# Hydrogen isotopic compositions and Raman spectra of organic particles in NWA 801 CR2 chondrite.

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[Introduction]
Carbonaceous chondrites contain up to 3-4% organic C, which mostly occur as insoluble organic matter (IOM) [1]. Significant deuterium (D)-rich organic globules have been identified from IOM or matrix [e.g. 2, 3]. It is widely accepted that the D-rich organic globules were formed in extreme cold environment in molecular clouds or outer protosolar nebula and record formation and evolution histories of the extraterrestrial organic materials [e.g. 2, 3].
Our previous study identified D-rich organic globules in matrix of Northwest Africa (NWA) 801 CR2 chondrite and revealed their various H isotopic compositions and morphologies [3]. In the matrix of NWA 801, organic particles without large D-enrichment (less D-rich) also occur [3]. Previous studies reported release of D-enrichments of IOM during aqueous alteration and thermal metamorphism [e.g. 4], thus, H isotopic compositions of organic materials are important tracer to understanding their evolution histories. Furthermore, Raman spectra are also useful parameter for metamorphism grade of organic materials [e.g. 5]. In this study, we investigate H isotopic compositions and Raman spectra of the D-rich and less D-rich organic materials in the NWA 801 to understand their evolution histories.
[Experimental]
A polished thin section of NWA 801, covered with a 30 nm thick carbon film [3], was used in this study. In situ quantitative H isotope ratio imaging was performed on matrix regions of the thin section using HokuDai isotope microscope system. The selection criterion for distinguishing D-rich materials that one of their D/H ratios is 2 sigma away from the 3 sigma the distribution of the surrounding matrix. Elemental ratio of H/C for the organic materials were measured using secondary ion intensity of $H^-$ and $C^-$ by SIMS analysis, assuming that average H/C ratio of less D-rich organic materials is corresponding to that of bulk CR2 IOM reported from previous study [4]. Identification and observation of organic materials were performed using FE-SEM-EDS. Raman experiments were performed by Ranishaw Invia Reflex Raman microscope at the Open facility of Hokkaido University. An excitation wavelength is 532 nm (Nd: $YVO_4$) with spot size of ~1 μm. The laser power on the sample was less than ~300 μW.
[Results and Discussion]
Less D-rich organic particles in NWA 801 occur as sub-micron-sized globules with various morphology that can be classified as follows: ring globule, globule aggregate, round globule, and irregular-shaped globule, that are similar to those of D-rich organic globules in NWA 801 [3]. Although molecular structure of IOM is modified and their H/C ratio is decreased by thermal metamorphism and aqueous alteration [e.g. 4], D-rich and less D-rich organic globules in NWA 801 showed similar H/C ratio, mostly <1.5. Our results imply that the less D-rich organic globules in NWA 801 are not attributed to release of D-enrichment from D-rich organic globules by metamorphism and/or alteration.
Raman spectra obtained from D-rich organic globules, less D-rich organic globule, and matrix showed "D-band" (at ~1400 $cm^{-1}$) and "G-band" (at ~1550 $cm^{-1}$). D- and G-band feature of the Raman spectra indicate more metamorphosed feature of D-rich organic globules than that of less D-rich globules and matrix, based on previous results of chondritic IOM [5]. Our results suggest that the D-rich organic globules in NWA 801 would have experienced thermal metamorphism individually, probably in

 

the early solar nebula.
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[Reference]
[1] Gilmour (2003) In Meteorites,Comets and Planets p.269. [2] Busemann et al. (2006) Science 312, 727. [3] Hashiguchi et al. (2013) GCA 122, 306. [4] Alexander et al. (2007) GCA 71, 4380. [5] Busemann et al. (2007) MAPS 42, 1387.

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