Petrochronology of Zircons from Magmatic Rocks of the Kişladağ Au (-Mo) Porphyry Deposit, Turkey

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Porphyry deposits occur in Andean-type subduction zones but also in post-subduction, collisional to extensional settings. Processes leading to the formation of magmatic systems associated with mineralization in these two different contexts might lead to differences in their metal endowments. It is therefore important to understand similarities and differences in the magmatic processes (e.g., source of magmas, intra-crustal evolution of primary magmas) leading to the formation of porphyry deposits in these two different contexts. This study focuses on the Miocene Kişladağ Au (-Mo) porphyry deposit (16.8 Moz Au) in western Anatolia, Turkey. The monzonitic to quartz-monzonitic stocks hosting the mineralization are of high-K calc-alkaline to shoshonitic affinity and are believed to represent a collisional to extensional tectonic setting.

Uranium-Pb dating by LA-ICP-MS has been performed on zircons (n >300) from six different samples from the early best mineralised Intrusion 1 to the late, essentially barren Intrusion 3, as well as from a barren latitc lava flow. Trace element and Hf isotope analyses of these zircons are helping to better understand the petrogenetic evolution of the magmatic system associated with the mineralization at Kişladağ and possibly provide information about the oxygen fugacity in the magmas (e.g., Eu and Ce anomalies). The Hf isotope data from zircons of the different porphyritic intrusions (Intrusion 1, 2, 2A, and 3), characterized by a constant decrease of Au and Mo grades over time, will be complemented by whole-rock Nd isotope analysis.

In order to better constrain the magmatic-hydrothermal lifespan of the deposit, we use a combination of three different chronometers. Uranium-Pb dating on zircons from Intrusion 1 will yield a crystallization age and thus mark the emplacement of the first porphyritic stock related to the mineralisation. The currently available minimum age of the deposit of 14.76 ± 0.01 Ma is based on a U-Pb age of Intrusion 2 whereas the emplacement of Intrusion 3, marking the end of the magmatism, has been dated at 14.36 ± 0.02 Ma. The Re-Os dating on molybdenite from Intrusion 2A will be compared to the Re-Os age from molybdenite of Intrusion 1 (14.49 ±0.06 Ma). Together with the dating of a suspected later molybdenite generation, this may help us to determine the duration of the mineralizing event and solve the question as to whether each intrusion brings in its own hydrothermal system. Finally, the cooling age obtained from Ar-Ar dating on alunite will mark the end of the hydrothermal system. Whole-rock major and trace element analyses of the porphyritic intrusions and volcanic rocks from the Beydagi caldera hosting them have been performed and will be used for geochemical modelling (e.g., source characteristics, magma evolutionary processes within the crust).