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Hydrogen Stable Isotope Analysis of Speleothem Fluid Inclusions

Speleothems are secondary calcium carbonate chemical deposits formed in caves. If formed under isotopic equilibrium conditions, speleothem stable carbon and oxygen isotopic compositions can be used as paleoclimatic indicators. Conventionally, speleothem stable isotope geochemistry involves studies on variations in oxygen and carbon isotopic compositions along the growth axis, which can only provide qualitative paleoclimate information, e.g., general variation and trends, such as warmer or cooler, drier or wetter, as compared with modern data. Fortunately, speleothems usually contain inclusions of water of varying amounts, which are believed to be trapped samples of cave water derived from local precipitation. Therefore, study of speleothem fluid inclusions can not only directly reveal the isotopic signal of paleoprecipitation, but also determine the absolute deposition temperatures of the speleothem, which are approximately equal to local mean annual surface temperatures. Clearly, such absolute paleotemperature records have great advantages over the qualitative paleoclimate records obtained by conventional methods.

There are so far about 5 laboratories around the world which have facilities to extract speleothem fluid inclusions, but none is in the United States. The main purpose of this project is to build up an up-to-date speleothem fluid inclusion extraction line at Baylor University, which will not only extend our analytical service from oxygen and carbon istopic analysis of carbonates to hydrogen isotope analysis of speleothem fluid inclusions, but also may complement and enhance the current Baylor Terrestrial Paleoclimatology Research Program in the Geology Department. This is because carbonate speleothems, in comparison with other paleoclimatic proxies, are well-preserved, broadly-distributed, easy to access and handle for both sampling and analytical purposes, and can be dated accurately and precisely; they thus have great potential in both regional paleoclimate history reconstruction and global paleoclimatic model/events correlation and refinement. Furthermore, the completion of this project may help other faculty members of the Department to study fluid inclusions contained in sedimentary rocks.