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2-D Petroleum System Modelling of the Browse Basin, Offshore Northwestern Australia

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Petroleum system modelling was performed for the Browse Basin, which is a hydrocarbon-bearing basin in the offshore area of northwestern Australia. The Browse Basin was formed by two cycles of tectonically controlled extension, thermal subsidence, and inversion. The first rifting had occurred by the extension in the Late Carboniferous to Early Permian, and the second was in the Early to Middle Jurassic. Thick sediments were deposited during subsequent subsidence and inversion in the basin. The Upper Jurassic to Lower Cretaceous succession is considered to have the high quality source potential. Major reservoirs are fluvio-deltaic and nearshore marine sandstone units in the Jurassic and Cretaceous. Late Cretaceous to Tertiary sequences are dominated by thick carbonate rocks.

Maturity model and paleo-heat flow history were made in 1-D petroleum system modelling by comparing with vitrinite values and temperature measured from the drill wells. Based on the geologic setting and the 1-D model, 2-D Petroleum system modelling was conducted on an E-W cross section crossing three wells to understand hydrocarbon generation, migration, and accumulation in the basin. Late Jurassic to Early Cretaceous formations, including Aptian, Vlanginian, and Callovian rocks, were assigned as source rocks in the 2-D modelling. The 2-D model shows that hydrocarbons were generated during Late Jurassic to Late Cretaceous. A thick succession of overburden rocks provided the source rocks with heat and pressure to generate a significant amount of hydrocarbons. Hydrocarbons expelled from the source rocks were migrated dominantly downward to Late Jurassic sandy reservoir rocks. Upward migration is restricted by dense shale and carbonate successions. Large accumulations of gas have been found in the basin, rather than oil. It seems that the amount of gases was significantly increased by secondary cracking of the oil in reservoir formations in deep and hot conditions.