Milankovic Cycles on Mars and the Impact on Economic Exploration

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Abstract

Milutin Milanković established a relationship between the variation in Earth's orbit and insolation, or incoming solar radiation. This variation in insolation correlated well with past ice ages, as evidenced in the geologic record, and today the scientific community generally accepts the importance Milanković cycles serve in forcing climatic change, and the resultant geologic expression. Milanković also extended his work on insolation to other planets, including Mars, and a calculation of Mars' mean temperature. This has led to speculation about a relationship between Mars' insolation and its climate, supported by photographic evidence from Mars' poles. This paper analyzes the Milanković insolation curves for both Earth and Mars, searching for periodic cycles via Fourier spectral analysis of obliquity and precession index. This analysis substantiates the 128,000 and 91,000-year cycles for Earth's precession index and a 40,000-year cycle for Earth's obliquity. Similarly, Mars has a 73,000-year cycle in its precession index and a 128,000-year cycle in its obliquity. Milanković cycles are known to manifest themselves in Earth's record of sediment deposition, which has been a factor in successful economic exploration. Similarly, the Martian periodicity lends itself to predicting climatic change, including Martian ice ages, the resultant geologic expression in basins, and the economic impact on mineral assemblages. However, Mars exhibits a longer Milanković cycle for obliquity and a shorter cycle for precession index, compared to Earth, suggesting either slower or faster changes in its geologic record of sediment deposition. The conclusion of this analysis is a prediction of prime zones for economic development of Martian resources, leading to an exploration plan that includes localities of best return. Mars basins can be modeled using this data, thus predicting sedimentation and its signature in Mars' geologic record.

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