

## Injection of short-lived and stable nuclides from a “faint” supernova into the early solar system

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The estimated initial abundance of  $^{60}\text{Fe}$  in the solar system (e.g. Tachibana *et al.* [1]), which is produced efficiently only by stellar nucleosynthesis, implies that stellar nucleosynthesis prior to or shortly after the birth of the solar system contributed to the inventory of the solar-system short-lived radionuclides. A faint mixing-fallback supernova, where the inner region of the exploding star experienced mixing, some fraction of mixed materials is ejected, and the rest undergoes fallback onto the core, reproduces the abundance pattern of hyper metal-poor stars [2]. We recently proposed that a single faint mixing-fall back supernova could be a source of  $^{26}\text{Al}$ ,  $^{41}\text{Ca}$ ,  $^{53}\text{Mn}$ , and  $^{60}\text{Fe}$  in the solar system [3, 4].

We evaluate here injection of stable isotopes of C, N, and O from a nearby mixing-fallback supernova to the solar system materials. Possible changes of C, N, O isotopes due to injection from a faint mixing-fallback SN with a dilution factor of  $10^{-4}$ - $10^{-3}$  would be a few tens ‰ for  $\delta^{13}\text{C}$ , <100‰ for  $\delta^{14}\text{N}$ , and < a few hundreds ‰ for  $\delta^{17}\text{O}$  and  $\delta^{18}\text{O}$ . Possible changes of oxygen isotopes would not be large enough to explain a difference in O isotopic compositions between pre-solar silicates and solar system materials. However, if SN materials were injected into a proto-solar disk (e.g. Takigawa *et al.* [4]), effects of injection of C, N, O isotopes in solar system materials are not negligibly small, and there might be differences in the abundances of those isotopes between the Sun and solar system materials, as suggested by [5].

[1] Tachibana *et al.* (2006) *ApJ* **639**, L87 [2] Iwamoto *et al.* (2005) *Science* **309**, 451. [3] Takigawa *et al.* (2007) *LPS XXXVIII*, #1720. [4] Takigawa *et al.* (2008, submitted) *ApJ*. [5] Ouellet *et al.* (2005) in *Chondrites & the Protoplanetary Disk*, eds. A. N. Krot *et al.*, 527. [6] Gounelle & Meibom (2007) *ApJ*. **664**, L123.

## Use of LC-IRMS for the direct determination of stable Carbon isotope ratios in river waters

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### Simple Application of LC-IRMS

Recently methods using liquid chromatography isotope ratio mass spectrometry (LC-IRMS) have become available for the determination of stable carbon isotope ratios ( $\delta^{13}\text{C}$ ) of organic carbon in aqueous solutions [1, 2]. It would be interesting if we could use the method to ascertain the origin of C in river waters. In this study, therefore, we applied the method to determine the chemical species of C in Japanese river waters, and then applied a non-column separation method for total  $\delta^{13}\text{C}$  measurement. We used a LC IsoLink interface, which couples a Surveyor HPLC to a continuous-flow Delta V Advantage IRMS (Thermo Fisher Scientific Co).

### Results and Discussion

All values of DOC were less than  $0.1 \text{ mg L}^{-1}$  in 41 rivers (410 samples). Inorganic C, i.e.,  $\text{CO}_2$ ,  $\text{CO}_3^{2-}$ , and  $\text{HCO}_3^-$ , thought to be the major C forms in these river waters, but, unfortunately, they cannot be separated by the HPLC-IRMS system. Using the non-column separation method, total soluble C content in the river waters and  $\delta^{13}\text{C}$  values were measured. Figure 1 shows the histogram of total  $\delta^{13}\text{C}$  in river waters. The mean value was  $-9.6\text{‰}$  which is close to atmospheric  $\delta^{13}\text{C}$  of about  $-7\text{‰}$ . There were some rivers which showed relatively low  $\delta^{13}\text{C}$  values; possible geological sources will be discussed.

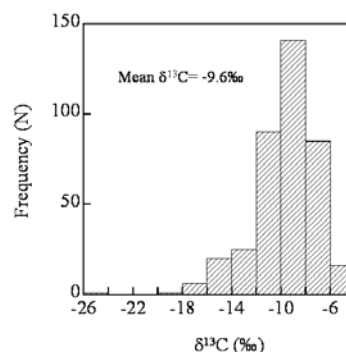


Figure 1: Histogram of  $\delta^{13}\text{C}$  in Japanese river waters.

[1] Krummen *et al.* (2004) *Rapid Commun. Mass Spectrom.* **18**, 2260-2266. [2] Heuer *et al.* (2006) *Limnol. Oceanogr. Methods* **4**, 346-357.