

Paper Number: 5498

3D geology modelling from boreholes, cross-sections and geological maps to support shale gas potential investigations in the Beaufort West area, South Africa

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The Council for Geoscience is conducting a three year research programme aimed at undertaking a wide range of geoscientific investigations in response to the start of the potential shale gas industry in the Beaufort West area. The research programme will potentially provide better shale gas quantification around the Beaufort West area based on the results obtained from the baseline investigations. The investigations are set to provide the information that will enable better conceptualisation of the geo-environmental issues, such as groundwater pollution, earthquakes and methane pollution related to potential shale gas activities in the western Karoo Basin. The main activity of the project is the drilling of a 4000m vertical borehole. Before, during and after deep drilling commences, a base line study must be done and this consists of surface investigations at various scales including airborne and ground geophysics data acquisition, geological and hydrogeology mapping and seismology studies.

3D geological modelling is important in the baseline study as it provides a three dimensional view of the sub-surface geology and hydrogeology and this will assist with understanding the distribution of deep ground water aquifers and provide information that may assist in avoiding any unwanted side- effects of shale gas exploration, such as polluting groundwater when drilling takes place. In 3D modelling data from various sources is integrated. The data used in the 3D model in this study includes geological maps, cross sections and boreholes. 1:50 000 scale geological maps of the areas were created using field mapping and satellite imagery. Structural data of the dolerite dykes and sills were also gathered to anticipate their habit at depth whether they would intersect the borehole or not and understand their role in the distribution of water conclusive features.

A hundred and fifty-nine lithostratigraphic boreholes from the National Groundwater Database (NGDB) provided subsurface information that were incorporated in the three dimensional model of the sub-surface geology of the Beaufort West study area. Borehole data was loaded in Rockworks 16 to create three, two dimensional section striplogs. These striplogs were combined with cross-sections created from the geological maps to create the final 3D model.

Preliminary results of the model show the surface and sub-surface geology of the Beaufort West area as well as water strike levels which may intersect the proposed borehole at depth. Furthermore, future work will include incorporating the results of the geophysics investigation as well as seismic interpretation in order to have a more precise 3D model to better understand the major structures at depth, geology and stress orientation for the proposed borehole.

