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Hibernia Field Delineation Using Three-Dimensional Seismic Techniques

Following Chevron's discovery of the Hibernia oil field in 1979, it was realized that 3-dimensional seismic methods would be required to resolve and understand the complex pattern of listric and normal faulting which makes up the structure. A total of 5,800 line-km (3,600 line-mi) of 60-fold seismic data were collected and processed through to 3-D migration by GSI. The resulting grid of depth points are orderly spaced at 25 m (82 ft) on lines 19 km (12 mi) long and 75 m (246 ft) apart over an area of 435 km^2 (168 mi^2).

Although data quality is variable, the 3-D program shows much better fault delineation and structural resolution than existing 2-D coverage. Data display techniques were extremely important when interpreting this large volume of 3-D seismic data. Examples of interactive computer displays and their contributions to our understanding and mapping of the structure are shown. Results of the survey enhanced our knowledge of the structure and will continue to assist us in all stages of the development of this giant oil field.

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Generic Comparison of Oil Shale and Tar Sand

Deposits of both oil shale and tar sand are classified as unconventional sources of petroleum. A number of dissimilarities exist in these two potential synfuel resources. From a geologic standpoint, major differences are found in depositional environments including both lacustrine and marine; in physical characteristics such as grain size, cementation, and fracture trends; and in chemical characteristics, mineralogy, and methods of migration. Other comparisons are made in kinds of organic matter, derived oils, and methods of extraction. Oil shale and tar sand deposits are found in both the western and eastern parts of the country, but usually not in the same localities. One exception is in the Uinta basin of Utah where tar sand beds are stratigraphically adjacent to and sometimes interbedded with oil shale. In Utah, Wyoming, and Colorado, oil shale is found in thicker and richer concentrations of smaller area extent compared to eastern oil shale deposits of Devonian age, which are thinner and less rich but which exist over a much larger area. Ninety-three percent of the known U.S. tar sand resources are found in Utah.

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Geology and Petroleum Habitat for Brazilian East Atlantic Margin Basins

Part I—Sergipe-Alagoas, Jequitinhonha, Espírito Santo, and Campos Basin Data.

Part II—General Model for Petroleum Habitat along the Brazilian East Margin.

Sergipe-Alagoas, Jequitinhonha, Espírito Santo, and Campos basins are located along the east Brazilian continental margin in South America.

These basins present 3 major Mesozoic and Cenozoic sedimentary sequences ranging from continental to open-marine environments. Two structural styles produced 3 major exploratory plays, both structural and stratigraphic. Structures are related, first, to an early tectonic framework of the basins caused by extensional forces, when an irregular hinge line was developed, and later, to gravity sliding and sedimentary loading when an entire set of structures was developed. Structures include listric faults, folds, and collapse structures that depict complex structural and sedimentary patterns from the border of the basins toward the hinge line, and from the hinge line down to the basins. The tectonic-structural model defines trends for hydrocarbon exploration.

More than 80 oil and gas fields have been discovered in both onshore and offshore portions of the east Brazilian margin basins. Oil-field data plus a large amount of subsurface and seismic reflection data support the proposed model used to establish the global exploratory strategy for the east Brazilian margin basins. Such a model can also be useful for homotaxial analogy in areas where similar geologic conditions occurred; however, it is necessary to keep in mind that each basin has unique features.

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Seismic Stratigraphic Modeling with Western Canadian Examples

The seismic response to four stratigraphic hydrocarbon traps has been analyzed using a microcomputer-based modeling system. This technique generates a suite of logs representing a gradual stratigraphic variation. Synthetic seismic traces are computed for each log and displayed as a model seismic section. The capabilities and limitations of the technique are illustrated by the following case histories: (1) Middle Devonian reefs in central Alberta, (2) Middle Devonian reefs in northwest Alberta, (3) Lower Cretaceous channel sands in eastern Alberta, and (4) Lower Cretaceous channel sands in southern Alberta.

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Determination of Productivity, Wilcox-Frio Sands, South Texas

The sharp lithological contrasts between and within the Wilcox and Frio Formations in south Texas frequently necessitate that different basic assumptions be used in interpreting logs of the formations. Accurate determination of the type, quantity, and rate of production of the interstitial fluids depends upon accurate interpretation of the well logs and the lithology of the rock. Ideally, geologic data should be quantified, digitized, and then integrated with digital well-log data. This allows log interpretation to be based on a detailed knowledge of the rocks. Use of logs allows this detailed knowledge of rocks to be extrapolated vertically for the well or used for older nearby wells where sample data may be unavailable. Detailed geologic data may be derived from small samples (cuttings, sidewall cores, or pieces of conventional core).

Lithological differences, such as those existing between the Wilcox and Frio, can significantly affect the radioactivity and density of the rocks. This, in turn, will influence calculations of shale volume and porosity. Differences in the composition of dispersed clays will affect S_w calculations. The calculation of porosity and water saturation does not identify either the amount or type of fluid production. Special log interpretation techniques, along with the detailed knowledge of the different clay varieties, allow an accurate prediction of the type of expected production.

Examples will be presented from the Wilcox and Frio of south Texas. These will include wells in which over-optimistic log interpretation resulted in repeated unsuccessful stimulation attempts, and examples of bypassed production.

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Rapid Sedimentation in Low-Energy, Microtidal Estuary

The St. Lucie River is an elongate, forked estuary formed during the Holocene rise in sea level and located on the southeast coast of Florida. It is 15 km (9 mi) long from its mouth to the end of each fork, and is a maximum of 3 km (2 mi) wide. Mean depth is about 3 m (10 ft). Although seasonal variation does exist, the combination of freshwater runoff and microtidal conditions produces a well-mixed, nearby freshwater estuarine system.

Extensive subbottom profiling and vibracoring have provided data for interpretation of the Holocene history of sediment accumulation in the estuary. Well-developed paleochannels and thickness of the surficial mud layer can be delineated by seismic profiling and confirmed by cores. Analysis of the distribution of ^{137}Cs shows that the rate of sediment accumulation in the estuary over the past 3 decades has approached 1 cm/year. Comparison of bathymetry between the late 19th century and the present shows a similar rate of accumulation.

Agriculture and residential development has been pronounced in the drainage basin, beginning in the 1920s. It is likely that this activity has produced a great increase in the rate of sediment influx to the estuary. The configuration of the estuary in combination with inefficient tidal flushing has permitted much of this sediment to accumulate.