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An absolutely dated high-resolution stalagmite record from Lianhua Cave in central China: Climate forcing and comparison with Wanxiang Cave and Dongge Cave records over the past 2000 years

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A 33-cm long aragonite stalagmite (LHD-1) from Lianhua Cave has been dated by MC-ICPMS ^{230}Th/U method on 41 horizons. Very high U contents (1∼6ppm) and low Th contents yield excellent ^{230}Th/U dates which provide reliable chronology of the stalagmite on sub-decadal time scale over the past 3350 years. A total of 1716 samples have been measured for δ^{18}O and δ^{13}C, spanning annual resolution over the past 1820 years. The stalagmite δ^{18}O is not only influenced by the "amount effect", but also affected by the moisture source. Enhanced the tropical monsoon trough under strong EASM brings higher spring quarter rainfall with isotopically light monsoonal moisture in the cave site, resulting in lighter stalagmite δ^{18}O. On decadal or longer time scales, increased solar activity produces warmer condition and stronger summer monsoon which lead to wet climates. On interannual-to-decadal scales, the Walker Circulation under El Niño conditions during cold periods will shift toward the central Pacific and result in weakening of EASM. Under such a circumstance, dry climates will be prevailed in the study area. Based on the δ^{18}O and δ^{13}C records, we have deciphered climatic and vegetation changes of the study area in decadal scales. The highly precise dated LHD-1 record has been compared with previous published Wanxiang Cave and Dongge Cave records. Although some similarities can be found, there are major discrepancies among the three well-dated records, especially during AD 500-700 and AD 1300-1600. In additional, the major weak monsoon periods defined in the Wanxiang Cave record during late Tang Dynasty, late Yuan Dynasty and late Ming Dynasty are not supported by the LHD-1 record. The heaviest δ^{18}O peaks (more than five continuous heavy values) over the past 2000 years appeared around AD 1990-2003, 1657-1662, 1220-1228, 663-669, 363-370, and 1082-1090 (in the order of heavy to light). None of these periods occurred Chinese dynasty collapse.