Nanosims analysis of C-grains from Martian meteorite NWA 6162

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Martian meteorites supply us with unique samples allowing use of sophisticated laboratory instruments for comprehensive analyses. NanoSIMS analysis of carbon grains from Martian meteorites could shed light on possible biotic activity, paleoclimate and carbon cycle on Mars. NWA 6162 is a Martian olivine-phyric shergottite. It consists of subhedral olivine grains up to 1.6 mm in size in basaltic matrix. The meteorite was heavily shocked and contains shock-induced melt pockets and veins. Carbon grains were found in some melt pockets, destributed as black dots (<2 μm in size) in the fine-grained host melt. They are usually round. Raman spectra of the carbon grains show broad bands at ~1360 cm^{-1} and ~1580cm^{-1}, indicative of kerogen and/or amorphous carbon.. TEM observations of FIB extracted slices from one of the C-bearing melt pockets reveal that few C-grains consist of nano-scaled carbon and SiO_2-rich glass.

H and C isotopes of carbon grains in the other two melt pockets were analyzed with NanoSIMS 50L. One graphite, two coals and one natural bitumen were used as working NanoSIMS references. The analyses reveal large variations in both H and C isotopes, with δD from (2SD= 80~210 ‰) -10 to +650 ‰ and $\delta^{13}C$ from (2SD= 2~4 ‰) -24 to +6 ‰. Those carbon grains with $\delta^{13}C$ < -15‰ are normal in H isotopes (δD<160‰), except for one grain ($\delta^{13}C$= -20±3‰, δD=540±75‰). Terrestrial contamination cannot entirely be excluded for carbon grains with normal H isotopes. In contrast, several carbon grains with $\delta^{13}C$ of -4 ~ +6‰ show significant D-enrichment (δD= 490~590‰). It is also noticed that these D-rich carbon grains have low H/C ratios and high $^{12}C^-$ counting rates, similar to the graphite standard but different from coal. They are probably graphite instead of organic carbon. We suggest that the D-rich carbon grains were formed by reaction of $CO_2+CH_4 = 2H_2O+2C$, which has been proposed to explain graphite found in hydrothermal system on the Earth. NanoSIMS analyses of carbon grains from NWA 6162 reveal rather complex carbon reservoirs on Mars. Further details will be presented at the meeting.