

Effect of the Moon on the history of life

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The Earth has a massive satellite Moon, which is not seen in any other planets in the Solar System. The effect of the Moon on the variation of the Earth's obliquity and on the climate is reviewed. The role of the Moon in the history of life on the Earth is also discussed.

The obliquity of a planet should affect the global climate of the planet. The Earth's obliquity varies by 1.3 degree around its mean value of 23.45 degree in a period about 4 times 10^4 years (Laskar & Robutel 1993). The glacial cycle of the Earth has been triggered by the periodic change of obliquity at least during the Quaternary (e.g., Milankovitch 1941). Mar's obliquity is believed to have suffered from a large-scale oscillation with an amplitude as much as 20 degree around its average of 25 degree on a time scale 10^5 - 10^6 years (Ward 1974, Ward & Rudy 1991). Recent Mars exploration has revealed that its ice ages are related with the variation in martian obliquity (Head et al. 2003).

In Solar System, obliquity of terrestrial planets tends to be suffered large variation (Atobe et al. 2004, Icarus, in press). Fortunately, Moon's gravity may control the variation of Earth's obliquity, avoiding large change of the obliquity. If the Earth had not have the Moon, its climate would drastically change, providing a significant obstacle to the development of complex life on the Earth. Reviewing the formation of Earth-Moon system in the course of solar system formation, we also discuss the probability of forming a large satellite like the Moon.