

High Pb and Zn concentrations in formation water from the Culzean Field – real or artefact?

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Abstract

Formation water compositions are an important input to scale management planning on new fields. The quality of these data can be verified by evaluating formation water sampling and analysis conditions and also by comparing the analyses with analogue data from similar fields. But, this can be problematic when the analyses of interest are not commonly obtained. In this paper we present such an example.

The HTHP Culzean Field is located in Block 22/25a, East Central Graben, UK North Sea. Although an initial evaluation of formation water samples/analyses obtained from the Skagerrak Formation indicated that their quality was reasonably good, the formation water contained 172 ± 9 ppm Pb and 452 ± 24 ppm Zn. These concentrations are high when compared with the few published/unpublished analyses for North Sea formation waters; at these concentrations there is a potential Pb-Zn sulphide scale risk at Culzean. To confirm the Pb and Zn analyses, they were compared with a wider variety of analogue data from a range of crustal fluids (including other global oilfield formation waters, and shield, geothermal, metamorphic, hydrothermal, and magmatic waters).

This showed that the Culzean formation water has a Pb/Zn ratio characteristic of crustal fluids and the high concentrations appear to be the result of (a) a geological source of Pb and Zn, (b) high salinity, low pH and low H₂S content of the Culzean formation water and (c) high reservoir temperature. It was concluded that high Pb and Zn concentrations of the Culzean formation water are likely to be representative of those naturally-occurring in the reservoir and are not an artefact of drilling, sampling or analysis.

This study has shown that analogue data from a variety of crustal fluids can be used to establish the quality of oilfield formation water analyses. This is particularly useful when the constituents of interest are not commonly detected or determined in oilfield formation waters. This has helped confirm the potential sulphide scale risk at Culzean and explains the reasons for elevated Pb and Zn in formation waters from other fields in the Central Graben of the North Sea.