

Cuenca Uspallata: An intermontane basin records episodic uplift of the Cordillera Frontal and Precordillera in the Late Miocene



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ABSTRACT

The timing, rate of subsidence and stratigraphy within retroarc and foreland basins is strongly controlled by the kinematics, migration and magnitude of the thrust system. Crustal shortening in the south-central Andes displays a significant decrease in shortening from the flat slab to the normal slab segment. Synorogenic Neogene basins at 33°S, including the Alto Tunuyan, Uspallata and Cacheuta basins, provide a sensitive record of the spatial and temporal patterns of tectonics, magmatism and orogenic exhumation. The question is do these basins represent the cannibalization of an initially contiguous foreland basin, or did they evolve independently during thrust migration.

Uspallata Basin lies between the Frontal Cordillera and Precordillera, and contains a complex succession of conglomerate, sandstone and mudstone deposited in an arid fluvial system. Basin strata overlie volcanic rocks of the Cordillera Frontal, and basal units represent a basin margin facies. Sedimentary provenance records an initial influx of detritus from the Cordillera Principal and Cordillera Frontal that interfingers upsection with detritus from the Precordillera. Sedimentation was active from 9-12 Ma, which is significantly younger than synorogenic deposits to the east. These constraints suggest Cuenca Uspallata developed as an intermontane basin and was not part of the main foreland succession.

PURPOSE

The south-central Andes are characterized by latitudinal stratigraphic variations that reflect changes in the rate and pattern of orogenic exhumation. The Nazca plate varies in subduction angle along the continental margin and therefore strongly influences the evolution of adjacent foreland basins. Basin comparisons between the flat, transisthonal, and normal segments will allow for a greater understanding of the patterns involved in basin development, timing of structural deformation, and how the subduction angle influences deformation.

Detailed sedimentologic and stratigraphic analyses in Miocene basins, including conglomerate clast counts, detrital zircon studies, zircon Hf isotopic analyses and detrital (U-Th)He analyses, constrain the timing and pattern of an eastward propagating fold and thrust system that has influenced Andean deformation since early Miocene time. The Uspallata basin occupies a tectonic position that is transitional between the flat slab segment to the north and the normal slab segment to the south. Understanding the evolution of the Uspallata basin will provide dynamic constraints on upper crustal deformation processes resulting from variations in subduction geometry along the Andean margin.



GEOLOGIC LOCATION

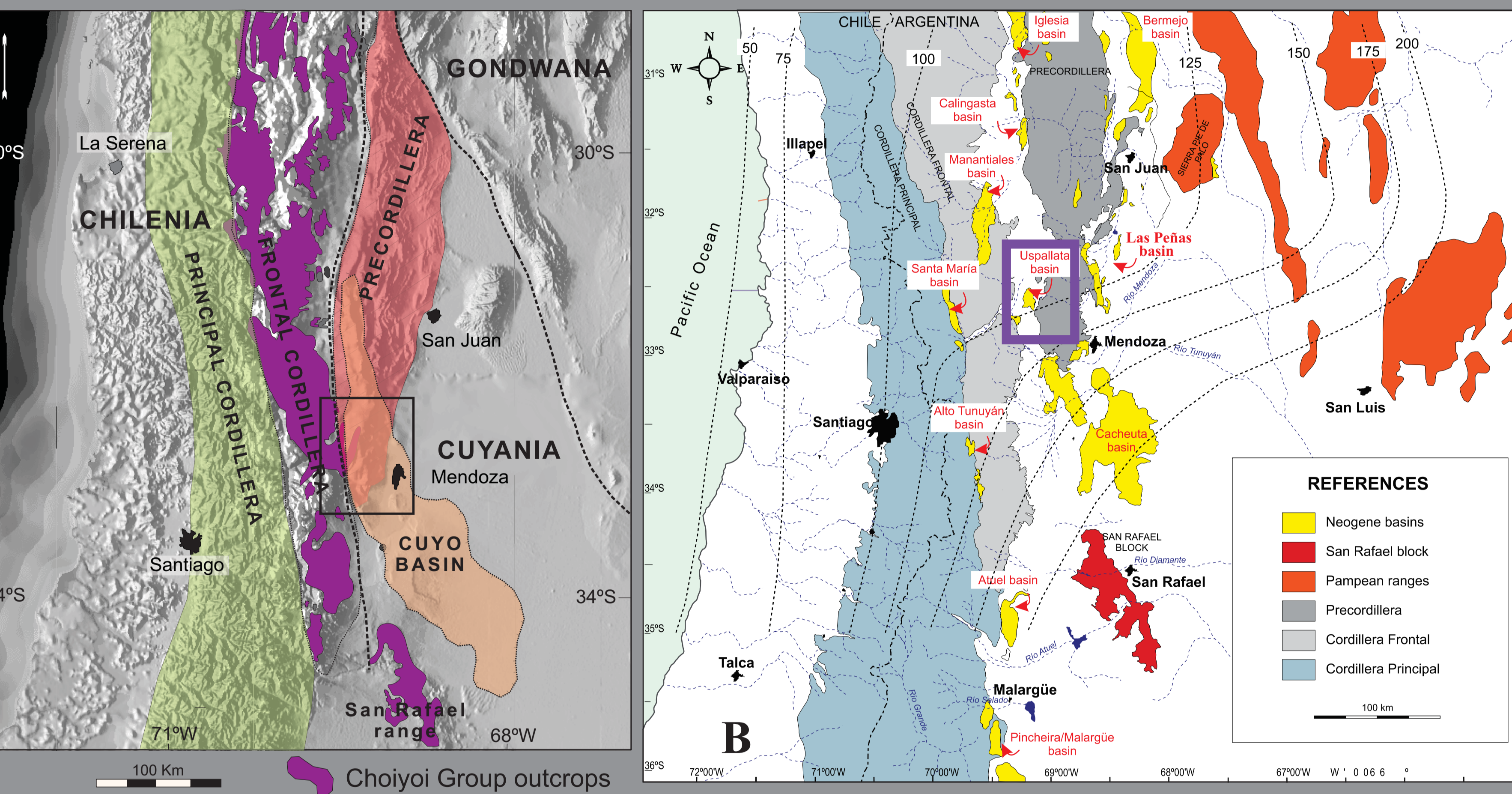
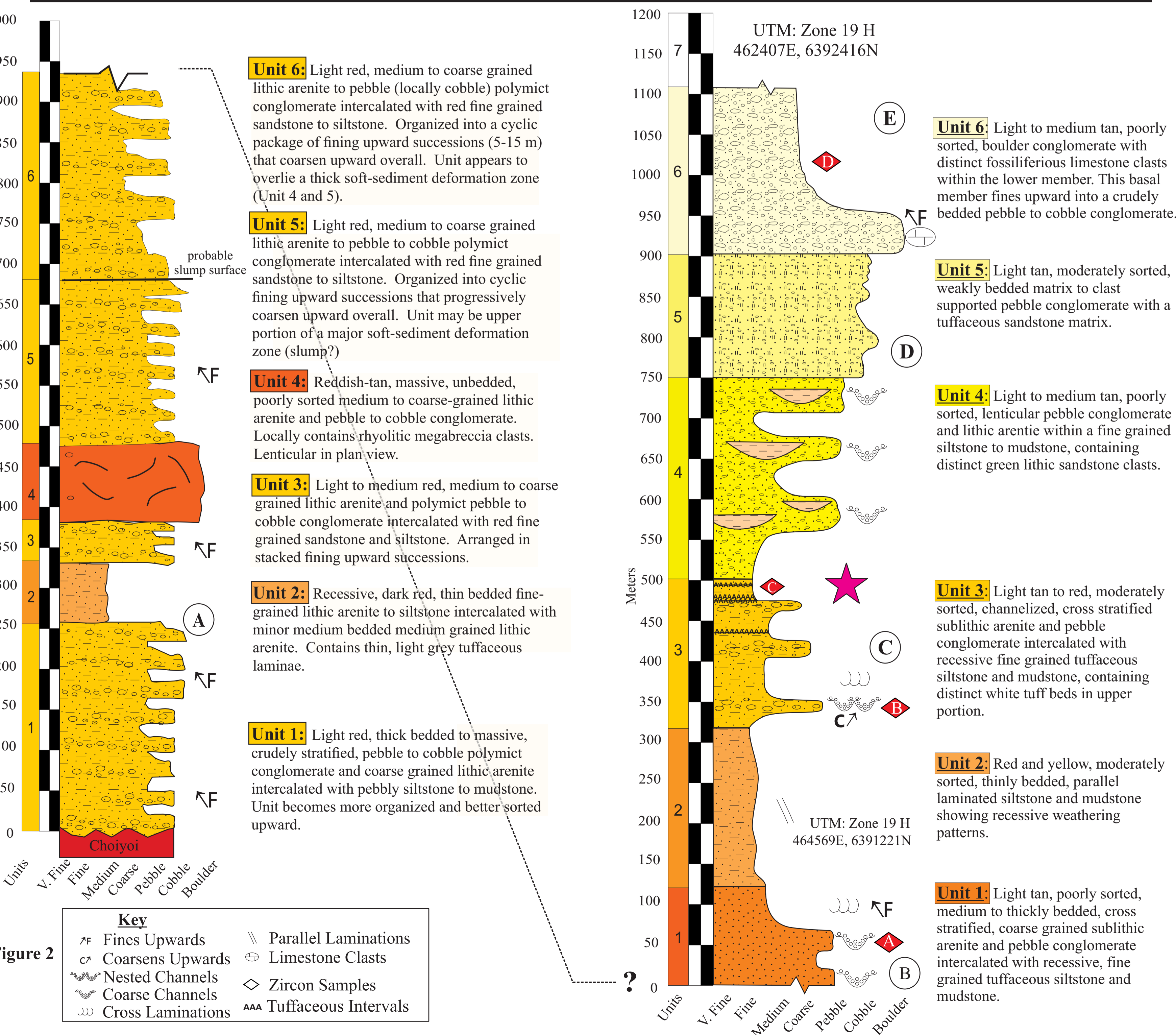


Figure 1: A) Morphostructural map of the south-central Andes, highlighting the structural belts and general age distribution in the region (Giambiagi et al., 2008, ages from Ramos, 2006). B) Neogene basin location map showing the morphostructural belts and the position of deposcentres in the retroarc foreland region. Contours illustrate the depth to the subducting slab. Note the location of the Uspallata basin between the Cordillera Frontal and Precordillera.

STRATIGRAPHIC SECTION OF THE USPALLATA BASIN



CONGLOMERATE DATA



Figure 4: Conglomerate clast data from the Uspallata basin. Note dominance of rhyolite clasts from the Choiyoi Group of the Cordillera Frontal throughout the succession. Distinct components include green lithic arenite from the Precordillera, andesite presumably derived from the Cordillera Principal, and Mesozoic limestone clasts from the Cordillera Principal. Note that each morphotectonic belt is represented throughout the stratigraphy. Abrupt changes (e.g. between clast counts D&E) are inferred to represent structural events within a particular source region (e.g. uplift event in the Cordillera Principal in the case of counts D/E).

DIAGNOSTIC CLASTS



Figure 5: Fossiliferous limestone clast in the upper portion of the Uspallata basin containing abundant pelecypods of Jura-Cretaceous age, and is derived from Mesozoic strata of the Cordillera Principal.

Figure 6: Fining upward succession within the upper Uspallata basin, consisting of a basal cobble conglomerate and an imbricated pebble conglomerate. Rhyolite clasts are derived from the Choiyoi Group of the Cordillera Frontal; green lithic arenite clasts are derived from the Precordillera.

DETRITAL ZIRCON GEOCHRONOLOGY

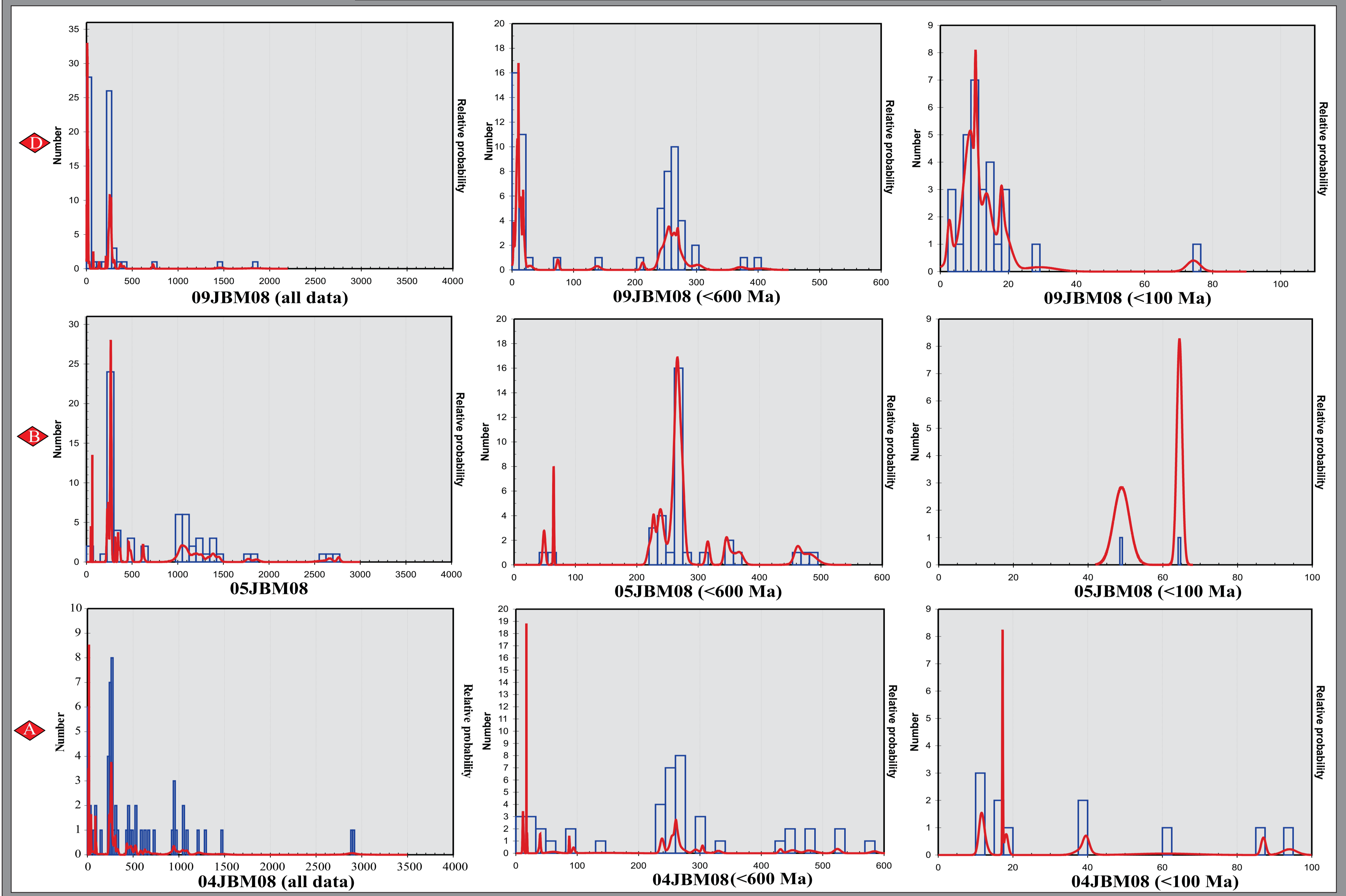


Figure 3: Detrital zircon plots from the Uspallata basin, arranged in stratigraphic order. Note vertical variation in provenance. Lower stratigraphic levels contains a distinct Grenville (ca. 1000 Ma) population as well as a lesser early Paleozoic population that are much reduced at higher stratigraphic levels. A prominent Permo-Triassic population is prominent in all samples. The uppermost sample has a significant late Tertiary population that is distinct from older strata. Grenville and early Paleozoic (Fammatinian) populations are inferred to be derived from the Precordillera, Permo-Triassic populations represent the Choiyoi Group of the Cordillera Frontal, and the Late Tertiary population is presumably derived from volcanism in the Cordillera Principal.

GEOCHRONOLOGIC CONSTRAINTS

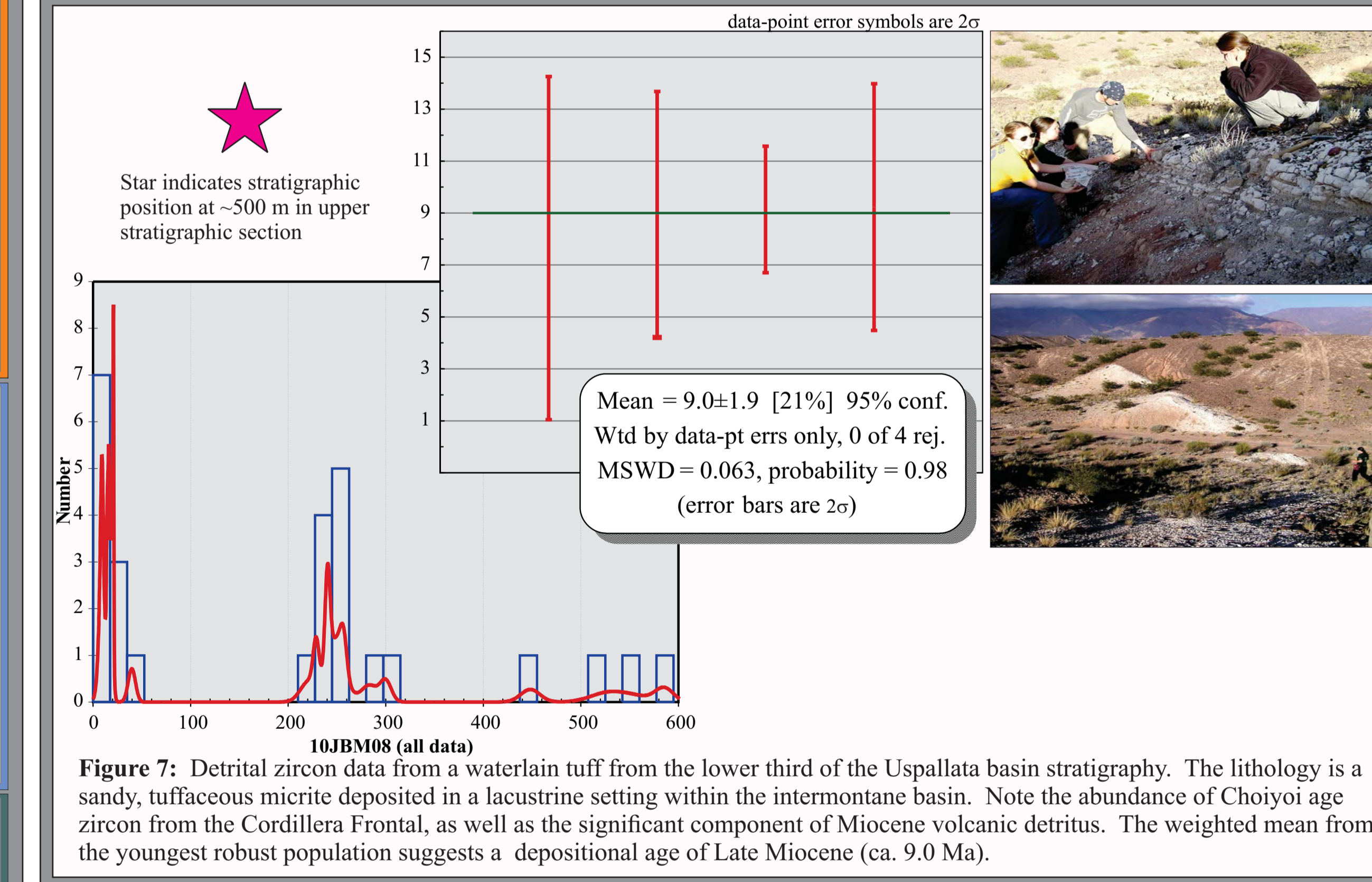
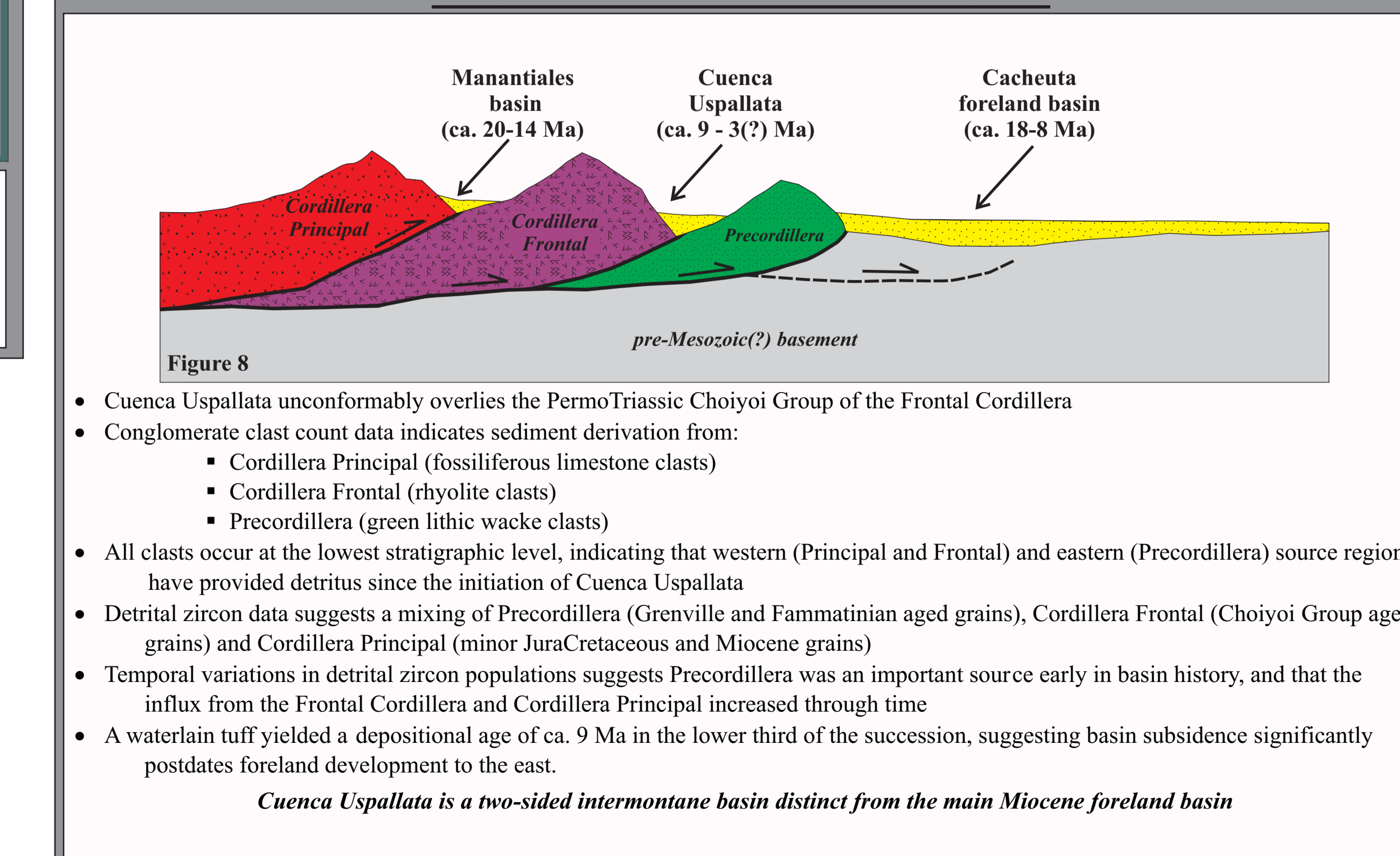


Figure 7: Detrital zircon data from a waterlain tuff from the lower third of the Uspallata basin stratigraphy. The lithology is a sandy, tuffaceous micrite deposited in a lacustrine setting within the intermontane basin. Note the abundance of Choiyoi age zircon from the Cordillera Frontal, as well as the significant component of Miocene volcanic detritus. The weighted mean from the youngest robust population suggests a depositional age of Late Miocene (ca. 9.0 Ma).

INTERPRETATION



Cuenca Uspallata is a two-sided intermontane basin distinct from the main Miocene foreland basin