Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12234

Zircon petrochronology of Cretaceous porphyry Cu-Mo-Au deposits of the Coastal Cordillera of northern Chile

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The Chilean Andes is host to one of the largest concentrations of magmatic-hydrothermal ore deposits in the world. Here, at least five metallogenic belts were formed in a continental arc setting since the Jurassic. The Jurassic-Cretaceous belt in what is currently the Coastal Cordillera of northern-central Chile, comprises several deposit types including IOCG, IOA, stratabound Cu-(Ag) and porphyry Cu-Mo-Au deposits. These Cretaceous porphyry Cu deposits are characterized by small stocks of dacite to diorite composition and contain estimated resources of <300 Mt with grades of <0.4% Cu, small in comparison to the giant porphyry deposits of Eocene-Oligocene and Late Miocene-Pliocene age in Chile. Porphyry Cu-Mo-Au deposits are formed associated with calc-alkaline magmas and relatively oxidized felsic intrusions. Hence, determining the oxidation state of the porphyritic stocks appears as a critical parameter to constrain the "fertility" of porphyry systems. However, most of these stocks are intensely altered hindering the use of primary magmatic minerals to quantify the magma oxidation state. Zircon is an ubiquitous accessory mineral in plutonic felsic rocks that is resistant to weathering and hydrothermal alteration. It is extensively used in geochronology and in petrogenetic studies due to its ability to incorporate several trace elements in its structure. Further, zircon petrochronology has been used to study the fertility of intrusive units [1,2] and more recently to trace the evolution of the early Andean Cordillera [3,4]. Here we report new U-Pb ages and trace element data of zircon grains from intrusive units related to the Cretaceous Pajonales (~115 Ma) and Cachiyuyo (~111 Ma) porphyry Cu deposits. Our preliminary results are compared with zircon trace element data from "barren" intrusions of the Coastal Cordillera and large Eocene-Oligocene porphyry Cu deposits (El Salvador, Chuquicamata) in order to determine variations in zircon petrogenetic and fertility indicators.

References

[1] Ballard et al. (2002) CMP 144, 347-364; [2] Lee et al. (2017) Economic Geology 112, 245-273; [3] Jara et al. (2021) Nature Communications 12, 4930. [4] Jara et al. (2021) Gondwana Research 93, 48-72