Magnetic Fabric in Granitic Rocks: its Intrusive Origin and post-Intrusive Tectonic Modifications

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The anisotropy of magnetic susceptibility (AMS) is one of the most powerful tools of the structural analysis of granitic rocks, because it can efficiently measure the preferred orientation of magnetic minerals (the magnetic fabric) even in massive granites which are isotropic at the first sight. In the magnetic granites (mostly represented by I type or A type granites), the AMS investigates the preferred orientation of magnetite by grain shape. In non-magnetic granites (mostly represented by S type granites), the AMS reflects the preferred orientation of mafic silicates (mainly biotite, less frequently amphibole) by crystal lattice.

The granites that have suffered no post-intrusive deformation show magnetic fabric created during the process of magma emplacement. The characteristic features of this magnetic fabric are as follows. The degree of AMS is relatively low, indicating only weak preferred orientation of magnetic minerals created during liquid flow of magma. Magnetic fabric ranges from oblate to prolate according to local character of the magma flow. Magnetic foliation is parallel to the flow plane and magnetic lineation is parallel to the flow direction. Magnetic foliations are steep in stocks and upright sheet-like granite bodies in which the magma flowed vertically. On the other hand, it is oblique or horizontal in the bodies where magma could not ascend vertically and moved in a more complex way. Magnetic lineation can be vertical, horizontal or oblique according to the local direction of magma flow. Magnetic fabric elements usually show close relationship to the shapes of magmatic bodies and to magmatic structural elements, if observable.

In the granites that have suffered tectonic ductile deformation the original intrusive magnetic fabric is overprinted up to obliterated by the deformational magnetic fabric. The degree of AMS of such rocks is often much higher, because the ductile deformation is a relatively efficient mechanism of orientation of magnetic minerals. Magnetic foliations and lineations deviate from the directions of the instrusive fabric elements towards the directions of the principal strains.