

Flow Directions in Sedimentary, Volcanic and Plutonic Rocks

Scientific note

Sedimentary rocks

The AMS in sedimentary rocks provides information on the deposition and compaction processes. In natural sedimentary rocks unaffected by later deformation, the magnetic foliation is always oriented near the bedding, while the magnetic lineation is mostly roughly parallel to the near-bottom water current directions. Less frequently, the magnetic lineation may be perpendicular to the current direction, which is typical of the flysch sediments of the lowermost A member of the Bouma sequence. The degree of AMS is relatively low and the AMS ellipsoid is in general oblate.

Volcanic rocks

The AMS of volcanic rocks is in general very weak reflecting very poor dimensional orientation of magnetic minerals (mostly titanomagnetites) in these rocks. Since the first investigations of the AMS of volcanic rocks it has been clear that it reflects the dimensional orientation of magnetic minerals created during lava flow. The magnetic foliation is often found to be near or even parallel to the flow plane in lava flows, sills, and dikes. The magnetic lineation is mostly parallel to the lava flow directions, even though perpendicular or oblique relationships can be also rarely found. The AMS enables not only the lava flow process to be investigated, but also rheomorphic flow in ignimbrites and motions of tuffs and tuffites.

Plutonic rocks

In plutonic rocks, the AMS is one of the most powerful tools of the structural analysis, because it can efficiently measure the magnetic fabric even in massive rocks that are isotropic at the first sight. The magnetic fabric of plutonic rocks is primarily 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. The magnetic fabric ranges from oblate to prolate according to local character of the magma flow. The magnetic foliation is parallel to the flow plane and the magnetic lineation is parallel to the flow direction. The magnetic foliations are steep in stocks and upright sheet-like bodies in which the magma flowed vertically. On the other hand, it is oblique or horizontal in the bodies where the magma could not ascend vertically and moved in a more complex way. The magnetic lineation can be vertical, horizontal or oblique according to the local direction of the magma flow. The magnetic fabric elements usually show close relationship to the shapes of magmatic bodies and to magmatic structural elements, if observable.

References

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