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The impact of dolerite intrusions on the organic-rich mudstones of the Ecca Group in a borehole from the central Karoo Basin

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The estimated economic shale gas reserve of the Ecca Group of South Africa has not been critically investigated with reference to the impact of voluminous Jurassic-aged dolerite intrusions in the succession. Magmatic activities within sedimentary basins could contribute positively or negatively on the hydrocarbon maturation/transformation of its organic matters and potential. [1, 2, 3]

This research studies the changes in mineralogy and chemistry of the Ecca Group mudrocks in relation to five dolerite sills (~20 to ~200m thickness). Drill cores of a 1405m thick succession of Karoo strata were analyzed from a borehole in the central part of the basin. We present results from optical microscopy, x-ray diffraction (XRD) on bulk and oriented clay mineral separates, RockEval pyrolysis, total organic carbon content (TOC) and isotopic composition of organic carbon ($\delta^{13}\text{C}_{\text{org}}$) analyses.

Under the microscope, the mudstones are poorly sorted, ranging from clay to silt-sized grain particles. Pyrite is a more noticeable mineral phase close to intrusions. The dolerites are medium-grained, with euhedral rectangular laths of plagioclase, clinopyroxene, poikilitic orthopyroxene, quartz, and pyrite. XRD results indicate that the dominant minerals in the mudstones are quartz, chlorite, illite, and feldspar. Illite crystallinity index increase with depth and towards dolerite sills and so does chlorite abundance. Black facie mudstones are enriched in TOC and $\delta^{13}\text{C}_{\text{org}}$ relative to more silty mudstones. There is also an enrichment of $\delta^{13}\text{C}_{\text{org}}$ and depletion in TOC close to dolerite sills. The organic matter ranges mainly from mature to post mature maturity and are of gas-prone type III kerogen composition.

The observations indicate both load metamorphism and dolerite intrusions influenced hydrocarbon transformation in the basin. Multiple to closely spaced thermal aureoles of intrusions had greater impacts.

References:

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- [2] Decker J and Marot J (2012) In: *Investigation of hydraulic fracturing in the Karoo of South Africa. Annexure A, Resource Assessment*: PASA
- [3] Geel C et al. (2013) *Energy Procedia* 40: 256 – 265

