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Controls on the 3D Orientation of Brittle Fractures: Integrating Theory with Field & Laboratory Measurements

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The three-dimensional (3D) orientation of brittle fractures and fracture sets has important implications for earthquake seismology, rock mass stability and fluid flow in fractured rocks because these structures exert a fundamental control on the evolution of bulk properties such as permeability. This session has been convened in an attempt to strengthen our theoretical understanding and provide better links with measurements of slip surface orientations from the lab and the field.

Historically, both the theoretical analysis and the practical measurement of localisation structures in rocks has been simplified to a 2D situation, either by considering only plane strain boundary conditions, or by assuming that the intermediate stress has no influence on fault development. In general, deformation of the lithosphere must involve non-plane 3D strain to a significant degree. Recent work by the conveners and the invited speakers highlights the need for fully 3D dynamic, physics-based models of natural deformation, including the development of advanced constitutive laws and numerical strategies to accommodate such deformation.

In this short contribution, we will outline the key issues to be addressed in this session, and suggest possible future links between theory and numerical modelling and the analysis of field and laboratory observations.