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APPLICATIONS OF THE FLUID INCLUSION TECHNIQUE TO PETROLEUM GEOLOGY AND ACID GAS STORAGE

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Fossil fluids from petroleum basins are present in diagenetic minerals as fluid inclusions. They are the witnesses of the original oil or gas composition and the memory of the pressure and temperature conditions at the time of fluid emplacement. Brines are always present as non-miscible phase at equilibrium with oils in reservoir in the form of free or irreducible water.

In order to reconstruct the conditions of fluid emplacement (pressure, temperature and composition) an analytical procedure of both aqueous and petroleum inclusions has been developed (PIRONON, 2004). It is based on PVT properties and gas composition estimates. Temperature of phase transitions is measured by microthermometry, dissolved methane content of aqueous inclusions is quantified by Raman spectrometry, CH_4 and CO_2 content of petroleum inclusions is approximated by Fourier transform infrared spectrometry and the volume of petroleum inclusions is reconstructed by confocal scanning laser microscopy. Thermodynamic models are based on Duan and Peng-Robinson equations of state and are applied to aqueous and petroleum inclusions, respectively. The intersection of the isochores of the two fluid systems gives the true pressure and temperature conditions of fluid trapping. The knowledge of the fluid pressure allows us to reconstruct the hydrodynamic evolution of reservoirs in various geodynamic regimes.

The fluid inclusion technique is not only applied to natural systems in order to reconstruct the geological history, but it has been recently applied to hydrothermal experiments in laboratory (JACQUEMET et al., 2004). It has been developed for experiments about aging of well and reservoir materials in the case of greenhouse and acid gases (CO_2+H_2S) sequestration. A natural quartz sample with decrepitated inclusions is put inside a reactor with reactants (acid gases, brines, minerals) at high temperature and pressure to mimic reservoir conditions. The inclusions trapp the fluid system at equilibrium with newly formed minerals and allow to determine the number and chemistry of the fluid phases generated by the injection of anthropogenic gases in geological formations.

References

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