vertical mixing and consequent high productivity. Therefore, the presence and fluctuation of the concentration of opaline silica in deep-sea sediments can be an important indicator of paleo-oceanographic conditions. Upward changes from sediments low in opaline silica to sediments high in opaline silica about 2 m. y. ago in the Antarctic region and about 4.5 m. y. ago in the North Pacific suggest an increase of vertical mixing at these times in these areas.

The widespread occurrence of middle Eocene cherts in the Atlantic indicates a strikingly different circulation pattern for Eocene time than exists today. A modfied Eocene circulation pattern is suggested on the basis of the probable shape of the Eocene Atlantic.

HEACOCK, R. L., Shell Oil Co., Denver, CO 80202 THIN-SECTION EXAMINATION OF OIL SOURCE-ROCK SAMPLES

Thin sections of 388 fine-grained rocks, which had been chemically analyzed for hydrocarbon content, were examined for details of lithology and paleontology. Three general types of thin-section observations were found to correlate with source-rock quality as determined chemically: (1) abundant visible organic matter, (2) dark-brown thin-section color, and (3) microlaminations (bedding <1 mm thick). Of the clastic potential oil source rocks (>500 ppm heavy hydrocarbon extractable) used in this study, 75% contain all 3 criteria. None of the nonoil-source rocks (<150 ppm HC) have all 3 criteria. The "typical" potential oil source rock is described as "dark-brown, abundantly organic, microlaminated shale." This "typical" rock is commonly barren of fossils, but it may contain a sparse benthonic fauna and (or) abundant pelagic microfossils concentrated in microlaminae. One set of depositional conditions able to produce this rock is a stable basin setting of relatively slow sedimentation, far from a major coarse clastic source, with no appreciable bottom currents, and with a low oxygen content at the sediment-water interface.

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DISSOLVED SILICA AND ITS RELATION TO DEEP-SEA SEDI-MENTS

Neither the concentration nor distribution of dissolved silica in the ocean is controlled by equilibria with solid silica or silicates. Rather, the observed pattern results from horizontal and vertical movements of oceanic water masses interacting with the formation, sedimentation, and dissolution of opaline tests of diatoms and radiolarians. Because the forces controlling this dynamic system are complex and in many cases poorly understood, it is difficult to construct a quantitative model of the present distribution pattern, or to deduce the distribution of silica in ancient oceans.

The residence time of silica in seawater, a few thousand years, is short from a geologic point of view. Consequently, the ocean can have little buffering effect on the dissolved-silica cycle. The rate of supply from continental weathering, submarine weathering, or volcanism, and upward diffusion of interstitial waters must therefore be balanced by the depositional removal of opal. Because there is little evidence for dramatic changes in the rate of supply of dissolved silica to the oceans during the Cenozoic, changes in the locus of sedimentation, rather than variations in the global budget of dissolved silica, probably were responsible for variations in the nondetrital silica content of Tertiary deep-sea sediments.

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- MORPHOLOGIC VARIATION IN RECENT PLANKTONIC FORAMINIFERA

Intraspecific variation of Globigerinoides ruber and Globigerinoides trilobus-Globigerinoides sacculifer was investigated in 20 core top samples from the Atlantic Ocean and Gulf of Mexico. Such samples come from the top centimeter of cores and represent about 1,000 years accumulation. The average number of specimens measured for each sample was 50 and the size of the specimens was coarser than 250μ . Specimens are largest in the Gulf of Mexico and Caribbean Sea, smaller in the equatorial Atlantic, and smallest in the North Atlantic. Between 15 and 25°C, specimen size is correlated with mean sea surface temperature. Above 25°C large size variations occur within a narrow temperature range. Expansion rates, as measured by the relative increase in chamber diameters in both species, are correlative with available nutrients. The highest expansion rates occur in the Atlantic Undercurrent (0-5°N), and in the North Atlantic north of 30°N. Between 5 and 30°N in the Sargasso Sea, expansion rates are lower than in the equatorial or North Atlantic. Thus, for both species temperature and nutrient availability affect maximum size attained and rate of chamber growth.

Comparison of size and expansion rates for G. trilobus and G. sacculifer distinguished by the presence or absence of a saclike final chamber show the 2 phenotypes to be statistically similar. Within populations of G. ruber, the width/height ratio of the test, and of the primary aperture show a general trend of increasing values with increasing latitude. Variations in aperture size are linearly correlated with mean sea surface temperatures.

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TRANSPORT AND DEPOSITION OF COARSE CLASTICS IN TURBIDITE BASIN IN FRENCH ALPS

Marine breccias of Jurassic to Early Cretaceous ages are present in the Breccia Nappe of the French Prealps. Breccia types Ia and Ib are restricted to the lower part of the sequence in the Lower Shale, Lower Breccia, and Upper Shale formations. Type Ia breccias occur in beds from a few centimeters to tens of meters thick. They contain clasts up to more than 1 m in diameter, and are sometimes graded. Sole markings oc-cur but are not common. Tops of some beds have large scale cross-stratification or parallel bedding, usually in granule-pebble grade material. Individual beds are of limited lateral extent-of the order of 1-2 km along the depositional strike and in places up to 7-8 km across it. The breccias have a clast framework and interstitial material is usually pebble or granule size. There is a continuous spectrum, with change in relative proportions of gravel and sand, from the breccias to pebbly turbidite sandstones.

Type Ib is much less common than Ia. It has clasts of the same composition and size but it is character-