The geochemical process of lower Paleozoic shale through artificial thermal evolution

XIAOWEI ZHENG[1] HAMED SANEI[2]

[1] Department of Geoscience, Aarhus University, Denmark
zhengxiaowei@geo.au.dk

[2] Department of Geoscience, Aarhus University, Denmark
sanei@geo.au.dk

With atypical hydrocarbon generation characteristics from the common marine kerogen type, the lower Paleozoic Alum shale has aroused great attention, especially the organic matter composition and the thermal maturity evolution. The rich faunal organic matter might be the reason. What's more, these faunal, especially the graptolite-derived organic matter, is the most abundant organic component in the Scandinavian Alum shale and contributes 20-93% of the dispersed organic matter in the Chinese lower Paleozoic shale, which revealed a widespread phenomenon of faunal organic matter enrichment in the lower Paleozoic shale. The Scandinavian Alum shale were characterized with a wide range of thermal maturity degree, while the immature samples were selected and applied in golden tube pyrolysis for artificial thermal evolution, representing the whole process of diagenesis, catagenesis, and metagenesis. The yield products and the remaining solid residue were used to analyze the organic matter composition and the thermal evolution pathway comprehensively from geochemical and organic petrological perspectives. With TOC all higher than 11wt%, samples representing type I and type II kerogen were selected for comparison analysis. The latter one showed higher graptolite fragments percentage, based on organic petrology statistics, while the former one was mostly composed by algea. These two samples all showed that the yield amount of CH_4 increase with raising temperature while the C2-C5 content reach the peak at 450℃, then decrease gradually. However, the yield gas volume of type I sample doubled in type II sample. Besides, the yield CO2 double the yield CH4 in type II sample, which showed the opposite ratio in type I sample. Although showing a general increasing trend, the stable carbon isotope of CH_4 show a drop from 375℃ to 415℃. The carbon isotope of C2-C5 all showed increasing trend, with slow rate below 400℃ while increase rapidly after that. The higher carbon number is, the more obvious rate increase it is. The yield bitumen also reached peak at around 400℃, and the geochemistry characteristics were more enrich with aromatic compounds, which might originate from the faunal organic matter.