igena, Uvigerina juncea, Adercatryma glomeratum, Haplophragmoides bradyi, and abundant radiolarians.

Tintinnids, pennate diatoms, plant fragments, and empty tests of *B. elegantissima* are more abundant off the mouth of the Columbia River and north of it than they are south of it. These inner shelf and land-derived biogenic particles appear to be distributed by the north-setting winter plume of the Columbia River.

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Sediment-Foraminiferal Relations within Inner Sublittoral Zone off Coast of Washington

Foraminiferal assemblages of the inner sublittoral zone (0–60 m) have been studied along the entire Pacific coast of the state of Washington and of northernmost Oregon. A substrate of fine sand having a mean diameter of 2.8–3.5 phi is prevalent, but relict gravel bars are seaward from the mouths of Grays Harbor and the Quinault River, and pockets of silt are present in the southern half of the area.

Regardless of sediment grain size, concentrations of Foraminifera increase seaward from less than one per gram of sediment to 10–25 per gram of sediment, and the percentage of arenaceous tests in foraminiferal assemblages increases seaward from less than 10 percent to more than 50 percent, except near the mouths of the Columbia River and Grays Harbor where dominantly arenaceous assemblages occur nearshore. The dominant arenaceous species generally is *Eggerella advena;* the dominant nearshore calcareous species generally is *Buliminella elegantissima,* except adjacent to rocky coastlines where *Elphidium* spp. dominates.

High relative frequencies of *Trochammina charlottensis* and *Cribrostomoides jeffreysii* are found only in the area of the gravel bars and high relative frequencies of *Cibicides lobatulus* and *Glabratella ornatissima* only in the area of nearshore rocky substrates. The general correspondence between occurrences of these species and a geographically restricted substrate is marked, but high relative frequencies of these species (probably representing displaced tests) may occur in sand or silt sediments near the gravel or rock exposures.

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Sedimentary Structures and Paleocurrent Analysis of Sespe Formation, Ventura Basin, California

Sespe redbeds, exposed along the margins of the Ventura basin and underlying the Santa Barbara Channel, record a middle Tertiary period of fluvial deposition. Both low and high flow regime structures were studied and mapped. Observed low flow regime structures include ripples, climbing ripples, microfestoons, trough cross-bedding, bar foresets, and delta foresets. Plane beds with parting lineation are the most common high flow regime structure. The association of so-called turbidite features such as flute casts (high flow regime), graded beds, load casts, and convolute laminae is not uncommon in lower Sespe beds. The "Bouma sequence" was noted in at least one locality; upper surfaces of mudstone beds commonly display shrinkage cracks, thus documenting a subaerial environment. High flow regime antidunes occur as asymmetric dune-shaped wedges of graded granular coarse sand with backset lamination dipping upcurrent. The antidune wedges are imbricated in a downcurrent direction and are overlain and underlain by bar foresets dipping downcurrent.

Bioturbation locally has obliterated internal structures of upper Sespe mudstone and sandstone beds. Convex terminal excrement deposits of *Repichnia* trace fossils indicate direction of movement of the mud-eating organisms; markings commonly parallel current features. Plant stems and "fernlike" plant molds show a preferred orientation, particularly in the type area of the Sespe Formation.

Two-dimensional structures were measured with a tilt compensator designed by the student, and mean current directions were calculated using the radius-vector summation method. By incorporating the radius-vector means of line-of-movement data with graphic vector means of unidirectional data, a more truly representative vector mean was determined for each sampling area. Consistency ratios, standard deviations, and Raleigh confidence levels were calculated.

Underlying Eocene upper "Coldwater Sandstone" beds have lignite, oyster fragments, climbing ripples, and trough cross-beds; together these features suggest an estuarine deltaic complex. Ripple normals and cross-beds of "Coldwater" exposures (about 1,200 ft below the Sespe-"Coldwater" transitional beds) on Sespe Creek trend S26° W; mudcracks were noted. In the Sespe type locality, lower Sespe conglomerate and middle to upper Sespe sandstone beds reveal paleocurrent means of N76° W and S16° W, respectively. In the Pine Mountain area, 79 imbricated pebble clusters in lower Sespe braided stream gravel yield a vector mean of S3° E. From east to west along the lower Santa Ynez Mountain slopes, lower Sespe (in italics) and upper Sespe paleocurrent trends in the following areas are: Casitas Pass (*S8° W,* S34° W), Santa Monica Canyon-Romero Canyon (*S27° E,* S28° E), Cold Spring Canyon-San Roque Canyon (*S17° W,* S57° W), Camino Cielo syncline (*S57° W,* S26° W), San Marcus Pass (*S30° W,* S37° W), San Marcus Road (*S6° W,* S58° W), Glen Annie Canyon (S56° W), Corral Canyon-Posta Canyon (vector analysis of Carver's data; S57° W), and Gaviota Canyon (S66° W). South of the Santa Clara River, data collected by Fan and Weser in the Oakridge province reveal Sespe streams flowing northwest. Weser's data from the Simi area and the Santa Monica Mountains show streams flowing westward to southwestward.

These paleocurrent data support Bailey's fluvial model. One or more prograding westward-flowing trunk streams with shorter southward- and northwestward-flowing tributaries drained bordering highland source areas of granodiorite, gneiss, volcanic rocks, Franciscan chert, and older sediments. A major Sespe trunk stream probably flowed along the axis of the Santa Clara River and extended into the present channel area near Rincon Point. Topography and basin geometry during Sespe deposition were influenced strongly by structural trends still present in the Transverse Ranges. Bimodal paleocurrent distributions support the concept of a system of westward- and southward-flowing Sespe streams in the Santa Ynez Mountains province. Paleocurrent analysis will be a valuable tool in predicting sandstone-body trends in Santa Barbara Channel exploration. Field techniques and dipmeter data can be applied productively to the study of subsurface cores