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Assessing the bedrock surface of overdeepened valleys by 3D gravity modelling

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High-resolution information on the topography of landscapes is of prime importance if the scope lies in the specification of the erosional processes. This also concerns the search for the mechanisms leading to the carving of overdeepened valleys surrounding the European Alps that are now filled with unconsolidated fluvio-lacustrine and glacial sediments.

For some of these valleys within the Alps, the bedrock lies well below sea level today, and in the Alpine foreland, the bedrock lies distinctively below the currently lowest erosional base level such as e.g., the river Rhine. Because of the post-erosional burial of these features, the processes leading to their formation have been contested (Cook and Swift, 2012).
Here, we reconstruct the shape of the buried bedrock surface in the Bern area, the region of confluence of the former Rhone and Aar glaciers situated to the north of the Central Alps.
In this region, the occurrence of overdeepenings, or alternatively tunnel valleys, has already been disclosed through drilling (Reber and Schlunegger, 2016).

To achieve our goals, we conduct a high-resolution gravity survey, based on the density contrast between the bedrock and tunnel valley fill and on densely spaced gravity measurements, adapted to capture the complex regional and residual gravity fields.

Because the shape of the buried bedrock topography is expected to be complex and strongly non-linear, we will employ the results of multiple gravity profiling, which significantly reduces the number of measurements and still seems to be appropriate to locally capture sufficient details on the geometry. Subsequently, we combine available drilling information, the results of the gravity profiling and the densely spaced gravity measurements into a 3D forward model (Nagy, 1966; Talwani and Ewing, 1960) in an effort to reconstruct the bedrock topography at a high resolution. The restored bedrock topography dataset will finally be used to infer the mechanisms of fluvio-glacial erosion. We will present first results of this ongoing study.

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