Establishing the Continental Crust of the Central Andes: Insights from Zircons in Bolivian Crustal Xenoliths

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The stable nature of the overthickened continental crust beneath the modern-day Bolivian Altiplano allows for billions of years of Earths geological history associated with orogenic, accretionary, and magmatic events to be recorded. Crustal xenoliths thus provide crucial insights into the composition of this continental crust, its crustal evolution timescales, and the tectonomagmatic processes involved during periods of juvenile growth and reworking. Here, the U-Pb-Hf zircon record from Bolivian crustal xenoliths is used to assess the timescales of crustal evolution, accretion, and tectonomagmatism pertaining to the establishment of the proto-Andean margin and the Arequipa-Antofalla basement (AAB) of the Central Andes. For the first time, we report a >3.0 Ga zircon that confirms the existence of material associated with the construction of the Amazonian Craton beneath the Bolivian Altiplano. The remaining zircon U-Pb ages (n=308) are subdivided into three populations: Paleoproterozoic (1.7-1.9 Ga), Mesoproterozoic (0.9-1.2 Ga), and Ordovician-late Neoproterozoic (0.4-0.7 Ga). The Paleoproterozoic age population and corresponding Hf signatures (Hf: -10 to +7) record evidence of significant continental growth and crustal reworking that is regionally related to the assembly of the Ventuari-Tapajos magmatic arc. The Mesoproterozoic age population is associated with the Sunsas orogeny and the Arequipa terrane accretion to the proto-Andean margin. The corresponding Hf record (Hf: -13 to +10) suggests that crustal reworking, combined with juvenile addition, were significant tectonomagmatic processes during this time. The Ordovician to late Neoproterozoic population provides the first evidence of Pampean-aged zircons within the AAB indicating that a reevaluation of its accretionary history to the proto-Andean margin is necessary. The zircon record from this study can also be correlated to global supercontinent cycles including tectonomagmatic events associated with the establishment of Nuna, Rodinia, and Gondwana. The Bolivian crustal xenoliths record >3 Gyrs of tectonomagmatic events associated with the development of the proto-Andean margin and provide new constraints on the nature and timing of processes that have established some of Earths thickest continental crust.

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