Active tectonic on long-lived sutures: A case of study of the Valle Fértil fault, Sierras Pampeanas, Argentina

Gustavo Ortiz*†[1], Agostina Venerdini‡[1], Andrea Stevens Goddard§[3,2], Julie Fosdick¶[3,2], and Patricia Alvarado‖[1]

[1]Centro de Investigaciones de la Geósfera y la Biósfera (CIGEOBIO), Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de San Juan - Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) – Meglioli 1160 S (5406) - Rivadavia, San Juan, Argentina
[3]Department of Geography, University of Connecticut – 215 Glenbrook Road, Storrs, CT, United States
[2]Center for Integrative Geosciences, University of Connecticut – 354 Mansfield Road, Storrs, CT 06269, United States

Abstract

The Sierras Pampeanas, located over the South Central Andes flat-slab subduction (27°S and 33°S), are characterized by a thick-skinned deformation of crystalline basement cored uplifts and high seismic activity. The Sierra de Valle Fértil (SVF) is one of the westernmost outcrops of the Sierras Pampeanas in west-central Argentina. The SVF fault, which bounds the western flank of the mountain range along its more than 200-km NW-SE length, is the main structure accommodating Cenozoic deformation in the Andean backarc. Recent crustal earthquakes $<$ 5M with reverse focal mechanisms are associated with this fault system. The SVF fault lies to the east of the thin-skinned Precordillera fold and thrust belt, another distinctive structural domain within the Andean orogenic belt that is located above the flat slab subduction. Interestingly, the SVF fault has been proposed as the Paleozoic structural boundary between two accreted terranes, Pampia and Cuyania.
We have developed a three-dimensional geological model of the SVF that integrates low-temperature thermochronology, seismic reflection data, receiver functions, modern seismicity, geological information from maps and cross sections, as well as outcrop direct observations into MOVETM software. The 3-D analysis characterizes the SVF fault geometry and a series of neighboring structures that we interpret to have accommodated Neogene to recent deformation at middle-to-lower crust levels. The 3-D model also shows that the SVF fault is the main lithospheric-scale structure that has produced a shift in the Moho discontinuity.

New thermochronology involving apatite (U-Th)/He (AHe) and apatite fission track (AFT) data was carried out across two E-W transects in the SVF. In general, the AHe and AFT

*Speaker
†Corresponding author: gfortiz@unsj-cuim.edu.ar
‡Corresponding author: agostina.venerdini@unsj-cuim.edu.ar
§Corresponding author: andrea.stevensgoddard@uconn.edu
¶Corresponding author: julie.fosdick@uconn.edu
‖Corresponding author: alvarado@unsj-cuim.edu.ar

systems show a range of cooling ages ranging from Cretaceous to Miocene at different exposed structural levels. Thermal modeling from both transects reveal a history of Cretaceous reheating that we suggest is related to sediment burial of the hangingwall block of the Ischigualasto basin. All thermal models show subsequent rapid Cenozoic cooling that suggests structural inversion of the rift basin in correspondence with regional flat-slab tectonics during the last 20 myr. Assuming a Neogene geothermal gradient of 20-30 ∘C, these data may account for _˜3-4 km of rock uplift and exhumation of the SVF.
In conclusion, reconciling short and long term observations, we propose the SVF fault is a major crustal structure, located within a zone of lithospheric weakness, and is capable of generating large earthquakes that pose substantial seismic hazard in west-central Argentina.