Dating diagenetic monazite in mudrocks: constraining the oil window?

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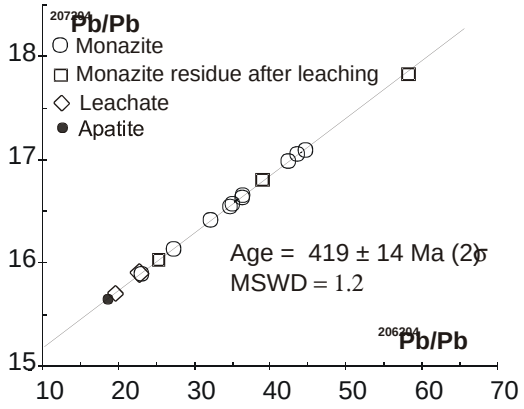
Authigenic monazite nodules, increasingly recognised in Pre-Mesozoic mudrock successions, provide a means for dating diagenesis by exploiting trace uranium within the monazite structure. But, dating is difficult in practice because of zonation and abundant host rock inclusions. We report here a refined technique that has yielded a date of 419 ± 14 Ma 2σ MSWD = 1.2 for a 17-point Pb-Pb regression age from a Telychian (Silurian: late Llandovery c.430 Ma) mudrock from central Wales.



SHRIMP analyses of the same material are consistent with this, and additionally demonstrate concordance of the U-Pb and Th-Pb systems. These results open the door to providing robust dates for a phase of burial related diagenesis, which, in Wales, seems approximately coincident with hydrocarbon expulsion.

Determination of variations in isotope ratios of Hg

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The question of whether Hg isotopes are fractionated to a measurable degree in natural environments by chemical, physical and biological processes remains unanswered. If isotopic signatures of Hg from various anthropogenic sources or environmental compartments are different, it may be possible to fingerprint Hg, partitioning accumulated Hg according to source.

Recent development of multicollector-ICP-MS (MC-ICP-MS) instruments makes it possible to measure isotope ratios of Hg with high precision. MC-ICP-MS has been used primarily in geological applications, and only recently has its potential for environmental applications begun to be explored. Measurement of high precision isotope ratios in environmental matrices presents a different set of challenges. Given the low concentrations of Hg in environmental media and the very small differences between ratios that we expect to find, sample introduction without contamination is a major problem to be overcome.

Mercury can be introduced to the MC-ICP-MS as a liquid, or vapour via hydride generation or directly after trapping and thermal desorption on gold traps. Each of these techniques has limitations with respect to isotope ratio measurement. We will discuss some of these limitations. Our preferred approach is the gold trapping method. As will be demonstrated, this technique minimizes potential for sample contamination. The major drawback is the necessity to work with transient signals, usually considered detrimental to measurement of high precision isotope ratios. However, our work suggests that acceptable precision can be achieved using transient signals, while maintaining the veracity of the original isotopic signature.

Hg isotopic signatures vary by more than 1‰ per AMU across a range of sample types. However, the differences are very small, and external variation among replicate samples is high. In part, this variability is attributable to the transient signals. The potential for blurring of signatures from external contamination remains a serious issue. Further work will be required to develop simple, standardized methods for Hg isotope ratio determination.