The enigmatic pre-Devonian volcanic and sedimentary rocks at Cerro Chilla, Bolivia: Their probable age, regional context and geodynamic significance

Heinrich Bahlburg[1], Udo Zimmermann[2], Ramiro Matos[3], Nestor Jimenez[4].
(1) Institut fuer Geologie und Palaeontologie, Geosciences, University of Muenster
(2) Department of Energy Resources, University of Stavanger, Stavanger, Norway
(3) Instituto de Investigaciones Geológicas y del Medio Ambiente, Universidad Mayor de San Andrés, La Paz, Bolivia
(4) Universidad Mayor de San Andrés, Instituto de Investigaciones Geológicas y del Medio Ambiente, La Paz, Bolivia

In the central Andes, pre-Devonian magmatic rocks are widespread only in NW Argentina where they are mainly linked to the Ordovician Famatinian active margin. Coeval volcanism occurs locally on the Altiplano of southern Perú and is unknown from Bolivia. Neoproterozoic volcanism is not recorded in Bolivia or Perú. However, zircon age data from Phanerozoic rocks of the area suggest the presence of a hidden Brasiliano-age magmatic arc located east of the Altiplano. On the Altiplano near La Paz, a pre-Devonian strongly deformed association of mafic volcanism with volcaniclastic sandstones and conglomerates occurs at Cerro Chilla. We present new whole rock geochemical data, and U-Pb ages and Hf isotope data of detrital zircons to determine the age and nature of this magmatism. The volcaniclastic rocks are quartz-intermediate and rich in resorption embayed quartz of magmatic origin. Lavas and tuffs are andesitic and geochemically transitional between calc-alkaline and tholeiitic. The compositions show contamination by continental crust with enrichment in incompatible elements compared to MORB and La/Yb(N) values of 3-5. Trace and REE patterns lack an arc affinity and may be representative of continental tholeiites. U-Pb ages of detrital zircons (n= 124) range between 1750 and 800 Ma with major maxima between 1300 and 1200 Ma (37% of all ages). Ordovician and Brasiliano/Pampean ages typical of Gondwana and the proto-Andean region are absent. Noting that Ediacaran and younger ages are present in virtually all analyzed Phanerozoic sedimentary rocks we conclude that the volcanosedimentary unit at Cerro Chilla most likely is of pre-Ediacaran, probably Cryogenian age, a novelty in the central Andes. epsHf isotope values of detrital zircons (n= 54) range between -14 and +8. Juvenile values cluster around TDM of 1500 Ma. All data form an array reflecting either a continuous isotopic crustal evolution of zircons derived from juvenile protoliths at 1500 Ma or they reflect protracted juvenile magmatism between 1500 and 900 Ma with increasing amounts of crustal contamination with decreasing age. There is no pronounced vertical data array at 1000 Ma which is present throughout detrital zircon populations from the central Andes and which reflects crustal contamination during the Sunsas orogeny. We conclude that the detrital zircons from the Cryogenian Cerro Chilla unit were derived from juvenile sources connected mainly to the Rondonia-San Ignacio orogeny of SE Amazonia.