marine or glacial environments, but must be evaluated in terms of interactions between the two.

ARMENTROUT, JOHN M., Mobil Oil Corp., Denver, Colo., FRED ROSENMEIER, Shell Oil Co., Houston, Tex., and JOHN ROGERS, Atlantic Richfield Co., Anchorage, Alaska

Glacial Origin of Megachannels of Upper Yakataga Formation (Pliocene-Pleistocene), Robinson Mountains, Gulf of Alaska

A tidewater glaciomarine depositional model is proposed for the upper Yakataga Formation in the Robinson Mountains, eastern Gulf of Alaska. The upper 2,000 to 3,000 m of the Yakataga Formation is characterized by major channels (depth >90 m) cut into and filled with both fluvial and/or marine rocks. The channels are elongate and steep walled, and appear to be confined within or parallel with paleotopographically low areas. Detailed studies of five channels show maximum dimensions of 430 m in depth and about 3 km in width. Channel length was not determinable.

Channel margins are in places grooved and striated. Channel-base conglomerates exhibit foreset bedding inclining down the channel axis, and are interpreted to be subglacial melt-water deposits. The channel fill is dominated by interbedded siltstones and pebbly siltstones (diamictites). The siltstones contain abundant in-situ marine fossils, commonly encrusting the tops of dropstones. These deposits are interpreted to be proglacial marine sediments and ice-rafted glacial erratics. Thin sandstones interbedded within the siltstones are graded and exhibit traction features. These are believed to originate as gravity-flow units from oversteepened clastic wedges deposited by subglacial melt-water discharge at the grounded terminus of a glacier. Diamictites are of two major types: (1) poorly sorted sandy siltstone units with patchy distribution of angular clasts (nonmarine tillite); and (2) moderately sorted, muddy siltstone units with in-situ fossils and evenly dispersed, slightly rounded clasts (marine tillite). Some of the diamictites are highly contorted, particularly those underlying younger channel bases. The contorted character is probably the result of loading sediments by an advancing ice lobe.

Nonmarine sandstones and conglomerates are present as interbedded lenticular packages, and are interpreted as fluvial units deposited within a braided glacial-stream complex. These units occur both within channels and as clastic wedges within marine-shelf sequences. The channels are interpreted as fiords, and the modern fiords of the Yakataga area (Icy and Yakutat Bays) serve as modern depositional analogs.

ARMENTROUT, JOHN M., Mobil Oil Corp., Denver, Colo.

Glacial-Marine Trace- and Body-Fossil Associations, Upper Yakataga Formation (Pliocene-Pleistocene), Gulf of Alaska

Glacial-marine deposits of the Yakataga Formation are characterized by six associations of trace and body fossils. These associations can be directly compared to modern associations within the tidewater-fiord and marine-shelf environments in the Gulf of Alaska, and allow definition of specific paleoecologic conditions.

Inner-shelf sandstones are extensively bioturbated by a community characterized by the infaunal pelecypods *Siliqua* and *Spisula* and the epifaunal gastropod *Neptunea*. Distinct trace fossils are absent.

Open-shelf siltstones are also extensively bioturbated. Epifaunal body fossils of the gastropod *Colus* and small ophiuroids are abundant. The infaunal pelecypods *Mya* and *Panomya* are locally common. Trace fossils include rare small vertical burrows and large pelecypod burrows parallel with and oblique to bedding planes.

Major channel systems within the upper Yakataga Formation are interpreted as fiord deposits. The fiord deposits have three rock-fossil associations. Rhythmically bedded siltstones and sandy siltstones have an infaunal community of the pelecypods *Acila* and *Macoma*. Distinct trace fossils are absent. "Massive" siltstones are extensively bioturbated, have locally abundant large burrow networks, and typically have locally abundant body fossils of the epifaunal gastropods *Beringius*, *Colus*, and *Musashia*, as well as small ophiuroids. Within the siltstone sequences of fiord deposits are thin, graded sandstones. These thin sandstones have an associated body-fossil community of shallow-burrowing *Nuculana* and *Clinocardium* and trace fossils of small vertical escape burrows, bed-top pelecypod resting impressions, and pelecypod foot-push trails.

A sixth faunal association consists of epifaunal organisms such as serpulid worms and barnacles that are attached to the upper surface of glacially derived dropstones.

BACLAWSKI, A. PAUL, Champlin Petroleum Co., Englewood, Colo.

Pleistocene Submarine Canyons of Northwest Gulf of Mexico—Study in Seismic Stratigraphy

Parts of six submarine canyons and canyon complexes on the shelf of the northwest Gulf of Mexico were studied using seismic stratigraphic techniques. These canyons were eroded during the late Pleistocene, probably by subaqueous processes acting on channels formed subaerially during a low stand of sea level. They have since been infilled and are now buried beneath as much as 6,000 ft (1,830 m) of sediment. The reflection patterns produced by the sediments infilling the channels range from parallel to mildly chaotic, and the reflections are variable in intensity. The sediments appear to have undergone considerable modification by slumping or flowage. They are mostly shale with some silt and lesser amounts of sand nearshore. The sediments that were deposited at the mouths of the canyons are mostly shale and, where undisturbed, display subparallel reflections. Individual canyons ranged in size from 2 to 20 mi (3.2 to 32 km) wide and were as much as 3,500 ft (1,068 m) deep before being infilled.

Oil or gas accumulations may be associated with these canyons in two ways. First, there may be hydrocarbon accumulations within the sediments deposited in deeper water at the mouths of the canyons. Second, the

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.

BACOCCOLI, G., ODIMAR A. J. CAMPOS, and R. G. MORALES, Petrobras, Rio de Janeiro, Brazil

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.

BACOCCOLI, GIUSEPPE, ROBERTO GAMARRA MORALES, and PAULO JACKSON MORGADO DE CASTRO, Petrobrás, Rio de Janeiro, Brazil

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.

BAER, CHRIS B., Shell Internationale Petroleum Maatschappij B.V., The Hague, Netherlands

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-