# MAGNETIC SUSCEPTIBILITY AND ORBITAL FORCING CYCLES: ONE ROUTE TO HIGH-RESOLUTION CYCLOSTRATIGRAPHY AND "FLOATING" TIMESCALES

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The existence of the record of orbital forcing cycles in the sedimentary record has been known for some time and has been established for Permian and younger sequences and suggested in pre-Permian sequences. Using a combination of biostratigraphy, magnetic susceptibility, and harmonic analysis we offer a method of efficiently extracting the signal of orbital forcing cycles from sedimentary units and identifying the cycle represented by each harmonic. The reference of cycles of known duration to biozones has strong implication for at least four areas: high-resolution cyclostratigraphy, knowledge of the duration of the biozones, creation of "floating" timescales, and realistic estimates of rates of sedimentation and evolution.

High-resolution cyclostratigraphy is possible not because orbital forcing cycles are unique, which they are not, but because each biozone will contain a certain hierarchy of these cycles. Each cycle then subdivides the biozone into objective subzones. Increases in resolution depend on the number of cycles per zone.

Identification of particular orbital forcing cycles, eccentricity, obliquity, and precession, with known or predicted durations makes possible the determination of the duration of a biozone. It is known that the durations of eccentricity cycles have not altered with Earth time but that the durations of obliquity and precession cycles have increased with time due to the progressive separation of Earth and its moon.

Once known, it is a relatively simple matter of summing consecutive biozone durations to produce the duration of an age, epoch, and era, all of which lead toward establishing a "floating" timescale. Such a timescale differs from an "anchored" timescale because it is based on the recognition of the many cycles of the orbital hierarchy rather than referred to a curve anchored to the Present.

Knowledge of the duration of zones also provides the timescale for better estimation of the rate of evolution by comparison of the first and last occurrence of taxa with specific orbital forcing cycles. This offers the exciting possibility of being able to judge the stability of rates of evolution over time. Comparison of the linear amount of sediment containing a hierarchy of cycles in the same time interval for several sections provides a more precise estimate of the rate of sediment accumulation than with other methods.

The various aspects of the method are illustrated with examples from the Frasnian-Famennian portion of the Woodford Shale of southern Oklahoma, the Frasnian/Famennian GSSP and auxiliary sections in the Montagne Noire of southern France, and the Kindblade and West Spring Creek Formations (Arbuckle Group, Tremadoc-Arenig) of southern and southeastern Oklahoma in outcrop and core.