Magma Fertility Assessment in the Atacama Region: Implications for Cu and Au Prospectivity and Geodynamics During the Cretaceous

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The Coastal Cordillera in the Atacama region of Northern Chile presents an important level of mining activity; however, it does not present the same level and number of studies for its characterization as the Eocene-Oligocene deposits (e.g. Chuquicamata-Escondida-Collahuasi). In a context of need to find more deposits, as a response to the increasing demand on critical elements, different fertility parameters have been proposed to evaluate the potential of magmas for Cu and Au mineralization. In this work, we utilize new parameters proposed by Loucks et al., 2024 for zircon and whole-rock chemical analyses and use the opportunity of integrating both zircon and whole-rock analyses by compiling geochemical data in the interval 26°-29,5°S in order to identify fertile sites as well as to understand known occurrences of Cu and Au mineralization in the region. Our data compilation consists of 105 whole-rock analyses and 1701 zircon spot analyses spanning the 140-90 Ma age range. The most fertile sites were identified in the 100-90 Ma interval for Cu and Au assessment, using Sr/Y, Al2O3/TiO2 and newly proposed (Eu/Eu*)/YbN x 104 + 5(Ce/√U x Ti)) copper fertility indicators, as well as Ba/Zr, Th/Yb and Nb/Y indicators of gold fertility. Although Cu and Au fertility can develop under different conditions,we propose a geodynamic model of evolution along the northern Chile Cretaceous arc wherein magmatic fertility for both elements arose during compressional events that took place during 120-95 Ma linked to the development of a “flat-slab” subduction, generated as south Atlantic seafloor spreading caused the paleo-Andean continent margin to over-ride the western subduction zone,inducing low-angle subduction and compressive stress conditions conducive to Cu-Au mineralization at 100-90 Ma.