Geophysical Research Abstracts
Vol. 20, EGU2018-19564, 2018
EGU General Assembly 2018

High-resolution active seismic survey across the Insubric Line

Andrew Greenwood (1), Ludovic Baron (1), Kaspar Merz (2), Antonio langone (3), Benoît Petri (1), Anna Orsolya Kard (4), Alberto Zanetti (3), Mattia Pistone (1), György Hetényi (1), Michael Weber (4), Othmar Müntener (1), and Klaus Holliger (1)

(1) Institute of Earth Sciences, University of Lausanne, Géopolis, 1015 Lausanne, Switzerland, (2) Geo2x, Technoparkstrasse 2, 8406 Winterthur, Switzerland, (3) Institute of Geosciences and Earth Resources, Italian National Research Council (CNR), Via Ferrata 1, Pavia, 27100, Italy, (4) Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Telegrafenberg, 14473 Potsdam, Germany

The Ivrea-Verbano Zone in the Italian Alps represents one of the most complete and best studied cross-sections of the continental crust. Since geological and geophysical observations indicate the presence of the Moho transition zone at shallow depth (as shallow as ∼3 km in Val Sesia), the Ivrea-Verbano Zone is a primary target for assembling data on the deep continental crust as well as for testing several hypotheses regarding its formation and evolution. In the context of a project submitted with the International Continental Scientific Drilling Program (ICDP), the Drilling the Ivrea-Verbano zonE (DIVE) team proposes to establish a set of drill holes penetrating structures in-situ across the Ivrea-Verbano Zone.

In preparation of drill site selection, seismic reflection data were collected along a 950 m section of road near Boccioleto (Italy) targeting a near-vertical contact between mylonites of the Insubric Line separating Austroalpine gneiss units from the Ivrea-Verbano Zone. A 400 kg weight-drop in conjunction with 15 Hz geophones and a GEODE distributed seismograph were utilized. Both the geophone spacing and source step were 5 m. Geophones were planted alongside the road and over embankments. Where outcropping solid rock prevented this, 8 mm holes were drilled in the concrete verge of the road to plant the geophones. Highly variable receiver elevations which were not co-located with the sources resulted in strongly contrasting apparent near-surface velocities.

Processing of the seismic line required rigorous static corrections to account for near-surface velocity variations (refraction statics) and corrections for elevation (elevation statics). Additional processing steps included: trace editing; bandpass filtering; 2D spatial filtering to remove direct wavefields; predictive deconvolution to remove ghost shots (source bouncing); spiking deconvolution to whiten the signal; amplitude corrections and spectral shaping to enhance reflection signals; velocity analysis; NMO correction and stacking; post-stack-time-migration using a constant velocity of 5500 m/s determined from constant velocity panels; F-X deconvolution and 2D filtering to improve coherency of reflectors; and finally time-to-depth conversion using a constant velocity of 5500 m/s.

Due to the steeply dipping nature of the geological structures, the final processed section is rather bland in appearance with no coherent reflectors spanning the length of the profile. However, migration has focused seismic energy into multiple short bright reflecting surfaces that commonly align semi-vertically. These bright spots, which also subtly change in dip, may be the apexes of local geological structures. Additionally in the profile, is a change in signal characteristic that dips sub-vertical to the west in close proximity to the geologically mapped gneiss/mylonite contact associated with the Insubric Line.

Although the origins of the seismic features remain speculative at this point, we can draw the following conclusions from this survey: (i) continuity of sub-vertical layers mapped at surface in the first 0.5 to 1 km depth; (ii) shear-modulus changes coincide with geological boundaries mapped at the surface; and (iii) geological structures seen at the surface do not seem to be interrupted by a major sub-horizontal fault and hence can be assumed to be continuous at depth.