Emerging Continuous Gas Plays in the Cooper Basin, South Australia*

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Abstract

The Late Carboniferous-Late Triassic Cooper Basin is an intracratonic, non-marine basin consisting of a basal glaciogenic succession overlain by fluvio-deltaic, floodplain and lacustrine deposits with extensive and thick coal measures.

The presence of a basin centered gas accumulation (BCGA) in the Nappamerri Trough, Cooper Basin has been suspected for over two decades. Resistivity of the Permian succession exceeds 20Ωm over large intervals, tests have recovered gas with no water, and gas is located within overpressured compartments indicative of hydraulic isolation. The Permian succession in the Nappamerri Trough is up to 1,000 m thick, comprising very thermally mature, gas-prone source rocks with interbedded sands, ideal for the creation of a BCGA. Excluding the Murteree and Roseneath shales, the succession comprises up to 45% carbonaceous and silty shales and thin coals deposited in flood plain, lacustrine and coal swamp environments.

The Early Permian Murteree and Roseneath shales are thick, generally flat lying, and laterally extensive, comprising siltstones and mudstones deposited in large and relatively deep freshwater lakes. Total organic carbon values average 3.9% in the Roseneath Shale and 2.4% in the Murteree Shale. The shales lie in the wet gas window (0.95 - 1.7% Ro) or dry gas window (>1.7% Ro) over much of the Cooper Basin.

Thick Permian coals in the deepest parts of the Patchawarra Trough and over the Moomba high on the margin of the Nappamerri Trough are targets for deep coal seam gas. Gas desorption analysis of a thick (18 metre) Patchawarra coal seam returned excellent total raw gas results ranging 15.3 - 27.8 scc/g and averaging 21.2 scc/g (680 scf/ton) over 10 metres. This equates to 15 Bcf gas in place in a 15 m seam in a one square kilometre area. Scanning electron microscopy has shown that the coals contain significant microporosity in variably preserved cell lumen within telinite and semifusinite bands.
Recent off-structure drilling in the Nappamerri Trough has confirmed the presence of gas saturation through most of the Permian succession, including the Roseneath and Murteree shales. Basin centered gas, shale gas and deep coal seam gas plays in the Cooper Basin are now the focus of an escalating drilling and evaluation campaign.
Emerging continuous gas plays in the Cooper Basin, South Australia: Cooper Basin introduction

The Cooper Basin is a Permian-Carboniferous to Triassic intracratonic basin located in north-central Australia, extending into southwestern Queensland (Fig. 1). The total area of the basin amounts to 101,000 km², and it is approximately 35,000 km² in area in northeastern South Australia.

The first significant tectonic compression and uplift in the Cooper Basin are believed to have occurred in the late Cretaceous and Eocene periods, which led to the formation of the Great Artesian Basin and the associated sedimentary basins. These changes were followed by a period of erosion and deposition, resulting in the formation of the Cooper Creek Formation.

The basement of the Cooper Basin is composed of Precambrian rocks, which are thought to have been uplifted and eroded during the late Neogene to Quaternary periods. The basin is filled with a complex sequence of sediments, including clastic, carbonate, and evaporite deposits.

The Cooper Basin is divided into three major structural provinces: the eastern Cooper Basin, the western Cooper Basin, and the northwest Cooper Basin. The eastern Cooper Basin is characterized by the presence of the Cooper Creek Formation, which is thought to be the source of the gas present in the basin. The western Cooper Basin is characterized by the presence of the Cooper Creek Formation, which is thought to be the source of the gas present in the basin.

The Cooper Basin is considered to be a major petroleum province, with a wide range of potential hydrocarbon resources. The basin is currently being explored for gas, with several prospects identified in the Cooper Creek Formation. The Cooper Basin is also considered to be a significant source of water, with a large number of groundwater bodies present.

REFERENCES


Emerging continuous gas plays in the Cooper Basin, South Australia: Shale gas play

The Early Permian Braemar Shelf and Mullewa basins are the primary shale gas exploration focus in the Cooper Basin. Figure 2 illustrates the Cooper Basin shale gas play and it summarises the key points of our data analysis. The blue box in the diagram represents the Early Permian Braemar Shelf and Mullewa basins with blue star markers indicating main gas shows in the area. Black star markers represent a secondary trend in the Cooper Basin. The red section lines represent the major geological trends.

The Cooper Basin has a complex geological structure with a series of fault blocks and anticlines. The main gas shows are located in the Early Permian Braemar Shelf and Mullewa basins, which are separated by the McArthur Trough. The gas shows are associated with the volcaniclastic and sandstone intervals of the Nappanee Group, which is a key target for shale gas exploration.

The Nappanee Group is a series of sandstone intervals in the McArthur Trough, reaching a maximum thickness of 85 m in the Nappanee Trough. The Cooper Basin is located in the eastern part of the Nappanee Trough, with the McArthur Trough bounding it to the north. The Nappanee Group consists of several sandstone intervals, including the Harwood Sandstone, the McArthur Sandstone, and the Nappanee Sandstone. The sandstone intervals are interconnected, forming an extensive gas-bearing system.

The Nappanee Group is well exposed in the Cooper Basin, with the Harwood Sandstone being the primary target for gas shows. The sandstone intervals are characterized by high porosity and permeability, which are essential for gas production. The sandstone intervals are also associated with a series of fault zones, which act as conduits for gas migration.

The gas shows in the Cooper Basin are associated with the volcaniclastic and sandstone intervals of the Nappanee Group, which are well exposed in the McArthur Trough. The gas shows are associated with the Harwood Sandstone, which is the primary target for gas exploration. The gas shows are characterized by high porosity and permeability, which are essential for gas production. The sandstone intervals are also associated with a series of fault zones, which act as conduits for gas migration.

REFERENCES


Emerging continuous gas plays in the Cooper Basin, South Australia: Tight gas play

The presence of a basin-centred gas accumulation (BCGA) in the Cooper Basin has been characterised by a tight gas system. Various geological factors, such as the Cooper Basin's location within complex palaeotectonic settings, indicator of tight gas accumulations (VG), regional geology, and exploration success have contributed to the development of tight gas systems in the Cooper Basin. The presence of a BCGA has been established by the identification of gas migration pathways, gas accumulation zones, and the presence of tight gas reservoirs. The Cooper Basin is characterised by a range of tight gas systems, including the Cooper Basin's palaeo-tectonic settings and the presence of tight gas accumulations.

The Palaeo-Trough enjoys a dominant position in the Cooper Basin, where tight gas accumulations have been identified. The presence of tight gas accumulations in the Palaeo-Trough suggests a favourable setting for gas accumulation. The Palaeo-Trough is characterised by a range of tight gas accumulations, including the Cooper Basin's palaeo-tectonic settings and the presence of tight gas accumulations.

The Cooper Basin's palaeo-tectonic settings and the presence of tight gas accumulations are characterised by a range of geological factors, such as the Cooper Basin's location within complex palaeotectonic settings, indicator of tight gas accumulations (VG), regional geology, and exploration success. The Cooper Basin's palaeo-tectonic settings and the presence of tight gas accumulations are characterised by a range of geological factors, such as the Cooper Basin's location within complex palaeotectonic settings, indicator of tight gas accumulations (VG), regional geology, and exploration success.

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Emerging continuous gas plays in the Cooper Basin, South Australia: Coal seam gas play
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The Palaeozoic coal seams are thinner than 2000 m in most of the Cooper Basin. 200 m is generally accepted to be the limit for coal production due to a combination of low permeability and the physical processes of gas escape.

The Permian Tynaghine coal measures are prominent in parts of the basin and are significant in gas exploration of the Cooper Basin. Fluid migration from the coal measures is likely to enhance production rates and optimise drainage. The coal is expected to have gas stored, but the production would not be necessary. However, the higher pressures at these depths mean that the gas will be contained, but little-pressurised gas is likely to be accessed.

Three, mutually exclusive coal seams are also characteristic of the Late Permian Toolebuc Formation (Fig. 27 and 29). The Toolebuc coal measures are sufficiently mature for thermogenic gas generation in the Nappanell and Anomaly troughs, and parts of the Paroo Warra Trough (Fig. 25) and high coal gas potential have been recorded whilst drilling through mature Toolebuc coals (Fig. 1).

Several operators are currently targeting the Palaeozoic and Tertiary coal measures for GSC and a number of coal cores are currently available for sale for research in 2012 drilling programs.

REFERENCES