fine-grained sediments infilling the channels may have acted as a seal, entrapping the oil or gas in the reservoir rocks through which the canyons cut.

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Namorado Field, Major Oil Discovery in Campos Basin, Brazil

The Campos basin is located offshore the State of Rio de Janeiro, between parallels 21 and 23°S. In 1974, while drilling the ninth wildcat in the basin, Petrobras discovered the Garoupa oil field. This field was the first in a new and important oil province in one of the little explored Atlantic-type basins. Between 1974 and 1978, 10 other significant oil discoveries have been made, but most of these new fields are still in the process of either delimitation or early development. At present only the 20-sq km Namorado oil field has proved reserves (recoverable oil volume) of 250 million bbl.

The Namorado oil field was discovered in 1975 by the 1-RJS-19 wildcat (22°27'S, 40°25'W) in 166 m of water. The prospect was located on a seismic structural high associated with an amplitude anomaly at the level of the Macae Formation (Albian carbonate rocks). In the interval between 2,980 and 3,080 m, the wildcat penetrated thick, oil-bearing sandstones interbedded with calcilutites in the upper part of the Macae Formation. In this well, an oil flow of about 6,000 bbl/day from the high-porosity (30%) and high-permeability (1 darcy) sandstone was estimated.

From sedimentologic analysis, the reservoirs were classified as deep-water marine deposits (turbidites) associated with the first major transgression over the Albian carbonate shelf. From this model, the first assumption was of variable sand distribution and strong stratigraphic control of the oil accumulation, which is now confirmed.

Today, six wells have been drilled in the field, some of them located by detailed interpretation of specially processed seismic data, such as synthetic acoustic impedance sections. This method proved to be very useful and accurate in mapping reservoir extension.

The reservoir rock, the Namorado Sandstone, was the result of coalescent deep-water channels and fans over a rough depositional surface when the area was a relative low containing several turbidite layers. In some places, there are continuous clean sandstone bodies 100 m thick. As a result of active faulting during the Late Cretaceous and because of different compaction over the reservoir, the relative low became an elongate dome-shaped high, partly limited by faults.

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Oil Exploration in Campos Basin, Brazil; Model for Exploration in Atlantic-Type Basins

Petrobrás drilling activities for oil exploration in Campos Basin, offshore Rio de Janeiro state, were initiated in 1971. Up to October 1978, 70 exploratory wells have been drilled and an estimated recoverable petroleum volume of 1 billion bbl has been discovered.

The structural style and lithologic characteristics of the stratigraphic column disclosed by seismic and drilling investigations reflect several stages of tectonic basinal evolution, as follows. (1) An Early Cretaceous intracratonic rift-valley stage is recorded by syntectonic terrigenous sediments, commonly underlain by or interbedded with basaltic lava flows; this section contains good oil-source beds but, up to now, only fair reservoirs have been found. (2) A transitional phase, still of Early Cretaceous age, characterized by evaporites, dolomites, and carbonate rocks, marks the transition from continental to marine conditions. (3) An Albian shallow-water marine phase is represented by thick carbonate deposition where oil entrapment is related to porosity variations. (4) A deep-water phase characterizes the younger part of the section; the sedimentation of this phase, begun in the Late Cretaceous with the deposition of a transgressive shale section with good source potential, was interrupted during the Paleocene and early Eocene with deposition of a thick turbidite section, which provided excellent reservoirs.

The Lower Cretaceous section exhibits rifting and fault blocks bounded by normal faults. Important halokinesis occurred in the Late Cretaceous and affected the sediments that underlie the depositional hiatus at the base of the Tertiary. As a result of salt extrusion and dissolution, salt scars, collapsed structures, sliding faults, and other types of holakinetic structures are common, and are of paramount importance in reservoir distribution and oil entrapment in the Albian-Eocene section.

The main oil fields in the basin have been found in combination traps, provided by turbidite sandstone lenses or porosity variations in carbonate rocks, mostly associated with collapse faulting. Minor oil fields, structurally controlled by block faulting, have also been found. These modes of oil occurrence seem to be good exploration models for oil prospecting in analogous Atlantic-type basins.

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Computer-Compatible Handling of Geologic Data

Results in hydrocarbon exploration will be improved if all available information is readily accessible to the explorationist. The great amount of data on geology, geochemistry, seismic, etc, now available to the interpreter, can no longer be handled efficiently by conventional methods alone. Bottlenecks owing to nonstandard data capture, time-consuming preparation of graphic displays, and integration of old and new data can be solved by the computer.

However, other constraints will be encountered unless standardized and disciplined data handling is ensured. (1) Data from different disciplines may be stored separately, but mechanical integration within a three-dimensional grid (x, y, z) must be ascertained. (2) Factual data (observation) and interpretation (subject to change) should be clearly distinguished. (3) Interpreta-