Measurement of ^{26}Al at the South Pole ◇

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1. Introduction

Our aim was the determination of the terrestrial input of interplanetary dust by a measurement of the radionuclide ^{26}Al ($T_{1/2}$ = 726 ka). In contrast to ^{53}Mn, ^{26}Al is also produced in the atmosphere in a comparable amount to the expected input from interplanetary dust. Therefore the atmospheric production has to be determined, too.

2. Production in the atmosphere

^{26}Al is produced in the atmosphere mainly by spallation on argon. To determine the atmospheric production rate the proton induced cross sections for the reaction ^{40}Ar(p,6p9n)^{26}Al were measured [1]. Using a cascade-excitation-model (CEM95) [2] the cross sections for the neutron induced reaction ^{40}Ar(n,5p10n)^{26}Al were calculated. With the differential flux of protons and neutrons in the atmosphere the total average production flux is calculated to be 0.69 atoms m^{-2} sec^{-1}. Due to atmospheric transport and the low precipitation rates the deposition fluxes at the poles are lower [4]. Using this box model, a deposition rate of 0.17 atoms m^{-2} sec^{-1} was calculated.

3. Production in cosmic dust

Interplanetary cosmic dust has the same composition as C1-chondrites. Using measured cross sections on Mg, Al, Si, Fe and Ca [5] and the flux of the solar cosmic radiation at 1 A.U. a saturation activation of 660 dpm kg^{-1} can be calculated. The main part of the interplanetary dust is produced in the asteroid belt and spirals in towards the sun due to the Poynting-Robertson-effect [6]. The activation is calculated to be one forth of the saturation. With an influx of 40 kt a^{-1} of dust [7] this leads to an influx of 0.21 atoms m^{-2} sec^{-1}.

4. Measured samples

To measure the dust influx it is nescessary to reduce the atmospheric component. This can be done by taking samples from regions with very low precipitation rates. This is true for the polar regions of the earth. We measured samples of the Antarctic Amundsen-Scott-station at the south pole. The precipitation rate at the south pole is $84 \pm 8,9$ mm a^{-1}, the sample size was 12 kg.

^{26}Al produced in the atmosphere is bound to aerosols with a typical size of a few μm whereas interplanetary dust particles have a size of several 10 μm. Therefore we used two filters with a pore size of 0.45 and 18 μm, respectively, to get three fractions (dissolved, atmospherically produced and cosmic dust). The results are given in table 1.

$> 18\mu$m	$> 0.45\mu$m	dissolved
$1,05 \pm 0,44$	$< 0,31$	$< 0,31$

Table 1: Deposition fluxes [Atoms m^{-2} sec^{-1}] (corrected for blank samples)

5. Conclusion

Assuming that the component in the 18 μm-filter is from interplanetary dust, the measured values of 0.31 atoms m^{-2} sec^{-1} would represent a dust infall of 79 kt a^{-1}. This value has to be considered as an upper limit as the measured concentration of ^{26}Al was below the detection limit.

References

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