Distribution, dating and origin of magmatism in the Bight and Eucla basins

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The breakup of Gondwana during the Mesozoic resulted in widespread basin formation along Australia's southern margin, of which the Bight Basin is a component. In contrast to many other extensional margins, the Australian southern margin has been classified as a non-volcanic rifted margin, despite the reported occurrence of scattered volcanic and intrusive rocks in the geological literature. Public release of the Flinders 2D seismic survey data in the Bight Basin has allowed the accurate mapping of widespread sills, dykes, lava flows and volcanoes.

The occurrences of volcanic and intrusive bodies are largely confined to the Ceduna Sub-basin and overlying Eucla Basin, with slight incursions into the Eyre and Duntroon sub-basins. These igneous rocks are hereafter referred to as the Bight Basin Igneous Complex (BBIC). The complex has a NW–SE orientation and covers an area of approximately 56,000 km^2. The easternmost part of the field, in the central Ceduna Sub-basin, contains the greatest density of igneous occurrences and the majority of large volcanoes. This field is roughly circular with a diameter of 130 km.

The timing of igneous activity has been constrained, in the absence of isotopically dated samples, by using the relationship between the igneous rocks and stratigraphic units of known ages. 'Forced folding' of the base of the Middle Eocene to Pleistocene Dugong Supersequence has been observed in the central Ceduna Sub-basin, and indicates a Middle Eocene date for sill intrusion. In addition, several volcanic cones can be traced down to the same horizon. These correlating ages imply that linked intrusive and extrusive activity within the area can be dated to a short-lived period during the Middle Eocene.

This correlation has allowed the BBIC to be placed into a geodynamic framework. The ages obtained correspond to an acceleration of sea floor spreading rates along the southern margin, and are coeval with other major changes in global tectonics. Furthermore, the inferred age of igneous activity in the Bight Basin broadly correlates with other volcanic events on the southern margin and the 'Older Volcanics' in Victoria. The timing and distribution relationships suggest that the BBIC was generated in response to upwelling of the mantle beneath a thinned crust coupled with the interaction of localised, more focused igneous activity centred on the densest clustering of volcanics. Other occurrences outside of this central area may be attributable to smaller thermal anomalies coinciding with areas of crustal weakness.

The influence of these rocks on hydrocarbon systems is uncertain at this stage; however, indications suggest that the negative impact will be minimal unless direct contact was made between existing hydrocarbons or accumulations and the igneous bodies. A more important concern is the potential effect a postulated magma reservoir at depth will have on the burial history scenarios and petroleum systems modelling for the Bight Basin.

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