High-precision and High-resolution Th-230 Dating for Coral and Speleothem Carbonates by MC-ICP-MS

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To facilitate the measurement of femtogram-quantity U-Th isotopic compositions suitable for highprecision and high-resolution 230Th dating of coral and speleothem carbonates, analytical techniques of multicollector inductively coupled plasma mass spectrometry (MC-ICP-MS) have been developed. The instrumental sensitivities are 1-2%, with a precision of ±1-2‰ (2) for abundance determinations of 50-200-fg 234U (1-4-ng 238U) or 230Th. Measurement consistency of this MC-ICP-MS combined with previous mass spectrometric results on U-Th standards and diverse samples demonstrates the validity of the SEMprotocol method. For fossil corals, a routine U-Th isotopic determination with ‰–level precision requires only 50 mg of carbonate. As little as 200 mg of young coral with an age of less than 20 yrs can be dated with a precision of ±0.3-0.8 yr. About 20-200-mg speleothem samples with sub-ppm-to-ppm U are required to earn a 5‰ precision on ages from 5-100 kyrs. Requirement of small sample size, 10s-100s mg carbonate, can permit high temporal resolution to date speleothems with slow growth rates, such as 1-10 mm/kyr. This high-precision 230Th chronology is critical to accurately establish age models, date events and splice geochemical proxy time series records from multiple samples in the fields of paleoclimatology and paleoceanography.

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