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TITLE: Chaotic evolution of the long-period Milankovitch cycle during the early Mesozoic: independent evidences from the Newark lacustrine sequence (North America) and the pelagic bedded chert sequence (Japan) (*Invited*)

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ABSTRACT BODY: The correlation of Earth's orbital parameters with climatic variations has been used to generate astronomically calibrated geologic time scales of high accuracy. However, because of the chaotic behavior of the solar planets, the orbital models have a large uncertainty beyond several tens of million years in the past. This chaotic behavior also causes the long-period astronomical cycles (> 0.5 Myr periodicity) to modulate their frequency and amplitude. In other words, their modulation patterns could be potential constraints for the orbital models. Here we report the first geologic constraints on the timing of frequency transition and amplitude modulation of the ~ 2 Myr long eccentricity cycles during the early Mesozoic. We examined the lake level records of the early Mesozoic Newark lacustrine sequence in North America and the biogenic silica burial rate of the pelagic bedded chert sequence in the Inuyama area, Japan, which are proven to reflect the astronomical cycle (Olsen, 1986; Olsen and Kent, 1996; Ikeda et al., 2010). The time scales of the two sequences were orbitally calibrated with the end-Triassic mass extinction interval as the age anchor, covering ~ 30 Myr and ~ 65 Myr, respectively (Olsen et al., 2011; Ikeda et al., 2010, in prep). We find that the frequency modulation of ~ 2 Myr cycle between 2.4 Myr to 1.6 Myr cycle have occurred at least the Middle to Late Triassic. In addition, the ~ 2 Myr cycle modulate its amplitude with ~ 10 Myr periodicity with in-phase relation between the two. Similar modulation patterns of ~ 2 Myr cycles from the two independent geologic records indicate convincing evidences for the chaotic behavior of the Solar planets. Because these modulation patterns are different from the results of the orbital models by Laskar et al. (2004, 2011), our records will provide the new and challenging constraints for the orbital models in terms of chaotic behavior of Solar planets.

<https://sites.google.com/site/masayukiikedaswebsite/ikeda-s-wedsite>

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