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LOWER TERTIARY PALEOCURRENT TRENDS, SANTA CRUZ ISLAND, CALIFORNIA

The Paleogene sequence of southwestern Santa Cruz Island includes approximately 200 ft of fine-grained, thin-bedded, calcite-cemented, arkosic sandstone of Paleocene (Ynezian(?)-Bulitian) age, approximately 1,400 ft of mainly shale and siltstone of Eocene (Penutian-Narizian) age, and a Narizian unit which consists of a lower coarse-grained sandstone and conglomerate member and an upper shale member.

Stratigraphic distribution of cross-bedding, small-scale sedimentary flow structures, imbricated pebbles, and oriented fossils at 36 stations were used to reconstruct the clastic dispersal system and conditions of deposition.

The Paleocene sequence contains thin layers of oriented *Turritella pachecoensis* and *Turritella infragranulata*. Apical orientations of the larger *Turritella* specimen have a vector mean of N30°W, whereas apices of the smaller *Turritella* specimen on the same bedding plane have a vector mean of S70°W. The vector mean of associated cross-beds is S10°E, indicating that in these beds the larger *Turritella* specimen became oriented with apices pointing upcurrent and the smaller ones acted as rollers and became oriented perpendicular to current-flow direction.

Vector means of cross-beds, small-scale flow structures, and imbricated pebbles and shale clasts show a paleoslope of S50°W during Eocene deposition. This is supported by a decrease in thickness and average maximum clast size in the conglomerate member in a southerly direction. Based on Foraminifera, the Eocene mud and silt were deposited in mainly bathyal water, a conclusion also reached by Doerner. Abundant cross-beds, diffuse flat laminations, dish structures, and an absence of graded bedding suggest a nonturbidite flow origin for the sandstone and conglomerate member.

Data from this study suggest a northerly source of sediments with the paleoslope changing from S30°E during deposition of the Paleocene deposits to S50°W during deposition of the Eocene.

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FIELD GEOLOGY IN A MARINE ENVIRONMENT

Many modern geologists overlook the significance of surface geology as it applies to offshore exploration. Such geologists tend to depend entirely on seismic data for evaluation of large areas along the continental margins of the world. Today there are tools available to the geologist which, where used together, can obtain essentially the same data as were obtained onshore by field mapping. These tools consist of dart sampling, shallow core drilling, SCUBA diving, sampling by submarine, shallow-penetration high-resolution sparker, *etc.* No one tool by itself can provide the total picture, nor can the same tools be used in all areas. Large areas still exist along the continental margins of the world where the geological picture can be compiled only by seismic programs and deep core drilling. However many areas, especially the more tectonically active parts of the continental margins, have submarine outcrops. These can be studied in nearly the same manner as outcrop areas onshore.

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SEDIMENTS OF INNER CONTINENTAL SHELF OFF NORTHERN WASHINGTON COAST

Much of the inner shelf off Washington is filled with well-sorted, positively to extremely positively skewed, and leptokurtic to extremely leptokurtic sediments having mean sizes between 2–3ϕ and 3–4ϕ. Gravel-rich sediments are common opposite and north of Cape Flattery, and at about depths 14–18 fm and 28 fm opposite Grays Harbor and at 14–28 fm opposite Quinault River. Only rarely are the sediments finer than sand size. These gravel and fine sediments are relatively poorly sorted compared with the other sediments.

The pebbles constituting the gravel-rich sediments are smooth and rounded. Thin-section study of the pebbles from opposite Grays Harbor reveals the following rock types: (1) chert, (2) volcanics (many of these being altered and albitized basalt and some of them andesite—a few of these are hypersthene andesites), (3) sandstone, and (4) some granite and quartz diorite. Similar lithologic types are revealed in the gravel-rich sediments north of Cape Flattery. The heavy-mineral study shows that in much of the area the sediments have low percentages of heavy minerals, although opposite Grays Harbor at depths of 10–12 fm and Hoh River at 16–28 fm, heavy minerals are more abundant. The sediments off Cape Flattery, especially in the nearshore areas, have smaller percentages of orthopyroxene and hornblende than do those farther south. Also, the proportions of hornblende, ilmenite, and magnetite generally are less in the present study area than in the sediments opposite Columbia River. These results suggest that many of the gravel sediments (of the offshore areas), representing the glacial drifts, and the heavy-mineral-rich sediments were deposited at sea levels lower than at present. The drift toward the north of the Columbia-derived sediment appears not to have diluted considerably the sediments supplied from other sources to the areas farther north of Grays Harbor.

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BATHYMETRY AND SEDIMENTARY STRUCTURES OF SANTA CRUZ BASIN, CALIFORNIA

As an intermediate basin between coastal and offshore depressions of the California continental borderland, Santa Cruz basin occupies a 1,900-m depression south of the Channel Islands. Steep walls with a thin sediment cover abut the flat basin floor. Hummocky topography, probably related to slumping, characterizes the northwestern quadrant of the basin floor. Three major canyon systems are filling the basin from the northern and southern island platforms, and buried channels show the previous existence of a fourth system. The western wall is relatively straight and featureless compared with the structural terraces, volcanic knolls, and other irregularities of the eastern slope.

Radiographic and photographic analyses of several box cores and numerous gravity and piston cores reveal a complex pattern of sedimentation. Paired cores indicate that this may be related partly to coring technique. Biologic structures are abundant, in many places disrupting sedimentary structures so greatly that they become almost indiscernible. Geologic structures, primarily related to very calcareous sand layers with