Late Tertiary Fluid Migration In The Timor Sea: "A Key Control On Both Thermal History and Seismic Velocity?"

Abstract of the address to be given to the VIC/TAS Branch luncheon meeting on Wednesday, 21 February 1996 by Geoff O'Brien (AGSO).

In the Late Miocene, the effects of continental collision partially to completely breached many charged Mesozoic traps in Australia's Timor Sea. Two key and inter-related processes resulted from this event. Firstly, the collision and attendant structural reactivation induced the upward migration of hot, saline brines from the deeply buried Petrel Sub-basin sequences, along reactivating, large-displacement faults, such as those that bound the Jabiru, Challis and Skua Fields. These brines migrated through the charged reservoir sections, where they locally leached the sands and enhanced porosity, and also entrained some, or all, of the reservoired hydrocarbons into them. Migrating through the Paleocene and Eocene carbonates, the brines induced recrystallisation and dolomitisation, which significantly, but locally, increased the sonic transit velocities of these intervals. Upon entering the Eocene Grebe Sandstone, bacterial oxidation of the hydrocarbons accompanying the brines induced localised carbonate cementation, with the formation of hydrocarbon-related diagenetic zones or HRDZs. The necessary cations and anions for this process were provided from the brines themselves. Apatite fission track work has shown that as a consequence of this brine migration, partially to completely breached traps in the Timor Sea show a well-developed, Late Tertiary heating event, which is in fact solely due to local fluid flow effects around major fault zones. In contrast, high integrity traps, such as Oliver and Montara, which have never leaked, and in fact have suffered gas displacement of a pre-existing oil column, have never experienced brine migration and as a consequence, are now at their present day temperature. It is these traps that are most representative of the temperature histories experienced by the source rock 'kitchens' in the Timor Sea. These local fluid flow effects can clearly produce large inter-field variations in apparent maturity, and importantly, can also produce marked differences within individual fields, with the highest geothermal effects being located near to fluid migration conduits (eg. Jabiru 2 versus 1a). The wider ramifications of these observations to the Carnarvon Basin and Malita Graben are discussed.

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