Fast chemical reaction between meteoritic organics and the ambient atmosphere

SEIJI SUGITA[1] AND PETER H. SCHULTZ[2]

[1] Dept. of Earth and Planetary Sci., University of Tokyo, Tokyo, Japan (sugita@eps.s.u-tokyo.ac.jp)
[2] Dept. of Geological Sci., Brown University, Providence RI, U.S.A. (Peter_Schultz@brown.edu)

A large amount of organic carbon may have been delivered to the prebiotic Earth through frequent meteoritic impacts. However, the dominant fraction of the delivered organic matter is destroyed by intense shock heating upon impacts, particularly if the atmosphere is rather oxiding. Nevertheless, the consequences of impact-destroyed organic matter are not understood well yet.

In order to observe chemical reaction of reduced carbon in an impact vapor within a rather oxidizing atmosphere, we performed a series of impact experiments at the NASA Ames Vertical Gun Range using carbon-rich projectiles, high-impedance metal targets, and N_2-O_2-Ar model atmospheres. The emission spectra of the impacts were observed with high-speed spectrometers.

The spectroscopic observation indicates that vaporized carbon readily reacts with atmospheric nitrogen and forms CN radicals, which are unstable in an oxidizing condition. This experimental result suggests that a carbon-rich meteoritic body vaporized in an oxidizing atmosphere may create a reducing local environment, which may help synthesizing organic matter from once destroyed meteoritic organic matter. Such re-synthesis of organic matter may increase the effective survivability of meteoritic organic matter significantly and may increase the organic inventory on the prebiotic Earth.

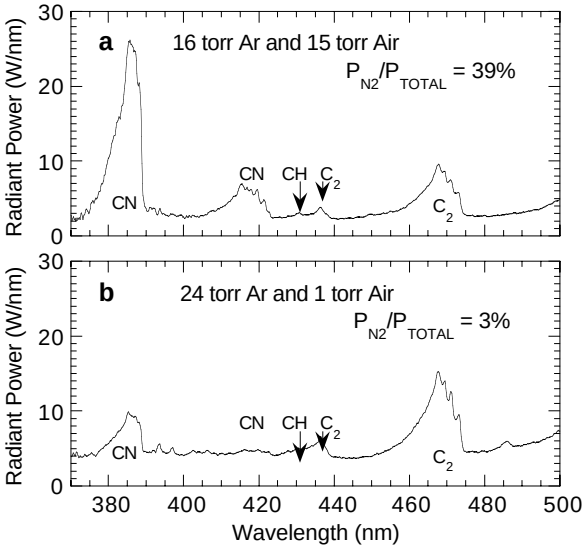

Figure 1: Emission spectra of impact vapor clouds in different atmospheric compositions.

The biogeochemical influence of groundwater on the material cycle in Tama River tidal flat sediments

K. SUGIURA[1,3], B. NARIN[2,3], N. YOSHIDA[2,3]

[1]Department of Environmental Science and Technology, Tokyo Institute of Technology (ksugiura@depe.titech.ac.jp)
[2]Frontier Collaborative Research Center, Tokyo Institute of Technology (bnarin@depe.titech.ac.jp) (naoyoshi@depe.titech.ac.jp)
[3]Also with SORST project, Japan Science and Technology corporation

Method

The influence of groundwater-input and seepage on tidal flat sedimentd was studied. We attempted a new incubation system (B), which is equipped with the seepage of groudwater in addition to the general experimental continuous-flow sediment-water system (A) (Usui *et al*., 2001). We incubated the cores (Φ10 cm, L~30 cm) for about 2 days at in-situ water temperature under dark condition.

The effluent water samples from the experiments for NO_3^-, NO_2^-, NH_4^+, N_2O, total dissolved inorganic carbon (DIC) and CH_4 were collected at 2-5 h intervals. Dissolved oxygen (D.O.) concentration was determined using electronic probe.

Results

D.O. of both systems (A and B) at upper-water decreased with time, generally decreased from 100% (0 h) to about 20% (48 h). However, D.O. of bottom-water decreased from 80% to 60% at 12 h and was constant until 48 h. The temporal change of nitrogen compounds were controlled by mainly nitrification and/or denitrification. N_2O concentration were always high (about 3 μmol/l) at bottom-water. At upper-water (B), N_2O concentrations were increased from 0.3 to 2.4 μmol/l after 31 h, while (A) was constant.

We suggest that nutrients (NO_3^-, NH_4^+) and produced gases (N_2O, CO_2) varied their diffusion rate, assimilation rate and biogeochemical processes in sediments.

In the future, we will indicate the detailed results of experiments with the other conditions.

References

Usui. T., Koike. I. & Ogura. N. (2001) , *Estuarine, Coastal and Shelf Science*. **52**, 769-781.