Receiver function analyses and joint inversion with gravity data: new constraints on the Ivrea geophysical body along a high-resolution profile

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We collected new seismological and gravity data in the Val Sesia and Lago Maggiore regions in NW Italy to constrain the geometry and properties of the Ivrea Geophysical Body. This piece of lower Adriatic lithosphere is known to be at anomalously shallow depth along the inner arc of the Western Alps, yet existing seismological constraints (vintage seismic refraction data, local earthquake tomography) are spatially sparse. With the aim to reach higher spatial resolution in imaging the structure of the IGB, we analyze the seismological data with various receiver function approaches to map the main velocity discontinuities, followed by joint inversion with gravity data to fill the bulk properties of bodies with densities.

The new data acquisition consisted of two type of campaigns. For seismology, we deployed 10 broadband seismic stations (MOBNET pool, IG CAS Prague) along a linear West-East profile at 5 km spacing along Val Sesia and across the Lago Maggiore. This network continuously recorded seismic data for 27 months at 100 Hz sampling rate. For gravimetry, we compiled existing datasets and then completed the spatial gaps by relative gravity surveys, tied to absolute reference points, to achieve 1 gravity point every 1-2 km along the profile.

The receiver function (RF) analyses aim at detecting velocity increases with depth: primarily the Moho and the shallow IGB interfaces and their crustal reverberations (multiples), together with their potential dip by analyzing the transverse component RFs. Furthermore, we aim at investigating the sharpness of the velocity gradient across the discontinuities by analyzing the frequency dependence of the corresponding RF peaks. We aim at reproducing the observations by simple synthetic models.

The 2D joint inversion combines S wave velocity $V_S$ and bulk density as physical parameters to match both the seismological and gravimetry data. The relationship between the two parameters is initially chosen from the literature, but depending on the first results the relation itself may be inverted for, considering the various high-grade metamorphic rocks observed at the surface in the area, whose properties may not align with classical $V_S$–density equations. In conclusion, we propose new constraints on the IGB, demonstrating the advantage of using multi-disciplinary
geophysical observations and improved data coverage across the study area.