Geophysical Research Abstracts
Vol. 16, EGU2014-4057, 2014
EGU General Assembly 2014

Characterization of the Neuhauserwald Quaternary valley, northern Switzerland, using high-resolution seismic-reflection and seismic-refraction imaging

Fabienne Reiser, Cedric Schmelzbach, Heinrich Horstmeyer, David Sollberger, Lasse Rabenstein, Hansruedi Maurer, and Johan Robertsson

ETH Zürich, Geophysics, Switzerland (fabienne.reiser@erdw.ethz.ch)

The Swiss Molasse basin is largely covered by Quaternary sediments which have a thickness ranging from a few meters to several hundred meters. These glacial, glaciofluvial, and glaciolacustrine sedimentary deposits are of high interest for a number of reasons; for example, they contain a large part of Switzerland's underground freshwater supplies, and resolving their structure and deposition processes is important to reconstruct the climate history. Furthermore, this usually thin, but highly heterogeneous near-surface cover can have a significant deleterious effect on subsurface imaging by regional-scale seismic-reflection surveying. The study presented here was motivated by the observation of a hithertofore unknown Quaternary valley observed on recently acquired regional-scale seismic-reflection data.

To characterize the depth and internal structure of the Neuhauserwald Quaternary valley, two high-resolution seismic-reflection/refraction datasets were acquired. The approximately 900 m long line 1 runs parallel to the valley axis, whereas the $\sim$ 700 m long line 3 is oriented perpendicular to it. A borehole on line 1 provides lithological information and seismic velocities for the upper 150 m, which were determined by means of a check-shot experiment. The lithological sequence consists of alternating sand and gravel units over lacustrine silty sands. Mesozoic limestones are found at 128 m depth below surface. The final processed seismic reflection images show reflections down to around 200 ms traveltime ($\sim$ 130 m). The first-arrival traveltime tomography models show a distinct velocity increase from around 500 m/s at the surface to around 4000 m/s at about 150 m depth.

For line 1, velocity variations between 500 m/s and 2000 m/s indicate vertical and lateral changes within the valley infill. The depth to the high-velocity basement, however, is only poorly constrained by a few rays in the refraction tomogram resulting from the paucity of long-offset traveltime picks due to the low signal-to-noise ratio. In contrast, the seismic-reflection images are of relatively high quality, showing a number of sub-horizontal reflections. Correlation with the borehole data reveals that the interface between the morainal sand-gravel unit and the underlying lacustrine sediment at around 160 ms (90m depth) is highly reflective, while the reflection from the basement at around 200 ms (130 m depth) is relatively weak. Without borehole control, the strong reflection from the top of the lacustrine sediments would probably have been mis-interpreted as the reflection from the basement. The refraction tomographic image of line 3 yields a clear image of the dipping basement. The quality of the line 3 reflection images is inferior compared to that of line 1, which is due to a not yet resolved static correction issue. The complex structure of the heterogeneous Quaternary infill and significant topographic variations complicate the static correction estimation. As a consequence, only a few short reflection segments are observed on line 3, which may indicate a more complex sedimentary structure close to the valley flank compared to the central part of the valley.