Characterisation of Carbonate Cemented Zones in the Paaratte Formation of the Victorian Otway Basin and Bass Megasequence of the Bass Basin using Wireline Log Data

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ABSTRACT

The identification and modelling of carbonate cemented zones represents one of the many challenges facing the world leading Carbon Capture and Storage (CCS) CO2CRC Otway Project in Victoria. Carbonate cemented zones are low permeability dolomite-dominated zones that form at the meteoric-saline water interface within winnowed tidal bar sandstones deposited in deltaic-marginal marine environments. Successful identification of these zones from wireline log data requires the creation of empirical tools that combine statistical analysis with geological interpretation. The Mean-Probability Log and the Vshale Facies Log are two empirical tools that, when combined, can successfully identify carbonate cemented zones from well log data. The Mean-Probability Log is derived from available well data contained at CRC-2 which includes the CCA_20 log (Elemental Capture Spectroscopy) and CarbCmnt log (carbonate cemented zones prediction log). These logs, combined with conventional raw and derived logs (Gamma, Sonic, Neutron, Density, Shallow Resistivity, Deep Resistivity, and Ratio) were used to create binned distributions required for a probability distribution model. Probability values from the model were incorporated into individual carbonate cement predictions logs for each of the raw and derived logs. An average of these logs resulted in the creation of a carbonate cemented prediction Mean-Probability Log. Flexibility of the Mean-Probability Log revealed only a variance of 13 samples when compared to Mean-Probability Logs lacking one of the key logs (e.g. Gamma). Calculation of a statistically derived cutoff was incorporated using the mode, standard deviation and a fixed spread (variance). Creation of a Vshale Facies Log was undertaken to assist accuracy of the Mean-Probability Log in predicting carbonate cemented zones within winnowed sandstones. The facies component of the log was derived from reclassification of an existing core-derived facies log used at CRC-2, whilst the clay-content (Vcl) of the log was derived from an existing Petrolog algorithm used in the Darling Basin of NSW. A cutoff value for CRC-2 (Vcl value of 0.6) was established for sandstones that are hosts for known carbonate cemented zones. Both the Mean-Probability Log and the Vshale Facies Log were successfully applied to both selected Otway Basin (onshore and offshore) and Bass Basin wells. Carbonate cemented zone analysis revealed a total of 126 carbonate cemented zones in onshore Otway Basin, 53 in offshore Otway Basin, and 7 in the Bass Basin. Interpretation of carbonate cemented zone results revealed a decrease in thickness and increase in clay-content from the Port Campbell Embayment to Shipwreck Trough in the Otway Basin, and a localised accumulation along the Pelican and Dondu Troughs within the Bass Basin.

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