On the origin of meteoritic organics – Clues from the proto-solar C and N isotopic compositions

K. HASHIZUME[1], B. MARTY[2,3] & M. CHAUSSIDON[2]

[1] Department of Earth & Planetary Sciences, Osaka University, Japan, kohash@ess.sci.osaka-u.ac.jp
[2] CRPG-CNRS, BP 20, 54501 Vandoeuvre-lès-Nancy Cedex, France
[3] Ecole Nationale Supérieure de Géologie, 54501 Vandoeuvre-lès-Nancy Cedex, France

Recent estimates of the solar isotopic compositions of C and N, deciphered from the solar wind component implanted into lunar grains (Hashizume et al., 2000; 2003), suggest that bulk of meteoritic C and N are largely enriched in ^{13}C and ^{15}N compared to their proto-solar compositions. Since C and N in primitive meteorites are predominantly in form of organics, such information permits us to explore the possible place and processes of organic birth in the interstellar or circumstellar gas medium. The widely observed enhancement of deuterium in meteoritic organics compared to the proto-solar composition is generally recognized as a signature suggesting that hydrogen isotopic fractionation through ion-molecule reactions had prevailed during the organic formation, implying that the reactions took place in a cool (say 10 - 100 K) place. Studies of C and N isotopic compositions have potential to pose more strict constraint on the formation condition, because their fractionation factors are more sensitive to temperature compared to the case of hydrogen. For example, in the case of C, organics formed in a cold molecular cloud condition (10 K) are expected to exhibit a fair degree of fractionation, either to ^{12}C- or ^{13}C-rich sides, due to competition of ion-molecule reactions and a photochemical reaction (self-shielding of ^{12}CO dissociation line) that respectively lead to enhancement of ^{12}C and ^{13}C in the organics. The systematic enrichment of ^{13}C in bulk of meteoritic organics, by ~10 % compared to the proto-solar composition (Hashizume et al., 2003), implies that the bulk of meteoritic organics could have formed in a warmer place where the fractionation by the ion molecule reactions is less effective, such as in the proto-planetary disk illuminated by ultra-violet light from the proto-Sun.

Solid planetary objects in the inner solar system exhibit systematic enrichments of ^{13}C and ^{15}N relative to the proto-solar compositions, however their isotopic ratios exhibit a wide range among them. Notably, individual interplanetary dust particles (IDPs), which contain the highest D/H ratios of solar system objects (Messenger, 2000) likely due to the presence of interstellar/circumstellar organics, show the largest range of the ratios, which possibly implies that mixing/isotope exchange reactions occurred between the organics and the nebular gas or its condensates, and/or sources of the organics were not unique.

References

Hashizume, K. et al. (2000) *Science* **290**, 1142-1145.
Hashizume, K. et al. (2003) *In Prep.*
Messenger, S. (2000) *Nature* **404**, 968-971.

Ir anomalies in marine sediments: case study for the Late Devonian mass extinction event

Y. HATSUKAWA[1], M.H. MAHMUDY GHARAIE[1,2], R. MATSUMOTO[2], Y. TOH[1], M. OSHIMA[1], A. KIMURA[1], T. NOGUCHI[3], T. GOTO[1] AND Y. KAKUWA[2]

[1]Dept. of Material Science, Japan Atomic Energy Research Institute, Ibaraki, Japan (hatsu@popsvr.tokai.jaeri.go.jp)
[2]Dept. of Earth and Planetary Science, University of Tokyo, Hongo, Tokyo, Japan (hosein@gbs.eps.s.u-tokyo.ac.jp)
[3]Dept. of Material and Biological Science, Ibaraki University, Mito 310-8512, Japan (tngc@mito.ipc.ibaraki.ac.jp)

Ir concentration in sedimentary rocks has been considered as an indicator for bolide impacts. Chondritic meteorites are rich in Ir compared to the mean value (~20 ppt) of the earth's crust. In this study, significance of Ir anomalies in the Late Devonian bio-event strata is discussed in relation with the other geochemical parameters and the other possible mechanisms to concentrate Ir in sediments.

Ir concentration has been determined by means of INAA - GEMINI system at JAERI for 37 carbonate and shale samples across the F/F boundary strata from Iran and south China. Anomalously high concentration (~1000 ppt) was detected for two samples at F/F boundary, some of which are characterized by negative $\delta^{13}C$ anomalies and high concentration of redox sensitive elements. Submarine volcanisms may have caused high concentration of Ir in oceanic sediments. Phanerozoic largest volcanic episodes occurred in northern Iran and East European platform at around the F/F boundary, but the Ir concentration of the alkali basalt is only 57 ppt, far below the observed anomalies. Microbial activities could concentrate Ir in sediments, but the community was common throughout the F/F boundary to the Famennian after mass extinction. Pelagic deep-sea sediments are likely to concentrate more cosmic dusts and Ir, because the sediment accumulation rate is very low. However, the maximum concentration of Ir in sediments from the eastern Philippine Sea and offshore Hawaii Islands is only 239 ppt, still quite lower than the observed F/F boundary strata. Significant positive excursion in $^{87}Sr/^{86}Sr$ ratio at the F/F boundary interval suggests an increased ^{87}Sr contribution from deep continental weathering. We cannot rule out the possibility of bolide impacts, but observed geochemical parameters seem to suggest that the continental weathering is the major source for Ir at the late Devonian. Ir anomaly cannot be used as sole evidence in support of bolide impacts. Ir anomalies have to be critically evaluated within the context of the overall PGE distribution pattern, the contemporaneous continental deep weathering as well as possible enrichment by sulfides under water column anoxia.