Benthic Biogeographic Provinces for the High Seas

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At the Mexico meeting, a group of experts on the distribution of organisms in the deep sea produced a preliminary map containing the locations of what were termed “the centers of distribution” of deep-sea provinces at bathyal (800-3500 m) and abyssal (3500-6500 m) depths. In addition, because hydrothermal vent communities were felt to be governed by processes separate from those determining the locations of broad bathyal provinces, a separate hydrothermal vent geography was produced. In this context, “provinces” are large areas of the ocean bottom over which mostly similar groups of animals are distributed. Provinces also tend to contain species not found outside the province boundary.

The experts at the Mexico City meeting recognized that for much of the deep-sea there is very little information that can be used to delineate biogeographic units, at the level of either province or region. The lack of information is partly due to lack of sampling in many deep sea regions, but also due to a lack of mapping or synthesis of data from expeditionary reports or other sampling programs where species have been identified, other than what has been summarized for deep-sea explorations conducted by Russian scientists (e.g., Vinogradova, Zezina, Belyaev).

At the time it was felt a biological approach should be adopted wherever possible, but that has proved difficult given the paucity and inconsistency of available data by area and by animal group. Hence for this benthic (bottom-dwellers) classification the tasks involved compiling available biological information and as much of the hydrographic data as possible, and mapping variables that might correlate with the distribution of benthic animals. To a certain extent, this effort is predicated on the idea that benthic species, at least those that are not highly mobile, are influenced in their distribution by the major water masses of the ocean. And, while the surface water mass distributions are well known, and to a certain extent well delineated, at depths below 800 m, water masses have not been comprehensively mapped.

The objective of the present effort, then, is to produce maps of the bathymetry, temperature, salinity, oxygen, and organic matter production that will be deposited on the sea floor for discrete depth layers that could then be used to assess the relationship between known organism distributions and water mass characteristics. It is acknowledged that this is a very restricted subset of factors that can potentially influence species composition and distribution, and often a combination of factors will be important. However, these factors are widely recognized as being key determinants. In addition, we have reviewed the pertinent literature on deep-sea zoogeography produced since the 1970s, and have drawn biogeographic maps using that literature and some of the hydrographic data as guides.

All data were separated into 0-300, 300-800, 800-2000, 2000-3500, 3500-6500, and > 6500 m layers. The 0-300 and 300-800 m layers were discarded as they are almost exclusively within the EEZs of various nations. Less than 1 percent of the 300-800 m bottom is present in high seas areas. The depth layers were chosen based on results of analysis of bottom samples taken over much of the world ocean by Russian investigators.

Images were produced showing the distribution of bathymetry, temperature, salinity, and dissolved oxygen at 800, 2000, 3500, and 6500 m depths. The water mass features were plotted on the bathymetry for each respective depth layer. Using these layers, and biological information from the literature as well as unpublished species distributions, biogeographic provinces are proposed for the lower bathyal (800-3500 m) and abyssal (3500-6500 m) depth layers. The biogeographic province arrangement of Belyaev for the hadal region was accepted with no changes.