Ruthenium isotopes in single presolar SiC grains

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We report here Ru isotopic compositions of single presolar SiC grains from the Murchison meteorite. Ruthenium has seven isotopes: two *p*-process, ^{96}Ru and ^{98}Ru; one *r*-process, ^{104}Ru; one *s*-only, ^{100}Ru; and three *r*- and *s*-process, ^{99}Ru, ^{101}Ru and ^{102}Ru; ^{99}Ru is also the daughter of *s*-process ^{99}Tc ($T_{1/2}$=211,100y).

The most common type of SiC grains, the mainstream ones, are believed have formed around AGB stars. On plots of δ^{XX}Ru vs. δ^{104}Ru, normalized to ^{100}Ru, grains from AGB stars are expected to lie along straight lines between the initial (assumed to be the same as the solar system) and He shell compositions, which are mixed in the envelopes of these stars [1]. Sixteen SiC grains data lie along such lines for ^{99}Ru, ^{101}Ru and ^{102}Ru. The He-shell composition of the parent star for each grain, or G-component, can be calculated by extrapolation to δ^{96}Ru = –1000 ‰. The weighted average G-components for mainstream grains are δ^{99}Ru = –754 ‰; δ^{101}Ru = –823 ‰; and δ^{102}Ru = –494 ‰. Calculated G-components for a 1.5 solar mass, solar metallicity AGB star are δ^{99}Ru = –856 ‰; $\delta(^{99}\text{Ru}+^{99}\text{Tc})$ = –735 ‰; δ^{101}Ru = –841 ‰; and δ^{102}Ru = –560 ‰. Grains and predictions for ^{101}Ru and ^{102}Ru agree within the uncertainties of the neutron capture cross sections used [2]. Unfortunately, the cross section for ^{99}Ru has not been measured; the value [2] we use was obtained by comparing the most recent theoretical estimates [3] with experimental data for nearby isotopes. Use of [3] directly would lead to lower predicted δ^{99}Ru values. The cross section for ^{99}Tc has been measured with an uncertainty of 6%. The SiC grain measurements are suggestive of in situ ^{99}Tc decay in grains. Measurements of the Ru cross sections are needed.

One SiC X-grain, likely from a Type II supernova, was analyzed and found to be enriched in all isotopes relative to ^{100}Ru by 1000–5000 ‰. This requires mixing of a number of different shells of supernova ejecta, including those near the mass cut that are enriched in *p*-process isotopes [4].

References

[1] Lugaro M. et al. (2003) *Ap. J.*, in press. [2] Bao Z. Y. et al. (2000) *Atom. Data Nucl. Data Tab.* **76**, 70. [3] Rauscher T. & Thielemann F.-K. (2000) *Atom. Data Nucl. Data Tab.* **75**, 1. [4] Rauscher T. et al. (2002) *Ap. J.* **576**, 323.

Long-range transport of enhanced carbon monoxide in winter season at the summit of Mt. Fuji, Japan

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Introduction

A high-mountain observatory at the summit of Mt. Fuji (35.4°N, 138.7°E, 3776m above sea level) in Japan is suitable for atomsopheric chemistry study to observe trace gas variations in the free troposphere. Because the shape of this mountain as a high and slim solo peak is unique to collect representative data above the boundary layer. We started carbon monoxide (CO) measurement at Mt. Fuji weather station in September 2000, in addition to ozone measurement (Tsutsumi et al., 1994).

CO mixing ratios at Mt. Fuji

The CO data in 2001 revealed a clear seasonal cycle with a maximum around March-April and minimum around August. The predominant feature of the CO variation at Mt. Fuji was a large variability with many enhanced CO peaks in winter season. We frequently observed very high CO mixing ratios with a maximum level around 300 ppb in winter season, although these enhancements of CO did not bring significant ozone increase. The very high mixing ratios of more than 200 ppb often lasetd for one or two days corresponding to a synoptic-scale weather perturbation, but it was not caused by diurnal cycle. These results indicate that the high CO reflects large-scale phenomena in free troposphere rather than contamination from local pollution.

Long range transport of CO

In order to deduce source regions of the high CO peaks, backward trajectory analyses clearly showed that the high CO was originated mainly from tropical Southeast Asia. A relatioship between CO and CO_2 suggests that the high CO might be influenced by emissions from biomass burnings and/or urban/industrial sources in tropical Southeast Asia. In addition, a numerical simulation using a 3-D transport model indicates that the summit of Mt. Fuji in the free troposphere is strongly affected by the anthropogenic emissions from the continent in winter season.

Reference

Tsutsumi, Y. Y. Zaizen, and Y. Makino (1994) Tropospheric ozone measurement at the top of Mt. Fuji, *Geophys. Res. Lett.*, **21**, 1727-1730