PALEOECOLOGICAL RECONSTRUCTION OF DEPOSITIONAL ENVIRONMENTS —SOME TECHNIQUES OF POSSIBLE EXPLORATION INTEREST

FRANCIS G. STEHLI

Organisms are extremely sensitive to many parameters of the physical environment, and their fossil remains may thus be used in the interpretation of ancient environments. Effective use of paleoecology depends on first determining what environmental parameters are of interest. Second, developing a model based on recent examples which can be tested on the fossil record, and third, testing the model on the record itself. Following this procedure, several methods for determining the depth of water in which deposition took place are considered.

A model based on the frequency distribution of three large and easily recognized groups of foraminifera (arenaceous benthonics, calcareous benthonics, and planktonics) appears very promising but has not yet been tested on the fossil record. This model uses a series of departure maps to contour water depth on a 25-foot interval and produces results that compare well with actual fathometer maps. The technique may be applicable to Cenozoic rocks in the Gulf Coast type of environment (Stehli, 1966).

The distribution of ocean currents across the continental shelf is considered as a means of locating barriers to circulation (growing positive structures). A model shows that ocean current patterns on the shelf are easily seen in variations in the ratio of planktonic to benthonic foraminifera. This ratio normalizes for the effect of variations and sedimentation rate allowing that parameter to be ignored. A test of the model on Upper Cretaceous rocks of the Gulf Coast region where much independent information is available for comparison shows that this very simple paleoecological technique works rather well (Stehli and Creath, 1964).

Climatic conditions strongly affect the distribution of certain stratigraphic traps, particularly such carbonate traps as reefs. Exploration for these traps is fruitless if climatic conditions at a particular time and place were such as to preclude reef development. Determination of past climatic zones is, however, difficult if not impossible, until the positions of the major continental masses in the past can be determined. Paleoecology, with its ability to reconstruct depositional environment, is in a strong position to examine both the question of continental drift and the question of polar wandering. A model which permits such an examination is developed and tested on the fossil record of the Permian. The model utilizes the latitude dependence of organic diversity as a means of determining the position of the equator and of the rotational poles. Smoothing of global diversity data by application of a best-fitting, second-order, spherical harmonic surface allows precise location of both polar and equatorial positions from diversity data relating to living forms. A test of the model on the fossil record of the Permian Period reveals a position for the rotational pole which is the same as that of today. This test casts very considerable doubt on the current interpretation given paleomagnetic measurements because continental configurations determined by paleomagnetic measurements require coincidence of the rotational and magnetic poles as a basic assumption. The test shows that rotational and magnetic poles of the Permian as seen from either North America or Eurasia differed by 45 degrees. Thus it appears on the basis of the paleoecological tests so far completed, that paleomagnetic measurements cannot yield valid data regarding the geographic latitude of continents in the Permian. It also seems that the presently accepted "dynamo" model for generation of the earth's magnetic field may require revision since it requires coincidence of the magnetic and rotational poles. In a general sense (but without real rigor) the test suggests that neither continental drift across latitude nor polar wandering is likely and that both the rotational poles and the latitudinal position of continents have probably remained unchanged at least since the Permian. If this is true, then the limits of tropical-subtropical conditions have varied videly through time, controlling as they varied the area of the globe suitable for reef development and in fact for extensive carbonate development (Stehli and Helsley, 1963; Stehli, McAlester and Helsley, 1967; Stehli, in press A, B).

A modification of the model used to test the hypothesis of continental drift and polar wandering shows promise for reconstructing the pattern of surface-oceanic currents of the deep sea. These currents are closely related to reef development which extends farther both to the north and south on the east side of continents than on the west because of them. The same technique suggests a possible means of learning more of the fundamental causes of glaciation if applied to glacial and interglacial patterns of oceanic circulation as revealed by variations in the diversity of planktonic foraminifera in deep sea cores (Stehli, 1965).

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BASIS FOR RED FORK SANDSTONE EXPLORATION IN NORTHWEST OKLAHOMA

PHIL C. WITHROW*

The Red Fork Sandstone produces oil and gas over a large area of north central Oklahoma. There are indications that several oil fields comparable to the Burbank Field (one-half billion barrels) can be found in northwestern Oklahoma during the next few years by using available well control for detailed reconstruction of the depositional environments of the Red Fork Sandstone.

The Red Fork Sandstone was deposited west of the Nemaha Ridge during "Chero-