Cenozoic sedimentary response to changing subduction dynamics in the northern Andes of Colombia

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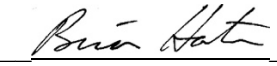
ABSTRACT

The northern Andes of Colombia provide an opportunity to compare similar geologic provinces that have been subjected to different Cenozoic subduction histories. This study seeks to understand the effects of subduction shallowing on basin subsidence, basin-margin uplift, sediment routing, and drainage reorganization due to regional tilting and local uplift of drainage barriers. In northern South America, subduction of the Nazca Plate is distinguished by the Caldas tear at 5.5°N, which abruptly separates a northern zone of active flat-slab subduction from a southern zone of normal subduction. Although these two regions share similar early Cenozoic records, they have contrasting late Cenozoic histories that can be associated with the difference in slab configuration. The contrasting sedimentary and exhumational histories can be evaluated in the Eastern Cordillera and the flanking proximal hinterland basin (Magdalena Valley) and distal foreland basin (Llanos Basin). The distinct provenance signatures of the major rock units within the Colombian Andes allow for a time-space reconstruction of major sources and routing of detritus to the flanking basins.

This study integrates detrital zircon U-Pb geochronological results for four separate localities within the Middle Magdalena Basin, including over 17 samples and new analysis of growth strata and depositional systems within a detailed measured stratigraphic section. Sedimentological analyses reveal a combination of source regions, including a syndepositional fold-thrust structure along the eastern basin margin that bounds the Carmen de Apicalá syncline. U-Pb age populations are compared to well documented igneous and sedimentary sources across Colombia (including the Western Cordillera, Central Cordillera, Eastern Cordillera, Llanos foreland, and distal craton) to determine the presence of diagnostic ages. The results variably suggest direct transport from adjacent magmatic arc and thrust belt sources as well as recycling of Precambrian-age detritus ultimately derived from the distal eastern craton. Paleo-drainage configurations are evaluated with stochastic mixing modelling (DZMix) for samples and sources, which help constrain the multi-stage evolution the intermontane Magdalena Valley Basin. Cenozoic basin development was initially guided by crustal shortening in the Western and then Eastern Cordilleras, followed by wholesale eastward tilting that may be the product of late Cenozoic flat-slab subduction. Further, the establishment and reorganization of the proto–Magdalena River reflects a complex response to basin-margin uplift governed by fold-thrust structures and regional tilting due to changing slab dynamics.

Supervisor Signature 

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