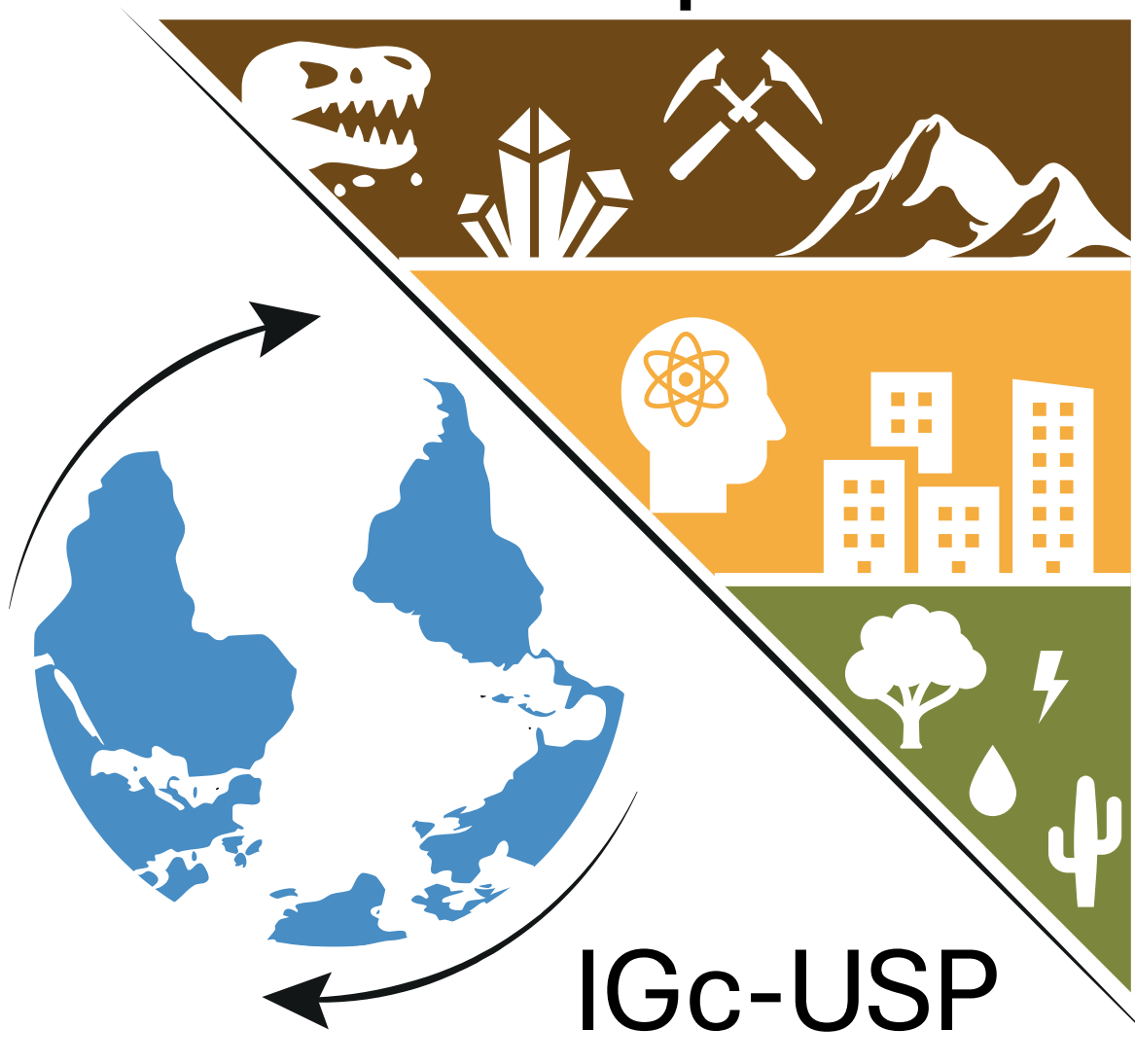


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Pós-Graduação



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Neogene sedimentary provenance and tectonic evolution of the southern margin of the Caribbean plate: Detrital apatite fission track, U-Pb, and trace element analysis

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The Sierra Nevada de Santa Marta (SNSM) in northern Colombia, a prominent orogenic massif adjacent to the Caribbean South American plate boundary, provides an exceptional natural laboratory for understanding the interplay between tectonics, exhumation, and sediment routing in an active margin setting. The ancient exhumation patterns have been studied in exhumed basins onshore, whose records go back to the middle Miocene. Earlier exhumation patterns can only be accessed in the subsurface using industry well data. This work employs an integrated provenance approach to detrital apatite grains recovered from Neogene successions in two strategically located wells: the Tairona-1 well, north of the Oca Fault, and the Ciénaga-1 well, south of it, aimed at reconstructing the tectonic and sedimentary evolution of the region. We combine detrital apatite U-Pb thermochronology, fission-track (AFT) thermochronology, and trace element (including REE) geochemistry, analyzed via LA-ICP-MS, on the same grains. This multi-proxy dataset is further anchored to reference signatures established from modern river sediments draining the principal geological provinces of the SNSM. Statistical and multivariate analyses enable the discrimination of sediment sources, the quantification of their relative contributions over time, and the assessment of their evolution in response to regional tectonics.

Our results aim to demonstrate that the SNSM has served as a significant source of sediments for adjacent basins throughout the Neogene, with systematic changes in provenance reflecting cumulative dextral displacement along the Oca fault. In addition to the relative provenance of each of the SNSM provinces in the wells, dynamic temporal variations are expected to be found, including exhumation pulses linked to major tectonic events and asymmetric exhumation of the SNSM blocks. The analysis also allows for a quantitative assessment of the tectonic role of the Oca fault as a first-order boundary controlling sediment dispersion and basin configuration in the coastal marine region of La Guajira. This integrated methodology not only refines the Cenozoic exhumation history and provenance dynamics at north of the SNSM but also validates the usefulness of multiproxy detrital apatite analysis for resolving complex tectonic and sedimentary histories in active orogens. The results provide a critical framework for future studies on provenance, tectonics, and hydrocarbon exploration in the Colombian Caribbean margin and comparable environments worldwide.

Keyword: Sierra Nevada de Santa Marta (SNSM), detrital apatite, fission-track thermochronology, trace element geochemistry, LA-ICP-MS.