**Biodegradation of oil: An overview**

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This presentation is a review of some important aspects of the biodegradation of liquid hydrocarbons, intended to provide greater awareness of the many factors influencing biodegradation risk – not simply present-day depth (temperature).

Biodegradation has major detrimental effects on the composition and physical properties of oils, increasing with the severity of the degradation. The most notable of these are reduced gravity and increased viscosity caused by the preferential removal of lighter hydrocarbons. However, it is important to note that the process also results in significant loss of oil from the accumulation.

Biodegradation occurs around the oil-water transition zone (OWTZ) where microbes use oxidants and nutrients in the water leg to degrade hydrocarbons in the oil leg. Hydrocarbon-degrading microbes belong to a very wide range of phyla of both bacteria and archaea. In the subsurface the process is probably almost always anaerobic (not requiring molecular oxygen in groundwater) and limited to temperatures of less than around 80°C. There are numerous additional factors influencing the rate of biodegradation including: water salinity & flow, the geometry of the accumulation, and the rates of oil charging and mixing within the oil leg.

Rates of biodegradation in the subsurface are difficult to measure, and are probably highly variable, yet they can be critical in the prediction of oil quality before drilling. Estimates suggest that rates of biodegradation are broadly similar to rates of hydrocarbon charging and that significant biodegradation of an accumulation is likely to take several million years.

Different compounds present in oils are more or less susceptible to biodegradation, resulting in the preferential loss of some compounds and greater resistance of others. The resulting changes in detailed molecular composition are used to define the severity of the biodegradation and to recognize early stages of degradation; but they also lead to difficulties in providing the normal interpretations of source maturity, correlations, etc. Although not used routinely, pyrolysis methods can liberate bound biomarkers from asphaltenes where they are protected from the effects of biodegradation, thus providing valuable molecular data for comparison with other non-degraded samples (which should be analysed by the same methods for consistency).

Biodegradation risk often simply considers the present day temperature of the prospect, but in fact the complete temperature history is more significant, particularly in areas that have experienced uplift. This is because palaeopasteurization may have destroyed hydrocarbon-degrading bacteria in a previously deeply-buried prospect, allowing oil to be undegraded despite present-day temperatures of less than 80°C. Cool, shallow accumulations of undegraded (or very lightly degraded) oil are found in many areas of the world with uplifted basins, including the Wessex Basin (UK) and areas of the Barents Sea. These shallow undegraded accumulations suggest that microbes don’t easily recolonize reservoirs, raising questions of how easily microbes can access fractured Basement reservoirs, and whether oil in such reservoirs might be less likely to be significantly biodegraded irrespective of their temperature history.