Basin Compartmentalization in the Foreland: El Cajon Basin, Southwestern Argentina

Jonathan R. Pratt - The Ohio State University,   Lindsay Schoenbohm - The Ohio State University,   Estelle Mortimer - University of Leeds

Basin compartmentalization in a thick-skinned setting: In a thin-skinned setting there is a fairly accurate model for basin compartmentalization, where thrusts propagate in sequence utilizing bedding planes in sedimentary rocks. However, in thick-skinned settings where reverse faults occur at higher angles, this model is compromised by the importance of pre-existing weaknesses.

Approach: Analyze the spatial and temporal evolution of one basin, the ***El Cajon Basin of Northwest Argentina*** as an example of a basin compartmentalization in a thick-skinned setting.

Data: As part of a collaborative effort, several data are combined to understand the process and controls that compartmentalized the El Cajon Basin.

1. Geologic mapping of the northern basin, (Fig 2a), produced by L. Schoenbohm.
2. Stratigraphic analysis (Fig. 1), produced by E. Mortimer.
3. **Rigorous cross sections (Fig 3a,b), produced by J. Pratt.**
4. Seismic data from southern basin (Fig 3c) produced by E. Mortimer.
5. **U-Pb dating of intercalated tuff beds (Fig 1 & Fig 2a), produced by J. Pratt**

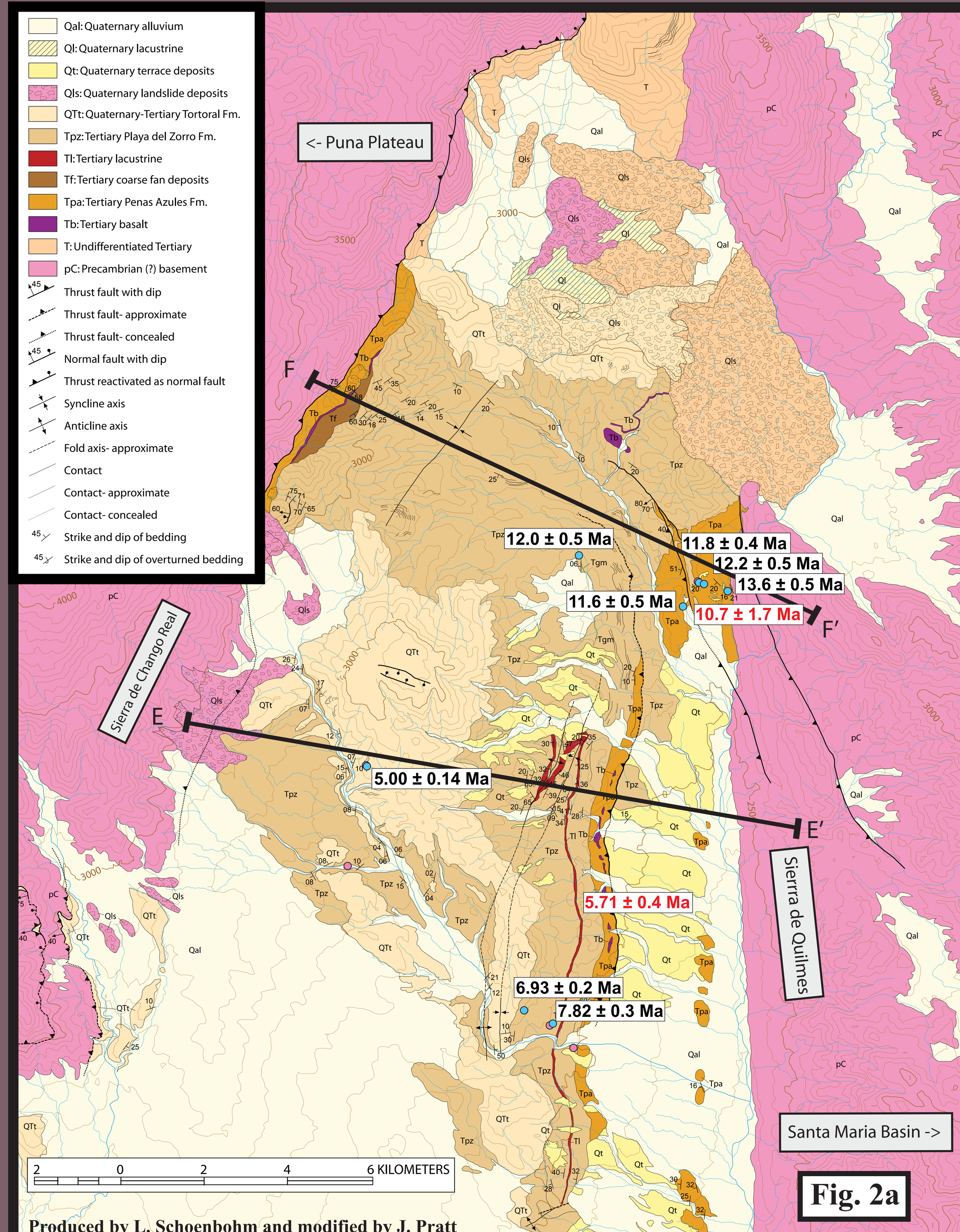


Fig. 2a

Produced by L. Schoenbohm and modified by J. Pratt

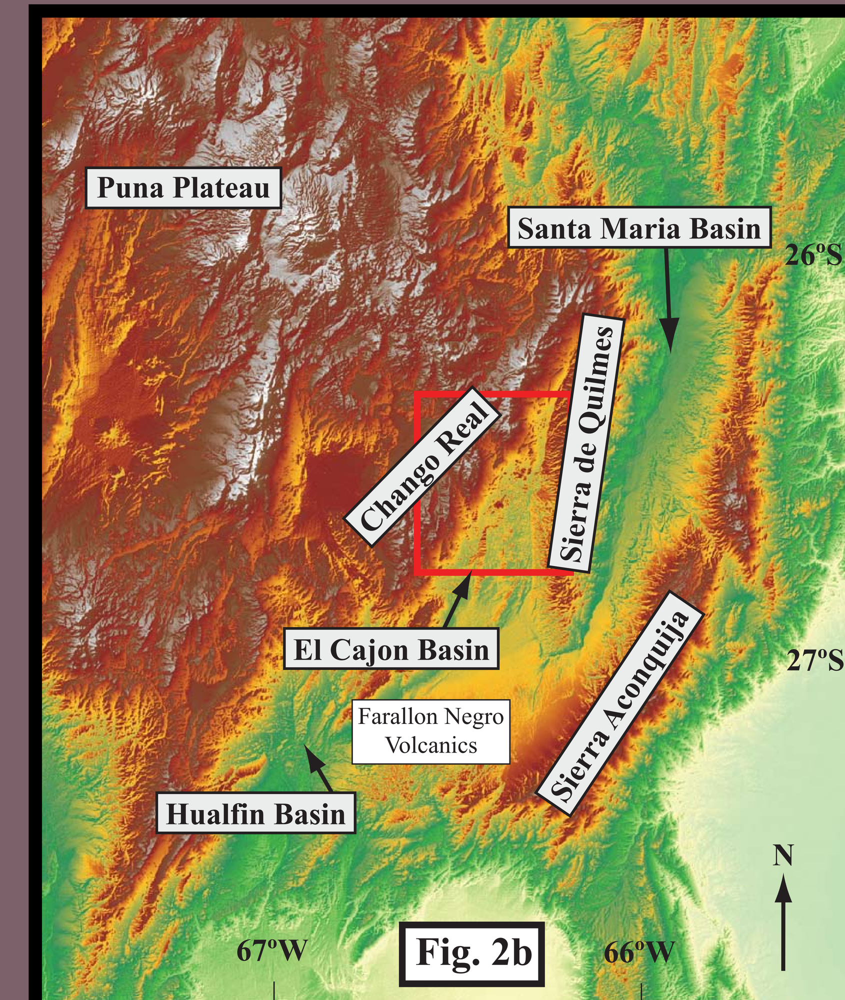


Fig. 2b

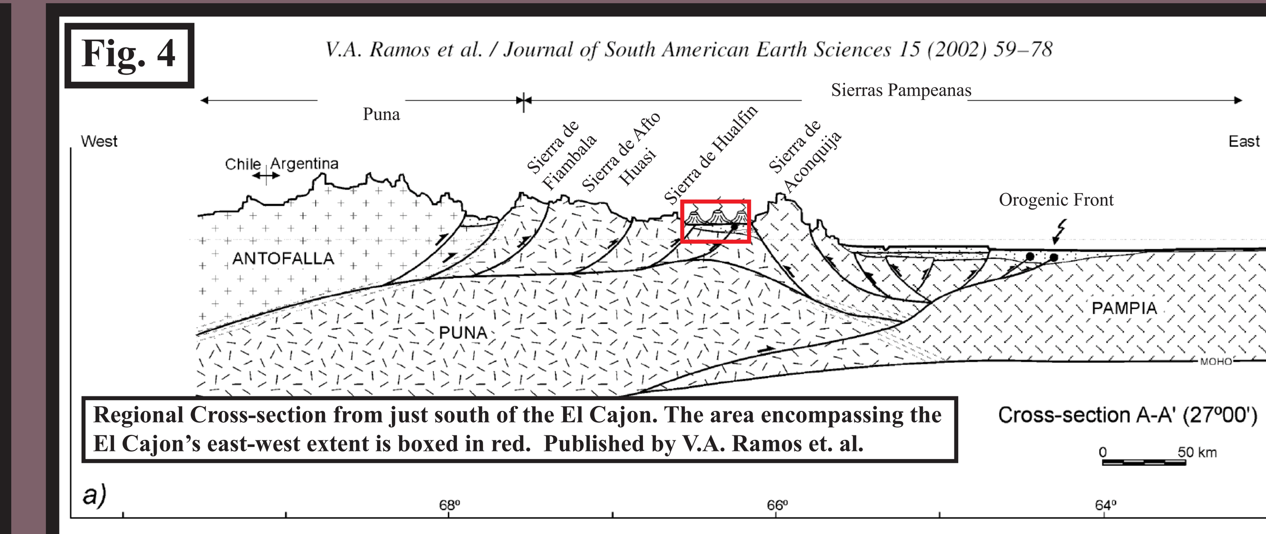
Geologic Background:

The El Cajon basin is one of several intermontane basins along the southeastern margin of the Puna Plateau (Fig. 2b). This part of the Andes is an active, foreland-propagating, thick-skinned fold and thrust belt, which is superimposed on the Cretaceous Salta Rift. Once part of a continuous foreland stretching from the Hualfin basin to the southwest to the Santa Maria basin to the east (Fig. 2b), the El Cajon was compartmentalized by the uplift of the Sierra de Quilmes.

The El Cajon basin contains three Miocene to Pliocene **alloformations**:

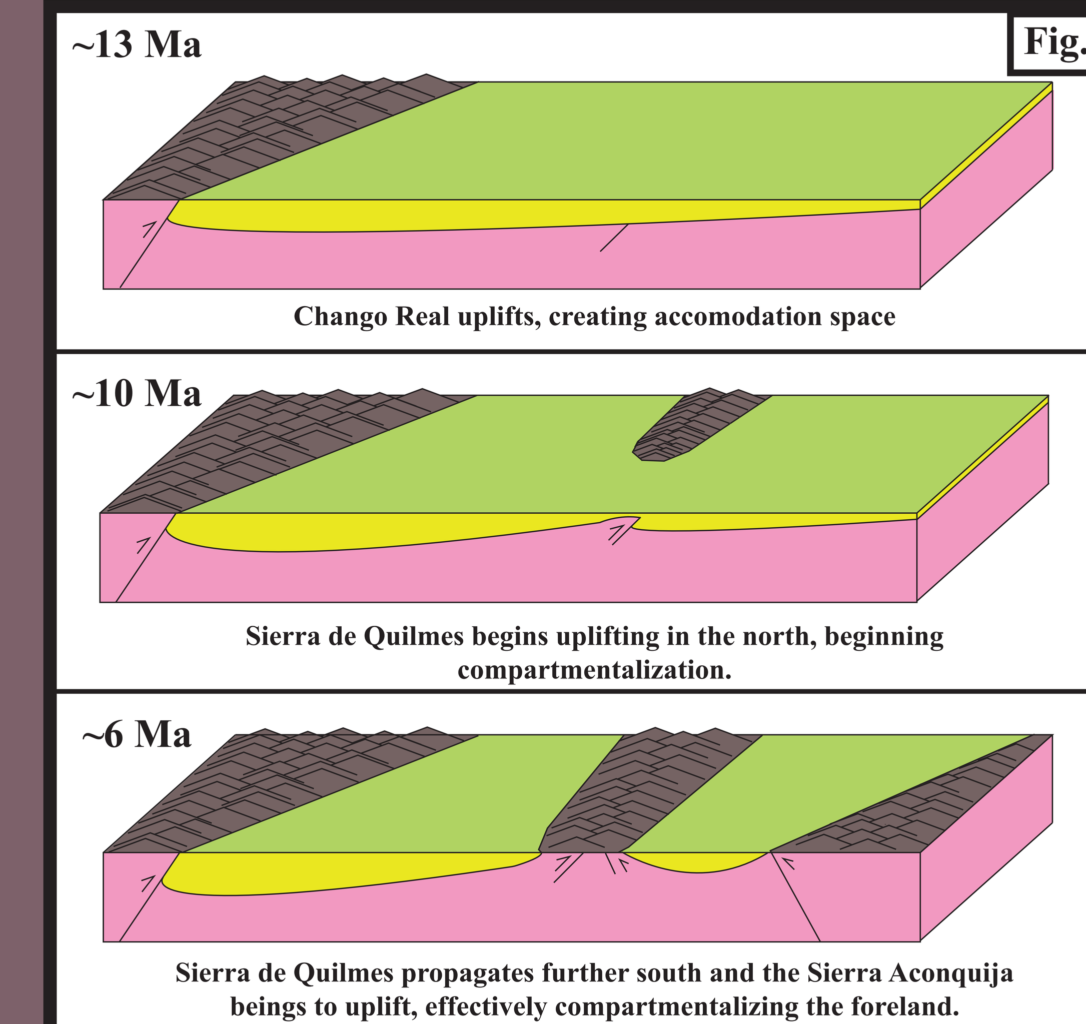
1. **Penas Azules:** a coarsening-upwards alluvial sequence between 11.8-13.6 Ma. Deposited before significant deformation.
2. **Playa del Zorro:** a coarsening-upwards alluvial sequence showing growth structures and containing a lacustrine unit. Syntectonic, between 6.93-11.8 Ma. in age.
3. **Tortoral:** Massive fan conglomerate, regionally widespread and sits above an unconformity in the El Cajon. Upper age of 5.00 Ma.

Fig. 4



Regional Cross-section from just south of the El Cajon. The area encompassing the El Cajon's east-west extent is boxed in red. Published by V.A. Ramos et. al.

Fig. 5



- Northern El Cajon
- Tpa thins eastward
- Eastern margin gives constraint on Tpa thickness. Potential pre-existing topography.
- Faults are most likely reactivated normal faults.

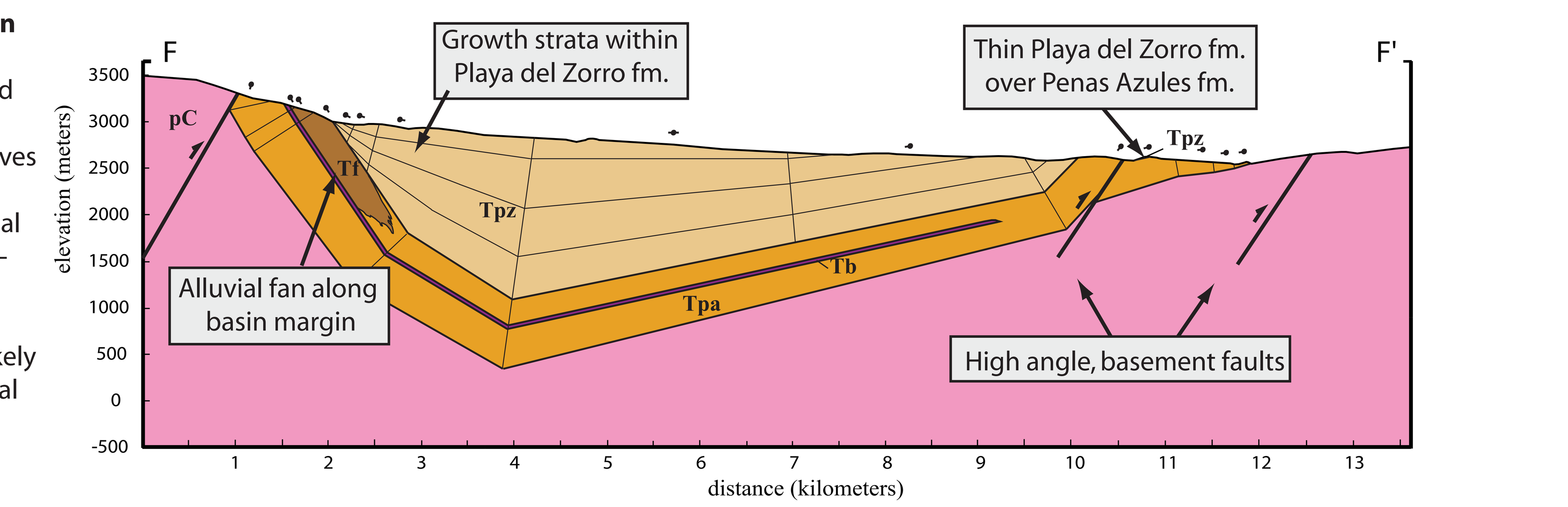


Fig. 3a

- Middle El Cajon
- Tpa thins eastward
- Less deformation along the Chango Real than in the north.
- Fault pair younger than in the north.

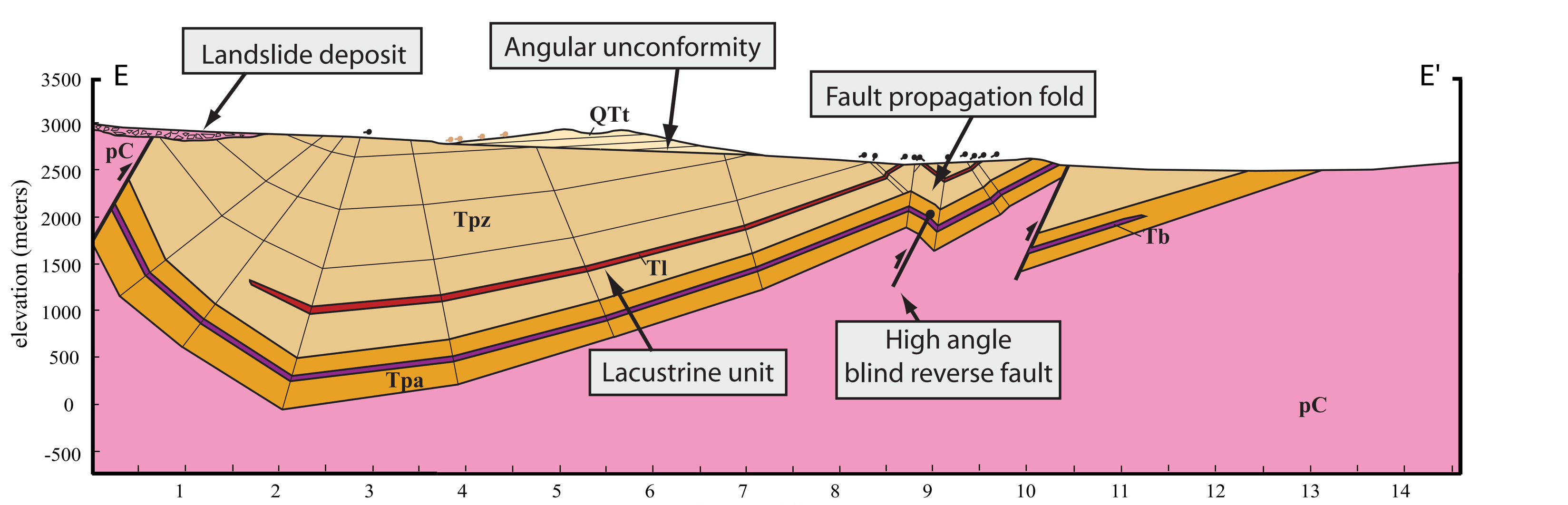


Fig. 3b

-Seismic section from south of the El Cajon subbasin

-Shows both high angle reverse faults and growth strata as exist in the north.

-SQS stands for South Quilmes Structure, which is the buried extension of the Sierra de Quilmes.

-Tpa thins, but to a lesser extent than it does in the north.

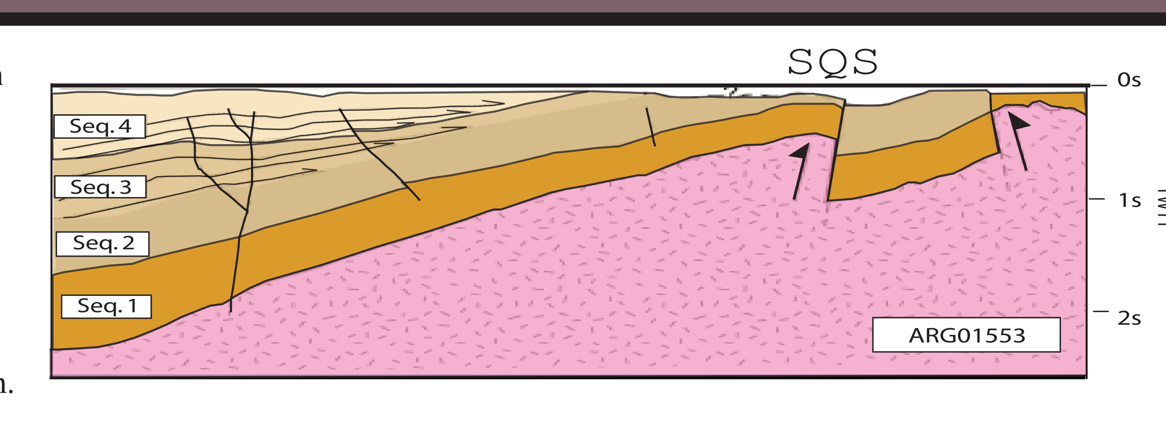
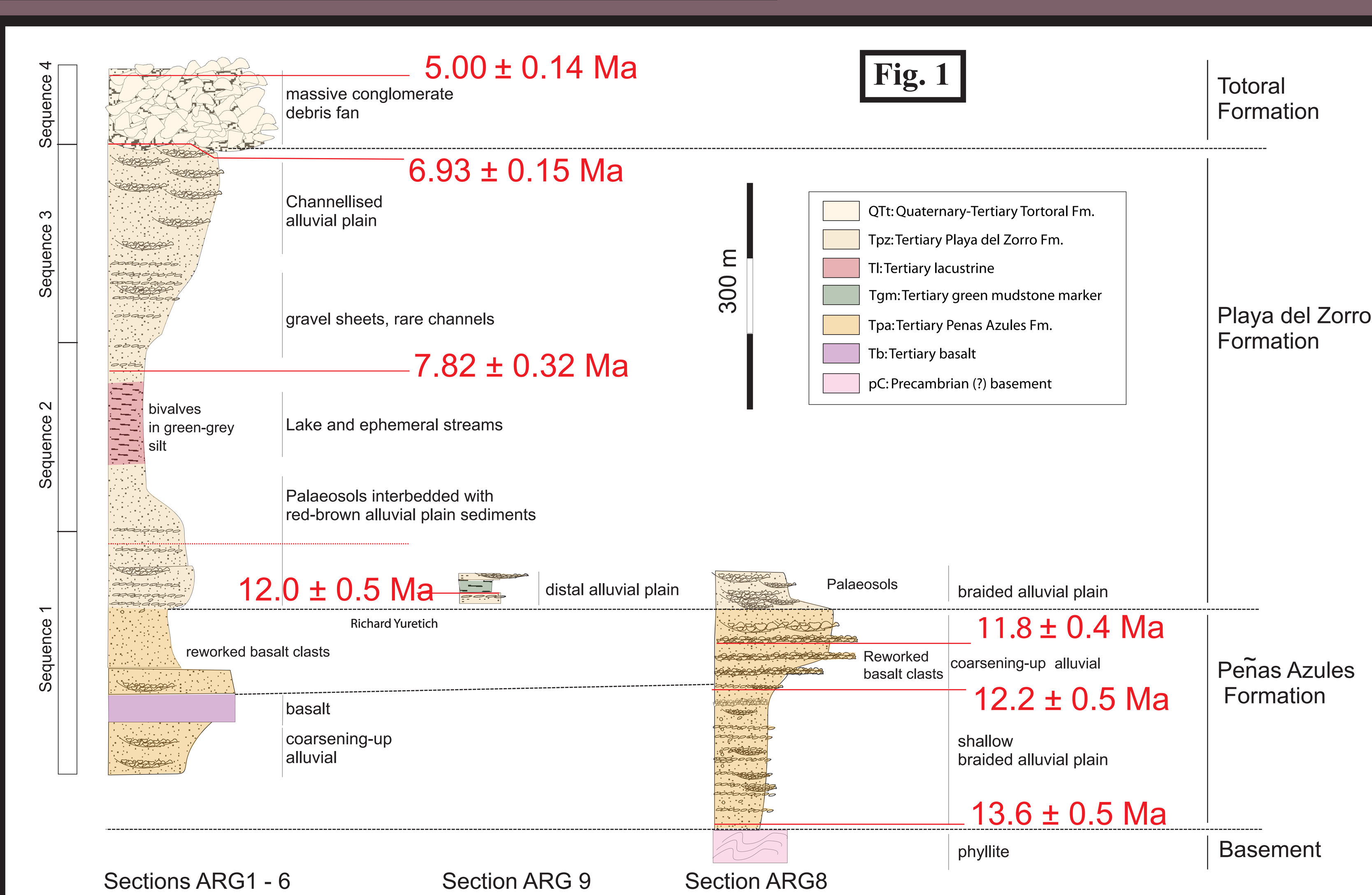


Fig. 3c

Produced by E. Mortimer and modified by J. Pratt

Fig. 1



Above:

Geologic map of the El Cajon containing locations of the U-Pb dated tuff samples and the cross-section lines corresponding to Fig. 3a and 3b.

The ashes were dated using an ion microprobe at the University of Los Angeles with the aid of Dr. Axel Schmidt.

Left:

Stratigraphic column showing the rock types and interpreted depositional environments.

U-Pb ages are placed in the column and are shown in red.

Of note is the bracketing of the lacustrine unit between 7.82 & 12.0 Ma.

Discussion:

By using the basal age of the sedimentary sequence of 13.6 Ma to approximate the onset of loading along the Chango Real, we can estimate that this is when significant uplift along the fault began.

The lacustrine bed serves as an indication of a switch from foreland drainage to internal drainage, which was most likely caused by uplift of the Sierra de Quilmes basement anticline as it propagated southward reactivating Salta Rift structures. The age of the lacustrine bed is bracketed between ~8 & ~12 Ma therefore the uplift of the Sierra de Quilmes is also bracketed between these ages.

The Sierra Aconquija is east of the El Cajon basin and is the eastern bound of the Santa Maria basin. Previous work by Strecker has dated the Aconquija uplift at 5.5 Ma.[3]

The evolution of the El Cajon basin is therefore an in-sequence compartmentalization following a propagating thrust-wedge model with deformation strongly controlled by pre-existing structures as is shown simplified in Fig. 5.

1 Mortimer et al, 2007, Fragmentation of a foreland basin in response to out-of-sequence basement uplifts and structural reactivation: El Cajon-Campo del Arenal basin, NW Argentina: GSA Bulletin: May/June 2007, p.637-653
2 Ramos, V.A., et al, 2002, The Pampean flat-slab of the Central Andes: Journal of South American Earth Science v. 15, p.59-78
3 Sobel, E.R. & M.R. Strecker, 2003, Uplift, Exhumation and Precipitation: Tectonic and Climatic Control of Late Cenozoic Landscape Evolution in the Northern Sierras Pampeanas, Argentina: Basin Research, p.1-21