EAGE

PG19

Water Geochemistry and Hydrogeology: A Valuable Yet Undervalued Tool in the Oil and Gas Industry

J.C. Matthews* (Total), J.P. Girard (Total), S. Dehez (Total), E. Gaucher (Total), V. Burg (Total) & C. Bortelle (Total)

SUMMARY

TBC

Proper sampling and characterization of formation water is a very important step for understanding the whole story of fluids in carbonate reservoirs. It has long been recognized that critical information can be obtained from formation water geochemistry. However, in many companies there still is an under-appreciation of the importance of high-quality water data. Information contained within the chemical and isotopic composition of formation water may be of critical importance for issues pertaining to reservoir compartmentalization, production allocation, injection water compatibility and scale risk, monitoring water-rock interaction processes in the reservoir, biodegradation, acid treatment or water breakthrough…

Formation water is present before HC charge and residual water remains in contact with the reservoir and with petroleum fluids during the life of the field. As a result, it records a great deal of the past history of fluids. At an exploration stage, the geochemistry of formation water can for instance provide important constraints on how the petroleum system functioned during basin history, and may help to unravel the charge history. During the development stage of a field, the waters produced with hydrocarbons must be treated and can then pose risks to flow assurance and installation longevity. In this presentation, we intend to illustrate the importance of characterizing and interpreting formation waters to answer geological or engineering questions by studying the "other" reservoir fluid.

This field of study is not new; there have been a number of important advances in understanding specific petroleum systems and specific field behavior by investigating formation and produced water in the past (see review by Kharaka and Hanor, 2007). In recent years, efforts have been made to develop new sampling techniques, new analytical approaches and new natural tracers to verify the representativeness of samples and to place them in a geological or engineering context.

Examples of water geochemistry studies will be shown to illustrate the utility of characterizing paleo-formation water, current formation water in the aquifers and in the HC leg of reservoirs. Produced water also needs to be appropriately sampled and analyzed in order to improve the quality of the interpretation based on such data. Transfer and analysis techniques on downhole water samples can have a large impact on the quality of the analytical results. For produced waters, a recommended workflow will be discussed for on-site sampling, sample conditioning and initial (mobile) sensitive analyses to be performed before further analytical work in the laboratory.

In addition to improved sampling and analytical protocols, two additional considerations can provide key understanding of petroleum system behavior and production time scale engineering issues. First, thermodynamic modeling of water compositions based on detailed knowledge of formation mineralogy can provide key data to evaluate the representativeness of samples and the quality of legacy geochemical data. Second, regional to sub-basin scale movement of water during the present day can provide important constraints on paleo-fluid flow and on present-day fluid distributions in the subsurface.

Kharaka Y.K. and Hanor J.S. [2007] Deep fluids in the continents: I. sedimentary basins. Treatise on geochemistry. V. 5. Elsevier, 1-48.