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Optimal geologic conditions for metal-rich hydrothermal systems in the Andes: insights from the Sollipulli and Cordón Caulle volcanic fields

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Metal and heat flux through the crust is strongly modulated by the interplay between tectonic activity and volcanism, which defines the evolution of magmatic-hydrothermal systems. The Southern Andes volcanic zone is an excellent natural laboratory to address such interplay because of the occurrence of regional, seismically active fault systems, intense volcanic activity, and abundant groundwater circulation leading to numerous hydrothermal systems. In this work, we integrate structural analysis at regional and local scale, heat and metal flux estimations, and geochemical analysis of hydrothermal fluids to define the evolution of tectono-volcanic-hydrothermal domains. We selected two hydrothermal systems in contrasting tectono-volcanic settings: (a) the NE-elongated Sollipulli stratovolcano, emplaced along NE-striking basement faults favorably oriented for shear and extension imposed by plate boundary deformation, and (b) the Puyehue-Cordon Caulle volcanic complex, located in a NW-trending tectono-volcanic domain, presumably built over fault network arrangements that promote development of magma reservoirs at the shallow crust. These hydrothermal systems are active and show evidence of a long-lived evolution of hydrothermal alteration and silica sinter deposition, allowing us to compare present real-time chemical analysis of water and gasses with the long-term chemical signature. Preliminary geochemical results for Sollipulli from major, trace (precious and base metals) and isotopic data (δ^7Li, δ^{11}B) indicate the presence of a mature geothermal system and support the model of a geochemical evolution of hydrothermal fluids controlled by fluid-rock interaction with no direct magmatic contribution for this tectono-volcanic association. Unlike the Sollipulli, the fluid chemistry of surface features at Puyehue-Cordón Caulle indicate steam heated waters that are controlled by argillic alteration and magmatic contribution indicated by isotopic data (δ^7Li, δ^{11}B). Results from this study provide new insights towards the role of tectono-volcanic associations on heat and metal fluxes and their implications to exploration for mineral and geothermal resources in the Andes.