

Assessing reservoir volcanic risk in the Browse Basin using integrated seismic and potential field workflows

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The Devonian - Cainozoic Browse Basin, offshore Western Australia, is a poly-phase basin situated in a volcanic rifted margin. It is a proven hydrocarbon province, with major gas and condensate discoveries, and minor oil.

Multiple phases of igneous activity can be identified within and beneath the basin using seismic reflection data interpreted in conjunction with suitably filtered gravity and magnetics; in particular, the correct treatment of magnetic data is essential, as the long magmatic history spans multiple magnetic field reversals, which mask igneous-related anomaly polarities and amplitudes.

Identified magmatic phases from our tectonostratigraphic framework study include:

- Permo-Carboniferous deep mafic rift piles and gabbro intrusions, related to failed rifting during Pangea breakup;
- Localised Triassic lavas and intrusions;
- Two phases of Jurassic magmatism, voluminously developed beneath the outer Caswell Sub-basin and Scott Plateau, related to Jurassic rifting and Oxfordian volcanic breakup with the Woyla-West Burma terrane, as well as thick Middle Jurassic (Bajocian-Callovian) lavas;
- Localised Valanginian to Aptian lavas, probably related to Valanginian-Hauterivian volcanic breakup with Greater India in the Gascoyne Abyssal Plain.

All magmatic features show strong structural and basement control, and spatially correlate to higher degrees of rift-related extension, within a long lived, multiply active igneous plumbing system containing both fissure style vents and stratovolcanoes.

Mapping of the different levels and locations of igneous centres using a combination of datasets allows a more reliable assessment of major volcanic risks, both at the Plover/Vulcan reservoir level, and of thermal degradation risk to in-place hydrocarbon accumulations during the basin evolutionary history.