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Seismic geomorphology and sedimentology of fluvial environments in the subsurface: fluviodeltaic Triassic Mungaroo Formation, North West Shelf, Australia

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Fluvial and fluvio-deltaic successions of the Late Triassic Mungaroo Formation accumulated in a long-term transgressive system tract. The formation represents the principal reservoir for a major gas play offshore northwest Australia, the key reservoir characterization challenge for which is to better understand the style and distribution of sand-prone channelized depositional elements. This study addresses this challenge through the integration of borehole and 3D seismic, with modern and shallow seismic analogues.

Architectural bodies are mapped within a high-resolution 3D seismic volume from the Exmouth Plateau of the Northern Carnarvon Basin. Interpretations of the palaeoenvironmental significance of these bodies are supported by analyses of lithofacies observed in core, borehole image and wireline data. Specific objectives of this study are to: (i) catalogue sub-seismic-scale fluvial and deltaic architectural elements in core and wireline log data; (ii) map the plan-form morphology of seismic-scale fluvio-deltaic elements; (iii) classify key stratigraphic intervals according to their accommodation setting; (iv) match the studied intervals to likely modern and shallow seismic analogues for the purpose of characterizing palaeoenvironments and depositional setting within the fluvial-deltaic transition.

Seven sub-seismic-scale architectural elements are identified in core: primary (high-energy) channel, low-energy channel, proximal crevasse splay, distal crevasse splay, gleysol (swamp), lake, and interdistributary bay. Flattening the seismic cube on key horizons has enabled visualization of stratally aligned slices, within which identified architectural element types have been mapped; attribute analysis highlights fluvial elements. Valley and channel belt, valley margin, floodplain, and gleysol (mire) seismic elements were identified and mapped in GIS. Analyses of well-log data confirm that valley-margin elements contain sub-seismic scale sand-prone intervals of probable crevasse-splay and accessory channel origin.

The dimensions of seismic elements are used to assess likely accommodation conditions within which the systems accumulated for different stratigraphic intervals. Apparently higher-accommodation settings led to the progressive fill of multi-lateral channel and valley elements ($<$7 km width), as well as the establishment of distributary channel networks and widespread gleysol development. Low accommodation settings resulted in laterally constrained ($<$1 km width) channel elements that potentially accumulated within incised valleys, with associated valley-margin elements. Settings that experienced negligible rates of accommodation generation are characterized by a complex mosaic of overprinted channel elements and only minimal preservation of overbank elements.