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Impact of a basement lineament on long-term and short-term stress/strain distribution across the Neuquen foreland basin (Argentina).

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Fold-and-thrust belts (FTB) and foreland basin developed on former continental margins characterized by pre-shortening crustal heritage. This inherited architecture has fundamental implications on the deformation patterns caused by later shortening events. We illustrate the role of a major basement lineament on the spatial and temporal variations of stress and strain fields during the FTB development, using the example of the Neuquén basin in Argentina.

The N-S Neuquén foreland basin developed along the eastern foothills of the southern Central Andes and experienced intraplate deformations linked with the Pacific subduction. Successive shortening phases from the Late Cretaceous to the Mio-Pliocene lead to basin inversion with mixed thin-skinned and thick-skinned tectonics. The NW-SE Cortaderas Lineament is a limit between the northern Chos Malal FTB and the southern Agrio FTB which have distinct structural styles. It also delimits two compartments in the folded foreland basin. Still, this structural feature does not have any straightforward expression into the sedimentary pile.

Seismic data provides the first image of this basement lineament, and allows us to analyze its impact on the long-term and short-term deformations. We illustrate how this lineament led to partitioning of the strain and stress through three stages of the foreland basin evolution: the pre-folding Layer Parallel Shortening (LPS), the FTB development and the present-day stress/strain distribution.

Fracturation analysis highlights the strong coupling between the basement and the sediments at the LPS stage. Structural interpretations using seismic data, field observations and satellite imaging document how this basement structure impacted the sedimentary basin during the successive stages of folding. InSAR dataset, microseismicity and borehole analysis provide an accurate view of the present-day stress/strain spatial variations: although the Cortaderas Lineament is not a defined fault cutting through the sedimentary basin, it still efficiently impacts the stress and the strain orientations.

Using a multidisciplinary approach, we show that the response of the Cortaderas Lineament to compression is an important controlling factor of the Neuquén basin evolution. Although not materialized by a fault plane, such a decoupling structure must be integrated by any means in 2D-3D mechanical modelling attempts to decipher the structural evolution and the mechanics of a sedimentary basin.