Geophysical studies of the spreading structure of the Troodos Ophiolite, Cyprus

Adrian Muxworthy (Imperial), Jenny Collier (Imperial) and Simon Allerton (Cardiff)

Figure 1. Troodos ophiolite.

Background: The oceanic crust covers 70% of the Earth's surface, and hosts many of the elements required for the energy transition. Whilst much progress has been made in studying the relationships between mineral concentration, tectonics and magmatism in the oceans, understanding remains limited by accessibility. The Troodos Ophiolite in Cyprus provides us with an invaluable analogue to investigate the structure of the oceanic crust at a scale difficult to achieve in modern oceans, and recent work has identified many key structural elements including fossil ridge axes, ridge-propagation boundaries and transform faults. Mineral extraction, particularly Cu has long been an important element of the Cypriot economy. Understanding how mineralisation is related to the spreading structure has important implications for exploration for minerals key to the energy transition in Cyprus, other ophiolites and in the oceans.

Rationale: A ridge propagation boundary where a new ridge has propagated through older crust has been identified in the Troodos Ophiolite based on structural and geophysical observations. This boundary has several Cu deposits associated with it, and it appears that the process of ridge propagation has focused mineralisation. Similarly, the Solea fossil ridge axis hosts two of the largest Cu deposits in Cyprus.

This PhD project will use geophysical methods (gravity, magnetics, electromagnetic (EM), palaeomagnetics) to characterize the key boundaries identified in the Troodos ophiolite. Legacy data demonstrates that gravity and magnetic anomalies are associated with the key boundaries controlling the spreading structure of the ophiolite. Drone magnetometry will be used to acquire high- resolution magnetic grids and detailed gravity data will be collected. EM responds very well to porosity and mineralisation and will be used to map faults. Palaeomagnetism and magnetic anisotropy measurements will be used to constrain crustal rotations and to identify dyke propagation directions. This study will provide important constraints on the dynamics of oceanic crust generation close to transform faults and will provide a new context for mineral exploration for volcanic-hosted massive sulphide deposits.

Student Profile: We are seeking a highly motivated individual with a background in geophysics, physics, or geology with a strong quantitative foundation. The successful candidate will be able to work independently and have a keen interest to do interdisciplinary work acquiring, processing and modelling geophysical data and integrating with geological information. The project will require fieldwork and lab-work plus data analysis.

For more information on this project please contact Adrian Muxworthy (adrian.muxworthy@imperial.ac.uk)

References

Qi, L., Muxworthy, A.R., Collier, J. & Allerton, S., 2024. Magnetic model of serpentinite near the fossil oceanic spreading axis of Troodos ophiolite and its implications to the emplacement of mantle sequences, *J. Geophys. Res.,* in review.