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Cyclostratigraphy – concepts, definitions, and applications

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with 15 figures

Abstract. Cyclostratigraphy is the subdiscipline of stratigraphy that deals with the identification, characterization, correlation, and interpretation of cyclic variations in the stratigraphic record and, in particular, with their application in geochronology by improving the accuracy and resolution of time-stratigraphic frameworks. As such it uses astronomical cycles of known periodicities to date and interpret the sedimentary record. The most important of these cycles are the Earth's orbital cycles of precession, obliquity, and eccentricity (Milankovitch cycles), which result from perturbations of the Earth's orbit and its rotational axis. They have periods ranging from 20 to 400 kyr, and even up to millions of years. These cycles translate (via orbital-induced changes in insolation) into climatic, oceanographic, sedimentary, and biological changes that are potentially recorded in the sedimentary archives through geologic time. Many case studies have demonstrated that detailed analysis of the sedimentary record (stacking patterns of beds, disconformities, facies changes, fluctuations in biological composition, and/or changes in geochemical composition) enables identification of these cycles with high confidence. Once the relationship between the sedimentary record and the orbital forcing is established, an unprecedented high time resolution becomes available, providing a precise and accurate framework for the timing of Earth system processes. For the younger part of the geologic past, astronomical time scales have been constructed by tuning cyclic palaeoclimatic records to orbital and insolation target curves; these time scales are directly tied to the Present. In addition, the astronomical tuning has been used to calibrate the $^{40}\text{Ar}/^{39}\text{Ar}$ dating method. In the older geologic past, "floating" astronomical time scales provide a high time resolution for stratigraphic intervals, even if their radiometric age is subject to the error margins of the dating techniques.

Because the term "sedimentary cycle" is used in many different ways by the geologic community and does not always imply time significance, we propose using "astrocycle" once the cycle periodicity has been demonstrated by a thorough cyclostratigraphic analysis.

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