Determination and Quantification of Petroleum Mixtures

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Petroleum accumulations are often derived from multiple source rocks. Basin analyses and petroleum system models that fail to include all the active sources indicated by such mixtures miss potential exploration targets, while models that assume unrealized sources may lead to dry holes. Yet such crude oil mixtures often escape recognition and quantification of the source components is elusive.

Crude oil mixtures can be unraveled by using new geochemical technologies with high source and maturation specificity. The following analyses can reveal most mixtures: 1. Quantitative diamondoid analysis reveals deep gas and light oil sources that can be masked in mixtures with black oil. 2. Diamondoids of the deep source predominate in such mixtures and compound specific isotope analysis of the diamondoids (CSIA-D) can be used to identify the deep source. 3. A plethora of age-related biomarker parameters can be used to constrain the shallow source. 4. Biomarkers can differ enormously in their isotope ratios. For example C29 hopanes in marine and lacustrine oil sources of the South Atlantic margins typically differ by > 14 ‰! Oil mixed from pre-salt and post-salt sources can thus be unraveled. 5. Marine-derived C30 steranes can now be analyzed with two to three orders of magnitude better sensitivity. This analysis detects marine oil contribution to lacustrine oil accumulations down to levels < 1 %!

Once oil mixtures are determined, quantification of the contributors can be made. The better the data bases of the key parameters analyzed in unmixed end-member oil samples the more precise such quantitative determinations can be achieved. Protocols to tighten up quantitative determinations will be discussed.

In the South Atlantic margin of Brazil the presence or absence of contribution from either the lacustrine or marine source in a given area has important consequences for exploration. Basin models derived from various co-sourcing scenarios will be discussed.