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Exploring the seismic expression of fault zones in 3D seismic volumes

David Iacopini (1), Rob Butler (1), and Steve Purves (2)

(1) University of Aberdeen, Geology and Petroleum Geology, Aberdeen, United Kingdom (d.iacopini@abdn.ac.uk), (2) Euclidity

Mapping and understanding distributed deformation is a major challenge for the structural interpretation of seismic data. However, volumes of seismic signal disturbance with low signal/noise ratio are systematically observed within 3D seismic datasets around fault systems. These seismic disturbance zones (SDZ) are commonly characterized by complex perturbations of the signal and occur at the sub-seismic to seismic scale. They may store important information on deformation distributed around those larger scale structures that may be readily interpreted in conventional amplitude displays of seismic data scale. We introduce a method to detect fault-related disturbance zones and to discriminate between this and other noise sources such as those associated with the seismic acquisition (footprint noise). Two case studies, from the Taranaki basin and deep-water Niger delta are presented. These resolve structure within SDZs using tensor and semblance attributes along with conventional seismic mapping. The tensor attribute is more efficient in tracking volumes containing structural displacements while structurally-oriented semblance coherency is commonly disturbed by small waveform variations around the fault throw. We propose a workflow to map and cross-plot seismic waveform signal properties extracted from the seismic disturbance zone as a tool to investigate the seismic signature and explore seismic facies of a SDZ.