



Stable hydrogen isotopic composition of hydrocarbons in torbanites (Late Carboniferous to Late Permian) deposited under various climatic conditions

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Abstract

We measured the stable hydrogen isotopic composition (δD) of selected aliphatic compounds in torbanites from Scotland and Australia, covering the Late Carboniferous to the Late Permian. The torbanites contain organic matter predominantly from a single algal source, *Botryococcus braunii*, and are of similar thermal maturity. The δD values of *n*-alkanes in the extracts appear to reflect the depositional palaeoclimate of each torbanite, in response to the typical δD values of meteoric waters. The δD values of *n*-alkanes in torbanites deposited at high latitude under glacial conditions are depleted in deuterium by up to 70‰ relative to *n*-alkanes in a torbanite deposited at low latitude under a tropical climate regime. Torbanites deposited in mid-latitude regions under cool-temperature conditions contain *n*-alkanes with δD values between those of *n*-alkanes in tropical and glacial sediments. A saw-toothed profile of δD values obtained for the *n*-alkanes in the Australian torbanites is attributed to a dual-source system, perhaps a predominant *B. braunii* input with a second minor contribution from land plants. Pristane and phytane from two Australian torbanites are significantly depleted in deuterium relative to *n*-alkanes in the same samples and a significant difference between the δD values of pristane and phytane is suggested to be caused by different sources for the two isoprenoids, or isotope effects associated with their derivation from a common phytol precursor. The offset between the δD of values of *n*-alkanes and isoprenoids is similar to that found in modern biological samples, indicating that their indigenous δD signatures may have been preserved for at least 260–280 million years.