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Seismic activity beneath the Iglesia Valley between the Andean Frontal Cordillera and the northern Precordillera, Argentina

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In this work we analyze the seismicity of the northern Precordillera of Argentina lying above the flat slab subduction of the Nazca plate beneath South America. This region of about 110 km by 280 km is located between the Frontal Andean Cordillera and the western thin-skinned Precordillera fold and thrust belt. The same region has been the epicentral area of the 1894 damaging earthquake (Bodenbender, 1894), which caused maximum Modified Mercalli intensities of IX. Although, little is known of its seismic source because of the unavailability of instrumental records at that time, it is possible to characterize present earthquake deformation. In this work we integrate seismic records from permanent (e.g. INPRES) and temporary stations (e.g. CHARGE and SIEMBRA experiments) to analyze crustal seismicity. We obtain seismic location (focal depth, with a concentration range between 10 and 30 km), magnitude (1.2<M<5) and focal mechanism for local earthquakes in the study region. We note that epicenters are mainly distributed in the southern sector of the study region, with a relatively greater concentration in the foothills of the Frontal Andes Cordillera in comparison to the eastern part of the Iglesia Valley. Maximum focal depths are about 40 km, which correlates with other determinations in the Precordillera region. P-wave first motion focal mechanisms including amplitude ratios between P and S waves are mainly reverse. Estimation of the stress field from focal mechanisms indicate shortening associated with a maximum deviatoric stress trending E-W. We developed a 3D geological model integrating geophysical and geological data, which consist of seismic reflexion E-W lines across the Iglesia Valley, neotectonic features, geology and structural information among others. Our model provides evidence for present seismic activity associated with a fault system in the frontal part of the western thin and thick-skinned Precordillera. This active region is in contact with the Frontal Cordillera and seems to be a result of compression mainly derived from plate convergence. This deformation is observed at long horizontal distances of about 325 km from the trench and is able to generate large continental earthquakes like the 1894 event.

Bodenbender, G., 1894. El Terremoto Argentino del 27 de octubre de 1894. Boletín de la Academia Nacional de Ciencias en Córdoba, 14: 293-329, Buenos Aires.