An approach to a practical petroleum charge and reservoir fluid residence time dating method

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One of the key tools that have been widely used in geological investigation is dating of geological events. However, dating petroleum charge and residence time from analysis of crude-oil alone, is currently not feasible due to the lack of a practical method. Oil charge times and rates are two main parameters in controlling petroleum occurrence by defining volumes of trapped petroleum and the dynamics of trap reliability, as well as leakage phenomena [1]. This research aims to assess the feasibility of age dating methodologies using chemical proxies based on irradiation products of crude oils, caused by the natural gamma radiation dosage associated with reservoir rocks. As a case history, 120 reservoir core samples from 4 wells in the Athabasca oil sands, were selected. Location of the samples was determined by considering a horizon with a high intensity spike in the gamma ray log that extends laterally across the area. The horizon will characterize sweet spots with high concentrations of major radioactive elements (U, Th, K) associated with reservoir features, such as shale intervals. Therefore, samples were collected above and below this zone at high resolution for further analysis. Basic geochemical analyses were conducted on the samples. We used extraction and a suite of quantitative liquid chromatography, gas chromatography-mass spectrometry methods to characterize the in situ oils. This will allow us to look into detailed compositional profiles of different compound classes and detect any general and local compositional variations within the reservoir relating to oil charge and large scale biodegradation impacts with depth and more locally, adjacent to the shale intervals. In order to assess the profiles of stable radiolysis proxies in the reservoir, the next step is to investigate possible variations in the oil chemistry associated with the variations in the concentrations of major radioactive isotopes of U, Th, K, and the decay systematics of these elements.

We discuss the compositional variations seen in the reservoir petroleum column and summarise some of the challenges in carrying out such developmental studies.

[1] Larter et al., (2012). *Geo Convention, cseg.ca*, 1-6.