

Regional polyphase deformation of the Eastern Sierras Pampeanas (Argentina Andean foreland): strengths and weaknesses of paleostress inversion

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The Eastern Sierras Pampeanas of central Argentina are composed of a series of basement-cored ranges, located in the Andean foreland c. 600 km east of the Andean Cordillera. Although uplift of the ranges is partly attributed to the regional Neogene evolution (Ramos et al. 2002), many questions remain as to the timing and style of deformation. In fact, the Eastern Sierras Pampeanas show compelling evidence of a long lasting brittle history (spanning the Early Carboniferous to Present time), characterised by several deformation events reflecting different tectonic regimes. Each deformation phase resulted in further strain increments accommodated by reactivation of inherited structures and rheological anisotropies (Martino 2003). In the framework of such a polyphase brittle tectonic evolution affecting highly anisotropic basement rocks, the application of paleostress inversion methods, though powerful, suffers from some shortcomings, such as the likely heterogeneous character of fault slip datasets and the possible reactivation of even highly misoriented structures, and thus requires careful analysis. The challenge is to gather sufficient fault-slip data, to develop a proper understanding of the regional evolution. This is done by the identification of internally consistent fault and fracture subsets (associated to distinct stress states on the basis of their geometric and kinematic compatibility) in order to generate a chronologically-constrained evolutionary conceptual model.

Based on large fault-slip datasets collected in the Sierras de Cordoba (Eastern Sierras Pampeanas), reduced stress tensors have been generated and interpreted as part of an evolutionary model by considering the obtained results against: (i) existing K–Ar illite ages of fault gouges in the study area (Bense et al. 2013), (ii) the nature and orientation of pre-existing anisotropies and (iii) the present-day stress field due to the convergence of the Nazca and South America plates (main shortening oriented WSW-ENE). Although remarkable differences in reactivation mechanisms have been observed for the various studied lithological domains (schist, gneiss and granitic rocks), the brittle regional polyphase deformation of the Eastern Sierras Pampeanas appears to be dominated by two extensional episodes (σ_3 oriented NE/ENE and WNW, respectively), which can be associated with Middle-Late Permian to Early Cretaceous tectonism, followed by a compressional paleostress (σ_1 oriented ENE), which is compatible with the present day Andean convergence. Paleostress inversion techniques, despite all uncertainties involved, represent a robust approach to disentangle complex polyphase deformation histories both in term of reactivation mechanisms and strain partitioning.

References:

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