

## Uranium distribution in meteorites and Pb-isotopic dating

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Modern U-Pb geochronology of terrestrial rocks is based on dating single mineral species and, to a large extent, single grains of minerals that concentrate U and exclude Pb, and are resistant to migration of radiogenic Pb. In contrast, meteorites are usually dated by analyses of whole rock samples or complex multi-mineral aggregates such as chondrules and CAIs. Interpretation of these dates as rock crystallisation, or cessation of diffusion, or a secondary event depends on knowing host minerals of U and radiogenic Pb.

At the concentration level of 10-100 ppm typical for chondrules, CAIs and most achondrites, U (and Th) concentrations can be mapped using a large ion microprobe with a detection limit of ~0.5 ppb [1]. Mapping chondrules from carbonaceous and ordinary chondrites shows that the principal hosts of U and Th are mesostasis and Ca-rich pyroxene. The most abundant minerals, olivine and Ca-poor pyroxene, usually have U concentration below 0.5-1 ppb. Distribution of U between minerals in CAIs is more uniform.

Application of these data to interpretation of Pb-isotopic dates is complicated by using multi-step partial dissolution, which is necessary for removal of non-radiogenic Pb. Matching chemical composition of step leachates to sequential dissolution of minerals may be possible [2] but is not straightforward due to likely incongruent dissolution of the minerals. For the partial leachates that contain sufficiently radiogenic Pb, comparison of directly measured and model Th/U ratios helps to recognise multiple host minerals of U, and can indicate whether the minerals dissolved congruently. Variations in concordance of the U-Pb isotopic systems can further help to recognise U-Pb fractionation that occurred during partial dissolution and/or in nature.

No single approach yields comprehensive data on U distribution in meteorites. In-situ mapping of U distribution by spot analyses is likely to miss important U carrier minerals that occur as rare small grains (e.g. apatite, perovskite), and interstitial material is difficult to analyse accurately, therefore comparison to whole rock and bulk mineral U concentrations and to U distribution between the leaching steps is necessary. An additional, yet unexplored, approach is imaging and analysis of polished meteorite surfaces leached in a procedure simulating step dissolution.

[1] Amelin Y. *et al* (2003) *34th LPSC*, 1200 [2] Connelly J. N. and Bizzarro M. (2009) *Chemi. Geol.* **259** 143–151