

THE TEMPORAL RESOLUTION OF THE STRATIGRAPHIC RECORD AND ITS ENVIRONMENTAL GRADIENTS

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Sedimentary particles, such as biogenic or volcanoclastic grains, are the building blocks of the depositional record. These allow the reconstruction of past life, climate, and environmental conditions. However, between their introduction to the sediment and before becoming immobilized in the stratigraphic record, biological and physical processes close to the sediment surface may mix sedimentary particles. As a result, particles of the same age can be found at different burial depths. For the same reasons, the ages of particle at a given burial depth can display offsets of more than a thousand years (time-averaging). This offset in age and burial depth is well documented for biogenic grains (fossils) from recent environments. However, the redistribution of particles is unappreciated in its impact of common geochemical analyses and the stratigraphic time series constructed from them. We use the interquartile range of particle ages at a specific stratigraphic position as measure for the temporal resolution of the stratigraphic record. It quantifies how many years are recorded by the grains contained in an individual sample, e.g. a cm-thick layer. Combining a global compilation of empirical sedimentation rates, mixing intensities, and bioturbation depths with a model of particle movement in surface sediments, we predict the temporal resolution of the stratigraphic records and identify its environmental gradients in marine environments. The results show that (1) due to empirical constraints on the model parameters, sedimentation rate exerts the strongest control over the temporal resolution of the stratigraphic record and (2) the temporal resolution drops below tens of millennia in slope and deep sea settings. The results provide an assessment of the maximum temporal resolution that can be achieved when deriving information from marine sedimentary stratigraphic records, which directly translates into the time series and age models derived from them.