to the upper limit of *Prunopyle titan*, a cosmopolitan radiolarian that is an index to the later Miocene of California. It is further proposed that in the Antarctic the Pliocene-Pleistocene boundary is located approximately at the upper boundary of *Saturnulus planetes*, a level which is just below the extinction level of discoasters. Marked telescoping of faunal zones indicates significant gaps in the depositional record of some Antarctic deep-sea cores, probably caused by slumping or non-deposition of sediments at different times. A transition from red clay to diatomaceous sediments occurrred within the Pliocene Epoch.

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TIME-TRANSGRESSIVE PROBLEMS OF CALIFORNIA CENOZOIC

A significant change from dextral to sinistral populations of *Globigerina pachyderma* occurred at the Pliocene-Pleistocene boundary in southern California, as recorded in deep-water deposits. By using modern populations as a basis for comparison, it can be shown that this represents a major shift from dextral warm temperate to sinistral subarctic populations, and it defines a point in time which should coincide more dependably with the Pliocene-Pleistocene boundary than a boundary based upon benthic species. Use of this method shows that the upper limit of the Wheelerian Stage, which is based on the upper limits of the *Epistominella pacifica-Uvigerina peregrina* faunas, ranges from more than 200 meters below to more than 300 meters above the Pliocene-Pleistocene boundary.

A second problem is recorded in the Eocene of the Santa Barbara embayment. Planktonic Foraminifera suggest that the Eocene Narizian Stage, based primarily on benthic species, is as young as late Eocene in the Santa Rosa Hills and as old as middle Eocene elsewhere. Similarly, planktonic Foraminifera indicate that the Ulatisian Stage, also based upon benthic species, is early to middle Eocene in some places and is entirely middle Eocene in others.

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RECONNAISSANCE GRAVITY AND OTHER GEOPHYSICAL DATA FROM CONTINENTAL END OF ALEUTIAN ARC

On the Alaskan continental shelf between the Shumagin Islands and Prince William Sound, ships of the U. S. Coast and Geodetic Survey have made about 12 traverses while recording gravity, sparker, magnetic, and bathymetry data, and about 12 other traverses while recording magnetic and bathymetry data alone. These marine measurements have been combined with gravity and geologic data obtained by the U. S. Geological Survey on adjacent shorelines to make a reconnaissance gravity map which provides new information on the structure of the continental end of the Aleutian arc.

The gravity anomalies associated with the oceanic part of the arc do not extend very far onto the continental shelf. A gravity high over the Aleutian Islands diminishes gradually near the continental margin, and negative Bouguer anomalies are present among the volcanoes of the eastern Aleutian Range and the southern Alaska Range; the gravity low associated with the inside edge of the oceanic trench is replaced by a gravity high that extends along the entire northern edge of the continental-margin trench. Between the eastern Aleutian gravity low and the continental-shelf gravity high is a series of elongate anomalies that parallel the tectonic trend and may be correlated with sedimentary and volcanic rock units.

Small gravity depressions in areas of positive gravity anomalies on the continental shelf indicate the presence of Cenozoic sedimentary deposits east of Kodiak and west of Middleton Island. Sparker data show that these deposits thicken northwest of a shelf-edge anticline where the free-air anomalies are greatest. However, a much larger decrease of 125–200 mgal. occurs at the southern edge of the Chugach Mountains geosyncline, which lies north of a coastal belt of lower Cenozoic submarine volcanic rocks (largely non-magnetic). These rocks cause local highs that are especially well developed in Prince William Sound and account for the steep gravity gradient between the continental shelf and Chugach Mountains. This 125–200-mgal. gravity change nearly coincides also with the line separating the emergence and subsidence areas of the 1964 Alaska earthquake. That earthquake increased the positive continental-shelf anomalies south of the gradient. At the northern edge of the Chugach Mountains geosyncline, another gravity high coincides with a belt of lower Mesozoic submarine volcanic rocks (largely magnetic); this high separates the Chugach Mountains low from a low caused by sedimentary rocks in Cook Inlet and Shelikof Straights. Although the gravity data indicate the presence of several thick sedimentary bodies, the large gradients associated with the volcanic and tectonic arcs make estimation of the thickness of the sedimentary column difficult.

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PROPOSED ORIGIN OF SUBSURFACE THERMAL BRINES, IMPERIAL VALLEY, CALIFORNIA

Saturated Na-Ca-KCl thermal brines (380°C @ depth) of unique chemistry (reported by D. E. White) are recovered by geothermal wells near the Salton Sea in the Imperial Valley—a tectonically active graben area of high heat flow at the north end of the Gulf of California. The reservoir chamber consists of alternating fractured greenschist and zeolitic facies metamorphic rocks at depths of 3,900–8,000 feet. The shallow waters adjacent to and overlying this and many other thermal anomalies are dilute $NaHCO_3$-Cl waters, high in B. NH_4, I, and F are present; the Na/K ratio is less than in the brines. CO_2 is abundant. The similarity of the deuterium content of these brines and various surficial waters of the Imperial Valley as determined by H. Craig and reported by White indicates that the waters of these brines are dominantly meteoric.

The most critical geochemical questions concern the mechanism by which the brines are concentrated to such a high degree, the origin of the Cl ion within the brine, and the surprisingly high Ca/Na, K/Na, and Cs/K ratios of the brine. The arkosic sedimentary fill of the graben contains ample material to provide by solution every chemical found within these thermal brines with the exception of the Cl ion. The high ^{18}O of the brines and its impoverishment