Provenance study of Phanerozoic rocks from the Cordillera Real of Bolivia

Álvaro Rodrigo Iriarte Ibañez[1], Umberto Giuseppe Cordani[2], Miguel Angelo Bassei[2]

(1) Universidad Mayor de San Andrés, Carrera de Geología, Facultad de Ciencias Geológicas, Campus Universitario calle 27 Cota Cota, La Paz, Bolivia
(2) Universidade de São Paulo, Instituto de Geociências, Mineralogía y Geotectónica, Rua do Lago, 562. Cidade Universitária, Sao Paulo, Brasil

U/Pb ages of detrital zircon grains from two samples of the Ordovician sediments of the Amutara Formation of NW Bolivia, collected near the Huayna Potosí and Zongo plutons of the Cordillera Real, were obtained for a provenance study. The analytical work was carried out at the Instituto de Geociências of the Universidade de São Paulo. The zircon ages for these two samples were added to similar data from the Amutara and Sandia Ordovician formations from SE Perú, and the resulting probability density plots of the $^{206}Pb/^{238}U$ ages were compared with similar density plots for the xenocrystal inheritance of most of the Triassic and Oligocene granitoids of the Cordillera Real, in order to constrain their genetic relationship and possible sources.

The granitic plutons cut through the entire thickness of the Amutara Formation, as well as through the sedimentary pile underneath, belonging to the Eastern Andes, and the age of their xenocrystals range between 300 and 2300 Ma. Many of them correspond to Gondwanide to Famatinian ages (300 to 450 Ma). However, Cambrian to late Neoproterozoic ages are abundant, together with minor older ages up to the late Archean.

The high peak of Cambrian to late Neoproterozoic ages is also recorded in the detrital zircons of the Ordovician country rocks. It is remarkable how the Ordovician samples, as well as the xenocrystal zircons within the granites, show a very compatible pattern for the older ages, with one notable peak related to very similar possible sources. The Kolmogorov-Smirnov test (K-S) was therefore employed to investigate distribution and affinity of ages, and it indicated that the probability density plots for the ages of the detrital zircon grains and those of the xenocrysts are clearly statistically correlated. Therefore, it is suggested that (1), assimilation of material from the sedimentary Ordovician units was carried out by the felsic melts, during their emplacement on the upper crust, and (2), crystallization of the magmas of the Cordillera Real of Bolivia probably occurred by means of an AFC process, with coeval crystal fractionation of several major phases, such as plagioclase.

Based on the resulting geochronological record and considering that the Ordovician sedimentary sequences from SE Peru and NW Bolivia have received zircon grains very probably from the same areas, we are encouraged to suggest potential sources of the detrital zircons, envisaging a possible picture for the paleo-relief in South America during Ordovician to Triassic times.

In a general way, more than half of the detrital zircon grains that were analyzed yielded Neoproterozoic to Cambrian ages, below 1000 Ma. The other half showed a wide age distribution, from 1000 to about 3000 Ma, with a concentration of ages producing a small peak around 2000 Ma. The older sources can be regarded as deriving from the Amazon region. They possibly reflect the existence of a large number of granitic rocks formed during the long-lived tectonic evolution of the Amazonian Craton, in which the largest area, back in Ordovician times, included the Paleoproterozoic rocks of the Central Amazonian and the Maroni-Itacaiunas provinces. Granitic rocks formed later during the successive provinces of Ventuari-Tapajós, Río Negro-Juruena, Rondonian-San Ignacio and Sunsás were also occupying large regions and contributed with somewhat smaller amounts of detrital zircons.

Coming to the largest peak with Neoproterozoic to Cambrian ages, we suggest that it was very probably produced by the erosion of the Himalayan-type mountains that emerged roughly between 900 and 500 Ma, during the formation of the West Gondwana Orogen, along the Trans-Braziliano-Kandi tectonic corridor. However, we cannot rule out sources related to the Sierras Pampeanas, Neoproterozoic belts hidden within the Central Andes, or recycled from pre-existent sedimentary units (such as the Tucavaca basin).