
Lithology and permeability in Kemira 1

Distinguishing the stratigraphy, structure and rock properties in the Kemira 1 well is challenging (Figure 2). The interval identified as the Manchester Marl Formation is generally predominantly a calcareous mudstone to the west of Kemira 1 in the East Irish Sea Basin. It is considered to be a non-reservoir rock, sealing to upward fluid migration. The formation is known to transition to a sandy facies east of Kemira 1. However, if the formation is correctly identified in Kemira 1, then it appears from the log responses that the Manchester Marl has already transitioned to the sandy facies at that location and, given the separation in resistivity curves, it appears to be permeable. An alternative explanation could be that the interval could be the Chester Formation (Formerly known as the Chester Pebble Beds) overlying the Kinnerton Sandstone Formation (rather than the Collyhurst Sandstone Formation). This is based on interpretation of core from a borehole called Speke north of the river Mersey and could fit with the cuttings logs described below.

When a well is drilled, the rock chippings (cuttings) are brought to the surface by the circulating drilling fluid. These are sieved out, examined and described to help with the geological interpretation. The company cuttings logs for Kemira 1 over the interval identified as the Manchester Marl Formation reports predominantly sandstone. The deciphering the description of the cuttings, it appears the sandstone is generally moderately to poorly consolidated with silica cement. Some loose grains, moderately well sorted and some siltstone frags are also reported, with a thin pebble conglomerate at the base.

The cuttings logs over the interval identified as the Collyhurst Sandstone Formation report a mixture of sandstone and siltstone, both moderately consolidated to friable with dolomitic and/or silica cement. More consolidated bands are reported at around 3050 ft and this roughly corresponds to a thin interval where the resistivity curves converge.

From the resistivity log response, the Collyhurst Sandstone Formation in Kemira 1 appears permeable, based on the separation in resistivity curves. The resistivity curves are slightly closer together over the basal part (below 980 m depth), which could suggest that this lower part is perhaps less permeable than the rest. When drilling a well, the drilling fluid (‘mud’) invades permeable formations during drilling until flow is capped off by the solids in the mud coating the borehole wall. When the mud is a different resistivity to the formation water, this invasion creates a transition in the overall resistivity from close to the borehole wall, outwards to the un-invaded formation. The resistivity tools measure resistivity at different distances into the formation from the borehole itself, so the invasion of drilling fluid is recorded by the separation in the output curve readings. When a formation is impermeable, no mud invasion can occur and so there is no transition in the resistivity away from the borehole wall. The resistivity curves reading at different depths into the formation therefore overlay each other.

This is considered to be the most likely scenario. However, there are a couple of alternative possibilities to this interpretation to be taken into consideration, given the limitations on data quality...
and data availability for this well:

1. The calliper is open to its maximum extent below 980 m, so the geophysical tools are likely to be outside their normal operating range. We don’t know the hole size, but it could be larger than the ILD's (deep resistivity curve) reach into the formation. i.e. both ILD & ILM (medium resistivity curve) could be reading mud in the borehole or at shallower depths into the formation than they are designed to, so they would not ‘see’ the full span of the invasion zone.

2. It could be that the uninvaded formation resistivity is the same as the invading drilling fluid resistivity below 980 m. The resistivities look to be similar, so the curve overlay could represent a (very) slight fluid or rock matrix change that would bring the mud and formation resistivities to become identical.

1. Fluid related changes could incorporate changes in the formation water salinity or hydrocarbon content. It is feasible that that the water in the shales and rocks below the Collyhurst Sandstone Formation (CS) are a different salinity to the CS, and there could therefore be a salinity gradient. It appears that the water in the shales beneath the CS is more resistive (less saline, or it could be hydrocarbon content). However, it seems unlikely that less saline water or small amounts of hydrocarbon would stay in a ‘block’ at the base of the sandy CS because of the density contrast, unless this is also reflecting a vertical permeability change.

2. Rock matrix related changes could be that the lower part of the CS formation (below 980 m) has slightly less conductive minerals than higher up e.g. pyrite (traces of which are reported in the cuttings log). Any lithological changes are difficult to detect, given that the enlarged hole is likely to have adversely affected the density-neutron curves, combined with the neutron curve processing difficulties (see Table 9 and Appendix 1 - Kemira 1 (SJ47NE/101)).

Without examining data from nearby wells to verify whether a similar curve response is in evidence it is not possible to improve confidence in the permeability or lithological analysis. Other nearby boreholes that could be assessed include Morley Bridge, Collinge, Lovels Hall, Hale, Knutsford and Blacon East 1. However, a quick look suggests that the geophysical log data quality and availability may also limit further interpretation in those wells.

Retrieved from ‘http://earthwise.bgs.ac.uk/index.php?title=OR/17/037_Discussion&oldid=31900’

Category:

- OR/17/037 Petrophysical interpretation of selected wells near Liverpool for the UK Geoenergy Observatories project

Navigation menu

Personal tools

- Not logged in
- Talk
- Contributions