NITROGEN ELEMENTAL AND ISOTOPIC ANALYSIS OF GENESIS TARGETS. B. Marty, L. Zimmermann and P. Burnard, CRPG-CNRS, B.P. 20, 54501 Vandoeuvre lès Nancy Cedex, France; bmarty@crpg.cnrs-nancy.fr

Introduction: The goal of the Genesis mission is to determine the solar isotopic composition of some key elements in order to document the protosolar nebula and, by comparison, to investigate planetary formation processes that have led to the observed isotopic structures in planets and meteorites. These elements are, in order of priority, oxygen, nitrogen, noble gases etc. We have developed a new analytical system in CRPG Nancy designed to analyse nitrogen together with noble gases (He, Ne and Ar). Our analytical blank allow us to investigate N components presents in gold-over-sapphire (AuoS) targets. We report tests we did on several different target chunks, including ^{15}N implants, spare flights and flown samples.

Experimental: Samples were cleaned in Open University (UK) by Stephen Sestak in an ozone chamber. Samples were handled in CRPG in a clean room (class 100 during loading in the laser chamber). The new line, partly automated, is made exclusively of stainless steel, Pyrex$^{@}$ and quartz, and is pumped by fluid-free pumps (residual pressure : 1.2 10^{-9} Torr). Targets were ablated with a UV laser having a wavelength of 193 nm. N_2 was concentrated on Pt at low temperature, then purified over CuO cycled gently at 450°C - 750°C - 450°C, and oxidized species are cryogenically trapped. Noble gases were purified classically in another section of the line. The analysis was done with a slightly modified noble gas static mass spectrometer. We used a low ionisation energy (trap current of 100 µA) in order to get a sufficiently long N_2 half-life. We analysed N isotopes at masses 28, 29 and 30 using a combination of Faraday and electron multiplier detectors. A mass resolution of 650 allowed complete separation of hydrocarbons from N_2+CO, and signals were corrected from CO using a classical mixing approach. Errors were systematically propagated using a Monte Carlo method. We checked, in the case of solar wind irradiated samples, the impact of varying the C and O isotope compositions of C and O in CO within ranges of possible solar values, and found that, given our typical N_2/CO mixing ratios, the effect could be a few per mil maximum, well below the observed variations. The system is calibrated with pipettes of atmospheric N_2 and noble gases which amounts are adjusted to the level of analysed gases. The ultimate procedural blanks including 30 mn static in the laser chamber are $5.6 \pm 0.7\ 10^{-13}$ mol $^{28}N_2$ (2-3 10^{-13} mol $^{28}N_2$ in the purification section and the rest in the laser chamber), with $\delta^{15}N = -22 \pm 15$ per mil (n = 10), thus allowing the analysis of solar wind (SW) N (expected amount : 1.7×10^{-12} mol SW $^{28}N_2/cm^2$).

^{15}N implants: AuoS spare targets implanted with ^{15}N at energies mimicking those of SW N (supplied by the Genesis team) were ablated over surfaces of typically 1 mm^2 in order to avoid ^{15}N memory effects in the line. The recovery yield was well reproducible at 80 % (4 runs) for 50 laser pulses per area and decreased for lower pulse numbers. The missing 20 % are likely to have been backscattered according to ion implantation simulations.

SW Ne in flown target: In order to test the recovery procedure on flown targets, we analysed SW Ne sequentially extracted from flown target 60132. Several areas were ablated with variable number of pulses. The release pattern of SW Ne (characterized using the $^{20}Ne/^{22}Ne$ ratio) is in fact comparable to that of ^{15}N implant, showing that 50 pulses are necessary for 100 % recovery (relative to the Ne content of Genesis targets measured by Univ. Washington at St. Louis and ETH Zurich, corrected for backscattering). From this recovery yield, we estimate that each 1 µJ pulse ablates a depth of approx. 1~2 nanometres. Depth profiling of SW ions was further investigated on a single surface area that was ablated sequentially, gases being analyzed after each given number of pulses. Thus we obtained depth profiles for N and noble gases over the range of solar wind implantation.

Nitrogen in AuoS targets: We analysed nitrogen in one flight spare sample (that is, a sample that was kept on the ground, ref : 3AuoS00813.1, hereafter labelled spare 813) and in one flown sample (ref: 60134, 30 mm^2) by sequential ablation.

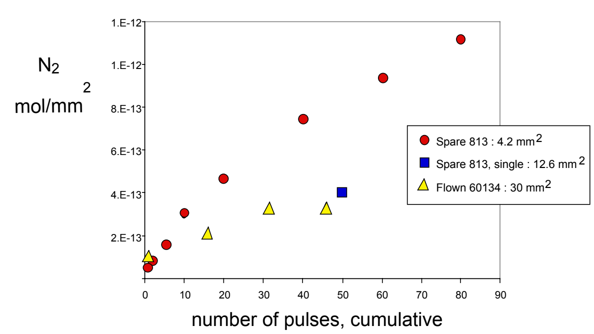

Fig. 1 : cumulative nitrogen release as a function of cumulative number of pulses (≈ depth). for two areas in spare 813 and one area in flown 60134.

Spare 813 was analysed on a single run with 50 pulses and then on another surface area with incremental pulse count. Flown 60134 was also incrementally analysed, and results show that for both types of samples the cumulative amount of nitrogen increased with the cumulative pulse count (Fig. 1), strongly suggesting that in both cases a significant amount of N is volume-correlated within the target for both spar and flown samples. Further evidence for a non-solar nitrogen component arises from the volatile element release pattern from flown 60134 (Fig. 2).

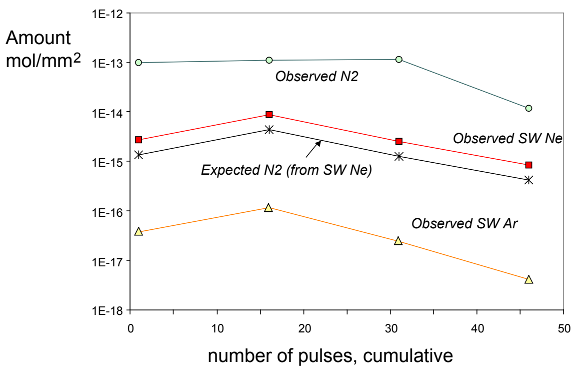

Fig. 2 : Observed nitrogen and noble gas release patterns from flown sample 60134 as a function of the cumulative number of pulses (≈ depth).

Significant quantities of nitrogen well above blank levels are released within the depth interval expected for SW ion release. However, the amount of N exceeds by 1~2 orders of magnitude the amount expected for implanted SW N for the exposure duration (computed from SW Ne). Thus only a few % SW N is released together with SW noble gases in this experiment. The other source of N will be characterized at the Conference using measured N isotopic ratios.

Conclusion: Our system allows us to analyze quantitatively N and noble gas amounts and isotopes in Genesis AuoS targets. The present results suggest that significant amount of N presumably of terrestrial origin are present in both spare targets and flown targets. Because this non-sol ar N component appears to be volume-correlated, it is unlikely to be the result of the crash. This complication will require careful analysis of nitrogen amount and isotopic ratio together with those of noble gases. Because the level of non-solar N is quite high for the two samples analyzed so far, special attention should be given to the analysis of concentrator target material. More targets are presently analyzed and isotopic data will be discussed at the Conference.

This study is funded by the Centre National d'Etudes Spatiales (CNES), the Centre National de la Recherche Scientifique, and the Région Lorraine. We are undebted to the members of the Genesis Team, in particular D.L. Burnett, A. Jurewicz, J. J.H.Allton and S. Sestak