

Preliminary geochemical data on the granitic plutons of the Cordillera Real of Bolivia

Álvaro Rodrigo Iriarte Ibañez¹, Umberto Giuseppe Cordani²

(1) Universidad Mayor de San Andrés, Ingeniería Geológica y del Medio Ambiente, Ciencias Geológicas, Cota Cota Calle 35A #16, La Paz, Bolivia

(2) Universidade de São Paulo, Instituto de Geociências, Mineralogia e Geotectônica, Rua do Lago, 562. Cidade Universitária, São Paulo, Brasil

The Cordillera Real of Bolivia comprises six Permian-Triassic plutons (age range of 260 to 220 Ma) represented by the Huato, Illampu, Yani, Huayna Potosí, Zongo and Taquesi and two Oligocene major plutons (27 Ma) represented by the Illimani and Quimsa Cruz. They were emplaced within Ordovician metapelites (Amutara Fm.) along the NW-SE strike of the Eastern Cordillera, within the Central Andes. The context over which the Permian-Triassic plutons were emplaced corresponds to an extensional setting of continental rifting associated to the Mitu group in northern Perú, while the Oligocene plutons were emplaced along a compressional setting that is associated to lower crust delamination. The Amutara Fm. was affected by a low grade regional metamorphism associated to the Gondwanian orogeny.

The magmatic suite is characterized by quartz diorites and tonalites as the more mafic units, however the main lithologies are granodiorites and granites. Pegmatites, aplites and a Sn-W greisen hydrothermal system are associated. Two mica granites correspond to the more evolved felsic melts, and they usually bear sub-rounded mafic enclaves of quartz-diorites and minor metapelitic xenoliths.

Some of the mafic units outcrop on the northern side of the Illampu batholith, and their U/Pb zircon ages indicate that they correspond to a pulse of 230 Ma. Granites and granodiorites of the same batholith, as well as some rocks from the Taquesi, Huayna Potosí and Zongo plutons yield U/Pb zircon ages of about 220 Ma. Therefore, an important antecrystal and xenocrystal population is recorded in the rocks of the younger pulse, implying melting and recycling of the older pulses as well as parts of the country rocks. A large antecrystal zircon inheritance was also observed for the Quimsa Cruz batholith, which yielded a U/Pb zircon age of 27 Ma.

Chemical analyses, made at the Institute of Geosciences of the University of São Paulo, together with many other from the existing literature, show that all the plutons of the Cordillera Real apparently belong to a calc-alkalic series, which is suggestive of a subduction setting. Their magmatic evolution probably occurred by means of crystal fractionation or assimilation/crystal fractionation processes, and the Huayna Potosí and Zongo granitic plutons were the more evolved. The calc-alkalic trend, along with the trace elements ratios, indicate that a complex magmatic system operated during the emplacement of the Cordillera Real Triassic plutons, whose final episode of crystallization coincides with a continental rift episode.

In the granite discrimination diagrams, the less evolved rocks fall within the within-plate field, meanwhile the more evolved ones fall within the fields of synchronous collisional or volcanic arc granites. In the variation diagrams, the major oxides with respect to SiO₂ for most of the analyzed samples, usually show negative slopes when compared to FeO_T, TiO₂, MgO, Al₂O₃ and CaO, and positive slopes when compared to K₂O and Na₂O, suggestive of crystal fractionation as the main mechanism of differentiation. LILE elements such as Rb and Ba are highly enriched and HREE are noticeably depleted in the more evolved granites. The former can be related to assimilation of metapelites and the latter to melting of pre-existent pulses.

In a general way, the geochemical character of the granitic plutons of the Cordillera Real of Bolivia is in agreement with models of upper crust evolution in terms of melt production, country rock assimilation and recycling. In addition, it brings some understanding on how melts evolved towards an ore-rich hydrothermal system.

Financing: CAPES.