PP33C-1335: Solar System Chaos and its climatic and biogeochemical consequences

Wednesday, 13 December 2017
13:40 - 18:00
New Orleans Ernest N. Morial Convention Center - Poster Hall D-F

Insolation changes caused by changes in Earth's orbital parameters are the main driver of climatic variations, whose pace has been used for astronomically-calibrated geologic time scales of high accuracy to understand Earth system dynamics. However, the astrophysical models beyond several tens of million years ago have large uncertainty due to chaotic behavior of the Solar System, and its impact on amplitude modulation of multi-Myr-scale orbital variations and consequent climate changes has become the subject of debate.
Here we show the geologic constraints on the past chaotic behavior of orbital cycles from early Mesozoic monsoon-related records; the ~30-Myr-long lake level records of the lacustrine sequence in Newark-Hartford basins (North America) and ~70-Myr-long biogenic silica (BSi) burial flux record of pelagic deep-sea chert sequence in Inuyama area (Japan). BSi burial flux of chert could be considered as proportional to the dissolved Si (DSi) input from chemical weathering on timescales longer than the residence time of DSi (~100 kyr), because chert could represent a major sink for oceanic dissolved silica (Ikeda et al., 2017).These geologic records show multi-Myr cycles with similar frequency modulations of eccentricity solution of astronomical model La2010d (Laskar et al., 2011) compared with other astronomical solutions, but not exactly same. Our geologic records provide convincing evidence for the past chaotic dynamical behaviour of the Solar System and new and challenging additional constraints for astrophysical models.
In addition, we find that ~10 Myr cycle detected in monsoon proxies and their amplitude modulation of ~2 Myr cycle may be related to the amplitude modulation of ~2 Myr eccentricity cycle through non-linear process(es) of Earth system dynamics, suggesting possible impact of the chaotic behavior of Solar planets on climate change. Further impact of multi-Myr orbital cycles on global biogeochemical cycles will be discussed.

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