How recently did fluid flow occur on CV and CM chondrites?

SIMON TURNER[1*], LUCY MCGEE[1], MUNIR HUMAYUN[23]

[1]Department of Earth and Planetary Sciences, Macquarie University, Sydney 2109, Australia (*correspondence: simon.turner@mq.edu.au)

[2]Department of Earth, Ocean and Atmospheric Science and National High Field Laboratory, Florida State University, Tallahassee, FL, USA

What is the true Th/U ratio of the solar system and what was the timing of the last alteration of fragments (CM chondrite meteorites) of the solar system? It is well documented that carbonaceous chondritic meteorites, particularly the CI, CM and CR subtypes, are aqueously altered and that the timing of this alteration was a few Ma after CAI (calcium-aluminium rich inclusion) formation in the early solar system. Thus, this must have occurred on the parent body. However, for some CI's, CM's and CR's, it has never been shown that aqueous alteration really ever ceased and the fluid-mobile nature of U means that this most certainly affected U/Th ratios. Some of these meteorites have cosmic-exposure ages of 200 kyr or less which fortuitously lies within the accessible time range of U-series disequilibria (especially ^{238}U-^{234}U-^{230}Th). Thus, we have begun to analyse U-series isotopes in sequential leachates and the final leached solid residue of selected CM chondrite falls to assess whether aqueous alteration continued on the parent body until recent times. We have undertaken bulk U-Th isotope determinations on the Allende (CV3) powder available from the Smithsonian Institute. The results provide a precise Th/U ratio of 3.54, higher than earlier estimates (e.g. Rochall and Jochum, 1993). They also show that the U-Th system (half life = 75 kyr) is in secular equilibrium within analytical error - (^{238}U/^{230}Th) = 0.996. What is striking is that the ^{238}U-^{234}U system (half life = 245 kyr) shows marked (17%) disequilibria with (^{238}U/^{234}U) = 1.170. On face value this implies addition of labile ^{235}U within the last 1 Myr. This is younger than some consmogenic exposure ages for Allende and, if correct, implies that fluid-alteration was persistent up until and potentially after separation of the meteorite from its parent body. Conseuqntly commenced a detailed, mass spectrometric analytical program to investigate the Th/U ratios and ^{238}U-^{234}U-^{230Th} disequilibria in a suite of Cm chondrites.