

Application of Spectral Gamma Ray, TOC, and Lithofacies to the Recognition of T-R Stratigraphic Surfaces in the Horn River Shales

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ABSTRACT

Devonian shales of the Horn River Basin (HRB) in NE British Columbia, Canada, are one of the keen shale gas plays in North America. There have been some efforts to understand shale deposition in this basin in terms of depositional sequence stratigraphy. This study adopts the transgressive-regressive(T-R) sequence stratigraphic scheme with rationale that shale deposition could predominates during transgressions. We reveal repetition of 3rd order-scale deepening and shallowing trend in the Horn River shales, based on variations in the ratios of three elements (Th, U, K), total organic carbon(TOC) and lithofacies. Using spectral gamma ray logs, we analyzed vertical variations of Th/U and Th/K, which can direct a textural/mineralogic sorting during deposition in a sedimentary environment. Two different methods were applied to estimate TOC concentration within the Horn River shales: (1) geochemical measurement on rock samples from well cores, and (2) computation of TOC from wireline logs using the Schmoker method. Six lithofacies have been recognized based on texture, sedimentary structure with supplement of bedding and composition characteristics. T-R sequence stratigraphic surfaces can recognized from analyses of multiple vertical trends of properties such as spectral gamma-ray and TOC. Th contents are used as a major criterion for the detection of key stratigraphic surfaces, because shales in this study area generally have moderate amount of U. Lithofacies are used to confirm stratigraphic surfaces recognized by Th/U, U/Th, and Th/K. High Th/U ratios likely represent 3rd -order T-R sequence boundaries with subaerial exposure, and high U/Th ratio might be indicate to possible maximum flooding surface. Th/K ratios are likely associated with key stratigraphic surfaces of sequences cycle. Siliceous lithofacies sets with high TOC values indicate a low energy environment, interpreted here as transgressions. Calcareous and argillaceous lithofacies sets with lower TOC values indicate regressions. Based on integration of trends of spectral gamma ray and TOC as well as lithofacies occurrence along the well, the Horn River shales represent ten T-R sequence cycles, which can be grouped into three cycles of 3rd order.