the *Globigerinoides trilobus* datum of the tropics; this is approximately equivalent to the base of the Saucesian Stage of California. In ascending order, the lower Miocene *Catapsydrax dissimilis, C. stainforthi,* and *Globigerinatella insueta* zones correlate with the Saucesian and basal Relizian Stages. Assemblages characterizing the *Catapsydrax stainforthi* zone have been identified in the upper part of the lower Saucesian Stage of Reliz Canyon, California. Further, *Sphenolithus belemnos* is a good index of the lower Miocene of tropical areas and of the Saucesian Stage of California.

The orbuline datum of the tropics, which is in the uppermost part of the *Globigerinatella insueta* zone, is the base of the middle Miocene. This level appears to correspond to the base or the lower part of the Relizian Stage of California. In ascending order, the middle Miocene *Turborotalia peripheroronda* and *Globorotalia peripheroacuta* zones correlate with the Relizian Stage, and the *Globorotalia praefohsi* and *Globorotalia fohsi* zones correlate with the Luisian Stage. *Sphenolithus heteromorphus* occurs in the Relizian Stage and also in the *Globigerinatella insueta* and *Turborotalia peripheroronda* zones of the tropics. *Discoaster kugleri* is an index of the uppermost zone of the *G. fohsi* sequence and it is identified in the upper Luisian Stage of Newport Bay, California. Orbulines first appear in the Luisian Stage in California.

The *Globorotalia menardii* datum is the base of the upper Miocene in tropical areas, and it corresponds approximately to the *Globigerina pachyderma* datum of California or the base of the lower Mohnian. The dextral *Globigerina pachyderma* zone of the lower Mohnian contains *Catinaster coalitus* and *Discoaster bollii,* which are indices of the *Turborotalia mayeri* and *Globorotalia menardii* zones of the tropics. The sinistral *Globigerina pachyderma* zone of the upper Mohnian and basal Delmontian Stages represents the first major cool event in the middle Neogene; it correlates with the *Turborotalia acostaensis* (*Globigerina bulloides*) zone of tropical areas and with the sinistral *G. pachyderma* zone of the Messinian of Italy.

The base of the Pliocene is marked by the appearance of "*Sphaeroidinella dehiscens*" and by the change from sinistral to dextral populations of *Neogloboquadrina dutertrei.*

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SEDIMENTATION IN SANTA BARBARA BASIN, CALIFORNIA

The Santa Barbara basin off California (depth, 575 m) obtains its surface water from the California Current, which brings cold, nutrient-rich waters from the north and from the subsurface through upwelling. This combination of events causes a high level of plankton productivity. The deep basin water is derived from the oxygen-minimum zone below the California Current, which is centered between 500 and 1,000 m depth and which is a consequence of *in situ* oxygen depletion by decay and respiration processes and of advection of oxygen-poor water. The bottom water of the basin is trapped below sill depth (480 m) and is nearly depleted of oxygen, because the only exchange is with low oxygen water and because the sediments have high organic content.

Burrowing animals therefore are absent in the center of the basin and sediment deposition is undisturbed. Sediments come from two sources, plankton and land detritus. The winter rains increase the supply of terrigenous detritus, whereas summer production supplies organic material. This biannual variation is recorded in the sediment as annual layers or varves.

Varves develop only below sill depth, and sediments away from the central region show progressively less stratification. Freeze coring and other new sampling techniques, as well as X-radiography, show that the varving extends from the surface to at least a 2-m depth in the central basin sediments, except where turbidite layers disturb the sequence. The characteristics of varved sediments may be useful in reconstructing the history of ancient anaerobic basins.

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ANAEROBIC BASIN SEDIMENTATION AND DIFFERENTIAL PRESERVATION OF PLANKTONIC FORAMINIFERA

In paleoclimatic reconstruction, fossil planktonic Foraminifera usually are related to ancient surface-water conditions. Processes on the ocean floor, however, are able to alter faunal composition drastically.

Ten core samples from various depths were taken in the Santa Barbara basin which is anaerobic below a sill depth of about 480 m. Sixteen samples were analyzed for their microfossil content, in four size fractions. In each size fraction there is a pronounced difference in composition between samples above and below sill depth. The anaerobic, black, laminated sediments obtained below sill depth contain numerous species and specimens, including very fragile forms such a *Hastigerina digitata.* Fragments are almost absent; pelagic gastropods and pelecypods (aragonite) are plentiful, as are thin-walled calcareous benthonic Foraminifera.

Just above sill depth, sediments are dark green and homogeneous, suggesting moderate aeration. The percentages of *Globoquadrina dutertrei* and of *Globigerina pachyderma* s.s. are much greater there than in the anaerobic samples. Fragments of both planktonic and benthonic Foraminifera are abundant. Thin-walled benthonic Foraminifera are much scarcer than in the deeper samples; aragonitic shells are virtually absent. Well above sill depth sediments are light green and homogeneous and appear well aerated. Both planktonic and benthonic foraminiferal numbers are greatly reduced and *G. dutertrei* strongly dominates all but the finest fraction. Fecal pellets are abundant.

There are several possible causes for the pronounced change in fossil fauna across the anaerobic-aerated boundary: (1) changes in supply, (2) mechanical destruction by benthonic organisms, and (3) chemical dissolution.

A change in supply from the overlying water is unlikely, because the effects of the aeration boundary do not extend into the productive zone. Mechanical destruction by benthonic animals is possible in the aerated zone. The siliceous skeletons of diatoms and Radiolaria, however, are much less affected by the aeration boundary than are calcareous fossils, which suggests that chemical dissolution is the most important factor. Two mechanisms may be responsible: (1) production of CO_2 by the oxygenation of organic matter in the aerated zone, and (2) a more vigorous exchange of interstitial solutions with bottom water by burrowing activity. These two effects of bottom aeration should enhance calcite solution.

The study of the distribution of the resistant Foraminifera, such as *G. dutertrei, G. pachyderma* s.s., *G.*