

Geological and Geochemical Controls on Crude Oil Acidity

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Analyses of various fractions isolated from 82 crude oils from Africa, Asia and North America demonstrate that the carboxylic acid fraction is responsible for the acidity in these oils. Fatty acids are important components in oils with relatively low thermal maturity, but naphthenic acids account for most of the carboxylic acid fractions in all oils. While crude oils with high total acid numbers (TAN = 0.5-5 mgKOH/g) are not limited to heavy oils (<20oAPI), crude oils with extremely high TAN values (>5 mgKOH/g) are often heavily biodegraded. Although biodegradation appears to be the main geochemical process that produces high concentrations of carboxylic acids in crude oils, the increase in the TAN values with increasing biodegradation, as measured from their hydrocarbon compositions, is clearly influenced by the depositional environment of the concerned petroleum systems. Thus, for crude oils at any given biodegradation ranking, their TAN values tend to increase from marine to inland lacustrine oils. Both the sulfur contents and TAN values of the oils increase in the initial stages of oil biodegradation. However, the fact that oils with the highest TAN values are those with the lowest sulfur contents in our sample set suggests that sulfur-containing compounds contribute little to the crude oil acidity. A number of non-biodegraded oils also show relatively high acidities, indicating that factors other than biodegradation, possibly related to the later addition of fresh oils to earlier biodegraded oil reservoirs can control oil acidity in vertically stacked oil reservoirs.