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Joint inversion of HDIL and SP with a five-parameter model for estimation of connate water resistivity and Archie's parameters

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The calculation of saturation is reliable when connate water resistivity (Rw) and Archie's parameters, such as saturation exponent (n) and cementation exponent (m), are available. However, rock-core measurements or chemical analysis of formation water are not always available.

A new joint inversion method with borehole spontaneous potential (SP) log and High Definition Induction Log (HDIL) is proposed for accurate estimation of Rw, and the Archie's parameters. In order to accurately simulate SP, the generated position of the membrane and diffusion potential, which are assumed as main contributors of SSP, are identified through simulation of fresh-water mud invasion. Then a five-parameter model is built up for precise construction of the complex resistivity distribution while fresh mud invasion happens. In so doing, the formation is divided into three zones: flushed zone, transition zone and virgin zone. The resistivity profile of transition zone is assumed to be a parabola shape, which is more consistent with the actual change of formation resistivity, especially when a low resistivity annulus occurs. Then the invasion profile is rebuilt with the five-parameter method, and Rw is also calculated with the SSP and mud resistivity (Rm). m and n are estimated by Archie or dual-water equations.

We successfully applied this method to an oil field in western China. Values of Rw , m and n yielded are consistent with those obtained from a traditional method. The method proposed here is an effective alternative to obtain water saturation wherein rock-core measurements or chemical analysis not available or questionable.

Biography

Li Hu is a PhD. student in China University of Petroleum School of Geosciences. He is a member of SPE and SEG. He is engaging in Applied Geophysics and Electromagnetic Logging method research

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Carbonation of a Portland cement under geological conditions

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Geological storage of CO_2 could be a viable way of limiting the effect of anthropogenic carbon dioxide emissions on the global warming. However, the containment of the gas has to be ensured and the understanding of how CO_2 could leak out of the sequestration formation is of great importance. The loss of the integrity of one or several wells located on the storage site represents one of the greatest risk of CO_2 leakage. For example, cement carbonation is one of the mechanism which can impair sealing capacity of a well. The knowledge of the long-term evolution of a hardened portland cement exposed to CO_2-rich fluids is therefore a key issue to ensure confidence CO_2 geological storage. Reactive transport modeling appears as the most reliable way to forecast the cement annular at very long term. However, reactive transport codes require reliable input thermodynamic data and validation with respect to experimental data in order to accurately predict the evolution of cement mineralogy and porosity at long term. The purpose of this study is to investigate the mineralogy changes in cement samples due to CO_2-rich water exposure in order to get quantifying data. The second goal is to clarify the carbonation kinetics under geological conditions, and to propose an analytical model allowing to describe the evolution of the carbonation depth with the exposure time. The evolution of the mineralogy and chemical changes have been studied as well as the speciation of the ageing solution by regular samplings during the carbonation experiments.

Biography

Thomas Millan is a physico-chemistry PhD student at IFP Energies nouvelles in Rueil Malmaison (France) and in collaboration with the EMSE (Ecole Nationale Supérieure des Mines de Saint Etienne) and the Paris 6 University. His researches focuse on cement behaviour during CO_2 storage under geological conditions and the modelling of long term evolution of the cement mineralogy in CO_2 environment

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