LONG-TERM VARIATIONS OF EARTH'S ORBITAL GEOMETRY AND IT S EFFECT ON THE CLIMATE SYSTEM

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ABSTRACT: Chinese Loess data over the past 2.4 million years are good proxy records for understanding past climate. Maximum entropy spectrum of magnectic susceptibility data at the locality of Luochuan, which is in Shaanxi province of China, have shown periodic fluctuations of about 21 kyr, 41 kyr, 100 kyr and 400 kyr. These periodic fluctuations are related to the long-term variations of earth's orbital elements of the obliquity, the climatic precession and the eccentricity respectively. The data series was separated into two parts to examine the variations of these fluctuations. The first part is from present to 1.1 Myr B.P.(i.e. million years before present), the second part is from 1.1 Myr B.P. to 2.2 Myr B.P. The periodic fluctuation of 93.4 kyr has the maximum amplitude in the first part of the data series, while the periodic fluctuation of 413 kyr has the maximum amplitude in the second part. The fluctuation about the 400 kyr was found in both parts of the data series.

Cross correlation calculations between the eccentricity data calculated from the paleoclimatic astronomical theory and Luochuan susceptibility data have been performed. The prominent spectral peaks of about 420, 123 and 96 kyr, which match the main values of the theoritical eccentricity periods, have been found in the cross correlation spectrum. The amount of cross correlation coefficient attained 0.89 after using digital filter with central frequency 410 kyr. Susceptibility data has the phase lag about 80 kyr.

The fact could be explained by paleoclimatic astronomical theory. Variations of earth's orbital geometry have changed the solar insolation received by Earth in the whole year. Variation of the eccentricity affects the earth's climate by changing the distance between the Sun and the Earth. The 100 kyr cycle is the mean effect of the eccentricity variations. The dominant peak of 100 kyr in the past 1 Myr may be not only relative to the external forcing, but also to the earth's internal processes.

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