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Geological controls on the morphology of an overdeepened canyon investigated by seismic surface waves (Lower Aare Valley, Switzerland)

Lukas Gegg¹, Lorenz Keller², Marius W. Buechi¹, Thomas Spillmann³, Gaudenz Deplazes³, Herfried Madritsch³, and Flavio S. Anselmetti¹

¹Quaternary Geology and Paleoclimatology, Institute of Geological Sciences, University of Bern, Switzerland (lukas.gegg@geo.unibe.ch)

²roXplore GmbH, Amlikon-Bissegg, Switzerland

³National Cooperative for the Disposal of Radioactive Waste (Nagra), Wettingen, Switzerland

Subglacial overdeepenings are common features of past and presently glaciated landscapes. In the Northern Alpine Foreland, these troughs occur mostly within the rather soft, poorly lithified sandstones of the Molasse basin. An exceptional setting is the Lower Aare Valley in Northern Switzerland, where a narrow, finger-like overdeepening (Gebenstorf-Stilli Trough) has been incised more than 100 m below the present surface into the fold-and-thrust belt of the Jura Mountains with its diverse Mesozoic lithologies including competent limestone units. Consequently, the morphology of this overdeepening can provide valuable information on lithological and structural controls on subglacial overdeepening erosion.

We investigate the Gebenstorf-Stilli Trough with three scientific boreholes located along the South-North oriented trough axis. In addition, a set of seismic cross-sections has been acquired by a combination of active and passive seismic approaches analysing surface waves, namely passive horizontal-to-vertical spectral ratio (HVSR) measurements, active measurements applying multiple filter analysis of group velocity (MFA), and extended spatial auto correlation of ambient vibration array data (ESAC).

Preliminary results show that the base of the overdeepening can be well imaged using our methodology. In combination with borehole information, surface elevation data and 3D models of the subsurface geology, we see great potential to better constrain the morphology of the Gebenstorf-Stilli Trough, and to assess how different bedrock lithologies and structures influence subglacial overdeepening erosion – an underexplored and poorly understood issue.