

## **Crustal Structure and Tectonic Evolution of the Northern Perth Basin, Australia**

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### **ABSTRACT**

The Houtman Sub-basin is an under-explored region of Australia's continental margin. It is located at the transition between the non-volcanic margin of the northern Perth Basin and the volcanic province of the Wallaby Plateau and lies adjacent to the Wallaby-Zenith Transform Margin (WZTM). In 2014, Geoscience Australia acquired new 2D seismic data (3300km) across the northern Houtman Sub-basin to better image deep crustal structures in this frontier province. Interpretation reveals that this depocentre contains up to 19 km of sediments and regional correlation of the seismic stratigraphy across the northern Perth Basin suggests this includes up to 16 km of Permian—Cretaceous succession. However, the depth and nature of the crystalline basement, the total crustal thickness as well as the extent and distribution of Seaward Dipping Reflector Sequences (SDR) and intra-basinal volcanics associated with development of the Wallaby Plateau volcanic province and the WZTM remain poorly constrained. An integrated geological and geophysical study, based on available seismic and potential field data was undertaken to aid the structural interpretation of the deep crust and Moho in order to better define the basin's crustal architecture. In addition, the transition between non-volcanic and volcanic margin segments was delineated and, in conjunction with the regional seismic interpretations, better understanding of the timing, distribution and magnitude of multiple basin forming events was gained. The Ocean-Continent Transition (OCT) shows along strike and dip variations from extended and hyperextended (<5 km thick) continental crust beneath the main Permian depocentre to a zone of volcanic SDRs located outboard. Continental thinning and stretching phases occurred during both the Permian and Late Jurassic extensional phases. Volcanic margin development began in the Early Cretaceous, immediately prior to the separation of Greater India and Australia, suggesting that the volcanic margin experienced a phase of hyperextension before the magmatic break-up. Structural inheritance played an important role in basin development. It is likely that Early Permian graben formation was influenced by rheological contrasts in the underlying Proterozoic basement. The distribution of Permian rifts in turn further localised strain during Jurassic—Early Cretaceous rifting, strongly influencing the location and style of rifted margin development during Valanginian continental break-up.