

COSMOGENIC NUCLIDES IN IAB IRONS – EXPOSURE AGES AND NOBLE GAS PRODUCTION IN METAL-SHIELDED SILICATES.

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Introduction: Cosmogenic nuclides are produced by interactions of cosmic rays with meteoritic target elements. While production rates are well known for most major elements in stony and iron meteorites, those for silicates embedded in metal are scarce due to the difficulty of modelling the influence of the bulk chemical composition on the cosmogenic nuclide production (matrix effect [1]). While large matrix effects have been calculated for the production of ²¹Ne from Mg (up to 100% higher production compared to chondrites because of larger amounts of secondary neutrons due to high Fe-Ni contents) [e.g., 2], also distinctly lower ones have been estimated, e.g., for the Chinguetti stony iron [3]. We compare exposure ages deduced from cosmogenic He, Ne, and Ar from the metal and silicate phases of Landes and Ocotillo using literature production rates to test their validity and to better constrain the influence of bulk chemistry on cosmogenic nuclide production in IAB irons.

Exposure ages and matrix effects: For exposure age calculation we used ²¹Ne and ³⁸Ar production rates from [2] and slightly adjusted ³He rates from [4], both taking into account matrix effects. Metal ³⁸Ar ages are most robust with respect to target chemistry and are 160 and 500 Ma for Landes and Ocotillo (both ± 15%). They agree well with metal ³He and ²¹Ne ages and silicate ³⁸Ar ages. Silicate ²¹Ne and in particular ³He ages are distinctly higher than the metal ages. Presuming identical exposure ages for metal and silicates, the ²¹Ne production rates, and thus the matrix effects, would need to be even higher than the ones given in [2]. This is in contrast to the results from a “Berne Plot” (³He/²¹He vs. ²²Ne/²¹Ne): The silicate data points of Landes and Ocotillo lie well off the modelled data field adjusted to IAB silicate chemistry, which can be explained by matrix effects of ~15% (assuming only minor effects for ³He).

Conclusion and Outlook: Argon-38 exposure ages for Landes and Ocotillo metal phases are ~160 Ma and ~500 Ma, respectively. The production rates of [2] and [4] yield consistent metal ³He, ²¹Ne, and ³⁸Ar ages for Landes and Ocotillo. Applying ³He and ²¹Ne production rates to our silicate inclusions yields distinctly higher ages than those of the metal phases, independent from the silicate chemistry used. This is in contrast to the rather low matrix effects suggested from silicate ³He/²¹Ne ratios. Therefore, we plan to re-model those production rates including matrix, shielding, and meteoroid size effects. If the discrepancy remains, preirradiation of the silicate inclusions needs to be considered. Therefore, the IAB iron meteorite Caddo County with a cosmic ray exposure age of only ~5 Ma [5] will be included in the study. We also plan to determine ³⁶Cl-³⁶Ar exposure ages, which are largely independent from the above effects and will thus serve as absolute ages, against which the noble gas production rates can be calibrated.

References: [1] Begemann F. and Schultz L. 1988. *Lunar & Planetary Science Conference XIX*: 51-52. [2] Masarik J. and Reedy R.C. 1994. *Geochimica et Cosmochimica Acta* 58:5307-5317. [3] Welten K.C. et al. 2001. *Meteoritics & Planetary Science* 36:939-946. [4] Leya I. et al. 2004. *Meteoritics & Planetary Science* 39:367-386. [5] Takeda H. et al. 2000. *Geochimica et Cosmochimica Acta* 64:1311-1327.