Characterising the Hutton Sandstone in the Northeastern Surat Basin

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Abstract

The Middle Jurassic Hutton Sandstone in the Surat Basin is reported to be a major aquifer in the Great Artesian Basin (GAB). It is an important formation for monitoring the impact of CSG-related dewatering in the Surat Basin (part of the GAB) given its proximity to the overlying CSG-productive Walloon Subgroup, and has trigger thresholds of CSG-related drawdown defined by the Queensland government. Limited work has been done on the Hutton Sandstone since the 1970s, and having rarely been a target for petroleum exploration, there is an overall lack of core data available. In addition, wireline log data is usually of insufficient quality to make a comprehensive petrophysical interpretation.

QGC has developed a network of monitoring wells across its tenements that include more than 10 specific Hutton Sandstone monitoring wells. These wells contribute a large amount of detailed wireline log and core data that were not previously available and present an opportunity to fully characterise the formation in this area for the first time. Published information on the Hutton Sandstone has been integrated with new sedimentological characterisation, core analysis and petrophysical interpretation focused near QGC's Surat Basin tenements.

QGC has acquired Hutton Sandstone core from the Woleebee Creek GW4 and Kenya East GW7 wells. Combined, these well have in excess of 1,000 routine core analyses (RCA) plugs from the Hutton Sandstone for porosity and permeability measurements, and a cross-plot is shown in Figure 1.

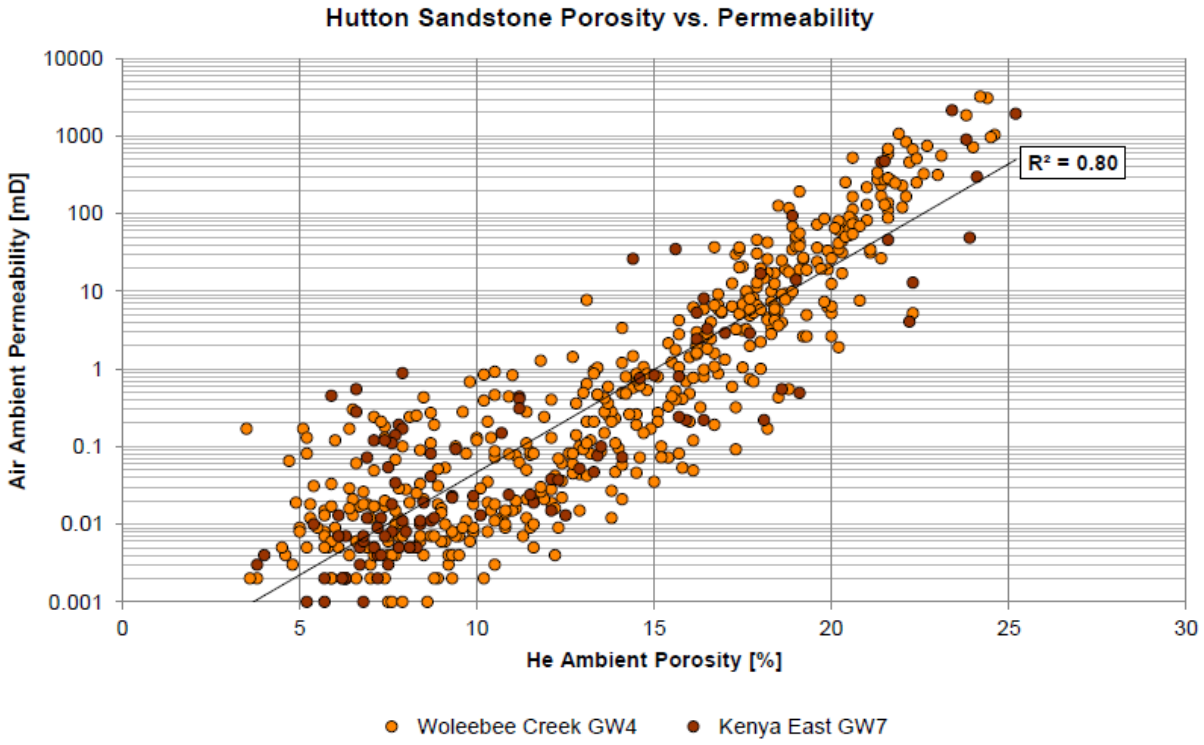

Figure 1. Core porosity and permeability data (horizontal) from the Hutton Sandstone.

Within QGC's tenements, the Hutton Sandstone is a heterogeneous succession of blocky, fining-up or multistory sandstones, interpreted to comprise fluvial and tidally-influenced deltaic channels, crevasse splay and floodplain facies. It was deposited in the lower fluvial plain-delta plain setting, where meandering channel systems fed deltas in a lake. At times, this lake was linked to the marine environment forming a restricted marine embayment, as evidenced by tidal indicators in core and biostratigraphic analysis. The more proximal deposits of the Hutton Sandstone are interpreted to comprise isolated meandering channel forms, with associated crevasse splays within a background of overbank and rare lake deposits. The more distal units are dominated by sand bodies deposited as mouth bars, which may be more laterally continuous, or deltaic tidally-influenced channels, within a background of lacustrine or brackish water fines. A diagram of the simplified depositional model of the Hutton Sandstone is shown in Figure 2. This model is based on the sedimentological interpretation of Woleebee Creek GW4 and Kenya East GW7.

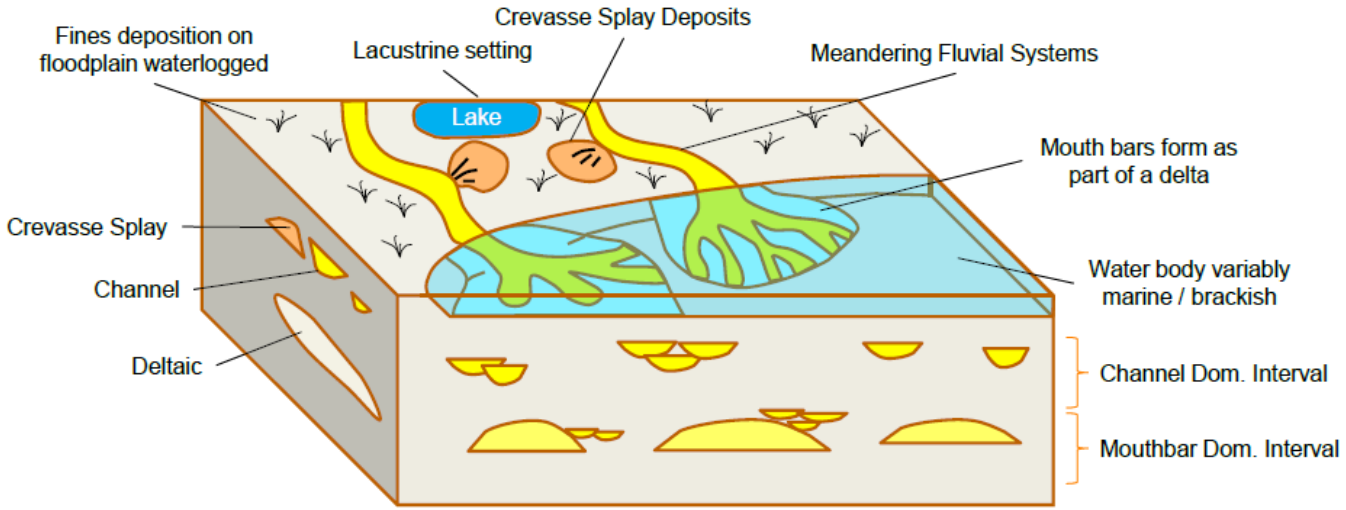

Figure 2. Block diagram of the depositional model of the Hutton Sandstone.

Bulk mineralogy results from XRD show variable quartz content (33-91%), feldspars (2-42%), and clays up to 37%. Authigenic minerals occur in moderate to abundant amounts; clays are dominantly authigenic with kaolinite being the most abundant type. Reductions in porosity are due to moderate- to very-high compaction, pore-filling cements (e.g. quartz and calcite), and pore-filling clays. Vertical variation is marked, supported by modified Lorenz plots showing defined isolated flow zones. Examination of regional wireline log responses shows deterioration in rock quality from the Roma Shelf to the Mimosa Syncline, proximal to QGC's Surat Basin tenements, similar to the findings of Exon (1976) and Houston (1972).

Key findings are that in QGC's tenements, the Hutton Sandstone comprises highly variable hydraulic units and has low net to gross, with only ~5% of the formation on average having liquid permeability greater than 10 mD. As a whole, the formation is a low yield aquifer tending towards aquitard (<10 mD), with the majority of facies exhibiting geometric mean permeabilities of <1 mD. With such a low net to gross and laterally restricted sand bodies, the aquifer units within the Hutton Sandstone in this area would be expected to exhibit extremely low vertical connectivity. From a monitoring perspective, this suggests that the potential for CSG-related impacts are significantly lower than previously assumed.

References Cited

Exon, N.F., 1976. Geology of the Surat Basin in Queensland. Department of National Resources, Bureau of Mineral Resources, Geology and Geophysics, Bulletin 166, pp.235.

Houston, B.R., 1972. Petrology of subsurface samples of Mesozoic arenites of the Bowen and Surat Basins. Appendix 2 in Geological Survey of Queensland Report 71, 89-98.