UPDATE ON RECOIL LOSS OF SPALLATION PRODUCTS FROM PRESOLAR GRAINS. U. Ott[1], M. Altmaier[1,2], U. Herpers[3], J. Kuhnhenn[3], S. Merchel[1,4], R. Michel[5], and R. K. Mohapatra[1], [1]Max-Planck-Institut für Chemie, Becherweg 27, D-55128 Mainz, Germany (ott@mpch-mainz.mpg.de), [2]present address: Forschungszentrum Karlsruhe, D-76021 Karlsruhe, Germany, [3]Universität zu Köln, D-50674 Köln, Germany; [4]present address: Bundesanstalt für Materialforschung und –prüfung, D-12205 Berlin, Germany, [5]Universität Hannover, D-30167 Hannover, Germany.

Introduction: Presolar grains can possibly be dated by analysis of cosmogenic nuclides produced during residence in the interstellar medium [1]. Among the critical parameters entering in this approach is the extent to which spallation products are retained in grains of about µm-size, and in previous reports of ^{21}Ne ages [1,2] losses have probably been seriously underestimated [3]. As suggested in [3], the recoil range of spallation Xe produced on the relative abundant barium in SiC is significantly shorter and may offer a better hope for dating presolar silicon carbide [4].

New experiments: Recoil data in our previous experiments were obtained with protons of 1600 MeV [3] and 1200 MeV [4], respectively. However, much of the production may have occurred at lower primary energy, details depending on the relevant cosmic ray energy spectrum in interstellar space [5]. Here we report on additional experiments with protons of lower energy, using the catcher technique as in [4]. The results are summarized in Table 1.

Table 1. Recoil range of spallation products in silicon carbide as directly determined in dispersed SiC grains [3] and as inferred from experiments using Ba glass targets and the catcher technique [4; this work].

proton energy	target element	recoil nucleus	recoil range	source
1600 MeV	Si	^{21}Ne	~ 2.5 µm	[3]
1200 MeV	Ba	^{126}Xe	~ 0.16 µm	[4]
267 MeV	Ba	^{126}Xe	~ 0.21 µm	this work
66 MeV	Ba	^{127}Xe	< 1.7 µm	this work
66 MeV	Si, Al	^{22}Na	~ 2 µm	this work

Xe produced at 267 MeV. A barium glass target as in [4] was sandwiched between aluminum foils. Fractions of ^{126}Xe found in the forward and backward catcher foils were ~ 6×10^{-5} and 2×10^{-6}, resp., with a mass dependence for the various Xe isotopes as in [4]. The inferred range for ^{126}Xe in SiC is ~ 0.21 µm. This is longer than the range derived in the 1200 MeV experiment, but may be more reliable, because in this work target and catcher foils were analyzed in the same mass spectrometer using the same standard for calibration so that the uncertainty in the absolute amount of calibration gas cancels.

Xe produced at 66 MeV. Only little xenon is produced by spallation at this low energy. A not very useful upper limit (≤ 1.7 µm) for the range of (radioactive) ^{127}Xe is inferred from an upper limit for its abundance in the catcher foils, which for this irradiation consisted of carbon.

^{22}Na produced at 66 MeV. Sodium-22 was produced in the Ba glass primarily on Si (16.2 weight %) and Al (2.96 %). Count rates in the carbon catcher foils were low and corrections for background ^{22}Na significant, especially for ^{22}Na emitted in backward direction, which after correction was zero within error. Formal calculation implies a range in SiC between 1.0 and 2.5 µm, with a value towards the upper end most likely if reasonable values for the ratio of forward to backward emitted recoils are assumed. The result is consistent with that for ^{21}Ne in the 1600 MeV experiment [3], and there is no indication for a significantly shorter range for neon produced at ~ 70 MeV.

Conclusions: Ranges determined at higher energies are also valid at energies as low as 70 MeV. In addition - with cross sections dropping sharply below ~ 200 MeV - production of Xe is less dependent on the cosmic ray energy spectrum than that of Ne. Hence it is clearly better suited as a measure of presolar cosmic ray exposure.

References: [1] Tang M. and Anders E. (1988) *Ap. J., 335*, L31-L34. [2] Lewis R. S. et al. (1994) *GCA, 58*, 471-494. [3] Ott U. and Begemann F. (2000) *MAPS, 35*, 53-63. [4] Mohapatra R. et al. (2001) *LPS,* XXXII, #1296. [5] Reedy R.C. (1989), *LPS, XX*, 888-889.