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Use of processed resistivity borehole imaging to assess the insoluble content of the massively bedded Preesall Halite NW England

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With the decline of the UK's remaining conventional reserves of natural gas and associated growth of imports, the lack of adequate storage capacity is a matter of concern for ensuring energy security year-round. In a number of countries, subsurface caverns for gas storage have been created by solution mining of massive halite deposits and similar storage facilities are likely to become an important part of the UK's energy infrastructure. Crucial to the economic viability of such facilities is the percentage of insoluble material within the halite intervals, which influences strongly the relationship between cavern sump and working volumes: successful development of these caverns is dependent upon maximising the efficiency of cavern design and construction.

The purity of a massive halite sequence can only be assessed either by direct means (i.e. coring) or indirectly by downhole geophysical logs The use of conventional geophysical logs in subsurface exploration is well established but literature generally relies on a very low resolution tools with a typical vertical logging sample interval of 15 centimetres. This means that such tools provide, at best, a "blurred" view of the sedimentary successions penetrated by the borehole and that discrete narrow bands of insoluble material will not be identifiable or distinguishable from zones of "dirtier" halite with disseminated mud materials.

In 2008, Halite-Energy Group (formerly Canatxx Gas Storage Ltd) drilled the Burrows Marsh #1 borehole and acquired resistivity borehole imaging (FMI) logs through the Triassic Preesall Halite in the Preesall Saltfield, NW England. In addition to near full circumferal imaging capability, rather than a single measurement per increment, FMI logs allows millimetre to centimetre scale imaging of sedimentary features, that is one to two orders of magnitude higher vertical resolution.

After binary segmentation of the FMI images to achieve a simple halite-insoluble ("mud") separation these were subject to a filtering process to develop a detailed understanding of the halite sequence's insoluble content. The results were then calibrated, post-normalisation, by new laboratory determinations of the insoluble content of laterally equivalent samples of core from the nearby Arm Hill #1 borehole. The FMI logs provide a greater degree of resolution when compared to conventional geophysical logs. With the statistical analysis provided by this process, it further enhances the correlation between the logs and core and ultimately, the assessment of insoluble content. Despite the obvious increase in resolution, precise statistical quantification of the success of the borehole imaging technique is somewhat obfuscated by the absence of both FMI logs and continuous core in a single borehole.

The acquisition parameters for these images are at the limits for the tools and therefore more noisy than those acquired in other lithologies or logging environments. The optimum acquisition parameters (in particular gain settings and logging speed), the nature of the filtering required to quantify the insoluble content and the effects of image noise on those calculations are discussed.