Multi-episode formation of the world-class Hemerdon W-Sn deposit and Cornubian batholith

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The post-Variscan Hemerdon W-Sn sheeted vein deposit (Drakelands Mine, Devon, SW England) ranks as one of the top five global W resources. Despite its intrinsic economic value and importance to understanding granite-related ore formation, a comprehensive genetic model for the hypogene ore body relative to the broader magmatic evolution of the host Cornubian batholith, has thus far been lacking.

We present a new, systematic and representative mineralogy-based vein classification and relative chronology for hypogene W-Sn ore formation. Paragenetic relationships and a preliminary Pb isotope study of hydrothermal K-feldspar suggest that W and Sn were not only decoupled during ore formation, but also likely originated from different magmatic sources that were focused through the same permeable conduit (host granite) at different times.

The challenges faced in generating robust and useful chronologies for magmatic-hydrothermal systems of Variscan–post Variscan ages, are ones of spatial resolution, accuracy, and precision. Hydrothermal monazites (<300 μm) that are inter-grown with oxide ores offer the best opportunity to robustly constrain ore forming events, yet microbeam U-Th-Pb analyses lack the necessary precision to make meaningful correlations with magmatic events at the timescales of interest. Accordingly, we are developing procedures to micro-sample petrographically constrained hydrothermal monazites and date them with high-precision U-Th-Pb ID-TIMS geochronology. These data will be coupled with our new high-resolution regional model for the evolution of the Cornubian batholith (21 samples, micro-sampled zircon CA-ID-TIMS U-Pb and low-volume solution Lu-Hf). Crucially, this model indicates discrete batholith emplacement stages and increasing mantle input as magmatism progressed, which was potentially reflected in the metallogenic affinity of the hydrothermal output. We propose the multi-episode evolution of the batholith has been mirrored in the episodic formation, and later Sn-enrichment, of the Hemerdon W-Sn deposit.