Provenance and geochronological insights into Late Cretaceous-Cenozoic development of the Subandean Zone and Oriente foreland basin of Ecuador

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ABSTRACT

The evolution of sediment source regions in Ecuador can be linked to Late Cretaceous-Cenozoic development of the Andean magmatic arc, retroarc fold-thrust belt, and associated flexural foreland basin. Andean shortening and crustal thickening in the Eastern Cordillera and Subandean Zone generated not only the topographic loading sufficient for foreland flexural subsidence but also surface uplift of diagnostic sources that supplied sediment to the Oriente Basin. An assessment of the chronostratigraphic, provenance, and depositional characteristics of the 3.5 km thick clastic succession of the Subandean and Oriente foreland basin provides insights into important shifts in the geodynamic setting and paleogeographic framework of the Ecuadorian Andes from Late Cretaceous to Neogene time.

Detrital zircon U-Pb geochronological results (1845 ages) from 17 sandstone samples provide an integrated provenance framework for sedimentary fill of the Oriente foreland basin. The U-Pb results span six stratigraphic levels that range in age from the late Early Cretaceous (Hollin Formation) to Pleistocene (Mesa/Mera Formation). Contributing source regions can be clearly identified by diagnostic age populations representative of four principal regions: (1) the western magmatic arc including the Western Cordillera (most of <100 Ma signatures), the (2) eastern foreland (1300-100 Ma signatures) segments of the Eastern Cordillera, (4) The Subandean Zone fold-thrust belt (200-145 Ma signatures) accompanied by reincorporated sediment, and (4) the eastern cratonic regions of the Amazonian shield (>1300 Ma). Upsection shifts in representative age spectra demonstrate the systematic introduction of new source regions as well as the progressive cannibalization of older basin fill incorporated into younger foreland deposits during eastward advance of the fold-thrust belt.

The recognition of different age populations from contributing source areas within the Andes provides an understanding of basin-scale sediment dispersal trends that can be linked to stratigraphic patterns and the evolution of foreland depositional systems. Specifically, eastward encroachment of the fold-thrust belt is expressed by the appearance early-late Jurassic signatures, the reincorporation of early cretaceous sediments, and a shift to more-proximal fluvial to alluvial fan depositional systems. The U-Pb results also reveal the existence of a previously undocumented Pan-African Brasialiano basement signature (900-650 Ma) and Late Cretaceous magmatic arc signature (68-89.8 Ma). Further, geochronologic results for the Tena Formation, including a young population of 68.6±3.5 Ma (n=3), indicate a wholesale switch from eastern cratonic sediment sources to early Andean sources that can be assigned to a Maastrichtian onset of shortening, flexural subsidence, and shift from marine to nonmarine deposition in the Ecuador segment of the northern Andes.

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