Age and Duration of Igneous Activities in the Cerro Colorado Cu Mine, N. Chile, constrained by Zircon Geochronology

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Previous studies of the Cerro Colorado copper mine, N. Chile, have identified three distinct sub-volcanic intrusive units: 1) a porphyritic quartz monzonite unit (PTO1); 2) a tonalitic unit (PTO2); and 3) a leucocratic quartz porphyry unit (PQZ). We have obtained new U–Pb spot ages of zircon grains from each of the three units using a LA-ICP-MS system at Nagoya University. The results show a wide range of different age populations, suggesting the common presence of xenocrystic zircons. CL images show the presence of multiple phases of zircon growth over older cores. In order to place the ages for the intrusive bodies in context, zircon ages were determined for the host Cerro Empexa Formation and the basement granite. Removal of the xenocrystic components reveals the presence of two distinct pulses of zircon growth at c.53Ma and c.50Ma. The younger age population is present in PTO1 and PQZ but absent from PTO2. These relationships suggest that PTO2 formed before PTO1 and PQZ, revising previously proposed age relationsihps. The newly obtained age data are compatible with observations of drillcore that suggest PTO1 and PQZ have gradational contacts, and that PQZ can be interpreted as the phyllic altered equivalent of PTO1. The relatively strong alteration of PTO2 is compatible with it being the oldest member of the intrusive suite.

The presence of multiple zircon populations with different ages suggests strong association between the Cerro Colorado mine and abundant igneous activities between 60Ma– 50Ma within the regional Palaeocene- early Eocene domain [1]. Our results show that obtaining reliable ages for the magmatic activities related to Cu mineralization in Cerro Colorado requires measurement of a large number of spot ages including the country rocks. In the Cerro Colorado Mine area, our new age data show that two pulses of igneous activity took place at c.53Ma (youngest age: 49.8±2.8Ma) and c.50Ma (youngest age: 45.7±3.3Ma). The 3 million year age gap brackets the timescale of copper mineralization.

[1]Maksaev *et. al.* (2007) in Moreno & Gibbons (Ed.), The Geology of Chile (pp.179-200). London: Geol. Soc.