Temporal Evolution of Miocene-Pliocene Magmatic Suites Fertile for Porphyry Cu Deposits: Preliminary Results from the Tres Cerrillos Porphyry Cu Prospect, Ecuador

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The Tres Cerrillos prospect is located in the foothills of the Western Cordillera in northwestern Ecuador. Magmas associated with porphyry-style mineralisation in the prospect present typical calc-alkaline arc signatures. Geochemical indicators (based on whole-rock geochemistry and zircon trace elements) from porphyries and phaneritic intrusions show a fertile signature for porphyry Cu systems, where whole-rock REEs show high enrichment of LREEs, variable depletion of MREEs and HREEs, and lack of Eu negative anomaly. That suggests those magmas experienced a deep crustal evolution, with amphibole (± garnet) fractionation, prior to emplacement in the upper crust, where they exsolved mineralising fluids.

LA-ICP-MS U-Pb zircon geochronology on these intrusions combined with whole-rock geochemistry reveal a temporal chemical evolution of REEs and their fertility proxies (Sr/Y, La/Yb, Dy/Yb, V/Sc, and Zr/Y), defining four magmatic cycles during the Mid-Miocene to Pliocene, with roughly similar behaviour at ~11, ~10.5, ~8.8, and ~2.8 Ma. In each cycle, the earliest intrusions (either a pluton or a porphyry) show the flattest REE spectrum and the lowest fertility signal, followed by the emplacement of porphyries with the strongest depletion of HREEs and MREEs and the highest fertility signal. Furthermore, in the case of the magmatic cycle at ~11 Ma, where we collected more data, HREEs and MREEs get progressively less depleted as the porphyritic intrusions become younger, but still overlap the fertility range (e.g., Sr/Y values between 50-150).

We suggest this magmatic evolution from unfertile to fertile behaviour could reflect a tectonic stress regime cyclically changing from stronger compression to more neutral stress. One hypothesis for this evolution could be the subduction of the topographically irregular Carnegie Ridge beneath the Ecuadorian continental margin. Thus, fertile magmas were transferred from lower to upper crustal levels at different epochs during the Mid-Miocene to Pliocene.