Zeitschrift: Schweizerische mineralogische und petrographische Mitteilungen = Bulletin suisse de minéralogie et pétrographie

Band: 59 (1979)

Heft: 1-2

Artikel: Studies in rockmagnetism and paleomagnetism

Autor: Wagner, J.-J. / Hedley, I.G.

DOI: https://doi.org/10.5169/seals-46052

Schweiz. mineral. petrogr. Mitt. 59, 157–159, 1979

Swiss National Committee for the International Geodynamics Project
Working Group 6b (Geneva): Paleomagnetism

Studies in Rockmagnetism and Paleomagnetism

Report by *J.-J. Wagner**) and *I.G. Hedley**)

The Petrophysics laboratory in the Department of Mineralogy of Geneva University has worked on the following topics within the scope of the Geodynamics project:

a) Contribution to the magnetic modelling of the oceanic crust through the study of ophiolites which are considered to be ancient oceanic crust.
b) Studies of the emplacement and deformation of continental and oceanic igneous rocks.
c) Paleomagnetism of quaternary lake and marine sediments.

a) MAGNETIC INVESTIGATIONS OF OPHIOLITES

Work has been carried out in the western Alps and in the eastern Mediterranean.

1. Ophiolite complexes of the Montgenèvre (French/Italian Alps) and Arosa (Swiss Alps).

2. Ophiolite complexes of the Hatay (Turkey) and Troodos (Cyprus).

The main differences in the field between the eastern Mediterranean and the western alpine ophiolites are that the latter do not exhibit a well developed sheeted dike complex and have a rather thin cumulate sequence. As these ophiolites may have been formed in different oceanic settings, we suggest that the above differences could be related to the spreading rate, the alpine one being the faster.

The magnetic signatures of the two ophiolite areas are also quite different. The following table gives the ranges of values of the natural remanent magnetization (NRM) and of the bulk susceptibility.

---

*) Department of Mineralogy, University of Geneva, 13, rue des Maraîchers, CH-1211 Geneva 4, (Switzerland)

Area *rock unit.*	*western Alps* *NRM (G)*	*SUSCEPT (G/Oe)*	*eastern Mediterranean* *NRM (G)*	*SUSCEPT (G/Oe)*
Pillow lavas	10^{-7}–10^{-3}	10^{-5}–10^{-3}	10^{-4}–10^{-1}	10^{-3}–10^{-2}
dikes	10^{-7}–10^{-3}	10^{-5}–10^{-3}	10^{-4}–10^{-2}	10^{-5}–10^{-2}
gabbros	10^{-6}–10^{-5}	10^{-5}–10^{-4}	10^{-5}–10^{-2}	10^{-5}–10^{-2}

The magnetic parameters are much lower for the western Alps. This could be related to the effect of the alpine regional metamorphism (pumpellyite-prehnite and pumpellyite-actinolite facies), but oceanic hydrothermal effects cannot be ruled out.

The different units of the ophiolites have been compared with actual oceanic crust and the following points should be noted:

1. If the low magnetization of the alpine ophiolites is a result of oceanic hydrothermal activity, the lack of magnetic lineations in some oceanic basins could be explained by using the magnetic model of the Montgenèvre ophiolite.

2. The gabbroic layer in off-ridge areas must contribute to the magnetic lineations (Hatay ophiolite model).

b) MAGNETIC FABRIC OF IGNEOUS ROCKS

In order to study the mode of emplacement and possible later tectonic deformation, the anisotropy of initial magnetic susceptibility (AIMS) has been measured on granites (western Turkey), on sheeted dike complexes (Hatay and Troodos) and on ophiolitic gabbros (Montgenèvre). As these investigations are still in progress, only the preliminary results are listed:

1. The study of granitic plutons (Kozak, Turkey) shows that the orientation of the AIMS ellipsoïd is in agreement with a structural development during diapiric emplacement.

2. The study of dikes from sheeted complexes seems to indicate that the principal AIMS ellipsoïd axes are not necessarily oriented as predicted by a simple flow model. In such a model the maximum and the intermediate axe are in the flow plane; the direction of the maximum being the flow direction. The minimum axis is perpendicular to the flow plane. The discrepancies noted in the dikes maybe related to injection under stress and also to further intrusion by a later series of dikes. The detailed investigation of the Troodos dike complex has been undertaken in collaboration with the laboratory of petrology, University of Nancy, France.

3. In a study of intra-oceanic crust deformation, the AIMS of progressively deformed gabbros shows that the fabric corresponds to deformation by simple shear.

c) PALEOMAGNETISM OF SEDIMENTS

1. A paleomagnetic study of non-consolidated quaternary sediments from Lakes Geneva and Morat (in collaboration with the Department of Geophysics, Edinburgh University) has revealed the recent geomagnetic declination variations for this region.

2. Deep-sea sediment cores from the Sicilo-Tunisian Strait have also been investigated (in collaboration with the Marine Geodynamic centre at Villefrance-sur-mer, France, GESIT 73). The most interesting discovery was the presence of greigite, (Fe_3S_4) a rare magnetic iron sulphide.

Literature

WAGNER, J.-J., 1971: Rockmagnetic studies on ophiolites from Montgenèvre (French-Italian Alps). Preliminary data. Zeitschrift für Geophysik, *37*, p. 589–593.

WAGNER, J.-J. and CREER, K. M., 1974: Magnetic stratigraphy of post-glacial lake sediments. EOS, Trans. Am. Geophys. Union, *55*, 5, 547.

COGULU, E., VUAGNAT, M., DELALOYE, M. and WAGNER, J.-J., 1975: Hatay-Kizildag masifi ofiolitlerinin jeokronolojik ve petrofizik etüdü. Turkiye Jeoloji Kurumu 1975, 29 Bilimsel ve Teknik, Kurultayi, Ankara (Résumé au Congrès annuel de la Société Géologique de Turquie). p. 21.

WAGNER, J.-J., DELALOYE, M. and HEDLEY, I. G., 1975: Données géochronométriques et paléomagnétiques sur l'extension du volcanisme du Hegau en Suisse (Ramsen, Schaffhausen). C.R. Soc. Phys. Hist. Nat. Genève, *10*, 1, 46–57.

VANDIVOET, E., 1975: Susceptibilité magnétique de sédiments non consolidés de la fosse de Malte. C.R. Soc. Phys. Hist. Nat. Genève, *10*, 1, 19–24.

CREER, K. M., MOLYNEUX, L., VERNET, J.-P. and WAGNER, J.-J., 1975: Paleomagnetic dating of 1-metre cores of sediment from Lake Geneva. Earth and Planetary Science Letters, *28*, 127–132.

WAGNER, J.-J., DELALOYE, M., HEDLEY, I. G., VUAGNAT, M., and COGULU, E., 1976: Magnetic Properties of a fragment of Tethyan lithosphere. EGS abstract in EOS Am. Geophys. Union Trans., *57*, p. 655.

HEDLEY, I. G., BINGÖL, E., DELALOYE, M., PISKIN, Ö. and WAGNER, J.-J., 1976: Application de l'anisotropie de susceptibilité magnétique à l'étude structurale du pluton de Kozak (Bergama, Turquie). (Note préliminaire). C.R. Soc. Phys. Hist. Nat. Genève, *11*, 31–38.

WAGNER, J.-J., HEDLEY, I. G., DELALOYE, M. and VUAGNAT, M., 1977: Magnetic anisotropy of a sheeted complex. IAGA abstract in EOS Am. Geophys. Union Trans. *58*, p. 711.

HEDLEY, I. G., STEEN, D., TINKLER, C., VUAGNAT, M. and WAGNER, J.-J., 1979: The magnetic fabric of some deformed ophiolite gabbros. UKGA abstract, Geophys. J.R. astr. Soc. *57*, 273-4.

ESPINOSA, A., HEDLEY, I. G. and WAGNER, J.-J., 1979: Paleomagnetic reconnaissance of the Grupo Diabasico, Western Andes (Colombia). Proceedings of second Geological Congress, Bogota. Colombia (in press).

Manuscript received July 23, 1979