# GEOLOGICAL AND GEOTECHNICAL INVESTIGATION OF SEDIMENT REDISTRIBUTION ON THE CENTRAL EQUATORIAL PACIFIC SEAFLOOR

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ABSTRACT

Sedimentation in the Central Pacific Ocean is controlled by proximity to sediment source areas, bottom water circulation, and bathymetric relief. Variations in circulation intensity and seafloor relief on local scales has produced significant differences in sediment accumulation over distances of a few kilometers. Sediment thickness is relatively uniform where slopes are less than $1^{\circ}$, while sedimentary sections are typically absent on slopes exceeding $10^{\circ}$. On abyssal hills where slopes are $1^{\circ}$-$5^{\circ}$, sediment thickness varies by factors of 2-4 between slopes and adjacent valleys. The purpose of this study is to evaluate the geotechnical properties of the present seafloor surface and to model the mechanisms involved in the sediment redistribution process.

Examination of DSDP data shows that erosion rates during intensified circulation "episodes" in Eocene/Oligocene and middle Miocene time range from 10-30 m/my. These episodes mark major transitions in oceanic circulation over periods of several millions of years. There is no correlation of the stratigraphic extent of hiatuses related to these episodes with sediment lithology or regional location of DSDP sites. This suggests that erosion and redistribution is primarily influenced by local factors such as bathymetric relief, tectonic history, or the frequency and lateral extent of erosive bottom currents (so-called "benthic storms").

In two localities studied, the majority of sediment redistribution occurred prior to late Miocene time and involved approximately 25-50 m of material. This could be accomplished either by a relatively continuous process at rates of meters per million years or by active erosion

during the middle Miocene "episode". Quaternary sedimentation, presumably under quiescent circulation conditions, also varies by a factor of two, suggesting that sediment redistribution in this region is a continuous process which is amplified during periods of climatic or oceanic change.

The majority of sediment cores collected in all bathymetric settings has a low-strength surface layer to depths of about 10 cm produced by bioturbation. Because these sediments have high shear strengths (termed "overconsolidation"), bioturbation may regulate erosion over geologic time. Erosion of the upper centimeter at a frequency of $10^3$ years will satisfy the estimated rates during active erosional episodes.

It is postulated that erosion of the seafloor occurs at current speeds greater than about 20 cm/sec, and that this process rapidly scours the upper 1-2 cm across wide areas (100's $km^2$). Dense concentrations of suspended material tend to dampen near-bottom turbulence causing erosion and vertical mixing, and these turbid layers transport material down slopes into local basins. These "lutite flows" have been observed in other marine settings and provide the best explanation for sediment redistribution in this region. Mass movement (slumping) is not probable on abyssal hill slopes because of their low angle and the overconsolidated nature of their sediment cover. Surface "creep" of the bioturbated layer or failure of thick sedimentary sections is possible only on slopes steeper than $20^o$-$30^o$, therefore this mechanism is restricted to seamounts or local fault escarpments and has a limited extent.

Future studies should involve the insitu monitoring of environmental conditions and quantitative modeling of short-term erosional events, although their rarity in abyssal regions poses a difficult problem.