Publications of the Institute of Geophysics, Polish Academy of Sciences
Geophysical Data Bases, Processing and Instrumentation
vol. 423 (C-112), 2018, pp. 59-60
DOI: 10.25171/InstGeoph_PAS_Publs-2018-031
16th Castle Meeting New Trends on Paleo, Rock and Environmental Magnetism, Chęciny, Poland, 2018

AMS: Evolution and Perspectives

Bernard HENRY[1,✉]

[1]Paléomagnétisme, Institut de Physique du Globe de Paris, Sorbonne Paris Cité, Saint Maur, France

✉ henry@ipgp.fr

A b s t r a c t

Shortly after the first geological pioneering application of the AMS (Ising 1942), Graham (1954) suggested to open a new way based on this approach. For more than 10 years, AMS use was very limited, due to the heavy conditions of measurement and to the necessary use of large samples. The development of new instruments, like the Digico Anisotropy Delineator (by Molyneux) and the Kappabridges (by Jelinek, Suza, and Pokorny) and the use of standard cylindrical samples offered the possibility to obtain results from fast measurements and easier sampling. AMS is now a routine method used in many laboratories over the world.

Another important evolution was the development of reliable statistical methods, based on determination of AMS mean data (using tensor variability – Jelinek (1978), parametric bootstrap – Constable and Tauxe (1990) – or bivariate analysis – Henry and Le Goff (1995)), but also keeping complementary approaches (e.g., density contours or non-parametric bootstrap, for directions as well as for parameters diagrams). The determination of the magnetic zone axis (Henry 1997) yielded additional structural information.

Magnetic fabric of sediments (Granar 1958) and of deformed rocks (Daly 1959) was first studied. Now, AMS is a standard approach for the determination of emplacement conditions and of deformation of intrusive (plutons, dykes) and volcanic rocks. But numerous other AMS applications have been developed, concerning various domains like for example for the study of the structural evolution in large sedimentary basins or of hydrothermal paleocirculation. Magnetic fabric was also used for correction of the paleodirection and of paleointensity values in paleomagnetism and archeomagnetism. Applications remain to be open for subjects such as study of building materials.

In rocks with visible structural elements, AMS directions (principal axes, magnetic zone axis) appeared sometimes as different from the corresponding visible ones, then highlighting an unknown complex evolution of the studied rocks and the composite character of the fabric (Daly 1967). The main recent AMS developments precisely concern the determination of magnetic sub-fabrics (see Hrouda (2018) – this meeting). To this aim, in very simple cases, statistical treatments were first proposed. Another possibility was the comparison of the AMS (using difference tensor) measured before and after physical or chemical modification of the samples by application of magnetic field or by heating. Direct measurements

of parts of some magnetic sub-fabrics are now possible (based on frequency dependence, high field, low temperature, out of phase susceptibility experiments…). Other approaches, maybe like measurements at different temperatures, will be probably proposed during the next years with development of new equipments, giving for example the generalization to standard samples of high field or low temperature experiments. Ending, future perspectives will be the combination of data from all these different approaches, including complementary data like anisotropies of remanent magnetization, in a simple way to obtain usable and detailed results associated to each of all the AMS sub-fabrics.

References

Constable, C., and L. Tauxe (1990), The bootstrap for magnetic susceptibility tensors, *J. Geophys. Res*. **95**, 8383–8395.

Daly, L. (1959), Sur l’anisotropie magnétique dans les roches déformées et la nature de leur aimantation rémanente, *Compt. Rend. Acad. Sci. Paris* **248**, D, 2614–2616.

Daly, L. (1967), Possibilité d’existence dans les roches de plusieures anisotropies magnétiques superposées et leur séparation, *Compt. Rend. Acad. Sci. Paris* **264**, D, 1377–1380.

Graham, J.W. (1954), Magnetic susceptibility anisotropy: an unexploited element of petrofabric, *Bull. Geol. Soc. Am*. **65**, 1257–1258.

Granar, L. (1958), Magnetic measurements on Swedish varved sediments, *Ark. Geofys.* **3**, 1, 1–40.

Henry, B. (1997), The magnetic zone axis: a new element of magnetic fabric for the interpretation of the magnetic lineation, *Tectonophysics* **271**, 325–329.

Henry, B., and M. Le Goff (1995), Application de l’extension bivariate de la statistique de Fisher aux données d’anisotropie de susceptibilité magnétique: intégration des incertitudes de mesure sur l’orientation des directions principales, *Compt. Rend. Acad. Sci. Paris* **320**, II, 1037–1042.

Hrouda, F. (2018), Magnetic sub-fabrics in rocks: measurement techniques and geological interpretation. **In:** *16th Castle Meeting New trends on Paleo, Rock and Environmental Magnetism, Chęciny, Poland*.

Ising, G. (1942), On the magnetic properties of varved clay, *Ark. Mat. Astron. Fysik* **29A**, 5, 1–37.

Jelinek, V. (1978), Statistical processing of magnetic susceptibility measured in groups of specimens, *Stud. Geophys. Geodaet.* **22**, 50–62.