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Structural evolution of Sierra de Umango, Western Sierras Pampeanas, Northwestern Argentina: the polyphase tectonic history of the proto-Andean margin of Gondwana

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In the Pampean flat-slab, Central Andes, crops out basement blocks (Sierras Pampeanas) uplifted and rotated in the Cenozoic times. Meta-igneous rocks of Grenvillian Mesoproterozoic age and metasedimentary units metamorphosed in the Ordovician times characterize the Western Sierras Pampeanas. These rocks are interpreted as the northern Cuyania Composite Terrane, a far-travelled microcontinent derived from Laurentia that was accreted to Western Gondwana during the Early Paleozoic. The Sierra de Umango is the westernmost Western Sierras Pampeanas, limited by Devonian sedimentary rocks of Precordillera on the western side, separated by tertiary rocks from the Sierra de Maz and Sierra del Espinal on the east, and with igneous and sedimentary rocks of Famatina System cropping out on the further east.

The structural evolution of the Sierra de Umango revealed a polyphase tectonic history including an Ordovician collisional event, a Devonian compressional deformation, the Late Paleozoic and Mesozoic extensional faulting and sedimentation (Paganzo and Ischigualasto basins) and the compressional deformation of the Andean foreland during the Cenozoic.

A Nappe System and an important shear zone (Cerro Cacho – Puntilla Shear Zone - CPSZ) characterize the Ordovician collisional event, related to the accretion of Cuyania Terrane to the proto-Andean margin of Gondwana. Three continuous deformational phases were recognized in this event: D1 phase is distinguished by relics of S1 preserved as internal foliation within interkinematics garnet and staurolite porphyroblasts and probably represents the progressive metamorphic stage; D2 phase exhibits P-T conditions close to metamorphic peak, recorded in a transposition foliation S2 or a mylonitic foliation which determine the main structure of Umango; and D3 phase, described as a set of tight to recumbent folds with S3 axial plane foliation and often related to thrust faults, that records the retrogressive metamorphic stage. The Nappe System showed a top-to-S/SW sense direction and the CPSZ worked as a right lateral ramp, facilitating the exhumation process. This structural pattern heads us to interpret an oblique collision, with Cuyania Terrane subducting to NE underneath the proto-Andean margin of Gondwana. The continental subduction and exhumation lasted at least 30 million years during the almost whole Ordovician times, reaching metamorphic conditions of upper amphibolite to granulite facies in medium- to high-pressure regime.

At least two latest events deformed the earlier structures. The D4 deformational phase corresponds to a normal folding with wavelength at about 10 km and general N-S orientation. These folds modified the S2 surface in a cylindrical type and are associated to discrete shear zones well exposed in the Silurian Guandacolinos Granite. The cylindrical pattern and the subhorizontal axes of the D4 folds presuppose that S2 were, originally, flat-lying surfaces. D4 folds are responsible for preserving the basement unit Ortogneisses Juchi synformal klippen. This deformation corresponds to the Chanica Tectonic, on the interval between Devonian and Carboniferous times. D5 folds, with E-W oriented axes, deform the previous structures and could be associated with the uplifting during the Andean Cycle.