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Sedimentation and provenance of the Antofagasta region of the southern Puna Plateau, central Andes

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Stratigraphic and provenance studies of Cenozoic non-marine sedimentary basins in the Central Andean Puna Plateau provide insight into the regional development and dynamics. The southern plateau hosts several poorly exposed intramontane basins bounded by basement-involved ∼N-S striking thrust faults; their origin is explained differently by contrasting geodynamic models. This study focuses on the Antofagasta region (NW Argentina). The top of the studied basin was over-thrust by basement rocks along a west-dipping thrust fault, which was likely active during exhumation of the Calalaste range to the west (25-29 Ma, Carrapa et al., 2005).

We studied three sections SW of Antofagasta de la Sierra. S3 (552 m) is the lowest section and is composed of mud playa to sandflat sediments, with at least two paleosol horizons. Lower S2 (1,263 m) contains ∼300 meters of proximal alluvial fan sediments. Upper S2 is composed of fluvial to shallow lacustrine sediments. The separation between the top of S2 and the bottom of S1 (1,062 m) is ∼540 m. The lower ∼600 m of S1 is composed of thick, distal alluvial fan and braided river sediments. In the upper S1, the depositional environment changes to fluvial-alluvial, with a paleosol developed at the top of S1. Imbricated pebbles suggest prevailing eastward paleoflow.

Modal compositions of 18 sandstones plot in the mixed zone on a Qm-F-Lt plot, and the transitional continental and recycled orogenic zones on a Qt-F-L plot (Dickinson, 1985). Their compositions cluster and do not show any evolutionary trends, despite being sampled from a ∼3000 m-thick sedimentary column. However, when combined with data from the Quinoas Formation (Late Eocene to Late Oligocene) and the Chacras Formation (Late Oligocene to Early Miocene), outcropped west of the study site (Carrapa et al., 2005), the Antofagasta samples mark the beginning of an evolving trend towards the dissected arc and transitional arc zones.

We analyzed U-Pb ages of detrital zircons from eight samples. Four young grains from three samples near the top of S2 yield ages of 38-39.5 Ma. If these grains were derived from air-fall volcanics, they indicate a late Eocene depositional age for the studied strata, but otherwise they give a maximum age estimate. We tentatively favour the former interpretation. For all samples, detrital zircon U-Pb age spectra show significant late Cambrian to early Ordovician and Precambrian (∼1000-1400 Ma, ∼1700-1900 Ma) sources. The ∼1000-1400 Ma cluster is well matched with ages from the Sierra de Maz, to the west. A minor Permian-Triassic source (∼240-290 Ma) is also present which could reflect limited exposures of plutonic rocks west of the study site.

Our work suggests that the ∼3000 meter thick unit in the Antofagasta basin is time-equivalent of the Quinoas Formation and accumulated with a high sedimentation rate. The sediments were sourced primarily from the west, with little input from volcanics. The consistent western source regions and the rapid subsidence lead us to favour a foreland-type origin for the late Eocene Antofagasta Basin.