

Evolution of the Manantiales Basin: Miocene Orogenic Patterns in the South-Central Andes

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Abstract

The Manantiales basin is a retroarc foreland basin succession flanked on the west by the Cordillera Principal and on the east by the Cordillera Frontal. The basin has been interpreted as a Miocene foreland basin developed in response to Miocene deformation in the east-vergent La Ramada fold and thrust belt. Six geochronologic analyses demonstrate that the base of the Manantiales basin succession is a previously unrecognized Eocene sequence with a maximum depositional age of 38.7 ± 0.2 Ma. The Chinchas Formation consists of a lower volcanic succession overlain by a thick coarse-grained clastic sequence that records progressive uplift of the western orogenic highland. The initiation of the Miocene succession is constrained by a 16.8 ± 0.2 Ma U/Pb age lapilli tuff within the lower volcanic unit, which is coeval with subsidence in the Santa María, Alto Tunuyán, and Cachuetas basins to the south. Ongoing thermochronologic (U-Th)/He analyses indicate exhumation initiated at 6-9 Ma, reflecting rapid erosion of the succession during eastward propagation of the La Ramada fold and thrust belt. These data combined with recent geologic mapping, stratigraphic and structural studies provide critical constraints on the development of the Manantiales basin and orogenic history of the south-central Andes.

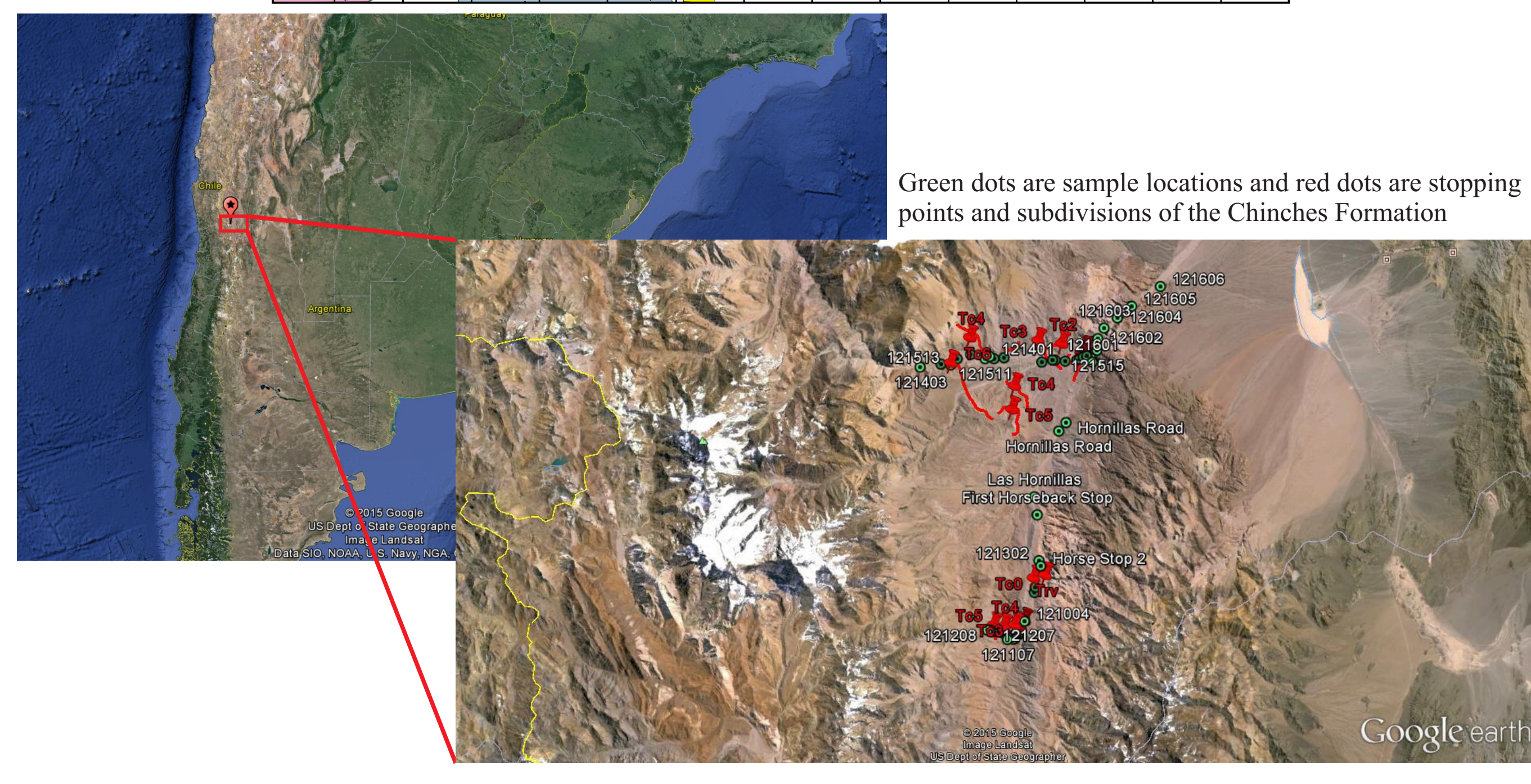
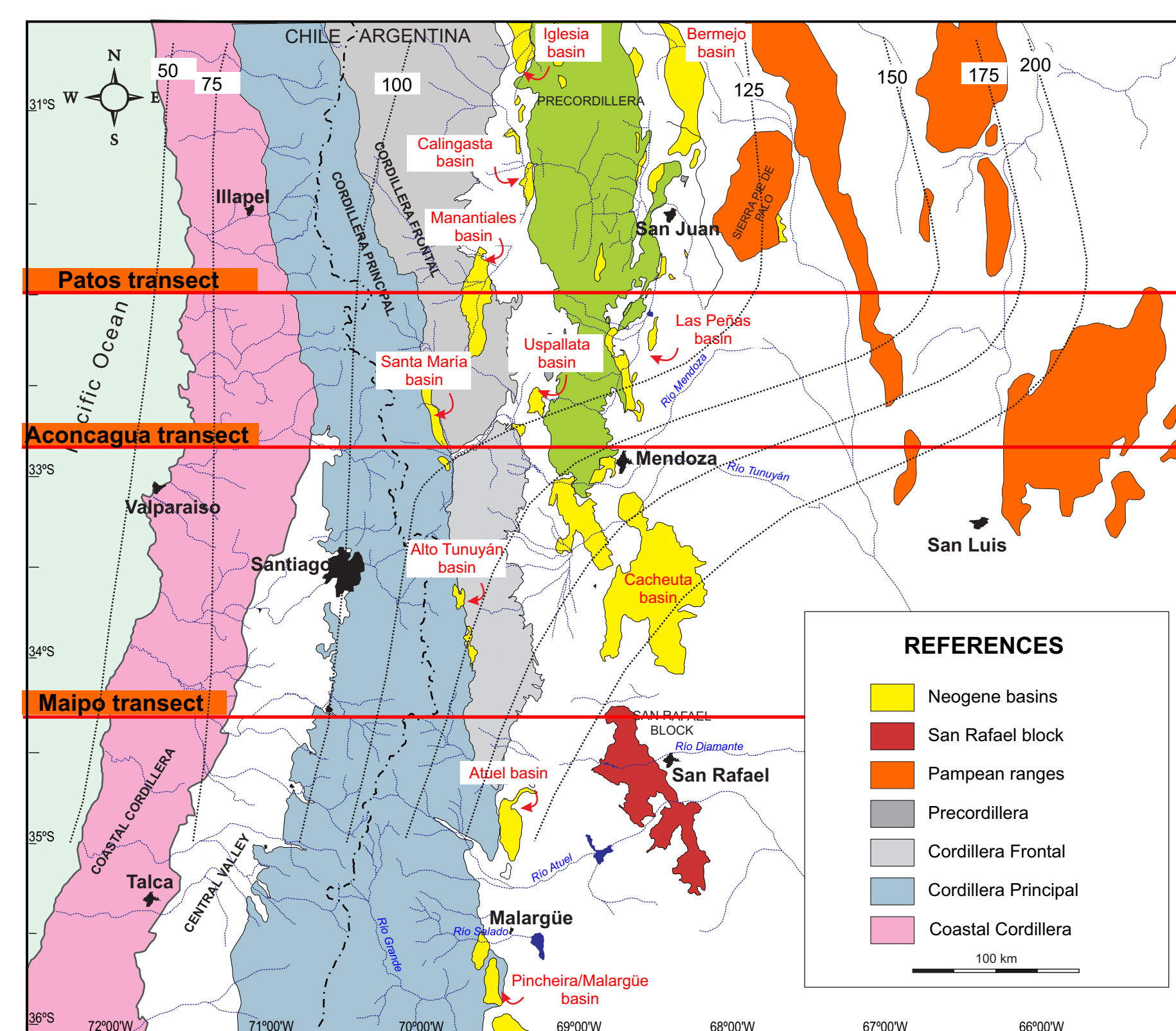
Introduction

This study of the Manantiales Basin is in conjunction with larger study of multiple basins in the south-central Andes. The basin has been interpreted as a Miocene foreland basin developed in response to Miocene deformation in the east-vergent La Ramada fold and thrust belt. Using detailed detrital zircon and apatite geochronology and thermochronology, geologic field mapping and thermomechanical methods, a detailed history of the area can be produced. Through this work we will determine sediment provenance and basin history as well as an understanding of the orogenic and exhumation history of the south-central Andes.

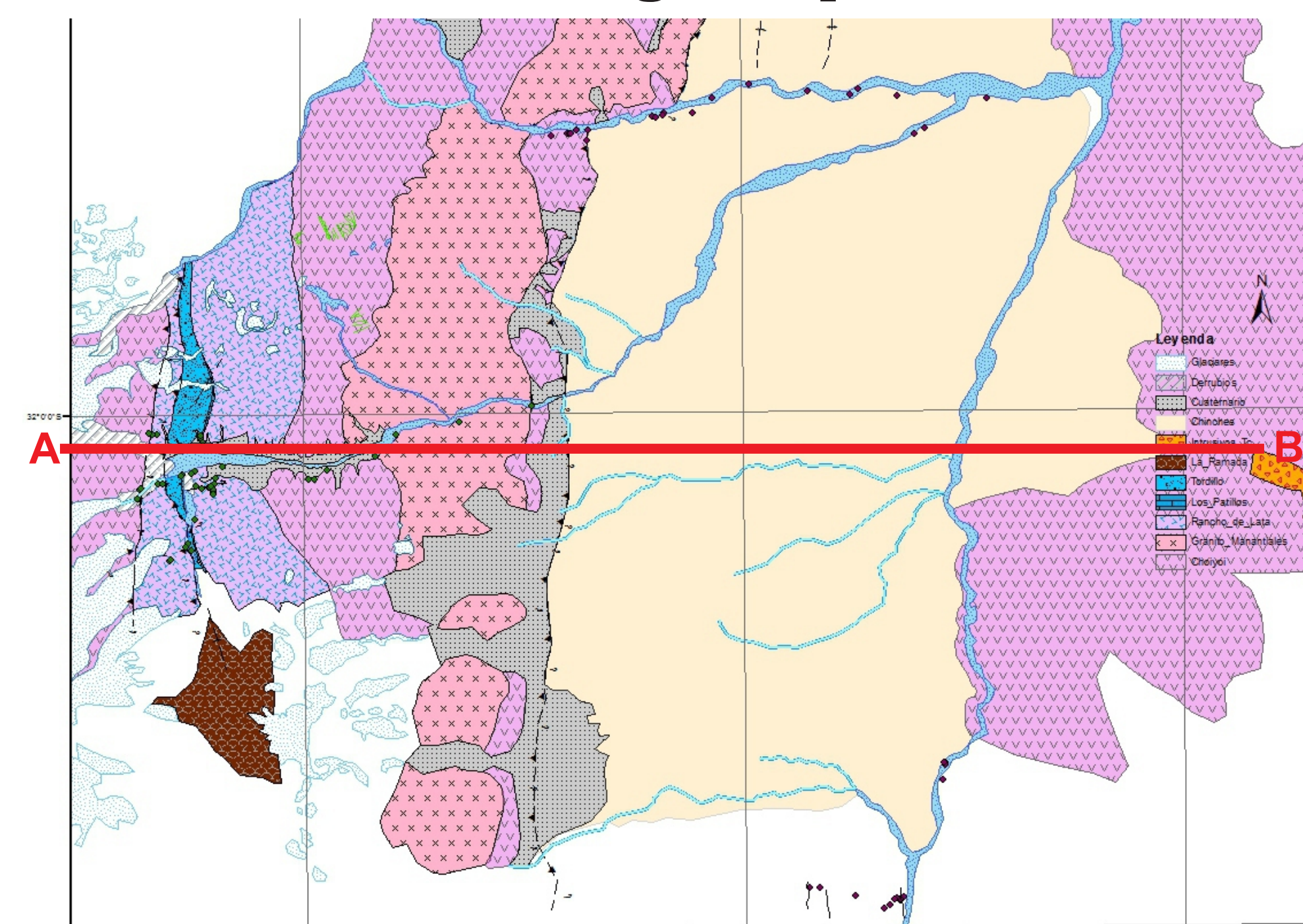
Study Area

San Juan Province, Argentina 32°S

The Manantiales Basin is a retroarc foreland basin succession flanked on the west by the Cordillera del Espinaco and on the east by the Cordillera del Tigre of the Cordillera Frontal

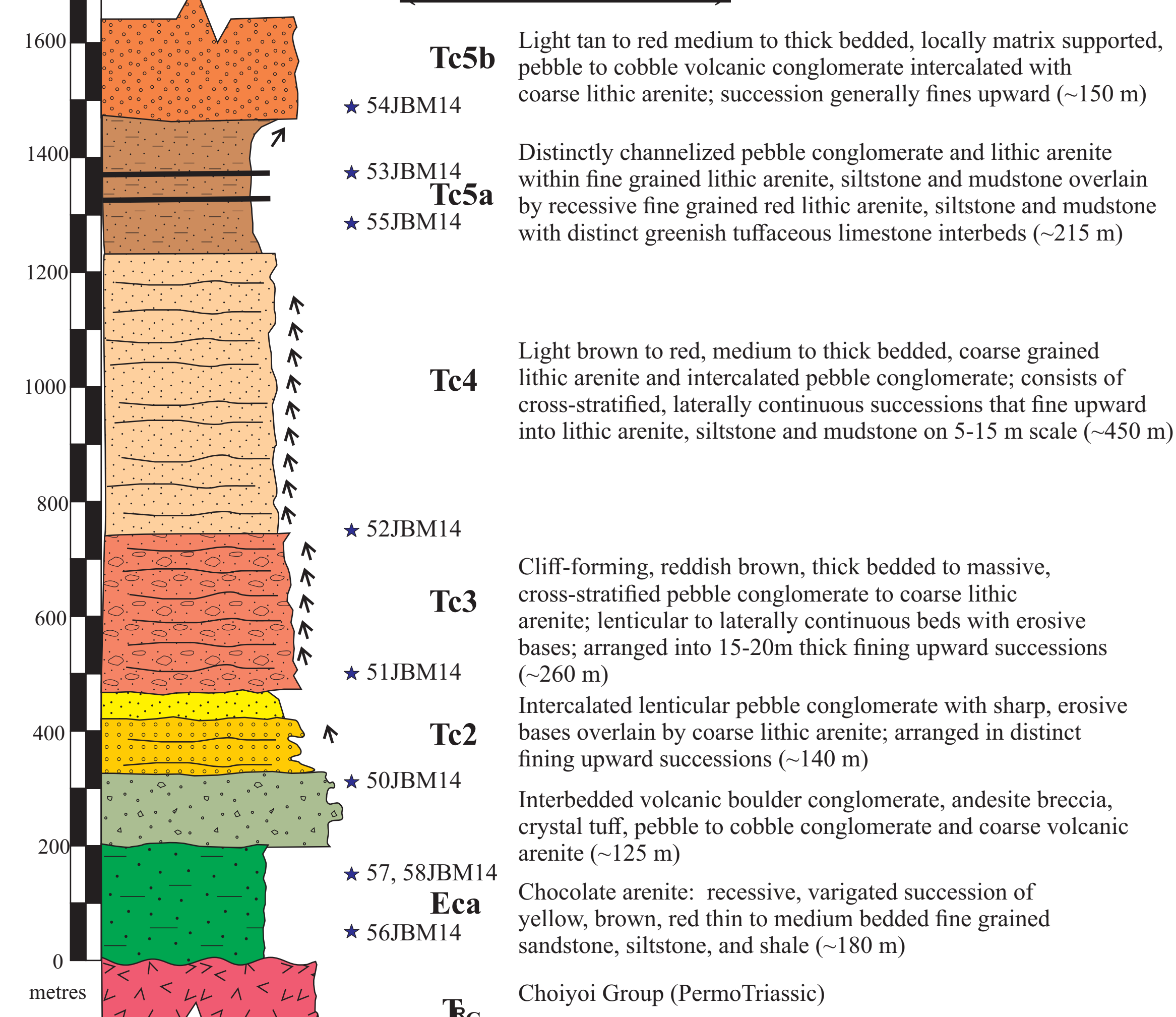


Geologic Map

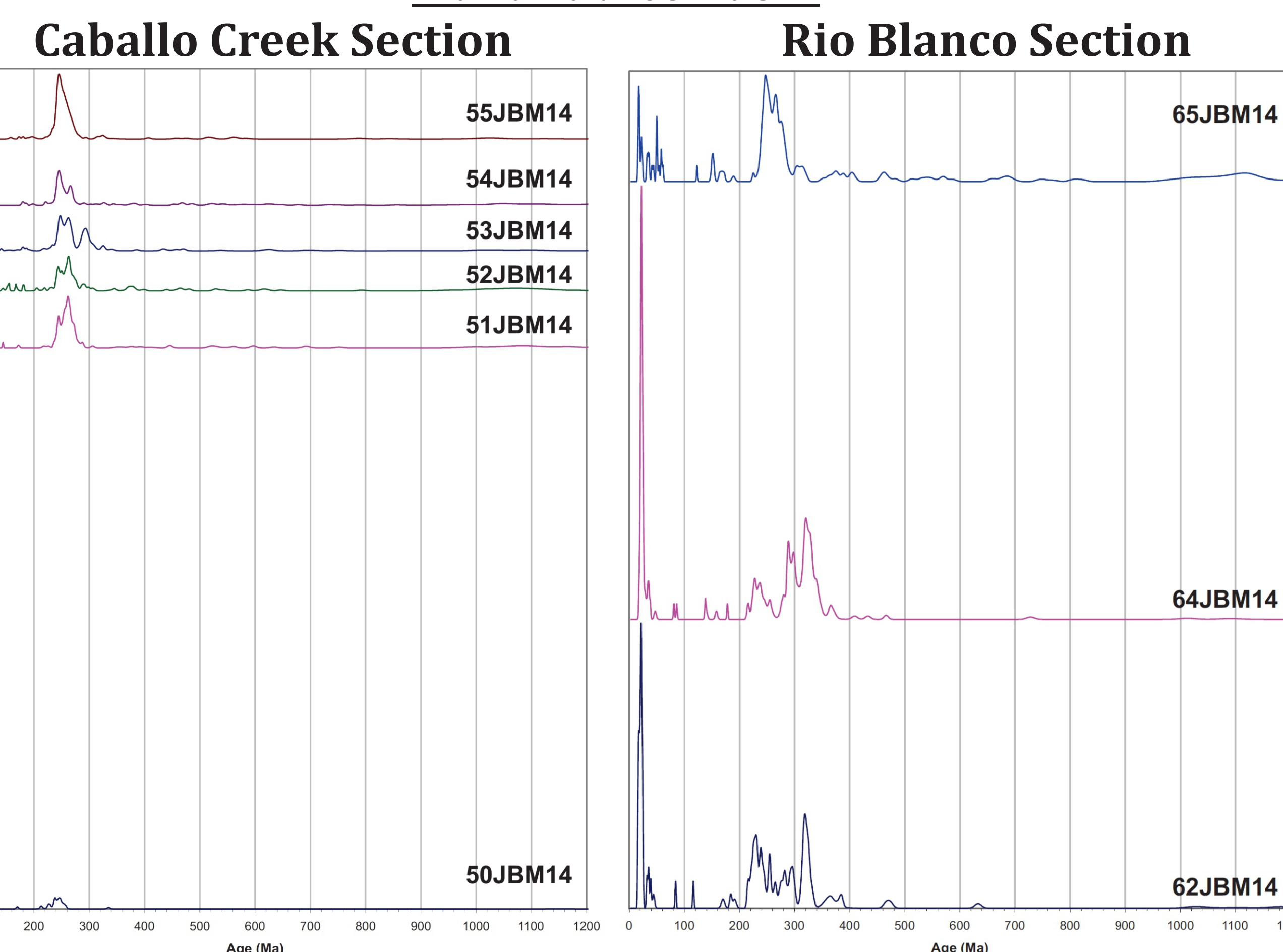


The Frontal Cordillera contains a thick succession (>3 km) of Permian-Triassic volcanic rocks and associated plutons that have been imbricated within a Miocene thick skinned fold and thrust system. The A-B line represents the structural transect shown in cross section.

Manantiales Basin South (Caballo Creek)

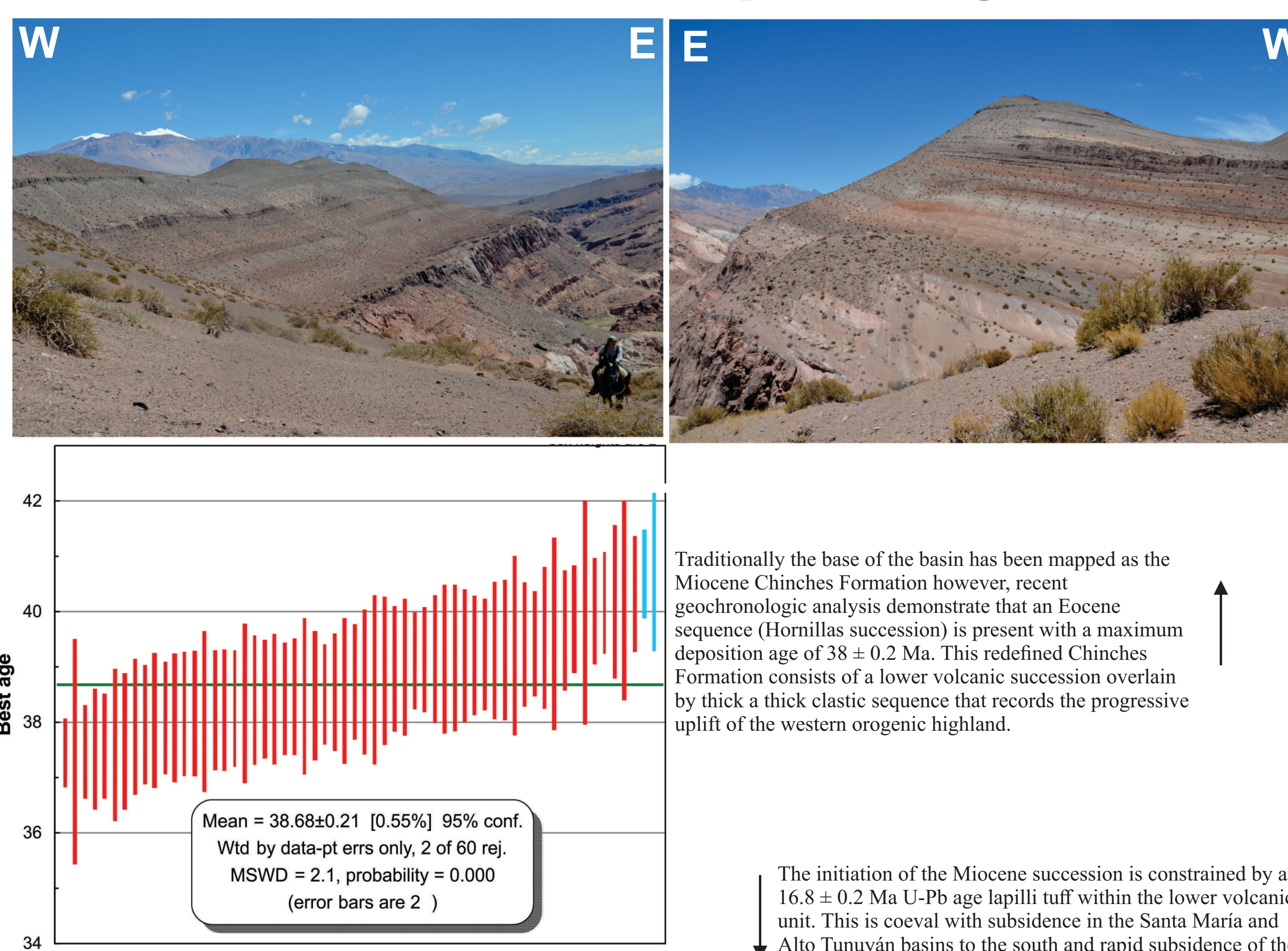


Manantiales Basin

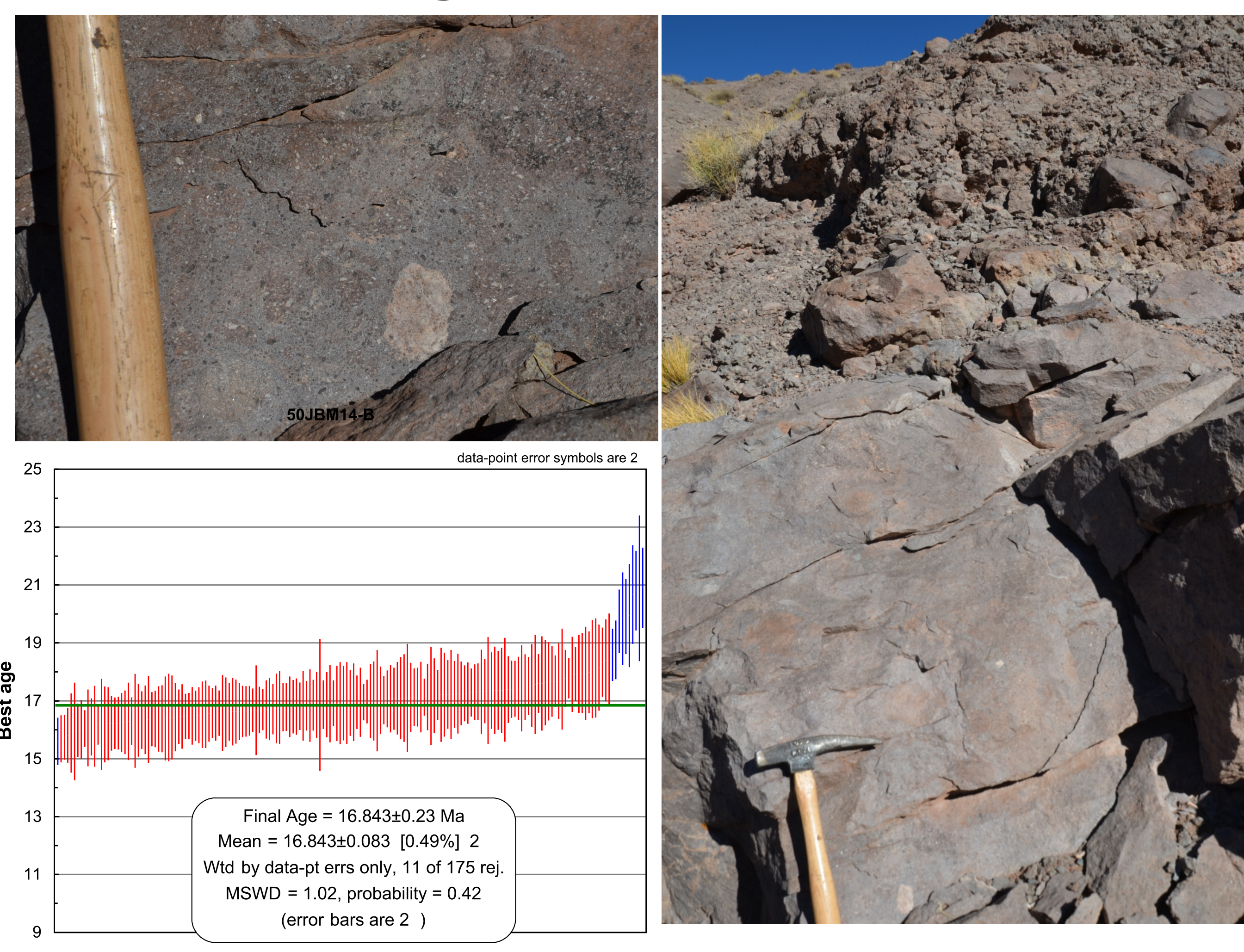


The detrital zircon populations in the Caballo Creek section indicate a bimodal sediment source derived from Permian-Triassic Choyoi Group plutonic and volcanic rocks with young syndepositional volcanics. The Rio Blanco section also shows a distinct syndepositional and Choyoi Group peak as well as an ~320 Ma signature.

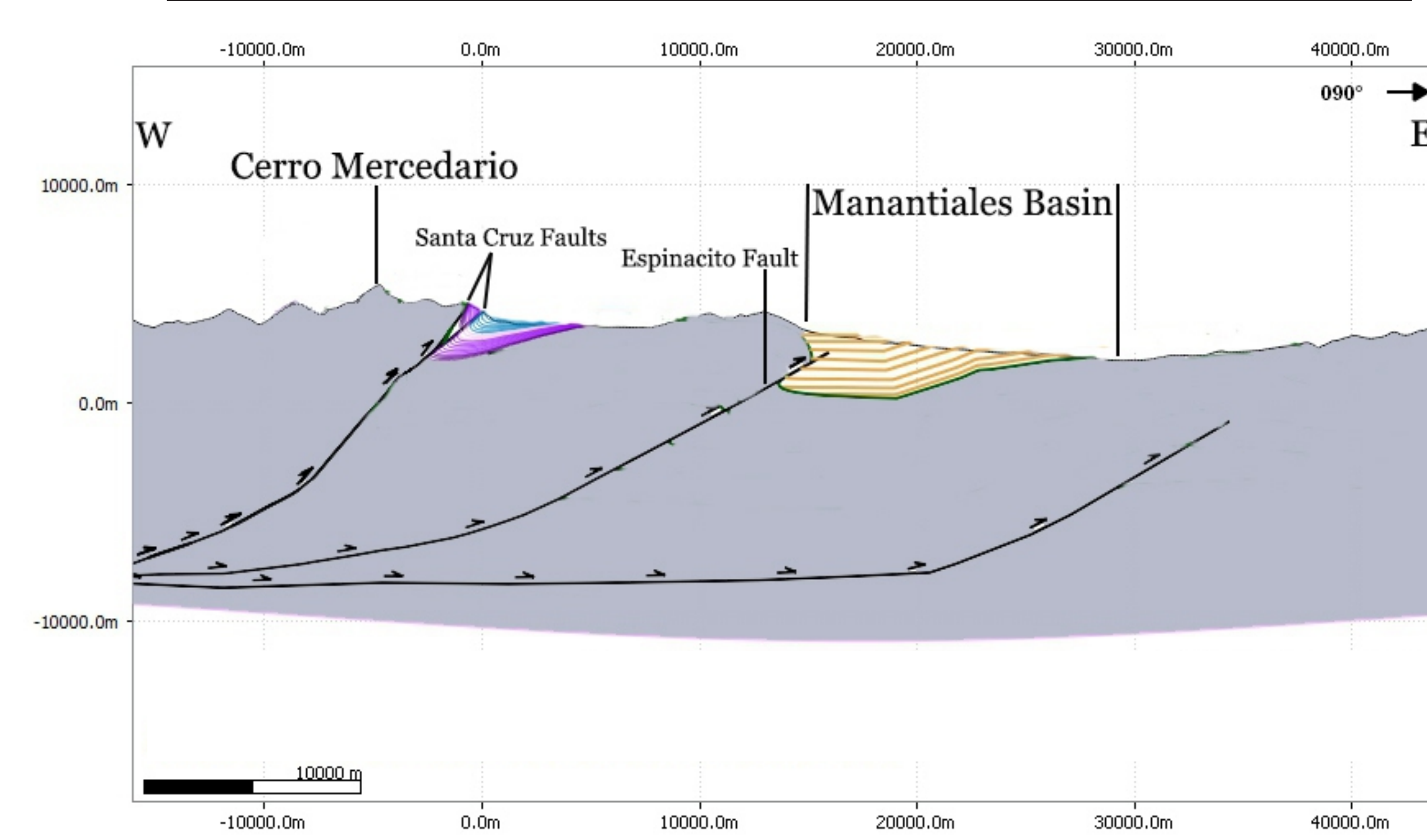
Chocolate Arenite Depositional Age



Age of Basin Initiation



Structural and Thermomechanical Cross Section



Previous cross sections of the area were based on Triassic rift structure reactivation forcing reconstruction of faults with extremely high angles and a dip detachment (21 km). New information based on thermomechanical behavior of the crust from Tassara and Echaurren (2012), we interpret a new cross section with a primary detachment at 9 km, and initial dip of 30° that steepens during eastward propagation, with a maximum shortening of 18 km.

Preliminary Conclusions

- Identification of a previously unrecognized clastic succession beneath the Miocene basin assemblage. These strata are Eocene in age (~38.7 Ma), and are referred to as the Hornillas succession
- Miocene basin subsidence initiated at ~16 Ma, based on a U-Pb zircon age from a lapilli tuff at the base of the succession
- Basin subsidence is coeval with other basins further south in the Cordillera Principal and may correlate with a period of rapid subsidence in the Cachuetas basin east of the Cordillera Principal
- Basin subsidence was distinctly episodic, as evidenced by multiple basin-wide coarse clastic sediment pulses. These pulses are inferred to correlate to episodic crustal shortening in the Cordillera Frontal
- Sediment provenance is bimodal, dominated primarily by Permian-Triassic sediment derived from the Choyoi Group of the Cordillera Frontal, with a smaller yet distinct syndepositional detrital signature
- Structural cross section of the Manantiales Basin suggests more shallow dipping fault planes than previously inferred, and constrain shortening to be ~18 km

