however, rocks of comparable age retain a paleomagnetic record of much lower paleolatitude. Geologic evidence bearing on the arrival time of the peninsular terrane are inconclusive and the implicated Tertiary tectonic boundary between indigenous and exotic components of Alaska is not known.

The paleomagnetism of a sequence of 30 Paleocene basalt flows just inboard of the peninsular terrane suggests a small amount of northward displacement and about 55° of counterclockwise rotation. Results from a nearby 44 Ma sequence suggest no displacement and no rotation. Collectively, our paleomagnetic data from seven volcanic sequences 30-40 Ma (about 70 flows), on the inboard part of the peninsular terrane, indicate that this region was in its present position with respect to North America when the lavas were extruded. The age of the unrotated localities indicates that the counterclockwise rotation of southern Alaska recorded by Late Cretaceous-early Tertiary rocks was completed about 44 Ma.

On the outboard side of the Alaska Peninsula, preliminary results from one sequence of Eocene or Oligocene volcanic rocks on the Kupreanof Peninsula also suggest no major latitudinal displacement or rotation. If this volcanic sequence adequately averages secular variation and if the Tertiary tectonic history of this region is representative of the rest of the outboard Alaska Peninsula, these paleomagnetic data preclude post-Eocene northward displacement of exotic southern Alaska along faults within the Alaska Peninsula. Additional data from other volcanic sequences in this region will test this hypothesis.

THURSTON, DENNIS K., Minerals Management Service, Anchorage, AK

Offshore Evidence of Glaciations in Lower Cook Inlet, Alaska

The Lower Cook Inlet is a northeast-trending tidal embayment of the North Pacific Ocean located in south-central Alaska between the Alaska-Aleutian Ranges on the west and the Chugach and Kenai Mountains on the east. Five major Pleistocene glaciations have been documented for the region. The first three glaciations completely filled the Cook Inlet trough, truncating Tertiary strata and creating an inlet-wide angular unconformity. In the last two glaciations, ice coalesced across the southern part of the inlet only, impounding fresh water from the north in a large proglacial lake.

High-resolution seismic-reflection records reveal many glacial and related features on the sea bottom and buried beneath Holocene marine sediments. Sea bottom features identified include sand waves, megaripples, sand ribbons, lag gravels, and ice-rafted boulders with associated comet marks. Subbottom features include terminal, lateral, and ground moraines; glacio-fluvial, glacio-marine, and lacustrine deposits; drainage channels and tunnel valleys; and eskers, outwash fans, and sand waves.

The sea floor may be divided into four morphological provinces separated by the 60-, 120-, and 190-m isobaths. The two deeper provinces are expressions of ice-erosional morphology, whereas the shallower provinces are dominantly expressions of ice-depositional morphology.

These buried features and the present sea-floor configuration reflect deposition and erosion during the last two glaciations and subsequent modification by tidal currents and marine deposition.

TROSPER, EDWARD, and ROBERT DOUGLAS, Univ. Southern California, Los Angeles, CA

Paleoenvironments of Forbes Formation

The Upper Cretaceous Forbes Formation of California's Great Valley is a sequence of mudstones, shales, and sandstones, interpreted as lower slope-fan fringe to midfan facies deposited in a forearc basin. It contains two different foraminiferal faunas: one is largely agglutinated; the other, restricted to the lowermost Dobbins Shale Member, is more diverse. These faunas are the result of turbiditic sedimentation and differential preservation.

The Dobbins—a limy, concretionary mudstone—represents low net accumulation rates above the carbonate compensation depth, but below the foraminiferal lysocline. Oxygen levels were low, but not continuously anaerobic. Sediment texture is nonlaminated, but the preservation of calcareous foraminifera suggests bioturbation was intermittent and not extensive.

An increase in sedimentation rates occurs in the middle Forbes, with an increase in the number and thickness of sand beds. The lack of calcareous species is largely the result of episodic sedimentation and increased bioturbation. In the upper member, the number of sand beds and the accumulation rate decrease. Paleobathymetric estimates, based on agglutinated foraminifera, suggest an upper abyssal-lower bathyal depth throughout the formation, with an indication of minor shallowing upsection.

The Santonian/Campanian boundary occurs at the top of the Dobbins shale, as marked by the first appearance of the calcareous nannofossil, *Broinsonia parca*. The Forbes Formation is included in the *Globotruncana arca* planktonic foraminifera zone.

TURNER, THOMAS R., Calista Corp., Anchorage, AK

Suspect Terrains of Alaska: Evolution Without Microplate Accretion

Present interactions (subduction, translation, rifting) between the Pacific oceanic plates (PP) and the North American craton (NAC) are similar to earlier events and represent a continuation of the tectonic evolution of the Cordilleran orogen. The formation and breakup of Pangea also influenced Cordilleran evolution. Based on these observations, it is possible to model the tectonic evolution of Alaska without accreting "exotic microplates."

In early Phanerozoic time, a passive marine shelf was present along the western margin of NAC, which was the depositional site of a miogeoclinal clastic-carbonate sequence. Subduction of PP beneath NAC, coincident with the formation of Pangea, began in early Paleozoic time and generated an island-arc/back-arc rift. Miogeoclinal fragments were incorporated in the back-arc rift. A middle Paleozoic orogeny collapsed the back-arc rift and obducted the arc onto NAC.

The Tethys Rift split Pangea into Laurasia and Gondwana in the Triassic. As Laurasia moved northward, a continental margin rift with 1,000-km left-lateral offset developed along the NAC's western margin. In the Late Jurassic, Laurasia rifted apart, and NAC moved westward relative to PP. Subduction collapsed the lower Mesozoic continental margin rift, generated a continental arc, and culminated as a major orogeny in the Late Cretaceous.

Cenozoic subduction of ocean-spreading ridges shifted the relative movement between PP and NAC. Northwest subduction of PP generated the Aleutian arc, and a translational boundary was established in southeastern Alaska. NAC's obducted outboard terrains were offset northwestward by the Tintina and related faults.

WALKER, GERALD G., K. KAWASAKI, and T. E. OSTERKAMP, Univ. Alaska, Fairbanks, AK

Transient Electromagnetic Detection of Subsea Permafrost near Prudhoe Bay, Alaska

Transient electromagnetic soundings were taken at several sites along a line from the North Prudhoe Bay State (NPBS) 1 well to Reindeer Island in the Beaufort Sea during the spring of 1984. The purpose of these soundings was to delineate the depth to, and the thickness of, the ice-bonded permafrost layer known to exist below the seabed.

Offshore, about 1.5-2 m of sea ice covers shallow (< 7-m or 22-ft) sea water underlain by saline, saturated sediments. Data reductions, appropriate for such high electrical conductivity, and subsequent interpretations suggest an unfrozen (or partially unfrozen) layer overlying a more resistive ice-bonded permafrost layer. Beneath the ice-bonded layer, the sediments are unfrozen and more conductive.

A permafrost profile along the line, showing the depths and thicknesses of ice-bonded permafrost, was inferred from the interpretations. The unfrozen sediments appear to increase in depth from zero onshore to a maximum of about 175 m at 6 km from shore. The thickness of ice-bonded permafrost steadily decreases with increasing distance offshore, from about 560 m onshore to 300 m at 6 km from shore; it displays an increasing complexity from 9 to 14 km.

WARNER, J. D., and D. D. SOUTHWORTH, U.S. Bureau of Mines, Fairbanks, AK

Placer and Lode Sources of Niobium: Tofty, Alaska

The Bureau of Mines, as part of a program to assess Alaskan reserves of certain critical and strategic minerals, has intermittently investigated niobium (Nb) associated with placer gold-tin deposits near Tofty, Hot Springs district, Alaska. These investigations have identified placer and