# Cenozoic foreland basins of Central Andes: a preliminary provenance U-Pb zircon analysis of sedimentary sequences of Calchaquí Valley, NW Argentina.

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## Abstract

The Eocene of northwestern Argentina records complex basin and structural evolution, including continental sedimentation of the post-rift Salta Basin and the beginning of the Andean uplift and foreland system evolution. This illuminates a significant period of evolutionary history of this and surrounding basins in northwestern Argentina. U-Pb zircon analyses by LA-ICP-MS for three formations representing post-rift to foreland stages allowed interpretation about provenance terrains. The Lumbrera Formation, representing the post-rift stage, shows bimodal sources with a main zircon population around 462 Ma, and a second population around 1023 Ma. The Los Colorados and Angastaco Formations representing the sedimentation in a foreland basin, show a unimodal source around 490 Ma, and 517 Ma respectively. Zircons younger than 50 Ma were not identified during this study.

*Keywords:* U-Pb detrital zircon, foreland basin, Calchaquí Valley, sediment provenance, Salta Group, Payogastilla Group.

## 1. Introduction and geological setting

Foreland basins are the lithospheric depression at the edges of mountain belts induced primarily by the regional isostatic compensation of the mountainous topography. The Cenozoic Andean foreland basins offer an excellent opportunity to define the relation between tectonism and sedimentation. The Central Andes in NW Argentina, shows two different stages of tectono-sedimentary evolution from post-rift deposits of the middle Eocene (Salta Group) to foreland

deposits of the Cenozoic (Payogastilla Group). In the Calchaqui, Tonco and Amblayo Valleys, the Payogastilla Group contains a complete stratigraphic record that clearly exposes the relationships with the Salta Group.

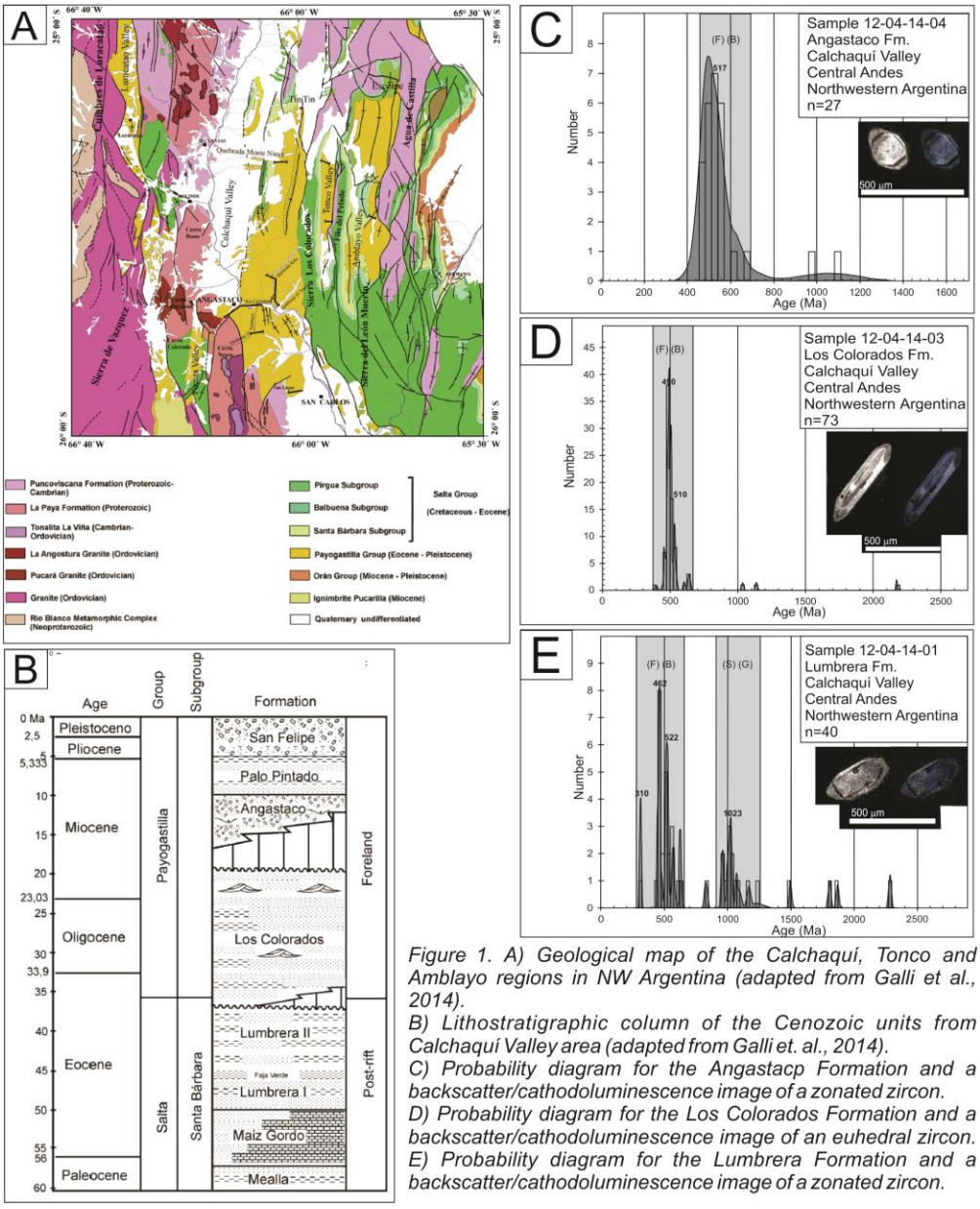


*Figure 1. A) Geological map of the Calchaquí, Tonco and Amblayo regions in NW Argentina (adapted from Galli et al., 2014).*
*B) Lithostratigraphic column of the Cenozoic units from Calchaquí Valley area (adapted from Galli et. al., 2014).*
*C) Probability diagram for the Angastacp Formation and a backscatter/cathodoluminescence image of a zonated zircon.*
*D) Probability diagram for the Los Colorados Formation and a backscatter/cathodoluminescence image of an euhedral zircon.*
*E) Probability diagram for the Lumbrera Formation and a backscatter/cathodoluminescence image of a zonated zircon.*

In this area, the Upper Neoproterozoic Puncoviscana Formation basement unit contains low-grade metamorphosed sandstones and mudstones that grade southward into schists, gneisses, and migmatites of the La Paya Formation in the Sierra de Quilmes and Cumbres Calchaquíes. Several plutons have intruded these metamorphic rocks through time, mainly

present in the western parts of the study area (Fig. 1). In the western part, at the limit of the Eastern Cordillera-Puna, the Sierra de Vázquez (Fig. 1) contains sillimanite schist and migmatite (Metamorphic Río Blanco Complex). In the north, the Cumbres de Luracatao (Fig. 1) are composed of Paleozoic granites from the eastern border of the Puna (Oire Eruptive Complex). A sedimentary succession that overlaps the Neoproterozoic to lower Paleozoic basement corresponds to the Cretaceous-Paleogene strata of the Salta Group and the Paleogene-Neogene record of the Payogastilla Group. Sedimentological and stratigraphic constraints on the Salta and Payogastilla groups of the Tin-Tin area (Calchaquí Valley), NW Argentina, provide important information on the final stage of the postrift basin and the beginning of the evolution of foreland basins of the Central Andes. The present study comprises U-Pb detrital zircon analysis and preliminary sedimentary provenance interpretation of one Lumbrera Formation (Salta Group) and two foreland formations (Los Colorados and Angastaco formations from Payogastilla Group) outcropping in the Tin-Tin area. The objective is to understand the evolution of tectonic uplifting and therefore, the evolution of sedimentation of this sector of Central Andes.

**2. Materials and methods**

Zircons were concentrated from three samples, 70 to 100 grains were handpicked from each sample and mounted. Using backscattered electron and cathodoluminescence images three groups of zircon were identified: one of inherited cores, a second characterized by euhedral grains and a third of anhedral grains–U-Pb isotope analysis was performed using a Thermo Finnigan *Neptune* multicollector inductively coupled plasma mass spectrometer with an attached New Wave 213 $\mu$m Nd-YAG solid state *laser* (LA-MC-ICPMS) at the Laboratory of Geochronology (University of Brasilia). Conditions for sample preparation, laser set-up, data collection, standards, and data reduction were described in Buhn *et. al.,* (2009).

**4. Results and discussion**

Seventy U-Pb isotope data for zircons (18 rim/core, 20 anhedral, 63 euhedral, 101 zircon grains in total) from the Lumbrera Formation (sample 12-04-14-01) were obtained. Only thirty-three zircons were inside the accepted concordance. The data distribution produced a bimodal histogram with a main peak at 462 Ma and a second peak at 1067 Ma; derived bimodal provenance from Granite La Angostura (Ordovician) and Puncoviscana and La Paya formations (Neoproterozoic). On sample 12-04-14-03 (20 rim/core, 21 anhedral, 54 euhedral, 95 zircon grains in total) from the Los Colorados Formation, 103 analyses produced 78 good concordance ratio data on 76 zircon grains (25 discarded). A probability diagram (Fig. 1) allowed the

interpretation of a curve consisting of one main age peak around 490 Ma, thus characterizing the Los Colorados Formation as a sedimentary sequence from an essentially unimodal source; derived from different granites of the eastern edge of the Puna. Sample 12-04-14-04 (16 rim/core, 14 anhedral, 86 euhedral, 116 zircons in total) from the Angastaco Formation produced little data, just 38 analyses on 31 zircon grains with 10 of those discarded. The probability density plot diagram (Figure 1) exhibits one main age peak at 517 Ma, suggesting that the Angastaco Formation originated from just one source region, derived from Cachi Formation and Tonalita La Viña that are on the eastern edge of the Puna. All samples provided evidence of crustal reworking with Proterozoic to rare Archean cores and development of Ordovician to Cambrian zircon rims. In many cases loss of Pb distorted the data creating concordance errors > 10%, although when analysed one by one, these data can be used as upper and lower intercept ages that are in agreement with what is found for most analyses (upper and lower intercept ages close to 1000 and 490 Ma, respectively). This supports the idea that before inversion of the basin, represented by a post-rift sedimentary formation (Salta Group, Lumbrera Formation), more than one source region was responsible for the provenance of sediments that filled the basin, probably a paleochannel providing sedimentary input from north to south based on crystallization ages of igneous provinces north from Calchaquí Valley. After inversion (Payogastilla Group, Los Colorados and Angastaco formations) the data suggest that sediments were brought in from one source region, changing input flux from before for at least the initial stage of this sedimentary foreland basin and, therefore, the paleochannels accountable for filling this basin.

## 5. References


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