LETTERS

Variation of the earth's rotation derived from timing records of solar eclipse in ancient China

In the study of variation of the earth's rotation based on the records of some ancient astronomical events, the timing records of ancient astronomical events and phenomena, such as solar and lunar eclipses and lunar occultation, are important components of the data. The reliable records, especially those from the countries and regions with advanced ancient astronomy and timing technology, contain valuable information on the variation of the earth's rotation. In China, a country with ancient civilization, since not only emperors believed that some phenomena were related to the rise and fall of their dynasties, but also the astronomical events and phenomena were needed for ancient calendars and astrology, great attention had been paid to the observations of solar and lunar eclipses, and the observations and records had a long history. As the timing technology was good and the timing observations were generally recorded by official astronomers, the reliability of Chinese observations data is generally high. Through serious textual criticism and selection, we may probably obtain the significant result for the study of variation of the earth's rotation from the ancient data.

Recently, the authors have made use of the Chinese timing records of solar eclipses occurring before the 8th century AD to study the variation of the earth's rotation. In order to ensure the reliability of our data, we selected the records from the official chronicles of ancient China (the "24 Chronicles") and remade the textual criticism for them. Up till now, we have known that the earliest reliable Chinese timing record of solar eclipse was made in Han Dynasty, the times of the first and last contact of a solar eclipse occurring on August 19, 134 BC were recorded in the chronicle, Han Shu, Wu Xing Zhi. During the following about 900 a till the middle of Tang Dynasty, total 34 reliable records of solar eclipse were collected. Through our textual research, we have found that two of them were duplicated and the date of another one was recorded wrongly, which can be used after being corrected. Since some solar eclipses were recorded for more than one phases, total 45 timing records of eclipse phases of the 32 useful solar eclipses can be used to study the variation of the earth's rotation.

The value of the orbital acceleration of the moon used here is $-26.0^\prime$/century$^2$. We calculated the elements of the solar eclipses based on the ephemeris time (ET) and calculated the universal times corresponding to the times of the ancient records (local solar time). A series of values of $\Delta T$ are obtained, which manifest the long period variation of the earth's rotation speed. The values of $\Delta T$ clearly display the secular slowdown trend

of the earth’s rotation and their distribution is shown in fig. 1. We also got the length

increasing of a day due to the secular slowdown of the earth’s rotation. The average
increasing of length of a day is about 1.5 ms/century (the average epoch of the data is
about 331 AD). The result coincides with the value (average 1.5 ms/century) obtained by
the authors (1994) based on Chinese timing records of lunar eclipses occurring from 221 to
1280 AD and the value (average 1.4 ms/century) obtained by British astronomer, Stephenson
et al. (1989) based on the medieval Islamic records of solar and lunar eclipses in the period
of 829—1019 AD. Probably the result will be significant for studying the secular variation
of the earth’s rotation, especially the effect of non-tidal factor among it and its variation.

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Single-grained zircon U-Pb isotope dating of Precambrian volcanic
rocks in western Zhejiang and its implications*

The Precambrian calc-alkaline volcanic rocks of western Zhejiang Province are

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