STABLE ISOTOPE GEOCHEMISTRY OF MAC 88105: COMPARISON WITH APOLLO SOILS AND OTHER LUNAR METEORITES; M.M. Grady and C.T. Pillinger, Planetary Sciences Unit, Department of Earth Sciences, The Open University, Walton Hall, Milton Keynes MK7 6AA, U.K.

MAC 88105 is the larger (662 g) of a pair of lunar meteorites returned from the MacAlpine Hills region of Antarctica by the 1988/89 ANSMET team. Preliminary hand-specimen and thin-section descriptions [1] indicate that MAC 88105 is a polymict microbreccia, poor in clasts compared to the only other lunar meteorite found on ice-fields associated with the Trans-Antarctic Mountain chain, ALHA 81005. Carbon and nitrogen abundance and isotope analysis of ALHA 81005, and a similar lunar meteoritic breccia from the Yamato Mountains, Y 86032, have shown that whilst nitrogen data for the lunar meteorites are directly comparable to results from nitrogen analyses of Apollo soils, measurements of carbon reveal surprising differences [2,3]. The lunar meteorites have a carbon abundance two to three orders of magnitude higher than Apollo soils, and are enriched in ^{12}C by over 30‰.

A 200 mg chip from slab ,11 of MAC 88105 was ground to a 50μm powder. Two separate aliquots were removed from this reservoir for carbon and nitrogen analyses.

Carbon: 3.8995 mg of MAC 88105 were combusted in steps from room temperature to 1200°C; results are shown in Figure 1. The total carbon abundance, at 143 ppm, is much lower than that measured in ALHA 81005 and Y 86032 (1055 ppm and 612 ppm, respectively), but close to that of an analogous Apollo 16 soil, 60016 (127 ppm). The yield profile is dominated by a single release below 450°C, 112 ppm with $\delta^{13}C$ summing to –28‰, presumably some form of terrestrial contaminant, found even in the cleanest of Antarctic meteorites. Between 500°C and 800°C, the amounts of carbon combusting drop to only slightly above blank levels, with a correspondingly increased uncertainty in $\delta^{13}C$. Above 800°C, a further 15 ppm carbon combust, with summed $\delta^{13}C$ of –24‰. By analogy with the other lunar meteorites, the high temperature carbon is from at least two components: (possibly) carbon in solid solution in iron metal ($\delta^{13}C$ *ca.* –25‰), and spallogenic carbon, with low abundance and extreme, positive, $\delta^{13}C$. Since $\delta^{13}C$ rises to only –19‰ at the highest temperature of the experiment, where spallogenic carbon would combust, it appears that MAC 88105 has had a low exposure to cosmic rays compared to most lunar soils, where positive values of $\delta^{13}C$ are recorded. The main difference between MAC 88105 and ALHA 81005 and Y 86032 is the absence in MAC 88105 of a high abundance component which combusts at 550 - 750°C, and tentatively identified as carbonate or elemental carbon [3].

C AND N IN MAC 88105

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Nitrogen: Figure 2 shows the nitrogen release profile generated by stepped combustion of 4.2854 mg of MAC 88105. In total, there are 43 ppm nitrogen with $\delta^{15}N$ *ca.* –8.7‰. As for carbon, the profile is dominated by a single release of nitrogen below 450°C (36 ppm with $\delta^{15}N$ summing to –11.5‰) ascribed to terrestrial contaminants. Above 450°C, the remaining 7 ppm are released (presumably indigenous lunar nitrogen), with $\delta^{15}N$ summing to +5.7‰, but rising to +42.3‰ at the highest extraction temperature, where spallogenic nitrogen is liberated. The abundance and isotopic composition of this indigenous nitrogen falls at the low end of the range of values for Apollo breccias, and is similar to the data derived from ALHA 81005 and Y 86032. The low $\delta^{15}N$ is again the reflection of only a small contribution from spallogenic nitrogen, confirming the conclusion drawn from the carbon data that MAC 88105 has experienced only low exposure to cosmic rays. This conclusion is further reinforced by the observation that monitoring of the ^{36}Ar peak during nitrogen combustion indicated that negligible quantities of ^{36}Ar were released, an indication of minimal exposure to solar wind.

The results from this preliminary stable isotope study of lunar meteorite MAC 88105 indicate that it is a low exposure breccia, similar in carbon and nitrogen systematics to Apollo soils, but quite different from two other lunar meteorites also recovered from Antarctica.

Figure 1: Carbon

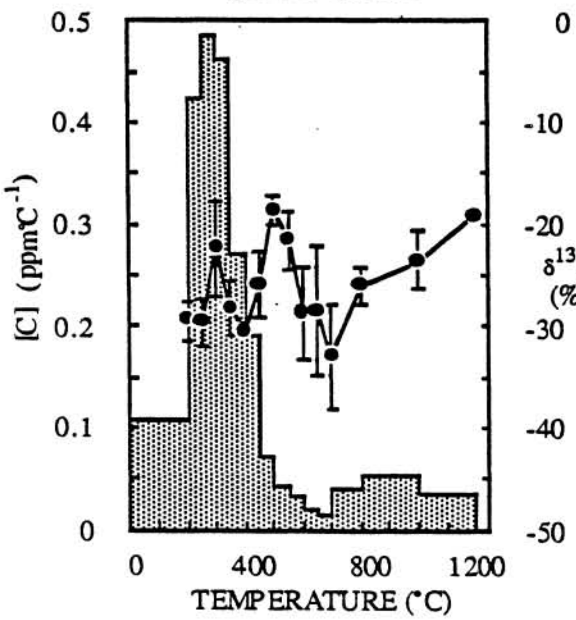
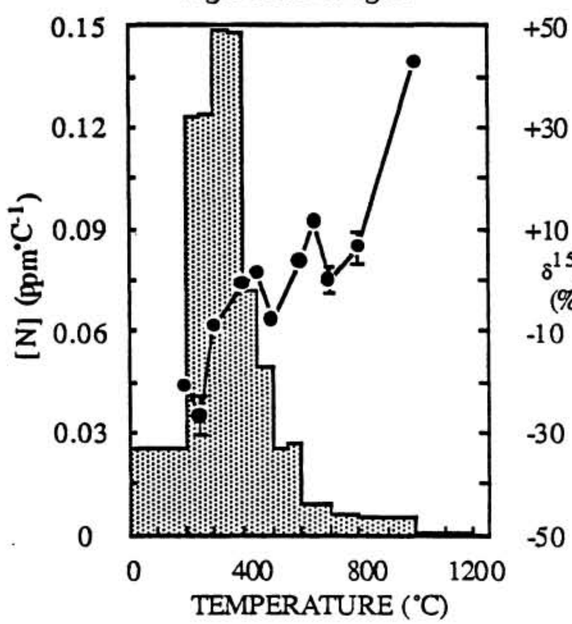


Figure 2: Nitrogen



References: [1] Score *et al.*, (1989) *Meteoritics* **24**; [2] Grady & Pillinger, (1989) *Meteoritics* **24**; [3] Grady & Pillinger, (1990) *Proc. NIPR Symp. Ant. Met. #3* (submitted).