Newsletter 3, November 2012 https://wiki.gns.cri.nz/DFDP

Deep Fault Drilling Project
Alpine Fault, New Zealand

Image courtesy of NASA/JPL/NGA

Quick updates:

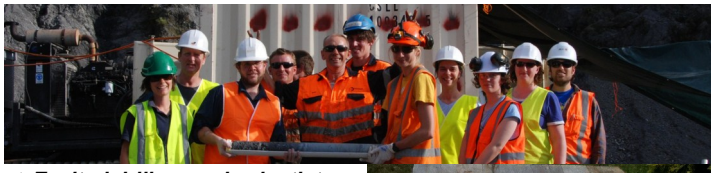
- DFDP-1 completed successfully at Gaunt Creek with two boreholes intersecting the Alpine Fault
- First publication from DFDP-1 to appear in the December 2012 issue of *Geology*
- DFDP-2 funding confirmed; drilling to start in the Whataroa River Valley in early 2014

In this issue:

DFDP-1 completed successfully

The first phase of the Deep Fault Drilling Project (DFDP) was completed in February 2011 with the successful coring, logging, and instrumentation of the DFDP-1A (101 m) and DFDP-1B (152 m) boreholes intersecting the Alpine Fault at Gaunt Creek.

The first results from DFDP-1 will be published in the December issue of *Geology* and further manuscripts are in preparation. Among the interesting observations made to date are the very low permeability of the fault core; the presence of an alteration zone overprinting the fault core and part of the damage zone; a 0.52 MPa fluid pressure step across the fault; and a high geothermal gradient (62°C/km). Subsampling of the cores is complete and samples have been sent to collaborators. Continuous pressure, temperature, and seismic data are being collected, and sent from DFDP-1 via GeoNet for online access.



▲Excited drillers and scientists with the section of DFDP-1A core spanning the Alpine Fault; ► DFDP-1B core remaining after subsampling

DFDP-2 to start in 2014

Funding for the second phase of DFDP drilling ("DFDP-2") has now been secured. The Royal Society of New Zealand's Marsden Fund and the International Continental Scientific Drilling Program have provided primary support for drilling and logging operations, and several national funding agencies have funded allied research projects.

Scientific and technical planning for DFDP-2 have now begun in earnest. A two-day meeting was held in Dunedin in August to review preliminary drilling plans and timetables following an external evaluation process.

A key decision reached during the Dunedin meeting was to proceed with a single DFDP-2 borehole rather than first drilling a separate shallow hole to confirm the Alpine Fault's near-surface geometry.

DFDP-2 is intended to intersect the Alpine Fault c. 1.2 km beneath the Whataroa Valley and to penetrate the footwall by 300 m.

In early 2014, rotary drilling methods will be used to drill and case the borehole to approximately 1 km, providing a firm foundation for deeper drilling. Diamond coring methods will then be employed to drill through the principal slip zone into the footwall.

Coring operations are unlikely to start before April 2014, and more likely the following austral summer (January 2015): collaborators wishing to schedule funding applications or on-site activities are urged to contact the project coordinators for further details.

Ahead of DFDP-2 drilling getting underway, four short-period borehole sensors will be installed at 30 m depth within 1.5 km of the DFDP-2 drillsite in January 2013. These will bring to 12 the number of seismometers operating within 10 km of DFDP-2 and are intended to provide a one-year baseline record of microseismicity in the immediate vicinity of DFDP-2.

Annie Zaino (Auckland) deploying a seismic sensor during the April 2012 active source survey at Gaunt Creek

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DFDP dinner on 5 December at AGU

A dinner for DFDP collaborators and other interested researchers will be held on Wednesday 5 December at New Delhi restaurant, 160 Ellis St., San Francisco (cost ~US$35). Please let us know by 2 December (virginia.toy@otago.ac.nz) if you would like to attend.

Upcoming events

25–28 November 2012 — Geosciences 2012, Hamilton (Symposium 5.2, Monday afternoon, focuses on the Alpine Fault and DFDP-1 results)

3–7 December 2012 — AGU Fall Meeting, San Francisco (sessions T31C, T34D have focus on DFDP and related projects)

11–14 November 2013 — ICDP workshop on continental scientific drilling, Potsdam

Grant O'Brien (VUW) and Jeremy Pesicek (Wisconsin-Madison) installing a seismic sensor as part of WIZARD

Canterbury earthquake sequence

Access the special issue of the *New Zealand Journal of Geology and Geophysics* on the Canterbury earthquake sequence at http://www.tandfonline.com/toc/tnzg20/55/3.

Recent Alpine Fault publications

Barth, N.C., et al. (2012), Scale dependence of oblique plate-boundary partitioning: New insights from LiDAR, central Alpine fault, New Zealand, *Lithosphere*, 10.1130/l201.1.

Berryman, K. R., et al. (2012), Major earthquakes occur regularly on an isolated plate boundary fault, *Science*, 10.1126/science.1218959.

Boese, C.M., et al. (2012), Microseismicity and stress in the vicinity of the Alpine Fault, central Southern Alps, New Zealand, *J. Geophys. Res.*, 10.1029/2011jb008460.

Boulton, C., et al. (2012), Physical properties of surface outcrop cataclastic fault rocks, Alpine Fault, New Zealand, *Geochem. Geophys. Geosyst.*, 10.1029/2011gc003872.

Cox, S.C., et al. (2012), Potentially active faults in the rapidly eroding landscape adjacent to the Alpine Fault, central Southern Alps, New Zealand, *Tectonics*, 10.1029/2011tc003038.

De Pascale, G.P., & R.M. Langridge (2012), New on-fault evidence for a great earthquake in A.D. 1717, central Alpine Fault, New Zealand, *Geology*, 10.1130/g33363.1.

Howarth, J. D., et al. (2012), Lake sediments record cycles of sediment flux driven by large earthquakes on the Alpine fault, New Zealand, *Geology*, 10.1130/G33486.1.

Sutherland, R., et al. (2012), Drilling reveals fluid control on architecture and rupture of the Alpine fault, New Zealand, *Geology*, 10.1130/g33614.1.

Toy, V.G., et al. (2012), Relationships between kinematic indicators and strain [...], *Earth Planet. Sci. Lett.*, 10.1016/j.epsl.2012.04.037.

Wech, A.G., et al. (2012), Tectonic tremor and deep slow slip on the Alpine Fault, *Geophys. Res. Lett.*, 10.1029/2012gl051751.

Field activities

(L to R) Alex Sims (Otago) in the Tartare Tunnels; Simon Cox and Delia Strong (GNS Science) recording the Copland Hot Spring's temperature; Carolin Boese (VUW) being interviewed atop Mt Fox about microseismicity in the Southern Alps

There are many exciting field projects related to DFDP underway, including:

* Geochemical analysis by recently completed PhD student Catriona Menzies (Southampton) and UK and NZ colleagues of hot springs, veins, and alteration products;
* Analysis of groundwater flow and seepage in the Tatare Tunnels near Franz Josef by MSc student Alex Sims (Otago) and colleagues at GNS Science;
* An active source seismic survey conducted by Jennifer Eccles (Auckland) and her team to link detailed observations of fault zone properties made in the DFDP-1 boreholes to the larger-scale velocity structure;
* Ongoing analysis by Otago and TU Freiburg researchers of the WhataDUSIE active-source seismic data collected in 2011 across the planned site of DFDP-2;
* Installation by GeoNet of a strong-ground motion sensor and telemetry equipment at the DFDP-1 site, enabling real-time access to seismic data and remote monitoring of the downhole fluid pressure and temperature measurements;
* Integrated field and desktop interpretation by GNS Science, Canterbury, and Otago geologists of LiDAR data collected along the Alpine Fault;
* Installation of >20 broadband and short-period seismographs ("WIZARD") by researchers researchers from Wisconsin-Madison, Rensselaer Polytechnic Institute, GNS Science, and VUW.

Visit https://wiki.gns.cri.nz/DFDP/DFDP_science for more details on recent work!