Shale Gas: an unconventional hydrocarbon resource in South Africa?

Some preliminary observations

Brian Horsfield[1], Hans-Martin Schulz[1], Maarten de Wit[2]

1 GFZ German Centre for Geosciences, Potsdam, Germany
2 AEON and University of Cape Town, South Africa

Gas shales are currently amongst the hottest plays in the United States as a result of high gas prices, and the remarkable technological successes exploiting the Barnett Shale of the Fort Worth Basin. Furthermore, viable gas shales most likely occur in many developed basins where an underutilized distribution infrastructure exists and markets are readily accessible. Annual natural gas production from shale gas reservoirs in the US is approximately 1.0 Tcf and comes from more than 40,000 shale gas wells (around 6-10% of total natural-gas production in the US today; numbers vary according to reference).

While high energy prices and advances in fracturing technology have enabled shale gas production to become a lucrative reality, it is the prediction of gas concentration, partition behaviour and rock properties ahead of drilling that is of paramount importance for reducing risk and identifying “sweet spots” or fairways. In other words, there is still a lot to learn scientifically about how shale gas systems actually work. Significant advances have been made over the last five years, but there are great opportunities for major advances in science and technology.

No commercial shale-gas enterprises are currently known from outside of North America. Estimations of more than 16,000 Tcf worldwide shale-gas resources are indications that a tremendous potential exists for future growth. Approximately 500 Tcf is forecast for Europe, and targets in Europe include the Posidonia Shale (Jurassic), Alum Shale (Cambrian), Wealden (Cretaceous), Mikulov Formation (Jurassic) and Riga Formation (Silurian).

About 200 Tcf shale gas potential has been forecast for sub-Saharan Africa. As far as South Africa is concerned, and while numerous black shale-containing formations occur throughout the stratigraphic column, the Whitehill and Prince Albert Formations and its equivalents (Permian) stand out as perhaps the prime candidate for exploitation. It consists of dark, carbonaceous lacustrine shale overlain in part by siliciclastic turbidites and tuffs, and was deposited in a sea-level highstand under strongly anoxic redox conditions (Faure and Cole, 1999; Summons et al., 2008). While its organic richness is beyond doubt, thermal maturity will likely play the critical role in distinguishing gas shale versus oil shale potentials. By analogy with the Barnett Shale and Marcellus Shale plays of the United States, advanced thermal maturity levels will be prerequisite in order to achieve high gas-in-place and enable high gas flow rates to be maintained. The role played by the Karoo basalts in defining maturation history is of paramount importance. Extremely high maturity levels (Rm = 2-4%) have already been documented in cores of the Whitehill Formation, and lateral continuity demonstrated by MT surveys (Branch et al., 2007 Inkaba yeAfrica Special Volume).

The current contribution will outline the attributes of gas shales in the United States, and explore the potential targets in South Africa, most notably the Whitehill and Prince Albert Formations.