Fluid Flow Modeling in Various Clay Textures

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ABSTRACT

Hydrothermal dolomite (HTD) bodies are important petroleum reservoirs in Northern America and are also well known for hosting Mississippi Valley Type (MVT) Pb-Zn ore bodies. This makes HTDs economically interesting for the oil, gas and mining industry. In several cases these carbonates contain insoluble residues such as clay minerals. The specific characteristics of clays such as their small size, variable texture and electrochemical properties complicate the reservoir behavior prediction. To evaluate fluid flow mechanism in these rocks, clay rich samples were investigated. Mineralogical, textural, geochemical, and petrophysical properties of these specimens were inspected by various analytical techniques such as X-ray diffraction (XRD), electron microscopy (FEG-EPMA, SEM), computed tomography (micro-CT) and mercury injection capillary pressure (MICP). The studied dolomites consist of <10% clay minerals in their intercrystalline space. Crystal supported sediments prevent clay minerals to be influenced by burial compaction. This phenomenon helps to study clays in different textures, with and without compaction effects. After identification of different clays and their spatial distribution within HTD, the geometry of pores was reconstructed based on electron microscopy images. Finite element simulations were then used to model one phase fluid flow in these clayey porous media. These simulations revealed that porosity, permeability and tortuosity which are the main parameters influencing fluid flow behaviors, are controlled by the type, arrangement and concentration of the clay. Furthermore, presence of different clay minerals together with some other minerals can help to preserve nano-porosities even in compacted states.