

Residual Oil Analysis Reveals Complex Filling History of Multi-Reservoir Fields in the Southwestern Cooper Basin, South Australia

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We have analysed a suite of produced and residual oils from stacked Cambrian, Carboniferous, Permian and Jurassic reservoirs in eight fields along the southwestern flank of the Cooper Basin. Here hydrocarbons expelled from Permian coal measures in adjacent troughs can migrate up section past the erosional edge of the Triassic seal and into Jurassic and Cretaceous non-marine sandstones of the overlying Eromanga Basin. In addition, several fields appear to have received charges from marine Cambrian source beds in the underlying Warburton Basin. Residual oils were recovered sequentially from the intact pore system of sandstone core plugs by high-pressure solvent flow-through extraction (SFTE). This analytical approach is based on the 'first in, last out principle' which assumes that the last oil to enter the reservoir (free oil) is the first to be extracted, whereas the initial charge (adsorbed oil) is recovered last. Molecular distributions of saturated and aromatic hydrocarbons in the residual oil fractions ($n = 2-4$) recovered from each core plug were compared with those of DST oils from the host and adjacent reservoirs. Differences in maturity (0.6-1.1% equivalent vitrinite reflectance) and source affinity (30-100% Permian) help constrain the charge histories of the fields in question. The same oscillating balance between Jurassic and Permian charge previously reported for Cretaceous reservoirs along the Murteree Ridge, 50-75 km to the southeast of the study area, is evident in Jurassic reservoirs of the Muteroo, Spencer and Taloola fields.