Geophysical Research Abstracts
Vol. 19, EGU2017-11504, 2017
EGU General Assembly 2017

Importance of inorganic geochemical characteristics on assessment of shale gas potential in the Devonian Horn River Formation of western Canada

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The gas generation and storage potentials of shale has mostly been assessed by original TOC (TOCo) and original kerogen type. However, in the Horn River Formation, organic geochemical tools and analysis are barely sufficient for assessing the TOCo and original kerogen type because residual carbon contents represent up to 90% of TOC in shales. Major and trace elements are used as proxies for the bottom water oxygen level, for terrestrial sediment input and for productivity, which is related with variation of kerogen type. By using the inorganic geochemical proxies, we attempt to assess original kerogen type in shale gas formation and suggest its implication for HIo (original Hydrogen Index) estimation. The estimated HIo in this study allows us to calculate a reliable TOCo. These results provide new insights into the accurate estimation of the hydrocarbon potential of shale gas resources. The inorganic geochemical proxies indicate vertical variations of productivity (EX-SiO_2 and Baauth), terrestrial sediment input ($Al2O_3$, Zr, Hf, and Nb) and oxygen content in bottom water during deposition (Moauth, Uauth and Th/U), which represent the temporal changes in the mixing ratio between Type II and III kerogens. The Horn River Formation has different HIo values calculated from EX-SiO_2 (biogenic origin) and it is ranked by HIo value in descending order: Evie and Muskwa members (500-700 mgHC/gTOC) > middle Otterpark Member (400-500 mgHC/gTOC) > upper Otterpark Member (300-400 mgHC/gTOC) > lower Otterpark Member (200 mgHC/gTOC). Based on the original kerogen type and TOCo, the gas generation and storage potentials of the Evie, middle Otterpark and Muskwa members are higher than those of other members. The source rock potential is excellent for the Evie Member with a remarkable difference between TOCo and measured TOC.