Neogene Basin Evolution in the Atuel basin, Sosneado Region, Mendoza, Argentina

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Abstract

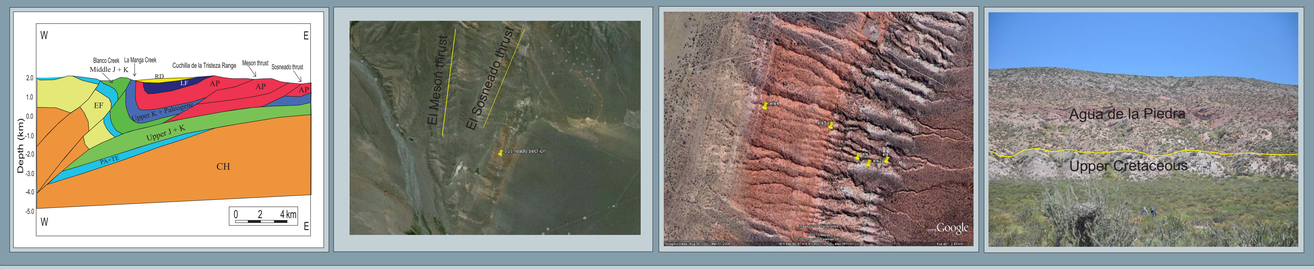
Stratigraphic successions in the southern Atuel basin record progressive orogenic exhumation and basin subsidence in the Miocene retroarc foreland basin related to the structural evolution of the Malargüe fold and thrust belt, northwest of Malargüe, Argentina (~35°S). Miocene strata in the eastern Atuel basin include thin- to medium bedded lithic arenite of the Agua de la Piedra Fm. unconformably overlying tilted strata of the Cretaceous Malargüe Group. The basal contact of the Agua de la Piedra is an angular unconformity with the underlying Malargüe Group. These successive angular unconformities show progressive deformation of synorogenic retroarc foreland basin strata in response to movement on the Malargüe fold and thrust belt.

Analysis of the Agua de la Piedra Formation constrains the depositional setting and provenance of these synorogenic strata. The base of the Agua de la Piedra Fm. (>550 m) is a parallel-bedded coarse pebble-boulder conglomerate; this begins a cyclic succession of four fining upward sequences grading from a basal lenticular cobble-boulder conglomerate into well-stratified coarse lithic arenite and overlying siltstone. Abundant structures (channel fills, basal scour marks, parallel and trough-cross stratification) indicate fluvial and alluvial fan deposition in the retroarc foreland basin.

Clast counts reveal episodic variations in clastic input. The first clast count collected 200 m from the base of the section shows abundant rhyolite detritus derived from the Permian-Triassic Choiyoi Group of the Frontal Cordillera. The second count collected 275 m from the base of the section shows an increase in sandstone and limestone clasts distinguished by ammonite fossils, characteristic of the Jurassic Tordillo Formation. Giambiagi et. al. (2008) inferred the maximum age for the Agua de la Piedra Fm. is ~13 Ma based on $^{40}Ar/^{39}Ar$ ages on conglomerate boulders. Clast data coincides with the exposure of both the Frontal Cordillera and Jurassic strata of the Neuquén basin at this time. Data from two detrital zircon samples indicate sediment derived from both the Permian-Triassic Choiyoi Group of the Cordillera Frontal and populations of Paleozoic and Mesozoic grains presumably derived from the Neuquén basin. Syndepositional grains were not recognized, implying a lack of volcanism during deposition of the Agua de la Piedra Fm.

Purpose

The south-central Andes are characterized by latitudinal stratigraphic variations that reflect changes in the rate and pattern of orogenic exhumation. Detailed analyses, including conglomerate clast counts, detrital zircon studies, and zircon Hf isotopic analyses, constrain the timing and pattern of an eastward propagating fold and thrust system that has influenced Andean deformation since early Miocene time. The primary objective of this investigation is to assess the influence of variations in subduction geometry along the Andean margin on basin development and evolution.



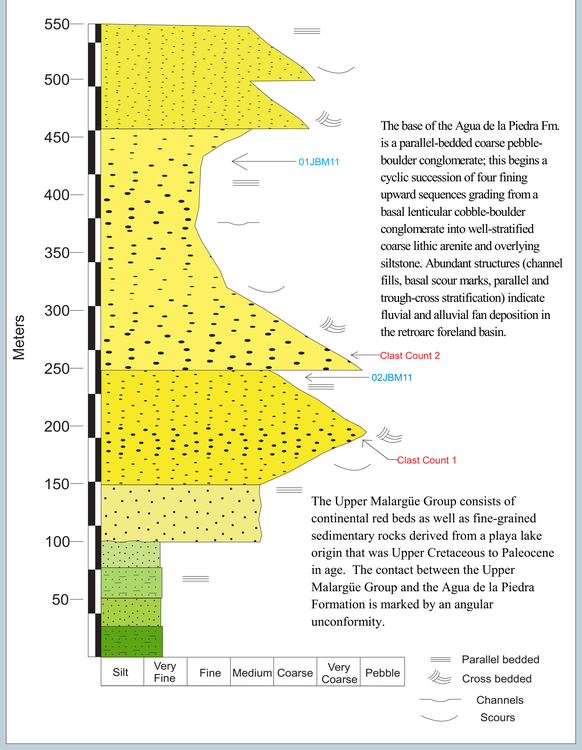
Left: Cross section of the Atuel basin region. CH: Basement Rock; EF: El Freno Formation; PA+TE: Puesto Araya and Tres Esquinas Formations; Middle J+K: M. Jurassic-Cretaceous; Upper J+K: U. Jurassic-Cretaceous; Upper K + Paleogene: Upper Cretaceous to Paleocene; AP: Agua de la Piedra Formation; LF: Loma Fiera Formation; RD: Rio Diamante Formation. **Middle Left:** Google Earth image of regional structure. Note El Meson and El Sosneado thrust faults duplicating Agua de la Piedra Fm. **Middle Right**: Google earth image of stratigraphic section. Yellow markers denote different stations throughout the section.**Right:** Photograph of measured stratigraphic section. Color change indicates stratigraphic units.

Above: Conglomerate channels in bold relief against finer-grained overbank deposits. (~350 m)

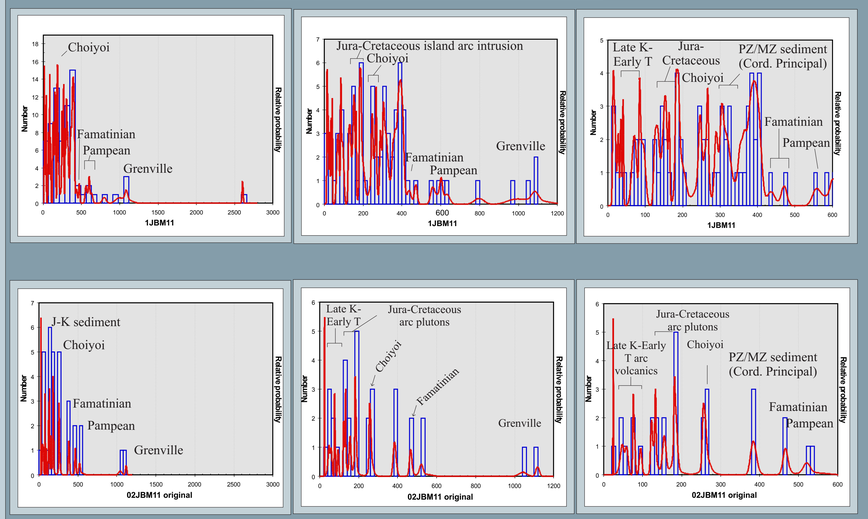
Above: Base of conlgomerate channel. Note coarse grained lag deposit, basal scour marks, and graded bedding (~250 m)

Above: Pebble conglomerate with well developed clast imbrication (~200 m)

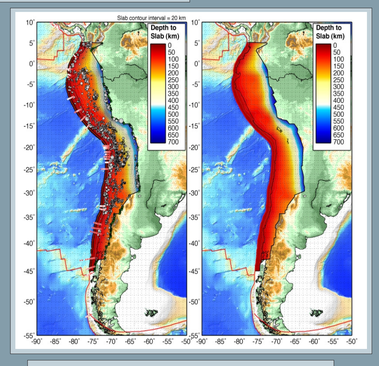
Sosneado Region, Atuel Basin Stratigraphy

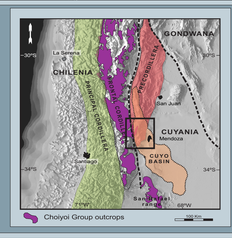


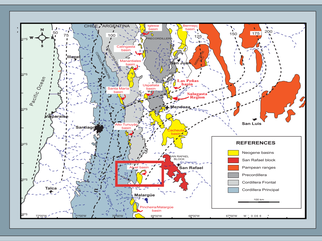
Detrital Zircon Geochronology



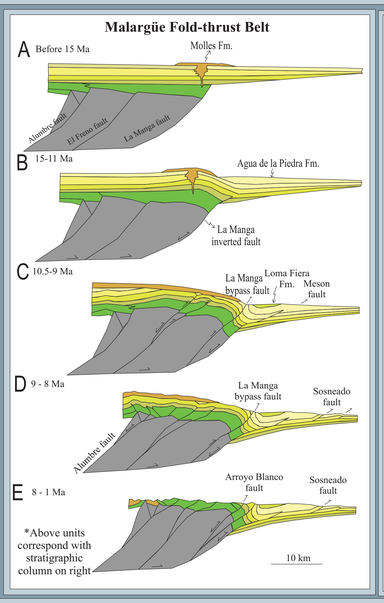
Andean Geologic History

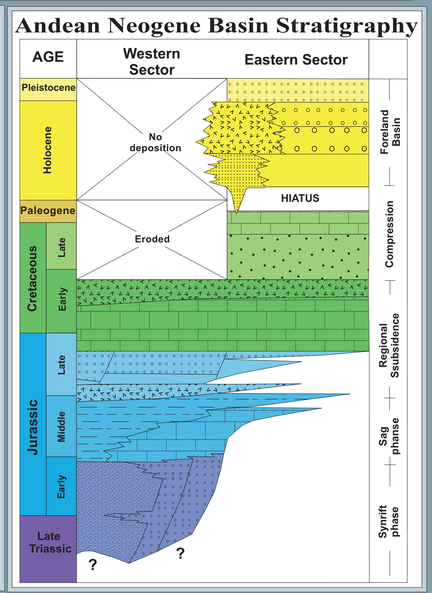






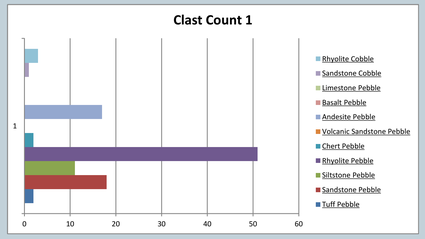
A. Digital elevation map of South America. Red circle denotes location of Mendoza, Argentina. **B.** Left map shows earthquake occurrences along western South America. Larger circles indicate a higher magnitude earthquake. Right map shows the depth to the subducting slab beneath western South America. **C.** Map of the morphostructural belts that characterize the south-central Andes. From east-west they are the Cordillera Coastal, the Cordillera Principal, the Cordillera Frontal, and the Precordillera. Further east are basement uplifts of the Sierra Pampeanas. **D.** Location map of the Atuel basin at ~35°S latitude.

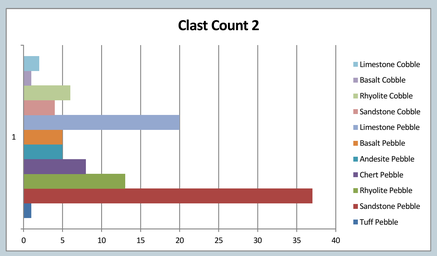




Left: Diagram of fold-thrust belt development within the Malargüe fold and thrust belt in last 15 Ma. Note progressive eastward development of thrust system, with sequential motion through the Alumbre, El Freno, La Manga and El Sosneado faults. **Right:** Stratigraphic section within the Atuel basin(Giambiagi et al., 2008).

Above: Brandon Wick and Greg Valitchka measuring the stratigraphic section. **Top right:** Clast count 1 taken from approximately 200m from the bottom of the stratigraphic section shows a large amount of rhyolite clasts, followed by andesitic and sandstone clasts. **Bottom right:** Clast count 2 taken from approximately 250m shows a significant decrease in rhyolite clasts, and a distinct increase in sandstone and limestone clasts.





INTERPRETATION

* The stratigraphic section measured represents a braided fluvial system within a retroarc foreland basin
* Conglomerate clast counts in the lower section reveal a large population of rhyolite detritus, probably derived from Choiyoi Group exposures in the Cordillera Principal.
* Clast counts in the upper section document an influx of sedimentary clasts, indicating renewed uplift of the Cordillera Principal
* Significant changes in detrital zircon populations between samples suggest major provenance shifts, probably indicative of episodic unroofing of progressively deeper levels of the Cordillera Principal during progressive eastward propogation of the thrust system within the Malargüe fold and thrust belt.

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References

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