The Integration of Geochemical, Geological and Engineering Data to Determine Reservoir Continuity in the Iagifu-Hedinia Field, Papua New Guinea.

by Russell Kaufman,
Chevron Overseas Petroleum,
San Ramon, CA, and
L. I. Eisenberg, and R. E. Fitzmorris,
South Pacific Chevron,
Brisbane, Australia

Recent reservoir studies of the Iagifu-Hedinia field in Papua New Guinea have shown the benefit of using a combination of geochemical, geological and engineering data. Each type of data reflects a different characteristic of the reservoir compartments. The combination of oil fingerprint and RFT pressure data demonstrates that some seals have been effective over geologic time, while others are effective only during production. The challenge to the evaluation of the Iagifu-Hedinia field is the result of the structural complexity of the region and the lack of useful seismic data.

In Papua New Guinea, a series of oil and gas fields, including Iagifu-Hedinia, occur along the leading edge of the Papuan fold and thrust belt. Formed during Pliocene to Recent compression, they are structurally complex, and typically broken into multiple reservoir compartments. The presence of the karsted Darai limestone at the surface over most of the fold belt prevents acquisition of useful seismic data. Reservoir mapping, and establishment of reservoir continuity, is therefore based solely on surface geologic data, drilling data, dipmeter and RFT pressure data, well production histories, and geochemical correlation of reservoir fluids. During appraisal of the Iagifu-Hedinia discovery, these complimentary data sets demonstrated that a single hydrocarbon column existed above a flowing aquifer in the main block of Iagifu-Hedinia field, a separate accumulation existed in the Iagifu 2X/8X block, and that two or more separate reservoir compartments existed in the Usano area.

Geochemical data have suggested the presence of reservoir compartments where other data were missing or inconclusive. Production history data has confirmed the geochemically based interpretations. Geochemical data suggest that oils at Iagifu-Hedinia have a common source. Slight differences in oil composition between reservoirs are likely due to variations in the reservoir filling history and multiple phases of oil expulsion from the same source rock.

Russell Kaufman

Technology to Identify Reservoir Compartments

In oilfield appraisal and development, a variety of tools are used to help understand future reservoir performance. Identification of reservoir compartments, whether vertical or lateral, is a critical part of this evaluation. Compartmentalization may develop over geologic time or during production depending on the characteristics of the seals which isolate the compartments. Frequently, the identification of many reservoir compartments are found only after the field is put on production.

One very common measurement for detection of reservoir compartments is formation pressure. In the early stages of field development these pressures come from well tests (DST or RFT). Different pressure regimes is usually a good indication of reservoir compartments. In some instances though, small pressure differences may be difficult to detect or pressure data may be missing.

A particularly powerful tool complimentary to pressure data is comparison of the reservoir fluids themselves. This represents a direct measure of hydrocarbon continuity. The use of compositional data from PVT measurements as well as physical property data (gravity, bubble point and gor) are common. While the compositional data from PVT measurements are typically in the C_1-C_6 region, other methods can extend to considerably higher carbon numbers.

Geochemical methods are also well suited for reservoir compartmentalization studies. These methods utilize all the formation fluids, gas, oil and water. For oil analyses, gas chromatography can rapidly give a detailed analysis of the oil composition from C_1 to about C_{16}. Oil composition determined in this way is often referred to as a fingerprint of the oil. Comparison of these oil fingerprints is a direct way to evaluate the presence of reservoir compartments.

Biographical Sketch

Russell Kaufman received his B.S in chemistry from the University of California at Davis in 1972 and his Ph.D. in chemistry from the University of Colorado in 1977. He joined Chevron Oil Field Research Company in 1978 and developed new tools for reservoir geochemistry studies. After an assignment at Chevron Canada Resources in Calgary, he joined Chevron Overseas Petroleum where he is currently a senior staff geochemist.