A REGOLITH ORIGIN OF "PRE-IRRADIATION" OF MURCHISON CHONDRULES.

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Introduction: Individual chondrules in meteorites sometimes have nominal cosmic ray exposure (CRE) ages which strongly differ from each other [e.g. 1-2]. Two hypotheses have been put forward to explain this; (1) some chondrules recorded pre-irradiation by the early active sun prior to meteorite parent body accretion [2], and (2) some chondrules experienced 2π irradiation in the parent body regolith by mostly galactic cosmic rays [1,3]. Here we investigate this issue further by determining cosmogenic ^{3}He and ^{21}Ne in individual chondrules from within a lithic fragment, so called "primary rock" fragment and from the surrounding clastic matrix in Murchison. Primary rock fragments are thought to have remained one unit during regolith history [4], hence, all chondrules within such a fragment will share regolith history. Therefore, if additional irradiation happened in the regolith all chondrules within a primary rock fragment are expected to have the same nominal CRE ages. If pre-irradiation by an early active sun occurred prior to accretion, then chondrules from within the fragment are expected to have similar distributions in nominal CRE ages as chondrules from the surrounding clastic matrix.

Methods: Chondrules were separated by freeze-thaw cycles, chondrule rims, rich in trapped noble gases [e.g. 5], were removed in an ablation cell [1] and sample masses were measured on a microbalance. Chondrules were melted with an IR- laser and He and Ne analyzed with a high-sensitivity compressor-source mass spectrometer [6]. Twenty-six chondrules were analyzed each from the primary rock fragment and the clastic matrix.

Results and Discussion: All chondrules from the primary rock fragment have a ^{21}Ne CRE age of ~2 Ma, close to the bulk CRE age of Murchison [e.g. 7], whereas 4 chondrules with higher nominal CRE ages (up to ~20 Ma) were found in the clastic matrix. Cosmogenic ^{3}He gives a similar picture as $^{21}Ne_{cos}$, though generally with slightly lower nominal ages. Roth et al. [1] found 7 out of 38 chondrules in Murchison with significantly higher nominal CRE ages than the bulk rock. Assuming this fraction (~17%) to be representative for Murchison chondrules in general, the probability to not pick a single high-age chondrule out of our sample of 26 primary rock chondrules is only ~1%. Thus, the difference between the two data sets is real and provides clear evidence that additional irradiation of chondrules in Murchison occurred in the parent body regolith. This confirms conclusions drawn from solar cosmic ray tracks in olivine grains, which occur exclusively in the clastic matrix [8]. Hence, chondrules in CM chondrites with different nominal CRE ages should not be used as evidence for irradiation by an early active sun.

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