

## The Geological Orrery: Using Earth's Sedimentary Record to Map the Chaotic Evolution of the Solar System

The Geological Orrery is proposed as an international program to explore the dynamic evolution and stability of the Solar System by recovering geological records of climate change on Earth to empirically constrain numerical solutions for the gravitational system of the Sun, planets, and smaller bodies. Because of the limitations imposed by the n-body problem, the precision of relevant measurements, and the inherently chaotic nature of Solar System, it is presently impossible to constrain the nearly endless number of solutions beyond about 50 million years; but, because the system's history is imbedded in climate records extending billions of years into the past it is potentially possible to massively improve the accuracy of the solutions, excluding those that do not conform to history. Here I will detail a proof-of-concept plan grounded in work on the Triassic-Jurassic Newark and Hartford basin (199-225 Ma) lacustrine records of tropical climate where I have previously shown the empirical modulations of climatic precession are inconsistent with the presently favored numerical solutions in period and phase, but not inconsistent with what is possible because of chaotic drift, thus comprising the first part of my proof-of-concept. The second part of the proof-of-concept consists of testing the Triassic part of the time scale by analysis of the recently recovered cores from the Colorado Plateau Coring Project where abundant U-Pb datable levels are being correlated to the Newark by paleomagnetic polarity stratigraphy. The time scale for the Early Jurassic age part of the Newark record has already been strongly corroborated by U-Pb dated zircons from interbedded lava flows and associated intrusions, comprising the second part of the proof-of-concept. Data from the contemporaneous obliquity-dominated high-latitude (60°) Junggar Basin (Ürümqui, China) suggest that the present  $(s_4 - s_3) - 2(g_4 - g_3)$  secular resonance was in effect, but this must be tested by higher resolution cored records obtained from Greenland and possibly the Junggar Basin correlated to the Newark basin by paleomagnetic polarity stratigraphy, comprising the third part of the proof-of-concept. Should it be possible to so determine both the period and state of the  $g_4, g_3, s_4, s_3$  system, for this 25 million-year long interval, as now seems likely, it should be possible to extend this process to pairs of low and high latitude cores spanning the interval from 50 Ma to 200 Ma and provide what Laskar has called the, "...the ultimate test for the gravitational model..." of the Solar System. By demonstrating the potency of geological tests of celestial mechanical solutions of the gravitational system, a fusion of Astronomy, gravitational theory, and Earth Science becomes possible, having the potential to advance understanding of not just the history and stability of our Solar System, but also provide tests of General Relativity and competing theories, the climate history of other planets in our system, and the habitability of exoplanets. It would also allow "correction" of decay constants of several radio-isotopic systems and provide targets for tuning of geological records and models of Phanerozoic Earth History, transforming geochronology, and paleoclimate. While ambitious by standard Earth Science criteria, The Geological Orrery has the potential to yield fundamental insights into deep physical processes of our Solar System and beyond by providing a new, robust, observational system for competing theories.