placed (usually laminae within pisolites). Replacement crystals range in diameter from 0.1 to 10 mm. Inclusions which reproduce primary fabrics are most commonly small (to 50 μm), irregular rounded blebs of unknown composition, but are rarely dolomite rhombs.

Generally associated with sulfate replacement zones are massive sucrosic dolomites displaying abrupt lateral transitions with unaltered limestones. These dolomites may form because of increased magnesium:calcium ratios in mixing-zone pore waters, because during replacement magnesium is not accommodated in the gypsum lattice.

Work is under way on the recognition of secondary carbonate fabrics related to these mixing-zone environments which would allow identification of gypsum replacement in rocks in which gypsum has totally dissolved or recrystallized.

RAINON, E., CGG, Massy, France

Reservoir Studies and Inversion of Seismic Traces

Inverting seismic traces is the means of finding a velocity or acoustic-impedance model from the recorded traces. Data are processed in preserved-amplitude mode. A wavelet inverse filtering results in a series of reflection coefficients. Reflection coefficients are simple functions of velocities and densities. A transformation of the series of reflection coefficients into relative velocities provides a display where the inverted seismic traces at a well location can be directly correlated to the sonic log.

Prediction of lateral changes affecting the formations intersected by the well is the most direct application. Provided the original surface seismic data have a sufficiently broad frequency spectrum, the inversion improves the detection of thin beds and lateral facies changes. Two examples of reservoir studies illustrate the application of the method: the first is in a deltaic sandstone and shale sequence; the second is a shelf-carbonate province.

RAO, C. PRASADA, Univ. Tasmania, Hobart, Tasmania, Australia

Glaciomarine Carbonate Sedimentation—Berriedale Limestone (Permian), Hobart, Tasmania, Australia

The Berriedale Limestone, an alternating sequence of impure limestone and calcareous shale with a few metabentonite layers, is associated with marine glacial sediments. There is less diversity of fauna (mostly bryozoans, brachiopods, and pelecypods) and allochems (only intraclasts) than in warm-water limestones. Lonestones (dropstones) commonly disrupt laminae. Quartz grains show glacial textures in SEM analysis.

Well-developed rhombs (up to 100μ), scalenohedra, elongated rhombic plates (length slow), and zoned and poikilotopic rhombic plates indicate low-magnesian calcite precipitated from normal seawater at a temperature of $<3°C$. The saturation of calcium carbonate fluctuated, ranging from undersaturated (pits, etchings, rhombic pores, and dissolution features) to saturated. The early diagenetic fabrics were extensively recrystallized.

The low-magnesium ($<0.3\%$) and high-manganese (201 to 912 ppm) concentrations confirm original calcite precipitation. The Ga, Rb, Ba, and total Fe concentrations reflect normal-marine conditions during deposition of the limestone units and brackish conditions (caused by melting of retreating, continental ice sheets) during deposition of the shale beds. The source of detrital material changed as a result of melting of icebergs during waning phases of carbonate deposition. The dropstones are clustered around limestone-shale contacts.

The vertical facies variation through shale-limestone-shale beds indicates that a gradual drop (~100 m) in sea level was followed by a rapid rise in sea level, corresponding to glacial and interglacial stages, respectively. The facies of shallowest water deposition occur slightly above the middle of most limestone beds. The limestone beds represent the coldest periods (glacial stages).

RAPOPORT, L. A., and GORDON C. GRENDER, Virginia Polytechnic Inst. and State Univ., Blacksburg, Va.

Application of Oil and Gas Discovery Functions to Resource Assessment

As part of the data development underlying the LORENDAS model (modeling of worldwide Long-Range Energy Development and Supplies), it was necessary to estimate the relations between exploratory drilling and expected oil and gas discoveries for appropriate groupings of the United States sedimentary basins. These discovery functions are essentially negative exponentials, asymptotic to the "ultimately discoverable resources." In our initial approach we combined our analyses of discovery histories with estimates of discoverable resources obtained independently by others. However, further investigations resulted in the development functions by individual basins and depth zones, and revealed that ultimately discoverable resources might be estimated by direct extrapolation of such detailed discovery functions.

REID, WILLIAM M., Earth Satellite Corp., Washington, D.C.

Rates of Creep of Active Faults in Northwestern Houston, Harris County, Texas

Tilt-beams and recording horizontal extensometers installed across the surface trace of three active faults in northwestern Houston, Harris County, Texas (the Long Point, the Piney Point, and the Eureka Heights faults), recorded 34 events during the 14 months from April 1971 through June 1972. The Long Point fault is an east-northeast-striking regional growth fault that is downthrown toward the coast. The Piney Point fault is antithetic to it. The Eureka Heights fault is associated with the long-abandoned Eureka Heights field.

The events recorded lasted from 1 to 96 hours and were separated by periods of apparent inactivity lasting from 4 to 60 days. The vertical separation recorded during an event ranged from 0.09 to 3.33 mm. The annual rate of vertical separation recorded during the period of observation ranged from 6.7 to 34 mm/year. Normal and reverse faulting resulted in 77 and 23% of the ob-

served events, respectively. The average vertical separation during episodes of normal and reverse faulting was 1.90 and 0.24 mm, respectively. The cumulative vertical separation recorded during episodes of reverse faulting was 20% of that recorded during episodes of normal faulting.

Events occurred at different times along the same fault. This suggests that faults that have not been demonstrated to be active still must be considered to be capable of moving at any time at possibly damaging rates.

The events appear to be caused primarily by differential compaction and expansion of the Chicot aquifer in response to changes of its piezometric surface. Lesser causes may be the release of tectonic extensional strain energy, the depressuring of hydrocarbon reservoirs, and the movement of salt domes.

REINSON, GERALD E., and PETER S. ROSEN, Geol. Survey Canada, Dartmouth, Nova Scotia

Depositional Sequence in Subarctic Sandy Beach Face, Central Labrador

Beach-face deposits on the strand-plain coast near Michael River, Labrador, contain four distinct units. The basal unit 1 (60 cm thick) is a graded sequence of well-mixed sand and gravel near the bottom and medium-grained laminated sand at the top. It is disconformably overlain by unit 2 (20 cm thick) which consists of fine to medium-grained sand with contorted and disrupted laminations and small pods of loosely packed sand. Unit 3 (25 cm thick) is a chaotic gravel and sand sequence devoid of sedimentary structures, whereas the uppermost unit 4 (20 cm thick) consists of well-laminated, fine to medium-grained sand.

The stratigraphic sequence is interpreted as follows. Unit 1 represents the normal berm accretionary phase of late summer 1977, and unit 2, the foreshore accretionary phase during early winter. In early winter, the wetted beach surface begins to freeze and a deposit of interlaminated sand and ice forms under the continuous action of swash-backwash. This deposit is later deformed, owing to volume reduction and loading, during thawing. Small sediment-laden ice blocks, which are washed up and incorporated into the accreting laminated sequence, are represented by porous sand pods when the ice medium melts. Unit 3 is the remnant of ice-rafting and ice-push deposits which accumulated during ice breakup in spring 1978, whereas unit 4 records the normal foreshore swash-backwash accretionary phase of early summer 1978. The fact that freeze and breakup events are recorded within a complete yearly cycle of beach-face accretion indicates that such events could be preserved in the rock record under rapidly aggrading summer-beach conditions similar to those at Michael River.

REYNAUD, R., P. R. LOUIS, and J. LACAZE, SNEA(P), Chambourcy, France

Deltaic Facies Recognition on Seismic Data

Seismic sections relating to shelf facies generally display parallel or slightly divergent reflections. An analysis of internal parameters (such as continuity amplitude, frequency, and phase), areal associations, and external geometry of each unit allows a direct prediction of the nature of the deposits.

In the Niger delta, diagnostic seismic facies relate to each environment (marine, littoral marine, littoral, sea marginal, and fluvial). These seismic facies are also closely related to the electrofacies. Seismic models have been computed for several types of environment and comparison to the real section supports the interpretation.

REYNOLDS, RICHARD A., and RICHARD E. CASEY, Rice University, Houston, Tex.

Neogene Radiolarian Biostratigraphy and Paleo-Oceanography of North Boundary Currents

Deep Sea Drilling Project (DSDP) cores from offshore Japan and California, land-based sections from California, and Holocene sediment samples from surrounding areas have been used to develop radiolarian biostratigraphies and to interpret paleo-oceanographic conditions for the Neogene of the Japan Current (a western boundary current) and the California Current (an eastern boundary current). Our studies suggest that (1) the present-day characteristics of boundary currents (western being deeper, narrower, swifter, and less productive than eastern boundary currents) have varied greatly throughout the Neogene, but are tied one to another; and (2) both mid-latitude regions can be correlated biostratigraphically to low latitudes. The Japan region is most correlative to low-latitude radiolarian biostratigraphic zones. The developed biostratigraphy of the region and inferred paleo-oceanographic trends aid in correlation of the California region to low-latitude radiolarian biostratigraphies. Comparison of material from boundary-current regions with equatorial and subpolar North Pacific DSDP material suggests that tectonic events such as the uplift of Panama may be tied to the observed Neogene changes in these boundary-current regions. These studies have also been instrumental in indicating radiolarian taxa that may be used to suggest relative paleodepth of deposition and eutrophic conditions in these boundary-current regions.

REYNOLDS, RICHARD L., and MARTIN B. GOLDHABER, Texaco Inc., Houston, Tex.

Marcasite in Roll-Type Uranium Deposits

Iron disulfide minerals occur in anomalously high concentrations in uranium-bearing zones of roll-type uranium deposits and are thus important components of the geochemical system that governs formation of these uranium orebodies. These high concentrations have been interpreted by previous workers as resulting from an ore-stage generation of sulfide superimposed upon a pre-ore generation. We have examined petrographically over 500 polished sections from five roll-type deposits, three from Texas and two in Wyoming, and have recognized both pre-ore and ore-stage generations of iron disulfides in each deposit. The two generations may be distinguished by textural relations. In each deposit, marcasite is present as an ore-stage sulfide; in