Geophysical Research Abstracts
Vol. 20, EGU2018-16133, 2018
EGU General Assembly 2018

Do chemical properties of organic matter affect the porosity during confined pyrolysis of organic rich shales?

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In recent years, there is a growing recognition of thermal maturity involvement in the development of the organic matter (OM) linked porosity in gas shales systems. Nevertheless, these variations of porosity with thermal maturity are not systematically clearly observed in some formations and the controlling processes remain poorly understood and controversial. The OM pore network greatly contributes to the shale gas storage capacity. It's therefore necessary to understand the exact role of OM chemical transformations on the development of this porosity during maturation. For this purpose, a two-pronged strategy has been followed. First, the porosity of immature (Kimmeridge Clay, UK) and gas-mature organic rich shales (Vaca Muerta, Argentina) was characterized. Then, artificial thermal maturation of the immature shales using confined pyrolysis experiments was performed to follow the evolution of porosity from the early oil-window to the dry gas-window stages. Porosity before and after maturation was measured by low pressure nitrogen adsorption and evaluated as function of both thermal maturity and shale composition. The organic and inorganic rock components were characterized by XRD, Rock Eval analyses, Organic petrography and SEM observations. The OM chemical transformations were investigated by GC/MS analysis of oil and gas generated during pyrolysis experiments. Preliminary results revealed that shale porosity considerably varies with thermal maturity. Contrary to immature shale samples whose porosity depends essentially on mineral interparticle pores, porosity of mature rocks is mainly influenced by OM hosted pores. Non-existent in immature stage, the intrinsic OM-porosity seems to increase sharply during thermal diagenesis. According to the pyrolysis experiments, this OM pore genesis begin with the start of gas production. Is there a link between the OM hosted pore development and possible reorganizations of the kerogen and residual bitumen during the oil-window? Pore size variations versus total organic carbon content (TOC) and thus, OM composition in general were observed in natural gas-mature samples. In what extent these small variations in OM composition could influence OM pore genesis during maturation? The complementarity effect of OM composition and thermal maturity on porosity could be probably the key to explain the diversity of trends observed in natural shale gas systems.