# FIRST I-Xe AGE OF A NEW SUITE OF LARGE IGNEOUS INCLUSIONS IN ORDINARY CHONDRITES.

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**Introduction:** Large inclusions consisting of either clasts (rock fragments) or macrochondrules (unusually large chondrules) are found in around 4 % of ordinary chondrite meteorites [1]. Many of these have igneous textures, but their origins are unclear. The oxygen isotopic compositions and major element compositions of most inclusions are broadly similar to ordinary chondrites and chondrules, although not necessarily the same as that of the host meteorite [e.g. 2], whereas other inclusions have distinctly different compositions that could be the result of igneous differentiation [3]. Some may have formed on early, differentiated parent bodies which were disrupted (most likely by impacts) and fragments subsequently incorporated into the chondrite parent bodies [e.g. 1-4], but others show no evidence that they were produced by igneous differentiation [5].

A suite of inclusions extracted from ordinary chondrite meteorites have been characterised using a variety of techniques: their petrology, bulk chemical compositions, trace element compositions and oxygen isotopic compositions have been determined [6, 7]. Data suggest that the samples in this suite are not the result of igneous differentiation [5]. The majority can be subdivided into four groups based on their chemical compositions: vapor-fractionated (*Vfr*), unfractionated (*Unfr*), K-enriched but otherwise unfractionated (*Unfr+K*), and feldspar-rich (*FldR*) [6]. The I-Xe chronometer [8] enables us to examine the timing and sequence of events that occurred in the first few million years of the Solar System with high resolution. In this work we are examining the I-Xe ages of a subset of inclusions from this suite, to shed new light on the timing of events in the early Solar System, and the histories of these objects.

**Experimental:** I-Xe dating relies of the decay of $^{129}$I to $^{129}$Xe ($\tau_{½}$ = 16.1 Ma). The aim is to determine the $^{129}$I/$^{127}$I ratio at the time of closure to Xe-loss. Samples are artificially neutron irradiated prior to analysis, to convert stable $^{127}$I to $^{128}$Xe. This allows for the simultaneous measurement of $^{129}$Xe produced from $^{129}$I decay and $^{127}$I as $^{128}$Xe. The $^{129}$Xe*/$^{128}$Xe* ratio (* denotes an excess due to radiogenic effects, i.e. production from iodine) is directly proportional to the $^{129}$I/$^{127}$I ratio, and from this 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, the absolute age of which is 4562.7 ± 0.3 Ma [9]. Following irradiation, analyses of the xenon isotopic compositions of these inclusions are currently in progress using the RELAX mass spectrometer [10, 11].

**Results and Discussion:** A 1.61 mg fragment of an inclusion from the LL3.7 chondrite Richfield (Rfd-I1, fragment B) is the first to be analysed in this work. It is classified as a vapor-fractionated (*Vfr*) droplet or megachondrule. Geochemical-textural data suggest that this inclusion experienced evaporative heating as a free-floating droplet. $\Delta^{17}$O is somewhat low compared to H, L and LL ordinary chondrites and compared to most chondrules, similar to other inclusions with broadly similar composition [6]. It has been suggested that this was caused by exchange with nebular gas of distinct oxygen isotopic composition [6].

Rfd-I1 contained negligible, if any trapped xenon. Low temperature heating steps were dominated by large quantities of uncorrelated $^{128}$Xe, and $^{131}$Xe attributed to neutron capture on $^{130}$Ba. Excess $^{129}$Xe derived from $^{129}$I was extracted in mid and high temperature heating steps. The heavier isotopes were dominated by a fission component at high temperature, the major source of which is likely to be neutron induced fission of $^{235}$U. $^{128}$Xe*/$^{129}$Xe ratios show evidence of shock, which is known to effect the I-Xe system, with iodine and xenon being redistributed differently [12]. As such it is difficult to determine a precise I-Xe age, but the data suggest that this object closed to xenon-loss ~0.6-2.2 Ma after CAI formation, consistent with it having cooled rapidly at an early stage. This supports the hypothesis that Rfd-I1 is an unusually large chondrule, which formed at about the same time as most other chondrules.

Analyses of other samples from this suite of ordinary chondrite inclusions are currently in progress.

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