Abstract:

The Oman ophiolite is a natural laboratory for the study of processes operating above a nascent subduction zone. It formed in the Late Cretaceous by supra-subduction zone spreading and shortly afterwards was emplaced onto the Arabian continental margin. Twelve massifs in the ophiolite expose complete sections of the Neotethyan oceanic lithosphere, including upper mantle peridotites, lower crustal gabbros, and upper crustal sheeted dykes and lava flows.

Previous palaeomagnetic studies have suggested that the southern massifs of the ophiolite were affected by a large-scale remagnetization event during emplacement, that completely replaced original remanences acquired during crustal accretion. In contrast, primary magnetizations are preserved throughout the northern massifs. This study aimed to: (i) apply palaeomagnetic, magnetic fabric and rock magnetic techniques to analyse crustal sections through the southern massifs of the Oman ophiolite to investigate further the extent and nature of this remagnetization event; and (ii) use any primary magnetizations that survived this event to document intraoceanic rotation of the ophiolite prior to emplacement.

Our new data confirms that remagnetization appears to have been pervasive throughout the southern massifs, resulting in presence of shallowly-inclined NNW directions of magnetization at all localities. An important exception is the crustal section exposed in Wadi Abyad (Rustaq massif) where directions of magnetization change systematically through the gabbro-sheeted dyke transition. Demagnetization characteristics are shown to be consistent with acquisition of a chemical remanent overprint that decreased in intensity from the base of the ophiolite upwards. The top of the exposed Wadi Abyad section (in the sheeted dyke complex) appears to preserve original SE-directed remanences that are interpreted as primary seafloor magnetizations. Similar SE primary remanences were also isolated at a control locality in the Salahi massif, outside of the region of remagnetization. Net tectonic rotation analysis at these non-remagnetised sites shows an initial NNE-SSW strike for the supra-subduction zone ridge during spreading, comparable with recently published models for the regional evolution of the ophiolite.

1. Paleomagnetic evidence for remagnetization:

A. Geological setting

B. Salahi massif: gabbros and lavas

C. Wadi Abyad

D. Wadi Gideah

E. Other paleomagnetic evidence

Figure 1. A: Simplified stratigraphic column and geological map of the Oman ophiolite, showing the sampled lithologies and locations (blue stars) of the Salahi massif, Wadi Abyad, and Wadi Gideah. The clock diagrams summarize palaeomagnetic declinations obtained from previous studies. B-D: Palaeomagnetic results from three studied locations. Equal area stereographic projections (tilt corrected) show site-mean magnetization directions and associated a<sub>c</sub> cones of confidence. Examples of orthogonal Zijderveld plots of thermal and alternating field demagnetization data (tilt corrected). Solid/open circles represent the projection of the remanence vector onto the horizontal/vertical plane, respectively. MIR = natural remanent magnetization. E: Equal area stereographic projection of site-level in situ magnetic directions from the Samail, Wadi Ta'in, Ibua, and Muscat massifs (layered gabbros and peridotites), as well as metabasalts of the Sah Hatat continental window (Feinberg et al., 1999). Note that Permian basement metabasalts, mantle peridotites and gabbros share a common NW direction of magnetization.

From Feinberg et al. (1999) - the first study to recognize remagnetization of the southern Oman massifs.
2. Remagnetization model:

3. Origin of magnetization:

A. Thermal event

B. Secondary Growth

D. Real data vs Model

(i) Wadi Abyad data

(ii) Model unblocking temperature spectra

(iii) Model Zijderveld plots

4. Net Tectonic Rotation analysis:

A. Initial dyke orientation

B. Tectonic model

5. Conclusions:

- Remagnetization in the Oman ophiolite is inferred to result from orogenic fluids related to the emplacement of the ophiolite on to the Arabian continental margin
- Remagnetization happened from the base upwards, involving the acquisition of grain-growth CRM/TCRM that decreased in intensity up-section
- Net tectonic rotation analysis suggest 100-150° CW rotations around sub-vertical axes, restoring the initial dyke strikes to NNE-SSW

References:

