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Origin of the Climatic Cycles from Orbital to Sub-Annual: Luminescence proxy data

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We developed a new real- space periodogramme analysis algorithm to calculate, compare and calibrate the real intensity of the cycles in speleothem luminescence time series. We studied variations of the length of these cycles with time by evolutive power spectral analysis.

We studied long cycles in luminescent speleothem records from Jewel Cave, South Dakota, US and from Duhlata cave, Bulgaria 10000 km apart, covering 89300- 138600 yrs B.P. and the last 250000 yrs respectively. These solar insolation proxy records contain orbital cycles of 41, 23 and 19 kyrs and solar luminosity cycles with duration from several centuries to 11500 years. The most powerful non- orbital cycle is 11500 years cycle (as powerful as the 23000 a. orbital cycle in our record). It was found previously to be the most intensive cycle in the delta C-14 calibration record and was interpreted to be of geomagnetic origin. Our recent studies suggest, that this is a solar cycle modulating the geomagnetic field. We determined the Solar origin of the cycles with durations of 11500, 4400, 3950, 2770, 2500, 2090, 1960, 1670, 1460, 1280, 1195, 1145, 1034, 935, 835, 750 and 610 years. It was done by their detection both in proxy records of speleothem luminescence, Δ^{14}C and the intensity of the

geomagnetic dipole. The main variations in the last two records are produced by the solar wind. The longest solar luminosity cycles can produce climatic variations with intensity comparable to that of the orbital variations.

We used the same digital analysis to calculate the intensity of the cycles of the speleothem luminescence (representing cycles of solar radiation or air temperature) in speleothems from Cold Water Cave, Iowa and Rats Nest Cave, Alberta. Obtained power spectra demonstrate that many speleothems recorded cycles of the soil temperature in the region with duration of about 11 and 22 years. These solar cycles produce variations of the solar constant with amplitude of less than 0.4% cosmic rays influence on the atmospheric transparency provides a mechanism of strong multiplication of solar variations on the solar radiation at the Earth's surface. Cosmic rays have strong modulation by the solar wind, which roles their concentration at the Earth.

Luminescence of speleothems from Rats Nest Cave, Alberta reproduce air temperature, but such records from this cave exhibit a strong cycle of 425 years, which is well known from $\Delta^{14}C$ to be an important solar cycle. So it should modulate air temperature as well as cosmic rays flux recorded by $\Delta^{14}C$ variations. The same records contain also the century and bi-century solar cycles.

In addition to the annual cycle produced by the Earth's rotation we found sub- annual cycles with duration of 27, 23 and 14 days in an extremely high- resolution luminescent record from Cold Water Cave, Iowa. Such cycles can be produced by the period of rotation of the Sun, which produces similar variations in the solar wind modulating cosmic rays flux. This period produces periodical appearance of the active zones on the Sun, which are major emitters of solar wind so produce strong variations of its density.