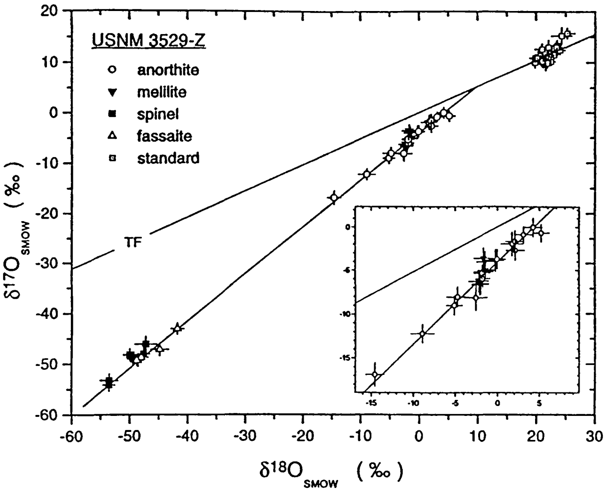

Fig. 1. Oxygen isotopic compositions of individual phases in USNM 3529-Z. Inset shows the variability in O isotopes due to zoning in two anorthite crystals.

model, at least for reasonably simple CAI thermal histories [6]. Moreover, mineral separate data indicate that anorthite and melilite did not equilibrate simultaneously with a common reservoir [3], which again suggests complicated formation and cooling histories for these CAIs.

By allowing isotopic measurements in a petrographic context, ion microprobe studies offer the possibility of directly observing partial isotopic equilibration and/or evidence of complex inclusion histories. Yurimoto et al. [4] used an ion microprobe to measure $^{18}O/^{16}O$ in an Allende CAI, finding no resolvable zoning in a fassaite crystal within their measurement precision (±5‰). We report *in situ* measurements of $^{18}O/^{16}O$ and $^{17}O/^{16}O$ in ~20-µm spots of melilite, fassaite, anorthite, and spinel from USNM 3529-Z, a coarse-grained type B1 Allende CAI that has been extensively studied for $(^{26}Al/^{27}Al)_0$ and initial $^{87}Sr/^{86}Sr$ [7]. The radiogenic isotope data and petrography indicate that 3529-Z is, by Allende standards, a relatively undisturbed inclusion of the type whose formation has been successfully modeled by slow cooling from a partial melt [8].

Oxygen-isotope measurements, performed on the CAMECA ims 1270, utilized a defocused Cs beam to sputter a flat-bottomed crater and an electron flood gun to compensate for sample charging. Negative secondary ions were measured at high mass resolving power (>6000) with no energy filtering; the intense (up to ~10^8 cps) ^{16}O peak was measured on a Faraday cup, and the ^{18}O and ^{17}O peaks were pulse counted in an electron multiplier (EM). Data were corrected for deadtime, EM yield, and mass fractionation utilizing a terrestrial spinel standard. Precision is ~0.5–1‰ per analysis spot (~15 min); accuracy still needs to be fully assessed for all mineral phases, but preliminary data indicate that it is in the same range.

The data fall along the CAI mixing line and are in general agreement with previous observations [1,2] in the sense that spinel and fassaite are ^{16}O-enriched relative to anorthite and melilite (Fig. 1). Spinel is slightly more ^{16}O-enriched than previously observed, possibly because we have analyzed only large grains from the inclusion interior. The most striking observation is that two anorthite crystals have significant ^{16}O excesses of up to ~20‰ and are strongly zoned in O isotopic composition. Both anorthites crystallized with live ^{26}Al at the level of ~4×10^{-5} and are primary by the criteria of Podosek et al. [7]. Further measurements of anorthite will determine if the zoning profiles can be modeled as due to diffusion or must be ascribed to secondary alteration or mineral growth effects. A traverse across a single normally zoned melilite failed to detect any O isotopic zoning at the level of ~2‰.

References: [1] Clayton R. N. et al. (1977) *EPSL, 34,* 209–224. [2] Clayton R. N. (1993) *Annu. Rev. Earth Planet. Sci., 21,* 115–149. [3] Mayeda T. K.et al. (1986) *LPS XVII,* 526–527. [4] Yurimoto H. et al. (1994) *EPSL, 128,* 47–53. [5] Clayton R. N. and Mayeda T. K. (1977) *GRL, 4,* 295–298. [6] Ryerson F. J. and McKeegan K. D. (1994) *GCA, 58,* 3713–3734. [7] Podosek F. A. et al. (1994) *GCA, 55,* 1083–1110. [8] Stolper E. and Paque J.M. (1986) *GCA, 50,* 1785–1806.

THE ROLE OF METEORITICS IN SPACEFLIGHT MISSIONS, AND VICE VERSA.

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Research on extraterrestrial materials plays a critical role in formulating the science rationale and design for spacecraft missions, and conversely, spaceflight holds great potential for solving some perplexing problems in meteoritics. The connections between meteoritics and sample return missions are obvious: Meteorite research can define sampling strategies, the capabilities of sampling devices, acceptable levels of chemical contamination and physical alteration of samples, and the conditions under which samples are stored prior to recovery on Earth. For their part, sample return missions will provide the geologic context for meteorites, increased sampling diversity (including materials not sampled as meteorites, such as soil, ices, and atmosphere), calibration for crater-counting chronology, and ground truth for remote sensing measurements of meteorite parent bodies. Most sample return missions are not yet mature concepts, but meteoritics also relates to spacecraft flyby and rendezvous missions that do not necessarily return samples. Specific illustrations of this mutual relationship, based on some recent or planned spacecraft missions, include identifying the source asteroid classes for ordinary and carbonaceous chondrites, and reconstructing their thermal and collisional histories (Galileo, NEAR, and Clementine II); determining the extent to which cometary dust and interstellar grains are found as interplanetary dust particles, and assessing volatile abundances, isotopic compositions, and molecular species in cometary nuclei (Stardust and Rosetta); understanding the compositions of ancient martian crust and the mantle sources for SNC meteorites, as well as inventorying the planet's volatile reservoirs and interactions (Mars Pathfinder, Mars Global Surveyor, Mars Volatiles and Climate Surveyor, and InterMarsnet); and assessing whether lunar meteorites provide a more representative chemical sampling of the highland crust and of mare basalts than do Apollo samples (Galileo, Clementine, and Lunar Prospector). Spaceflight is the first priority of the space agencies that fund most research on extraterrestrial materials, and the continued level of support for such research may be linked, in part, to its use in spacecraft exploration.

EXPOSURE HISTORY OF STONY AND IRON METEORITES: DETERMINATION OF ^{10}Be, ^{26}Al, AND ^{53}Mn VIA ACCELERATOR MASS SPECTROMETRY (AMS).

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Long-lived radionuclides produced by cosmic rays in meteorites archive information that can be used on the one hand to determine the spectral distribution and constancy of the cosmic-ray flux and on the other hand to study the history of the meteorites themselves. The combined ^{10}Be, ^{26}Al, and ^{53}Mn data enable us to discuss, for example, preatmospheric size, exposure, and terrestrial age, and possibly complex exposure history.

For the first time we determined ^{53}Mn contents via AMS instead of conventional radiochemical neutron activation analysis (RNAA) in a larger number of interesting meteorites. The advantages of this method, performed at the 14-MV tandem at Munich, are obvious.

The radiochemical separation was done basically by the method of Vogt and Herpers [1]. But due to the special demands on the measurement of ^{53}Mn via AMS, it was necessary to perform some modifications. We tested the quality of our separation method and the AMS technique on meteorites with known radionuclide concentrations, and furthermore, we compared the results with ^{53}Mn data measured by RNAA.

Our investigations not only concentrate on stony meteorites from the Sahara (e.g., two Rumuruti-type chondrites: Acfer 217 and Dar al Gani 13),