IODINE-XENON CHRONOMETRY OF H CHONDRITES.

S. A. Crowther[1], K. J. Theis[1], M. Schönbächler[2] and J. D. Gilmour[1], [1]School of Earth, Atmospheric and Environmental Sciences, The University of Manchester, Manchester, UK (sarah.crowther@manchester.ac.uk), [2]Institut für Geochemie and Petrologie, ETH Zürich, 8092 Zurich, Switzerland.

Introduction: There is evidence to suggest that thermal metamorphism of the H chondrite parent body took place according to the so-called "onion-shell" model [e.g. 1-3]. However, there is debate about the accuracy of this model, and Scott et al. [4] concluded that the H chondrite parent body did not cool as an undisturbed onion-shell structure. Among their arguments they note that cooling rates do not correlate with petrologic type. They also show that the H4 chondrites used to develop the onion-shell model, Ste. Marguerite, Forest Vale and Beaver Creek, underwent periods of very rapid cooling which could only be achieved through impact disturbance.

The I-Xe chronometer [5] enables us to investigate the timing and sequence of events that occurred in the first few million years of Solar System evolution with high resolution. In this study, we determined I-Xe ages of H chondrites to constrain the history and thermal evolution of the H chondrite parent body. We have previously reported I-Xe ages of mineral separates from Allegan (H5) [6], Forest Vale (H4) [7], and an orthopyroxene separate from Ste. Marguerite (H4) [7]. Here we present ages of further mineral separates from Ste. Marguerite.

Experimental: I-Xe dating relies of the decay of ^{129}I to ^{129}Xe ($t_{½}$ = 16.1 Ma). Samples are artificially neutron irradiated prior to analysis, to convert stable ^{127}I to ^{128}Xe. This allows the simultaneous measurement of ^{129}Xe produced from the decay of ^{129}I and ^{127}I as ^{128}Xe, the ratio of which is proportional to the ^{129}I/^{127}I ratio at the time of closure to Xe-loss. From this ratio, a relative age in relation to other material can be determined. The absolute age is calculated by reference to enstatite from the aubrite Shallowater, which is used as the irradiation standard, and has an age of 4562.7 ± 0.3 Ma [8]. Mineral separates were produced by crushing and hand picking of individual grains. Samples were analysed using the RELAX mass spectrometer [9, 10].

Results and Discussion: All Ste. Marguerite mineral separates produced well defined I-Xe ages (Table 1). With the exception of the clinopyroxene, the ages of the samples analysed in this study are all within uncertainty of each other. The plagioclase age determined here is slightly older than the previously reported feldspar age [11].

Sample	Relative age (Ma)	Absolute age (Ma)
Plagioclase	1.72 ± 0.16	4564.4 ± 0.3
Olivine	2.08 ± 0.31	4564.8 ± 0.4
Enstatite	1.72 ± 0.16	4564.4 ± 0.3
Orthopyroxene	1.62 ± 0.19	4564.3 ± 0.4
Clinopyroxene	-1.7 ± 1.7	4561.0 ± 1.7
Phosphate [11]	-1 ± 6	4562 ± 6
Feldspar [11]	0.7 ± 0.4	4563.4 ± 0.5

Table 1. I-Xe ages of Ste. Marguerite mineral separates. A positive relative age indicates a sample is older than Shallowater, a negative age indicates that it is younger. Phosphate and feldspar ages are from a previous study [11].

These data, combined with our Allegan [6] and Forest Vale [7] data and other literature data, suggest thermal evolution of the H chondrite parent body was more complicated than can be accounted for by the simple onion-shell model. A trend of more metamorphosed meteorites having younger radiometric ages than less metamorphosed material is observed among some samples: Ste. Marguerite and Forest Vale I-Xe ages are older than the corresponding ages for Richardton (H5) and Kernouve (H6) [11], for example. However this trend is not universal: the oldest age determined in this study is that of Allegan pyroxene, and it is very difficult to account for this being older than the H4 samples within the constraints of the onion-shell model. The Ste. Marguerite and Forest Vale I-Xe ages are very similar to the corresponding Mn-Cr [12, 13] and Pb-Pb ages [14] (taking into account recent revisions to Pb-Pb ages [e.g. 15, 16]), implying a period of rapid cooling, most likely due to impact disruption of the parent body, as also identified by [4]. However rapid cooling is not ubiquitous among the H chondrites: I-Xe and Pb-Pb ages for Richardton (H5) [11, 14], for example, imply that it cooled more slowly.

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