

## BIOGENIC GAS RESOURCE POTENTIAL IN THE VIRGINIA AREA, FREE STATE PROVINCE

### SOUTH AFRICA

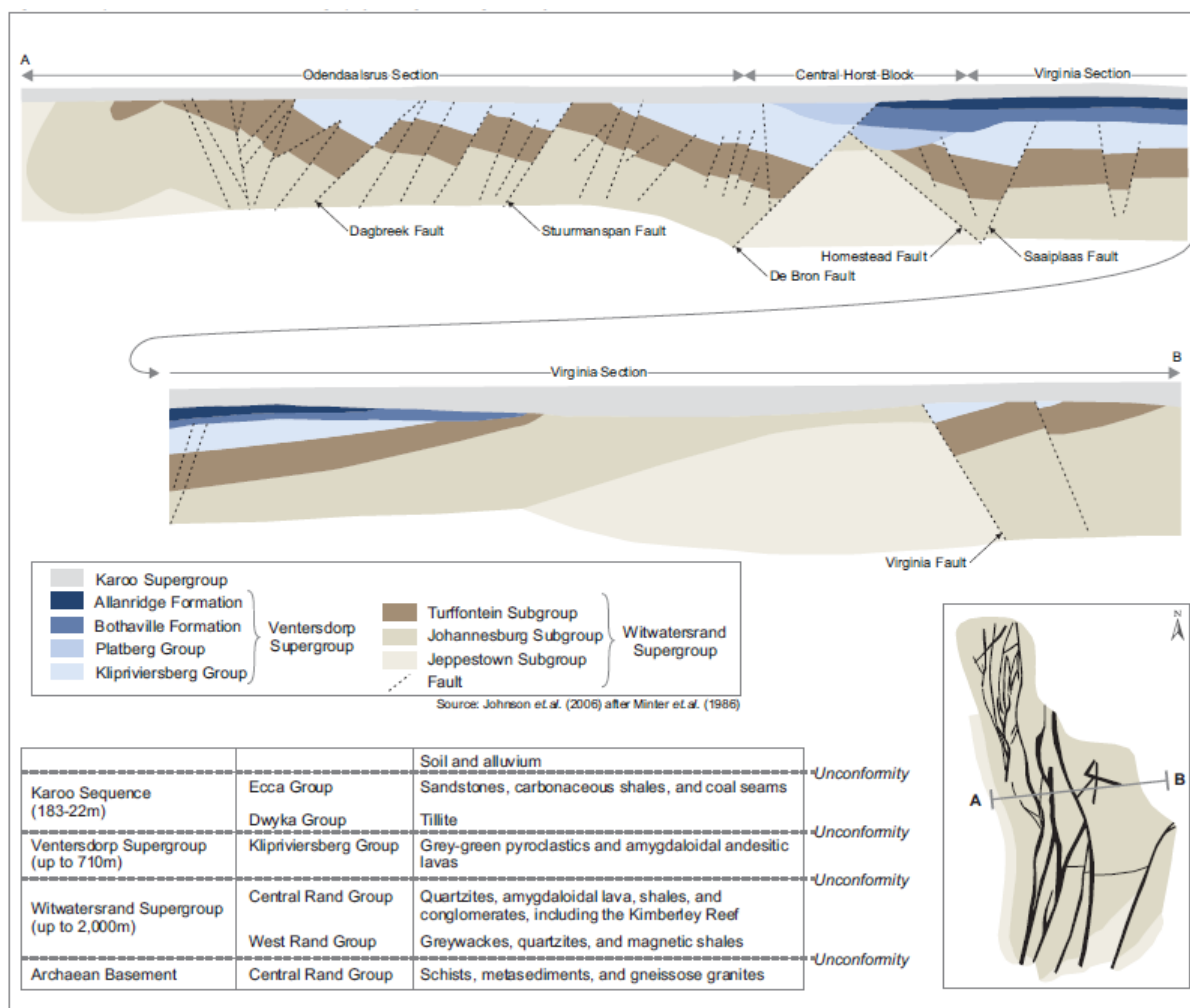
The methane encountered in underground gold mining of the Archean Witwatersrand Basin in the Free State and Evander goldfields was regarded only as a mine explosion hazard and flared in large quantities. The gas is composed predominantly of methane, and other hydrocarbons including helium. Gas encountered is not generally contained in traps but rather is being continually generated at depth and migrating to surface along natural fracture systems, faults and dykes. Published data (Ward et al., 2004; Sherwood-Lollar et al., 2008) indicate that much of the produced gas is of microbial origin, generated by primitive bacteria that inhabit deep water-bearing fissures. In addition, a secondary gas target is identified within the shale or coal-bearing Karoo strata. The presence of hydrocarbons is, to a large extent, controlled by the geologic formations in which the gases are found. Possible traps or play types have been suggested to account for hydrocarbon gas to migrate up through faults and become trapped within these fractures.

The Biogenic Gas resource potential project is the **first proven gas reserves** onshore Karoo South Africa. The operator (Tetra 4) has developed a petroleum production facility in the Virginia Production area and commercial exploitation of biogenic methane has become a reality with opportunities for small scale production. Virginia area is located in the Free State Province of South Africa, some 250km southwest of Johannesburg. The project covers a vast area where gas-emitting boreholes have been identified from mineral exploration. To date, it is reported that Tetra 4 onshore have proven **gas reserves** at 2P values **127.39 billion cubic feet** (Bcf of Proven and Probable) (Table 1) with associated helium reserves values 2.99 Bcf.



## Overview of the Virginia Area (Free State Gas field)

The Virginia production area is located in the Free State Province, approximately 250km south-west of Johannesburg and 200 km northeast of Bloemfontein. The gas field is located within the Welkom Goldfield in the southernmost extent of the Archean Witwatersrand Basin. The Witwatersrand Basin is well known for its exceptional gold mineralization and has thus been intensively investigated. The Virginia area is structurally complex, with crustal fracture zones trending approximately north-south and east-west intruded by dolerite dykes and diamond-bearing kimberlites. The abundance of semi-vertical cross-cutting dykes, kimberlite fissures and fractures throughout the Witwatersrand Basin suggest the potential for gas migration and transport along these structures. These structural trends and numerous well penetrations in the area suggest further exploration should occur along the major faults for the development of future gas resources. Thus, understanding the structural trends and extent is important in predicting target gas intersections. The dolerite sills and impermeable overlying Karoo Supergroup sediments, which have not been faulted, may play an important role as a capping rock. The structural geology and simplified cross section and stratigraphic column are illustrated in Figure 1.



**Figure 1:** Simplified geology, structure and stratigraphic column of the Virginia (modified by Venmyn, 2016; McCarthy, 2006)

## Biogenic Gas Resource Potential

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Recoverable Volumes (Bcf)	Proven (1P)	Probable (2P)	Possible (3P)
Methane (CH <sub>4</sub> )	36.36	127.39	269.05
Helium (He)	0.8	2.99	6.21

**Table 1:** Summary of net reserves independently certified (MHA Petroleum Consultants, March 2018).

The forecasts of reserves and resources were based upon a review of production data from gas-emitting boreholes, geological interpretations, analyses of the produced gas composition, field development and historical data available from the area. Given the unusual nature of this unconventional play, commercial exploitation of biogenic gas has become a reality with business opportunities for compressed natural gas (CNG) and liquefied natural gas (LNG) production, power generation supply and helium for industrial applications.

## References

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