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Drilling overdeepened Alpine Valleys (DOVE)

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A recently submitted ICDP drilling proposal targets formerly glaciated areas, which are often characterized by deeply incised structures filled by thick Quaternary deposits. These buried troughs and valleys were formed by glacial overdeepening, likely caused by pressurized subglacial meltwater below warm-based glaciers. The proposed multinational drilling initiative consists of 14 drill sites in six different countries, all linked by the fact that they surround a formerly glaciated, densely populated mountain range, the European Alps. Being the best studied mountain range, the Alps will serve as textbook example allowing application of drilling results to other glaciated areas around the world.

The drill holes, to be cored all the way to bedrock, will explore the type and age of the infillings of these overdeepened troughs. Such drill cores, paired with matching geophysical and instrumental data, hold the keys to understand how and how fast mountain ranges and their foreland are shaped by repetitive glaciations. The overarching goal will be to date the age and extent of past glaciations and their connection to paleoclimate, paleoecology and landscape history. As of today, it is not known how these glaciations varied along and across the Alps during the past, and to what extent the ice build-up along and across the Alps reflects changes in atmospheric circulation patterns. First results of drill holes in similar settings have produced local knowledge of the timing of glacial activity. Only an alpine-wide drilling initiative, however, will allow to reconstruct the full spatial and temporal scale of glacier advances and erosion and related landscape-forming processes over several glacial-interglacial cycles.
Next to these paleoglacial, paleoecological and paleoclimatic aspects, the thick valley fills hold large, untapped aquifers. In the light of an increasing demand for water resources likely amplified by the projected climate change, testing these aquifers in the framework of this project is of high relevance for future hydrogeological applications. Related to this role, these drill holes may be used for shallow geothermal applications, which, however, to date rely on poorly constrained physical properties of the infilling sections. In addition, the areas represent areas of high seismic hazards related to their unfavorable seismic site effects.
All these goals will be first addressed by state-of-the-art geophysical surveys that quantify the geometry of the overdeepenings. Drillholes will be analyzed by downhole logging, groundwater sampling and subsurface biosphere testing. Sedimentological, geochemical and palaeobiological analyses will characterize the sediment cores, and a combination of different approaches (biostratigraphy, luminescence dating, cosmogenic nuclide dating, magnetostratigraphy, and tephrastratigraphy) will establish the chronological framework. Eventually, the results from the above approaches will be cross-checked with the outcome of modeling both glacial flow and erosion and atmospheric circulation.