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Mechanisms of mafic magma emplacement at a mid-crustal level: insights from AMS, AARM and EBSD analyses on the Sondalo gabbroic complex (Alps, N-Italy)

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With the aim of assessing the mechanisms of mafic magma ascent and emplacement in the continental crust, we describe the magmatic and magnetic fabrics of the Sondalo gabbroic complex emplaced at a mid-crustal level (∼15 km) during the Permian (Campo unit, Eastern Central Alps, N-Italy). Detailed mapping, field observations and petrological investigations enable to study the general structure of the Sondalo gabbroic complex. The pluton is concentrically zoned and composed of Ol–gabbros in the central zone surrounded by gabbros in the intermediate zone and diorites to granodiorites in a border zone of a variable thickness. We characterize the anisotropy of magnetic susceptibility (AMS) fabric of the intrusions. In order to detect potential abnormal (intermediate) magnetic fabrics with respect to the petrofabric, we refine the magnetic fabric characterization with anisotropy of anhysteretic remnant magnetization (AARM) measurements while the identification of magnetic mineralogy is investigated by coercivity-unblocking temperature spectra of ferromagnetic minerals. In addition, the petrofabric is evaluated by measuring the crystallographic preferred orientation (CPO) in test sites with electron backscatter diffraction (EBSD) measurements. Additional petrological and geochemical observations provide insights on the crystallization sequence of the magmatic rocks and facilitate the interpretation of the magnetic record.

The bulk susceptibilities of the rocks range from 448 to 3540*10-6 SI with most of values below 10-3 SI, attesting of a mixed contribution to the AMS signal of paramagnetic and ferromagnetic minerals. Variation of the magnetic susceptibilities can be correlated to both the lithology and the magnetic mineralogy. Measured magnetic foliation orientations are remarkably similar to the observed macroscopic magmatic fabrics defined by the preferred orientation of magmatic plagioclase, pyroxene, hornblende and rarely biotite. In the central zone, the magmatic and magnetic foliations are steeply N- or S-dipping, parallel to the elongated metapelitic rafts and their internal foliation and in continuity with the host-rock main foliation. In the border zone, both magnetic and magmatic foliations are moderately to steeply dipping with a trend roughly following the margin of the pluton. Eventually, these results provide new insights into the characterization of magnetic fabrics of mafic rocks and mafic magma emplacement in the continental crust.