Paper Number: 4941

Seismic imaging of sills, dykes and hydrothermal vents in the Main Karoo Basin, South Africa: implications for shale gas potential

Webb, S.J.[1], Manzi, M.[1] and Scheiber-Enslin, S.E.[1]

[1]School of Geosciences, University of the Witwatersrand, South Africa, susan.webb@wits.ac.za

---

The emplacement of igneous intrusions (sills and dykes) and the subsequent explosive release of gas through hydrothermal vents in the main Karoo Basin of South Africa have been proposed as a significant contributor to climate change at 183 Ma [1,2]. These sills and dykes have a complicated three-dimensional interlocking structure and their interaction with the hydrocarbon rich layers may impact significantly on the potential of the Karoo as a shale gas reservoir. Understanding the geometry of this intrusive network is of interest to the petroleum industry and has implications for groundwater. Here we present a 2D seismic reflection line in the central Main Karoo Basin. These 16 s high resolution data were acquired by the Gold Division of Anglo American Corporation of South Africa (now AngloGold Ashanti Ltd) in 1990s. The re-processed seismic profile focusses on the top 2s of the data.

Strong seismic reflectors marking the top of the basement and base of the Beaufort Group are found at 1.4 s and 1.0 s, respectively. These seismic reflectors show a good correlation with the well WE1/66 data. The well is located ~40 km east of the seismic profile and intersects Beaufort, Ecca and Dwyka Groups and the Karoo basement (Figure 1). Seismic data delineate dolerite sills (20 -70 m thick) that correspond with those observed on the geological map (Figure 1). The shallow strong reflectors often terminate laterally in distinctive inclined sheets, indicative of a saucer shaped sill. The seismic data also mapped interconnected networks of dykes and gas-escape features that crosscut the dolerite sills, units of the Ecca and Beaufort Groups. These gas-escape features correspond to large, dome-shaped, sub-vertical convex reflections and disturbed seismic horizons within the Ecca and Beaufort Group, and are interpreted in this study as hydrothermal vent complexes. These features may correspond to those previously identified in the Stormberg Group by Svensen et al. [3]. This is the first subsurface evidence where these vents have been imaged in the Karoo.

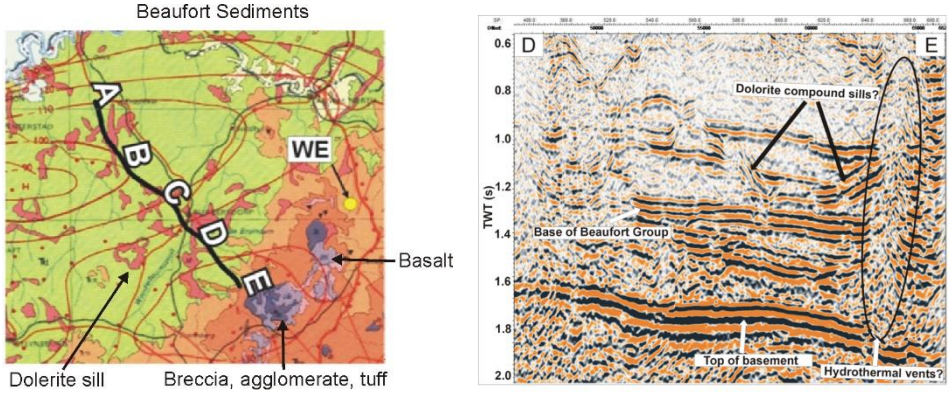

Figure 1: (a) Seismic line in the central Karoo basin passing over Beaufort Group sediments, dolerite sills, dykes and hydrothermal vents. (b) Seismic section DE showing these features in the subsurface.

Our work demonstrates that there is an extensive network of sills with associated vents, some of which may not reach surface, or may not be obvious at surface due to subsequent erosion. Our results indicate that the estimated volume of emissions could be significantly larger than those made by

Svensen et al. [1]. These observed vents also have implications for the preservation and maturity of any gas resources in this region of the Karoo. This seismic slice also highlights the complications around the evaluation of the shale gas potential and water resources of the Karoo.

References:

[1] Svensen H et al. (2004) Nature 429: 542-545
[2] Svensen H et al. (2007) Earth and Planetary Sci Letters 256: 554-566
[3] Svensen H et al. (2006) J Geol Soc London 163: 671–682