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Revitalizing early seismic reflection data combined with 3D inversion of gravity data to reduce uncertaintiy for geothermal exploration

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Switzerland is undertaking an energetic transition by developing geothermal energy resources. In the Geneva Basin, Western Switzerland, Lower Cretaceous and Tertiary geological units have first been targeted as potential layers to be exploited for geothermal energy uses. However, little is known about the lateral and vertical distribution of such units. Seismic acquisitions performed in the late 80ies suffer strong uncertainties due to velocity model heterogeneity and the lack of information concerning the shallow Quaternary layers.

This study proposes to revitalize old reflection seismic data and combine them with affordable gravity methods to reduce the uncertainty of the current geological model of the Geneva Basin. Using several available well logs we decoupled the Quaternary and Tertiary layer obtaining ad hoc velocity laws. Next, we used the obtained geological model to constrain 3D gravity inversion in Geneva Basin. The associated resolution study suggests that density variations are extremely well resolved for the shallow part of the basin. The obtained density maps show that regional faults might expand to more than 1 km depth and high-density variations occur across Tertiary and Cretaceous layers. This study points out the use of gravity exploration for geothermal energy even for sedimentary basins characterised by an average geothermal gradient.