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Lithological and facies analysis of the Roseneath and Murteree shales, Cooper Basin, Australia

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a b s t r a c t

Unconventional shale plays have received marked attention over the last five years because of their economic potential for hydrocarbon generation, and yet they are amongst the least understood of all clastic sedimentary rock systems. The Cooper Basin is one of the largest Gondwana intracratonic basins in Australia, extending from northern South Australia into south-western Queensland and covering approximately 130,000 km^2. The basin is may be prospective for shale gas, particularly within the lacustrine shales of the Permian Murteree and Roseneath formations. This study investigates lithological characteristics of these two units in relation to reservoir evaluation. Core samples representing the Dirkala-02 and Moomba-46 wells were used for petrographic analysis. A combination of wireline log analysis, thin section petrography, X-ray diffraction and pyrolysis analysis was used to define and characterize four distinct lithofacies facies within the Roseneath and Murteree shales: siliceous mudstone, organic siliceous mudstone, calcareous siliceous mudstone, and silty siliceous mudstone. The siliceous mudstone and organic siliceous mudstone are the most common. Diagenetic siderite occurs in all four lithofacies. A conceptual depositional model is developed for deposition of the Roseneath and Murteree shales. Wireline-log cross plots were interpreted and utilized in the construction of electrofacies. The study was concentrated on the northern portion of the basin between the Nappameri and Patchawarra Troughs in order to understand the nature of lithofacies and variability in reservoir architecture, which was controlled by relative lake level fluctuation. The results of this study will aid in the evaluation of shale gas potential for this portion of the basin, as well as a better understanding of shale gas opportunities in the Cooper Basin more generally.

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1. Introduction

Advancements in drilling and well completion techniques over the last 20 years have resulted in the exploration of many unconventional liquid and gas reservoirs around the globe (Wüst et al., 2015). Unconventional hydrocarbon reservoirs differ from conventional reservoirs in that they commonly represent both source and reservoir for hydrocarbon generation and accumulation. During burial and diagenesis, some hydrocarbons may be lost due to migration, but much remains in place due to the low permeability of the host rock (Myers, 2008). To date, unconventional shale gas has mostly been developed in North America, with a minimal exploitation of this resource in other parts of the world.

The Cooper Basin (Fig. 1) is the largest onshore petroleum province in Australia and has both conventional and unconventional reservoirs (Hill and Gravestock, 1995). Its sedimentary succession hosts a significant amount of Australia's onshore oil and gas, which has been in production since 1963, mainly for natural gas (with some liquids). The main hydrocarbon reservoir intervals in the basin are located within the Late Paleozoic Gidgealpa Group (Fig. 2). The Cooper Basin is widely regarded as one of the most

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