

REE characteristics of the Utica Shale in southeastern Quebec, Canada

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This study presents the preliminary results of whole rock rare earth elements analysis of the Utica Shale in southeastern Quebec. Samples obtained from Talisman Saint-Edouard No1 (deep Utica; ~2000 m) and Junex Saint-Augustin No1 (shallow Utica; ~400 m) exploration wells. The sample lithology varies from shale to fine to medium grained calcareous siltstone (MINC up to 12%).

Samples have generally fair to good TOC content ranging from 0.08 to 2.25%, with average 1.31%. The major organic matter constituents of samples are migrated solid bitumen and chitinozoan skeleton. Saint-Edouard No1 samples are in dry gas window ($Ro_{equiv.} = 2.1\%$) while Saint-Augustin No. 1 samples are in oil generation window ($Ro_{equiv.} = 1.2\%$).

Average chondrite-normalized patterns of two samples are identical to the pattern of upper continental crust with minor depletion in the REE concentration relative to upper continental crust. The normalized LREE (La-Eu) content of two sets of samples are identical, however, there is a divergence in normalized HREE (Gd-Lu) contents with HREE enrichment in Saint-Edouard No. 1 samples. The lower maturity samples have a good and consistent correlation between REE elements and aluminosilicates, while in the higher maturity samples, the correlation between aluminosilicates and REE is more towards HREE.

Organic acids are by-products of organic matter thermal maturation, with their generation to increase with temperature and the level of maturity [1]. The higher concentrations of organic acids resulting from thermal cracking of kerogen may cause remobilization of HREE [2] for the higher maturity samples. The results of this study could have important implications for environmental studies regarding the late diagenetic processes and trace and rare elements remobilization in shale gas target units..

[1] Barth & Bjorlykke (1993) *Appl. Geochem.* **8**, 325-337. [2] Clauer *et al* (2006) *Chem. Geol.* **234**, 169-177.