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Petrographic, geochemical and petro-physical analysis of the Collingham Formation near Jansenville, Eastern Cape, South Africa – potential cap rocks to shale gas in the Karoo

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The Lower Ecca Group of the Karoo Basin potentially contains significant unconventional gas, hosted in gas-shales, of which the most significant sequence is the organic rich shales of the Whitehill Formation. The Whitehill Formation is directly overlain by clastic and volcaniclastic rocks of the Collingham Formation. Due to the potential for the upward migration of hydrocarbons from the gas-shales it is important to establish the integrity of the overlying formation. Here we report on the mineralogical, geochemical and physical properties of the Collingham Formation to test its ability to act as a cap rock to the underlying carbon-rich, potentially gas-bearing shales of the Whitehill Formation.

Fresh core samples from a borehole drilled through the Lower Ecca Group near Jansenville, in the Eastern Cape, South Africa, were analysed for their mineralogical and geochemical content, using thin section microscopy, X-Ray Diffraction ("XRD"), X-Ray Fluorescence ("XRF"), Total Organic Carbon ("TOC") and Scanning Electron Microscopy ("SEM"). The main rock types of the Collingham Formation contain three pore types (intrapore, interpore and microfractures) that are predominantly nanopores (< 1 micron). The small size of pores, low permeability values, and their mineral content suggest that the Collingham Formation formed in a marine environment, subsequently modified through burial and regional metamorphism. Physical properties, determined through mercury porosimetry include porosity, permeability and density. Results show that the large proportion of clay minerals, a low TOC, the fine-grained nature of lithologies, a low porosity, a lack of permeability, a moderate fracturability, average density values, and the laminate nature of the formation, favour it as a suitable cap rock.

We conclude that, although the characteristics of the formation favour it as a cap rock, and therefore a sealing sequence to the Whitehill Formation, our results apply only to the Collingham Formation affected by the Cape Fold Belt. Further work is needed farther into the basin, to reveal its potential as a cap rock.