New *in-situ* micro-characterization methods for organic materials from carbonaceous chondrites

Y. KEBUKAWA[1,2], S. NAKASHIMA[1,2], K. MASUDA[1,2] AND N. KUYA[1,2]

[1]Department of Earth and Planetary Science, Tokyo Institute of Technology, O-okayama 2-12-, Meguro,Tokyo, 152-8551, Japan; yoko.soleil@geo.titech.ac.jp

[2]Interactive Research Center of Science, Tokyo Institute of Technology, O-okayama 2-12-, Meguro,Tokyo, 152-8551, Japan.

Detailed characterization of high molecular weight organic materials in carbonaceous chondrites has been limited except for the recent studies by Nakamura *et al.*, (2002, 2003), because of the lack of organic rich areas devoid of coexisting mineral matrices.

Firstly, we conducted *in- situ* kinetic heating experiments in air under an infrared (IR) microscope for organic components from carbonaceous chondrites (Murchison and Orgueil). The decrease rates of C-H and C=O bands were measured and the activation energies were determined. The same type of experiments were also conducted for some analogue organic compounds. These results were compared together with our data on *in-situ* thermal decomposition kinetics on aqueous humic substances by using ultraviolet-visible spectroscopy, in order to discuss their organic structures and thermal history.

Secondly, we are developing a new type of IR spectrometer by using near-field optics (we can call it Nano-IR) enabling characterization of organics in submicron scales. This system can measure 3-dimentional (3D) topography of the sample surface like an atomic force microscope and obtain IR spectra at the same time. In order to test the capability of the instrument, we conducted spectral mapping of polystyrene deposited on an Al mirror with 200 nm steps in a 1x1 micrometer area. Near-field IR spectra showed three distinct C-H stretching peaks in the 2850-3200 cm^{-1} region. The area intensity of this region is used to present a 3D distribution map of C-H. The 3D map indicates clearly heterogeneous distribution of polystyrene with a spatial resolution of about 200 nm, which is ten times higher spatial resolution than that of conventional IR microspectroscopy. This new apparatus is expected to be able to characterize IR signatures of organic components in nanoscale and so that provide precious information on organic-rich areas in carbonaceous chondrites and cosmic dusts and their relevance to life in the universe.

References

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Noble gas and halogen evidence on the origin of Scandinavian sandstone hosted Pb-Zn deposits

M.A. KENDRICK[1], R. BURGESS[2], D. HARRISON[3] AND A. BJØRLYKKE[1].

[1]The Geological Survey of Norway. mark.kendrick@ngu.no

[2]The University of Manchester. Rburges@mail1.mcc.ac.uk

[3]ETH Zentrum, Zurich. harrison@erdw.ethz.ch

The combined use of noble gas (He, Ar, Kr, Xe) isotopes and halogens (Cl, Br, I) together with fluid inclusion thermometric data provides a powerful tool for unraveling the source, timing and interaction of mineralising basinal-brines preserved in fluid inclusions. Sphalerite, galena, pyrite, fluorite and barite samples were selected from; the world class Laisvall deposit, Sweden (120 Mt 4% Pb+Zn); the smaller Vassbo deposit, Sweden (5 Mt 6% Pb+Zn); and the related Osen occurrence in Norway. This comparative regional approach provides tighter constraint on alternative genetic models than would be available from detailed analysis of Laisvall alone and has improved our understanding of regional brine provinces in Scandinavia.

Fluid inclusions in impregnation ore at Laisvall, Osen and Vassbo are characterised by highly radiogenic helium isotope values (0.003 to 0.031 Ra, where the atmospheric $^{3}He/^{4}He$ of $1Ra = 1.39 \times 10^{-6}$) typical of long lived crustal brines. Galena concentrated within micro-fractures at Vassbo has a higher R/Ra value of 0.1-0.3 characteristic of a small component of mantle-derived volatiles. This suggests that the Vassbo deposit experienced multiple episodes of fluid flow.

The maximum $^{40}Ar/^{36}Ar$ value for the Laisvall deposit of 16226 was determined in vein fluorite. Impregnation ZnS-ore (max. = 8969) has a higher $^{40}Ar/^{36}Ar$ value than impregnation PbS-ore (max. = 2028) and vein barite (max. = 2677). Vassbo and Osen had similar $^{40}Ar/^{36}Ar$ values with maximums (7344 and 2025, respectively) measured in pyrite.

At Laisvall the ^{4}He concentration in fluid inclusions is exceptionally high, up to 0.1 cm^{3} $cm^{-3}H_20$. This, and the very high $^{40}Ar/^{36}Ar$ ratios are compatible with a premineralisation residence time on the order of 100's of Ma and a Caledonian age for mineralisation. Preliminary ^{4}He concentration estimates for Osen and Vassbo samples are significantly lower. This difference is probably explained by a difference in basement composition with only Laisvall underlain by a U-rich HHP granite.

At Laisvall, molar Br/Cl values of $4\text{-}8 \times 10^{-3}$ are above the value of seawater indicating aquistion of salinity by the evaporation of seawater well beyond halite saturation. I/Cl values are well above what can be achieved by seawater evaporation and the highest values correlate with an enrichment in ^{84}Kr. The elevated I/Cl is characteristic of fluid interaction with organic-rich sedimentary rocks.

Halogen analysis for the Osen and Vassbo deposits are currently being carried out and will be presented at the meeting.