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Multi-scale magnetic mapping of serpentinite carbonation and its future application for deep submergence magnetometry

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Understanding peridotite carbonation is of fundamental importance to many facets of Earth science, including the global atmosphere-hydrosphere carbon exchange, lithospheric material recycling driven by subduction zones and mid-ocean ridges, the habitability of microbial organisms hosted by this metasomatic process, and the evolution of this dynamic planet Earth related the amount and distribution of carbon within a planetary system. In addition, the peridotite carbonation process can potentially be one of the most efficient applications for geological CO_2 sequestration. In recent years, numerous near-source geophysical remote sensing technology has brought to deep submergence survey sites to document geological, biological, and chemical processes associating with the serpentinization and carbonation processes; however, most of our current understanding of reaction mechanisms is based on hand specimen and laboratory–scale analyses. In this talk, we present the first geophysical characterization of serpentinite carbonation across scales ranging from km to sub–mm by combining aeromagnetic observations, outcrop– and thin section–scale magnetic mapping to establish a link between laboratory–scale observations to field–scale processes. We observed that, at all scales, magnetic anomalies coherently change across reaction fronts separating assemblages indicative of incipient, intermittent and final reaction progress. The abundance of magnetic minerals correlates with reaction progress, causing amplitude and wavelength variations in associated magnetic anomalies. This correlation represents a foundation for characterizing the extent and degree of in situ ultramafic rock carbonation in space and time.