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Magnetic characterization of the Ivrea-Verbano zone (NW Italy): A key to understand the magnetism and structure of the continental lower crust

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The continental lower crust remains today the less known layer of the external Earth, and only relatively recently became the focus of researches addressing its structure, composition and magnetic characteristics as deduced from seismological, geophysical, geological, geochemical and petrological data. Particularly, very intense magnetic anomalies measured over cratons imply that strong magnetic source exists at lower crustal depths beneath the continents, but its nature has remained elusive so far.

One of the approaches to obtain valuable information on the continental lower crust is studying tectonically uplifted crustal cross-sections. The likely more complete continental lower crustal section exposed on Earth is the Ivrea-Verbano (IV) zone (NW Italy), considered as a petro-geophysical reference of the continental lithosphere. The IV exposes lower crust rocks of Adria (hence of African affinity) uplifted and tilted due to the Mesozoic and subsequent Alpine tectonics. Moving NW-ward along the section, originally deeper lower crust rocks are exposed, lying adjacent to the Insubric line marking the Alpine tectonic boundary. Three main lower crust types exist in the IV zone and their best exposures are along the Val d'Ossola, Val Strona and Val Sesia. Val d'Ossola and Val Strona outcrops show continental lithologies (mafic and felsic protoliths with few marbles) in both amphibolite and granulite metamorphic facies. The Val Sesia section hosts gabbros and diorites originated from a giant input of basaltic magmas underplated at crust-mantle interface in Permian times. Moving towards the Insubric line (lower part of the lower crustal section) few subordinate slices of peridotites are exposed (Megolo, Balmuccia and Finero, this latter in the northeastern most part of the IV zone). For instance, at Balmuccia (Val Sesia), a mantle slice of peridotites is tectonically embedded within the gabbros. Here seismic and gravimetric data suggest that paleo-Moho is very shallow.

We sampled the IV rocks along three sections exposed in the Val d'Ossola, Val Strona and Val Sesia at 34 paleomagnetic sites (eight oriented samples at each site) and 7 non-oriented sites (from two to eight hand-samples) for a total number of 306 samples and measured: 1) the magnetic susceptibility (k), 2) the direction and intensity of the natural remnant magnetization (NRM), 3)

hysteresis loop parameters, and 4) density. These results will represent the input data for a forward magnetic model of the IV zone at a crustal scale, to be considered as an analogue for others lower continental crust settings.

These results were gathered in the frame of the Pianeta Dinamico "UNLOCK" INGV project, which aims at improving the knowledge on the structure, composition, magnetic properties and fluid content of the continental lower crust towards the mantle transition, by integrating new seismic, magnetic, mineralogical, petro-structural and geochemical data with unprecedented resolution from two worldwide known sampling localities, the Ivrea-Verbano and Serre (Calabria) lower crust sections.