

MOLECULAR AND STABLE ISOTOPIC (D/H AND $^{13}\text{C}/^{12}\text{C}$) COMPOSITIONS OF NATURAL GAS FROM THE EXMOUTH PLATEAU AND RANKIN PLATFORM, CARNARVON BASIN, AUSTRALIA

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This study documents the natural gas compositions of accumulations on the Exmouth Plateau and adjacent Rankin Platform in the Carnarvon Basin, a proven super-giant gas province on the North West Shelf of offshore Western Australia. The Exmouth Plateau contains Australia's largest undeveloped gas resources. The primary reservoirs are the Middle–Late Triassic Mungaroo Formation (Chrysaor, Dionysus, Geryon, Maenad, Orthrus and Urania discoveries), the Late Jurassic sands of the Dingo Claystone at Geryon and Io/Jansz, and the Early Cretaceous Barrow Group at Scarborough. The gas accumulations at Geryon, Io/Jansz, Maenad, Orthrus and Urania are dry, with condensate to gas ratios (CGRs) of about 3 bbls/MMscf, although they contain low proportions of wet gases (average $100 \times (\text{C}_1 / \sum \text{C}_1\text{--C}_5) = 93.4\%$). These gases typically have low concentrations of carbon dioxide ($\text{CO}_2 < 2.6\%$). The gas at Scarborough is extremely dry ($100 \times (\text{C}_1 / \sum \text{C}_1\text{--C}_5) = 99.9\%$), with low concentrations of carbon dioxide ($\text{CO}_2 = 0.4\%$). The $\delta^{13}\text{C}$ isotopic value of methane is -42.3% , signifying the bacterial alteration of a thermogenic gas (Boreham et al., 2001).

Wet gas is produced from the Mungaroo Formation on the northern Rankin Platform, with some of the wettest gases occurring at Goodwyn (CGR = 143 bbls/MMscf) and Echo/Yodel (CGR = 235 bbls/MMscf). The Mungaroo reservoir gas is drier (CGR ~12 bbls/MMscf) in Gorgon, located on the southern Rankin Platform. The Gorgon and neighbouring West Tryal Rocks, Chrysaor and Dionysus accumulations have elevated carbon dioxide (CO_2) contents with the concentration and isotopic enrichment of CO_2 increasing from the shallower ($\text{CO}_2 = 8\%$; $\delta^{13}\text{C CO}_2 = -5\%$) to the deeper ($\text{CO}_2 = 23\%$; $\delta^{13}\text{C CO}_2 = -3\%$) reservoirs. The isotopically enriched CO_2 may originate from either a magmatic source or from the thermal decomposition of limestones within the deeply buried Permian, Triassic and Early Jurassic sediments. Mixing of inorganic and organic CO_2 could explain the concentration–isotopic trend observed in these accumulations.

Gas–gas correlations based on the carbon ($\delta^{13}\text{C}$) and hydrogen (δD) isotopic compositions of individual hydrocarbons from methane to *n*-pentane ($\text{C}_1\text{--C}_5$) are shown in

Figure 1. The Geryon 1, Jansz 1, Maenad 1A, Orthrus 1 and Urania 1 gases have similarly shaped $\delta^{13}\text{C}$ isotopic profiles that show little differentiation between ethane, propane and butane (Figure 1a). Such a flat isotopic profile is typical of a terrigenous gas source (James, 1990) and may indicate either different sources for the wet gases and methane or facies changes within the same source rock. The most likely primary source of the Exmouth Plateau hydrocarbon gases is the regressive fluvial–deltaic Triassic Mungaroo Formation.

The isotopic profiles of the Gorgon 3 and North Gorgon 6 (southern Rankin Platform) and Chrysaor 1 gases display an almost linear $\delta^{13}\text{C}$ *n*-alkane profile (Figure 1c) and imply a different source province from that of the other Exmouth Plateau gases, most probably from Triassic–Jurassic sediments in the Barrow Sub-basin, as well as within the Rankin Platform.

The carbon and hydrogen isotopic profiles of the Dionysus gas are most similar to the other Exmouth Plateau gases (Figure 1b, d); however, its high concentration of isotopically enriched CO_2 is most similar to the gases from the Gorgon area, suggesting the mixing of multiple sources of gas from different depocentres into this accumulation.

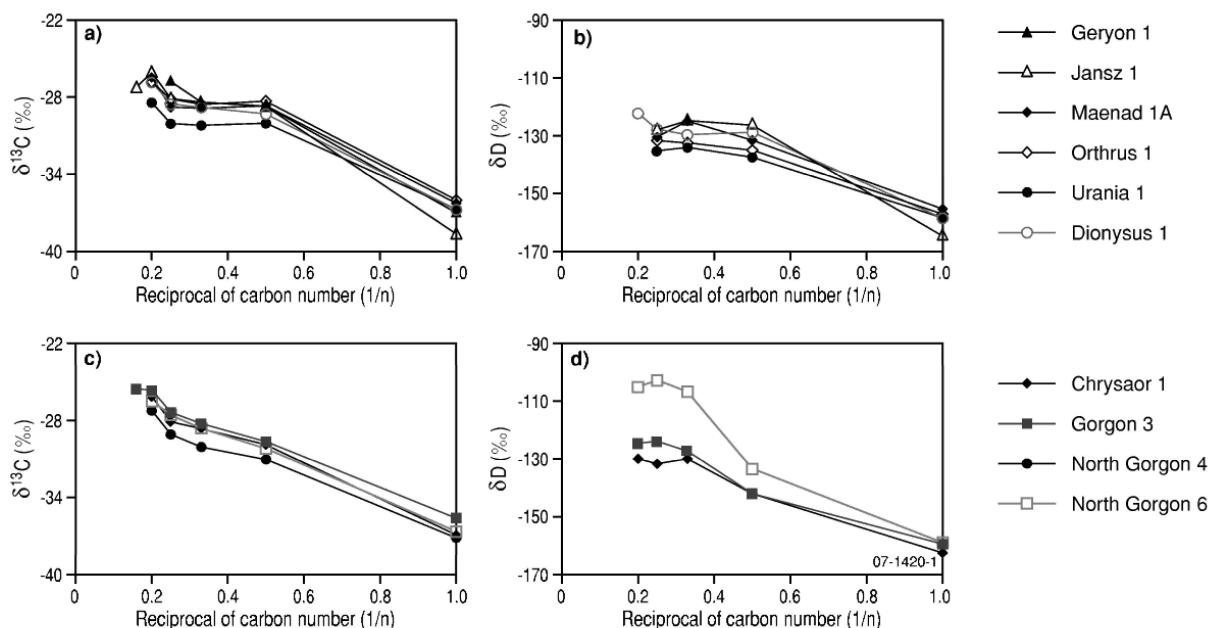


Figure 1. Carbon and hydrogen isotopic values for individual gas components from the Exmouth Plateau and Gorgon area highlighting source differences.

REFERENCES

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