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Petro-rheological and geophysical characterisation of the Mafic Complex, Ivrea-Verbano Zone (Italy): A work-in-progress on the correlation of crustal lithostratigraphy and geophysical structures of the Earth's lower crust

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The Ivrea-Verbano Zone (Southern Alps, Italy) is one of the most complete, time-integrated crust-upper mantle archive in the world. It is a unique target for assembling chemical and physical data on the lower crust and testing several hypotheses of formation, evolution, and modification of the continental crust through space and time. In the southern Ivrea-Verbano Zone cross-cut by the Sesia river, the 11-km thick Mafic Complex consists of hornblende-bearing gabbro (bottom part), gabbro-norite (intermediate part) and diorite (upper part). The Mafic Complex was emplaced into the pre-Permian metasedimentary sequence (Kinzigite formation) and represents the deep roots of the Permian Sesia Magmatic Plumbing System.

In continental areas, the interpretation of seismic, density, and magnetic structures have largely been based on correlations with exposed lower-crustal rocks. However, it is unclear how vertical and lateral differences in lower crustal compositions can be geophysically detected. The ability to constrain interpretations of crustal geophysical data is mainly based on laboratory measurements, calculations of rock physical properties, and stochastic modelling.

Here we present a work-in-progress rock physical dataset based on the combination of field observations and analytical data (X-ray and neutron tomography, pycnometry, anisotropic magnetic susceptibility, electron backscattered diffraction) detailing variations in rock types, mineralogy and fabrics, completed by P- and S-wave velocity simulations (Perple_X, COMSOL, SOFI3D). Using this dataset, we shed light on the nature of the seismic, magnetic, and gravity anomaly sources along banded lithological sequences such as shear zones, gradual and abrupt mineralogical variations, and rock interfingering. The main goal is to provide a quantitative correlation of crustal lithostratigraphy and geophysical structures as well as generating new integrated petrological and geophysical models that aim at unravelling the compositional and physical architecture of the Earth's lower crust and the processes that forge it.