THE INFLUENCE OF REVERSE-REACTIVATED NORMAL FAULTS ON POROSITY AND PERMEABILITY IN SANDSTONES: A CASE STUDY AT CASTLE COVE, OTWAY BASIN

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An understanding of fault zone structure and transmissibility can have significant implications for reservoir appraisal and development within petroleum systems. Previous studies have demonstrated that porosity and permeability is significantly reduced adjacent to fault zones due to pore collapse, grain crushing, and cement precipitation during deformation. We present results from a detailed mineralogical and geomechanical investigation of the Castle Cove Fault within the Otway Basin at Castle Cove, southeast Australia. Castle Cove provides excellent exposures of the Lower Cretaceous Eumeralla Formation, which is a fine-grained volcanogenic sandstone with moderate to highly porosity (up to 27%), but with generally low permeability (mostly <1mD). The Castle Cove Fault originated as a normal fault during the late Cretaceous and was reverse-reactivated during NW–SE mid-Eocene to Recent compression. Core plugs were sampled at distances between 0.5 to 225 m from the fault and were orientated with respect to the fault plane. We show that closer to the fault (within 75 m), porosity increases by nearly 10% (i.e. from approximately 17% to 24%) and permeability increases by two orders of magnitude (from 0.02 mD to 3.74 mD). Microstructural investigations from thin sections show an increase in microfracture intensities closer to the fault. This study highlights the importance of detailed mineralogical and geomechanical analyses when attempting to understand fault seal generation and reservoir properties in high porosity and low permeability sandstones.