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Control of obliquity directions on structural development, from rifting to inversion: Examples from the Tethyan domain

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Oblique rift systems form when the axis of rifting is not orthogonal to the direction of tectonic extension, normally due to pre-existing zones of weakness that influence the location and orientation of new faults. Irrespective of the regional-scale obliquity, most individual extensional faults will tend to nucleate according to the orientation of the tectonic stress orientations, and therefore normal to the direction of maximum extension. Transfer faults in oblique systems will tend to form parallel to the direction of extension and, in contrast to orthogonal rifting, will play a major role in the architecture and development of the rift and its sedimentary basins.

An intriguing feature in oblique rift systems is the formation of reverse structures evocative of wrench tectonics during the syn-rifting stage. This stems from the orientation of geological structures relative to the direction of tectonic extension. Even slight changes in tectonic transport direction or stress orientations during the development of the rift system can lead to events of transpression or transtension along transfer structures. Because of the relevance of transfer structures in oblique systems, transpression can result in the appearance of discontinuities in the sedimentary record that are often interpreted as, somewhat incongruent, inversion events.

Oblique structures also play a crucial role during the full inversion of the rift system during convergence, particularly so because tectonic shortening will strike at an angle to the orientation of faults. Irrespective of the evolution of oblique rifting and inversion, the initial fault pattern is also normally preserved in fully inverted systems involved in fold-and-thrust systems. In many of cases, when the original rift obliquity is not well understood, the characteristic rhomboidal pattern is interpreted to relate to wrench tectonics. In this presentation we will review evidence from Iberia, Northwestern Africa and the Eastern Alps to discuss the role that obliquity plays in rift development and its inheritance in fold-and-thrust belts with different degrees of inversion.