especially within a marine-to-terrestrial facies transition. Otherwise, an interpretation of frequently shifting sites of supratidal sedimentation along a mainland is favored.

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FORAMINIFERAL TRENDS WITHIN INNER SUBLITTORAL ZONE OFF COAST OF WASHINGTON

Foraminiferal and diatom distributional trends within the inner sublittoral zone have been studied along 170 km of the coast of Washington from Grays Harbor to Cape Flattery. The samples are from water depths of 7–59 m.

Trends in the concentration of foraminiferal tests and diatom frustules in bottom sediments appear to be closely related to wave-induced turbulence at the sediment surface. Concentrations of tests markedly increase seaward at 20-m water depth, apparently the deepest limit of intense turbulence. Frustules, because of their very slow settling velocity, are prevented from settling at depths less than about 50 m except in certain microenvironments. These trends are not correlated with trends in sediment grain size, a fact which suggests that little modern sediment is accumulating in this area.

One trend is related to increasing depth and distance from shore; *Elphidium* spp. decrease markedly seaward of 30 m as *Eggerella advena* increases. Comparison with other studies in nearby areas indicates that this trend is heterobathyal. Off Oregon it occurs at about 100 m and off Washington south of Grays Harbor, if the *Elphidium* fauna is present at all, it occurs at depths less than 20 m.

Other foraminiferal trends are related primarily to substrate. Rocky substrates near the coastline have a characteristic *Cibicides lobatulus-Glabratella ornatissima* fauna. Relict coarse sand substrates offshore have faunas with abundant *Trochammina charlottensis, Cribrostomoides jeffreysii,* and *Elphidiella hannai.*

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HOLOCENE OCEANOGRAPHY OF CHUKCHI SEA

Piston cores from the southeastern Chukchi Sea have permitted differentiation of modern from Holocene sediments deposited when sea level stood about 20 m lower. Because microfossil distributions in modern sediments are associated closely with ice-free oceanographic conditions, the following trends appear to be related to Holocene oceanographic conditions. *Eggerella advena,* indicative of warm, dilute Alaskan coastal water, is as abundant in Holocene as in modern sediments, but *Reophax arctica,* indicative of central shelf water, and *Spiroplectammina biformis,* indicative of cold bottom water in the northern Chukchi Sea, are much less abundant in Holocene sediments. Frustules of the planktonic diatom *Coscinodiscus,* presently displaced northward by the Bering Strait current from regions of maximum phytoplankton concentrations in the overlying water, are more abundant in Holocene than in modern sediments in cores directly north of Bering Strait.

The northward-flowing Bering Strait current controls conditions in the southeastern Chukchi Sea. This flow was reduced during the Holocene because the cross-section area of the strait was smaller; apparently, however, the flow was reduced at the expense of central shelf water as Alaskan coastal water filled the southeastern Chukchi Sea. Although currents were slight in the central part of the southeastern Chukchi Sea, waters still piled up against the coast near the present settlement of Kivalina and produced a high-velocity northwest current. As evidence of this, Holocene sediments northwest of Point Hope contain more plant fragments and sand than nearby areas, and these presumably were deposited from the current.

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FRINGING REEF OR ALLOCHTHONOUS BLOCKS?

Many Permo-Pennsylvanian reef complexes of the Permian basin, Texas, have flanking carbonate mounds or "reefs." Faunal evidence indicates that these are topographically low relative to equivalent-age sediments in the reef proper. The shallow-water carbonate rocks were deposited either at times of lowered sea level, or they flowed or slid down the slope *en masse.* It is a real challenge to the subsurface geologist to identify their mode of deposition, particularly in the absence of cores.

Lloyd C. Pray and colleagues, using geopetal fabrics, showed that the so-called Bone Spring "patch reefs" in the Guadalupe Mountains were emplaced by gravity. In Howard and Glasscock Counties, Texas, large reef-dolomite blocks are embedded in a cherty forereef limestone facies of the Wolfcampian Wichita-Albany, and there is no question that they are allochthonous.

On the flanks of the Pennsylvanian and Wolfcampian "Horseshoe atoll" in Howard, Scurry, and Kent Counties, Texas, the problem is less simple. The greatly leached and porous atoll was raised intermittently above sea level, and fringing reefs should have formed on the flanks of islands. However, this does not preclude the other methods of emplacement of shallow-water limestone. Very careful study is required to differentiate the various types of deposits. Differentiation of each type is critical to the exploration geologist because the fringing reefs appear to make prolific petroleum reservoirs whereas the allochthonous or turbidite carbonates commonly host noncommercial accumulations.

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VIBRO-BOX SAMPLER: NEW TOOL FOR STUDY OF SEDIMENTARY STRUCTURES IN NEARSHORE SANDS

Increased exploration for stratigraphic traps in ancient shallow-marine sandstone and the resulting problems in environmental reconstruction have emphasized once again the lack of information on the characteristics of modern counterparts. The vibro-box sampler is designed to provide data on sedimentary structures of sand from the important zone between low tide and the 10-fm line. The sampler is a combination of the box sampler of Klovan, as modified by Imbrie, and the vibro-corer of Sanders.

The sampler is made of stainless steel (to resist corrosion) and can recover a 20 by 19 in., vertical, undisturbed "slice" from the bottom. A compressed-air vibrator is used, first, to drive the sampler into the bottom and, second, to activate a diagonal plate which seals in the sample. Additional vibration is necessary to free the sampler from the bottom. Surprisingly, the