

FLUORINE ENRICHMENT ON THE SURFACE OF ANTARCTIC C3O- AND H-CHONDRITES BY NUCLEAR REACTION ANALYSIS (NRA) AND THE SOURCES OF THIS TERRESTRIAL FLUORINE.

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Terrestrial enrichment of F on the surface of Antarctic meteorites was investigated by the PIGE-NRA technique (Proton induced gamma emission, a class of nuclear reaction analysis [1,2]) using the nuclear reactions $^{19}\text{F}(p,\alpha\gamma)^{16}\text{O}$ and $^{19}\text{F}(p,p'\gamma)^{19}\text{F}$ and proton energies of ~ 3 MeV. With this technique, the F-profiles of the H-chondrites ALHA 77294, TIL 82409, LEW 86015 and the C3O-chondrites ALHA 77003 and ALH 83108 were measured. The F enrichments obtained for the H-chondrites show an analogous sequence as revealed by earlier results which were obtained by a different approach [3,4]. The selected samples have terrestrial ages in the range of 10'000 to 110'000 years and weathering indexes from A to C. The measured enrichment of F shows only a poor correlation with the weathering index and none with the terrestrial age of the samples analyzed. For two C3O- and one H-chondrite from the Allan Hills, the concentration of F in the unaltered sample material and in the topmost surface layer of ~ 0.04 mm depth are given in Table 1. The surplus of F in the surface layer, stemming from terrestrial contamination, is also shown.

TABLE 1. F-contents in the surface layer and in the volume of one H5- and two C3O-chondrites in 10^{-6} g/g.

Meteorite	Surface F-conc.	Pristine F-content	F-excess in surface layer
ALHA 77294	118 \pm 6	10 \pm 2.3	108 \pm 6.4
ALHA 77003	92 \pm 5	21 \pm 2.3	71 \pm 5.5
ALH 83108	232 \pm 10	17 \pm 2.2	215 \pm 10

The values of Table 1 were obtained by the reaction $^{19}\text{F}(p,\alpha\gamma)^{16}\text{O}$. Measurements with $^{19}\text{F}(p,p'\gamma)^{19}\text{F}$ on the topmost surface layer of ALHA 77294 and ALHA 77003 gave 98 ± 18 and 89 ± 15 10^{-6} g/g, respectively. Since different spots were investigated and the layer's depth was ~ 0.05 mm in this case, the agreement is quite satisfying. Terrestrial contamination should mainly occur during the time span an Antarctic meteorite resided on the surface of the ice.

So, its enrichment of F is an indication of this surface residence duration. Based on the integral enrichment in the topmost surface-layer of the two C3O-chondrites analyzed and in relation to the enrichment function deduced for ordinary chondrites, we come up with maximum exposition duration for ALHA 77003 and ALH 83108. The exposure time span for the latter was definitely longer than for ALHA 77003. Furthermore, the diffusion profiles for the C3O-chondrites are rather steep in comparison to the ones found for H-chondrites [2].

There are several sources for the terrestrial enrichment of F on Antarctic meteorites conceivable [2]. The previous hypothesis, assuming sea-salt aerosols to be the main source [4], has become rather remote after recent research results [5]. Thus, besides continental dust and layers of volcanic ash emerging in blue-ice ablation zones [6,7], the constant volcanic exhalations of Mt. Erebus (Ross Island), with their exceptionally high concentration of F [8], are proposed to play an important role as a dominant source for the terrestrial F enriched in Antarctic meteorites. This view will be further discussed together with additional indications [2].

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