and allied research, the physical character of tectonic deformation at depth within a major active continental fault that is late in its seismic cycle and which can be scientifically monitored in the coming decades.

The Deep Fault Drilling Project (DFDP) proposes to drill, sample, and monitor the Alpine Fault to better understand processes of rock deformation, seismogenesis, and mineralization. By taking advantage of excellent surface exposures and capitalizing on a long history of detailed surface studies and geophysical experiments, DFDP will provide new insight into how the Alpine Fault and other major active continental faults evolve and operate.

Virginia Toy (University of Otago) collecting samples of Alpine Fault gouge at Gaunt Creek.

March 2009 workshop reports published

The International Continental Scientific Drilling Program (ICDP) approved funding in 2008 for a workshop addressing the state of knowledge of the Alpine Fault; the significance and feasibility of a multi-national program of drilling and allied science; and the preliminary steps required for site characterization, preparatory drilling, and longer-term science planning.

The workshop was held astride the Alpine Fault at Franz Josef on 22–28 March 2009 and attended by 61 researchers from seven countries. Three principal scientific themes emerged from the workshop discussions: (1) evolution of a transpressive orogenic system; (2) ductile and brittle deformation mechanisms, and their interaction; and (3) seismogenesis and the habitat of earthquakes. Reports describing the opportunities the Alpine Fault provides to relate real fault rocks and in situ measurements to models of earthquake rupture and mesothermal mineralization have since been published in *EOS* and *Scientific Drilling*. Links to electronic copies of these reports will be found at the DFDP website.

Current activities

This year has seen strong progress on a range of existing Alpine Fault projects, as well as successful applications for DFDP-related field, laboratory, and computational studies. The top priorities at this stage are densification of the seismic network; drilling and recovery of core from a preliminary shallow borehole or boreholes; and multidisciplinary site characterisation studies and aligned research along the central section of the Alpine Fault.

Among other projects, work continues on the Marsden-funded SAMBA borehole seismometer network and a wide variety of Foundation for Research, Science, and Technology-funded

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Upcoming deadlines

8 December 2009 — National Science Foundation

14 December 2009 — Continental Scientific Drilling Town Hall Meeting, San Francisco

15 January 2010 — ICDP Training Course scholarship applications

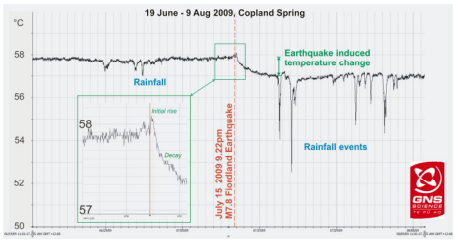
4 February 2010 — Marsden Fund preliminary applications

M_W7.6 Dusky Sound earthquake

An ongoing monitoring experiment at Copland hot spring has observed an unexpected bonus — temperature fluctuations caused by the 15 July 2009 M_W7.6 magnitude Dusky Sound earthquake, 360 km away in Fiordland. In early 2009, Simon Cox installed a rain gauge and temperature recorders at Welcome Flat in the Copland Valley. Pool water temperatures fluctuate about background values of 57–58°C, with minor diurnal variations and dramatic temperature drops during episodes of heavy rainfall.

The Dusky Sound earthquake produced local intensities of MM3–4 in the Copland Valley area with peak ground accelerations of 0.5–2%g. The earthquake caused an immediate small rise in temperature to 58°C, then a lowering to a new background value of 57°C over the next four days . The temperature of deeper upwelling water appears to have been affected permanently.

The earthquake is interpreted to have altered the permeability structure of the Southern Alps. Simon has discovered hydrological responses to the Dusky Sound earthquake at other sites throughout the South Island and is currently collating and modeling these data. Contact s.cox@gns.cri.nz for details.



Temperature data from the Copland hot spring showing background fluctuations, temperature drops associated with heavy rainfall, and a small rise in temperature and subsequent decrease in response to the Dusky Sound quake.

DFDP Permitting Advisory Group

Geological research activities undertaken in New Zealand almost invariably require permissions or permits. The March workshop highlighted the fact that it would be useful to have some coordination and advice for obtaining permits related to DFDP research. A Permitting Advisory Group has been established to provide advice on permitting issues and requirements, assist in making contact with the relevant authorities, and coordinate applications. It is hoped the advisory group will facilitate good communication between researchers, government bodies, landowners, Iwi/Māori, and other interested parties and maintain existing good relationships. The group consists of Simon Cox (GNS Science, s.cox@gns.cri.nz), Stephen Bannister (GNS Science), and Virginia Toy (University of Otago). See http://drill.gns.cri.nz/nzcdp/dfdp/advisory.html for further details.

Current activities

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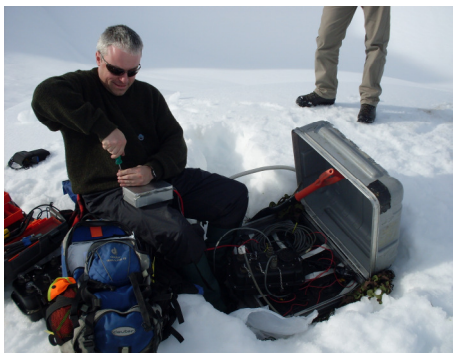
projects led by GNS Science. Funding has also been received for a deployment of short-period seismometers in the Whataroa and Wanganui catchments (Townend et al.), active-source seismic experiments in the Whataroa River Valley (Gorman et al.), and acquisition of a short continuous core through the Alpine Fault cataclasites (Norris et al.). All three studies will begin in 2010.

National Environmental Research Council proposals submitted by Prior et al. and Teagle et al. for borehole drilling and fluid and rock chemical analysis, respectively, have reached the second round of evaluation, and proposals for dense seismic observations and experimental rock physics experiments are under development for submission to the National Science Foundation in December 2009.

Research continues as part of several MSc and PhD projects. A full list of more than 30 projects in various stages of development is provided on the DFDP website.



Mark Henderson (Victoria University of Wellington) servicing a seismograph in the Southern Alps Microseismicity Borehole Array (SAMBA) deployed by VUW, the University of Auckland, and GNS Science.