

## **Recycled volatiles determine fertility of porphyry deposits in collisional settings**

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The most important volatile elements controlling the transport of ore metals in magmatic fluids are Cl and S; therefore their source and evolution are a major question for the genesis of porphyry deposits, especially in post-subduction settings. Here, we present geochemical data on apatite (860 major-element analyses, 627 minor-element analyses, 205 in-situ Rb-Sr isotope analyses) from 12 porphyry systems across Iran, Tibet and western China, and from seven coeval barren localities within the post-subduction metallogenic belt. High rare-earth element contents, V/Y and (Ce/Pb)<sub>N</sub> characterize apatite in fertile porphyries, reflecting a water-rich magma. Apatite from fertile suites also has higher chlorine and sulfur contents than those from coeval barren suites, revealing that high contents of magmatic Cl- and S-rich fluids are a prerequisite for the formation of magmatic-hydrothermal (porphyry) ores. The less radiogenic Sr isotopes of apatite from fertile magmas suggest that the elevated chlorine and sulfur reflect derivation of mantle-derived magmas from enriched sub-continental lithospheric mantle, metasomatised by previous oceanic subduction. Therefore, high-precision Cl, S, trace-element and Sr isotope data on apatite reveal a mantle-derived volatile-rich magma, and can distinguish fertile (Cu ± Au ± Mo) from barren magmatic suites; this provides a useful tool for fingerprinting porphyry deposits. Analyzing the compositions of detrital apatites from an area with little geologic information or poor outcrop, such as the Tethyan belt, could assess whether the drainage source area is dominated by fertile systems, which could help focus exploration on prospective areas, especially in covered terranes.