Lateral Heterogeneity of Carbonate Lithotopes Across Modern Depositional Surfaces

Wilkinson, Bruce [1]; Drummond, Carl [2] (1) Earth Sciences, Syracuse University, Syracuse, NY. (2) Department of Geosciences, Indiana University—Purdue University Fort Wayne, Fort Wayne, IN.

Examination of maps across many modern carbonate platform surfaces leads to the general conclusion that units of like sediment type and areal extent tend to be clumped in space; the validity of this truism is a direct measure of lateral sediment heterogeneity, and requires that sizes (areas) and frequencies (numbers) of different facies units exhibit certain relations to each other. Size-frequency distributions for modern carbonate lithotopes on most Holocene platforms and ramps are the same as those for several other types of natural mosaics that are developed across the Earth's surface, such as areas of large fluvial drainage basins, geopolitical divisions, lithotopes on global geologic maps, and the Earth's tectonic plates. These similarities emerge because in each case divisions between mosaic elements (such as facies boundaries) along some linear transect (such as across a carbonate platform) are more-or-less randomly distributed in space. Area-frequencies of individual facies patches are closely approximated by the distribution that would result from the random partitioning of the platform surface into some specified number of subregions, such that distances between boundaries along any transect are exponentially distributed. Although amount of platform area is finite, numbers of lithotopes occurring on any depositional surface is largely a matter of definition. However, agreement between measured and anticipated lithotope area frequencies implies that only two variables, the number of mapped facies units and the total depositional area under consideration, determine area frequencies and lateral heterogeneities of lithotope lithotopes.

While data on lithotope exposure area from several modern depositional platforms suggest that, in aggregate, these surfaces can be adequately described as being randomly partitioned with respect to sediment types, in actuality there is considerable obvious non-random spatial structure in both the distribution of lithotope sizes and sedimentologic compositions. Because sediment of similar type is clearly associated in space, it therefore follows that larger units will be clustered in space with larger and smaller with smaller. Thus, the probability of crossing a facies boundary in any given surface transect also depends on where that transect happens to be located with respect to platform margins, a fact that derives from the spatially-structured distribution of carbonate sediment generation and transport.