ISOTOPIC BEHAVIOR OF MG AND SI DURING CONDENSATION PROCESS OF SILICATES: C.Uyeda and A.Tsuchiyama,College of General Education,Osaka Uiversity, 560, Japan

The evaporation-condensation processes in the primitive solar nebula have been extensively studied through the large mass fractionations found in refractory elements of primitive meteorites[1,2]. In connection with this problem, Esat et al. have measured the Mg isotopic behavior of laboratory distillated silicates[3]. The evaporation residues were fractionated towards the heavy isotopes, which were comparable to those of coarse grained CAI's of Allende meteorite. Whereas the condensates fractionating towards the light isotopes were comparable to those of fine grained CAI. A linear correlation was observed between Si and Mg mass fractionation for CAI inclusions, which was comparable to that obtained for the residues of partially evaporated forsterite[4]. The isotopic behavior of the condensation process have been studied by our group[5]. The mass fractionation of $^{26}Mg/^{24}Mg$ ratio for condensates with respect to the initial source changed from positive to negative as the condensation temperature Tc changed from 1300 ℃ to room temperature. The fractionation between the silicate gas and the condensates was discussed. In the present work, the isotopic behavior of Si is studied in connection with the Mg-Si correlation of the CAI inclusions.

The condensates were produced in a vacuun furnace under a hydrogen pressure of about 1.4Pa[6]. The evaporation source (synthesized Fo) was placed at the bottom of a Mo crusible, and evaporated at about 1600℃. A cold finger, which has a temperature gradient from 1500℃ to room temperature is inserted into the crusible from the top side. As evaporation proceeded, Fo(Tc=1400-900℃), Fo and Px mixtures(Tc=900-600℃) and Mg rich material(Tc<600 ℃) condensed on the cold finger. This mineral sequence was reproducable through several truns of experiments.

For isotope measurements of Si and Mg, condensates of varioustemperatures were collected. A modified Hitachi IMA-2A microprobe analyzer was used for the isotopic measurement[7]. The obtained relation between isotopic data and condensation temperature for Si and Mg was similar to the results reported previously[5], and the condensates are fractionated both towards the heavy and light isotopes, depending on the consentration of the residual gas. Fig.1 shows the relation between Mg and Si mass fractionation for the condensates. A linear correlation similar to that of CAI inclusions is seen between Mg and Si. We assume a Rayleigh fractionation process between the condensates and the residual gas phase for analysing the relation between ($\triangle 26$) and ($\triangle 30$). The temperature curve of mass fractionation for the condensates is written as, $(\triangle M)_s = \alpha_M f(T_c)^{-1}\{((\triangle M)_v{}^o+1000\}-1000$(‰), where M=26 for Mg and 30 for Si. α_M is the fractionation factor of the condensate with respect to the gas phase. f is the fraction of residual gas phase which can be estimated from the amount of condensates obtained on the cold finger. Thus the theoretical line is obtained as, $(\triangle 30)= a(\triangle 26) + b$ where $a=\gamma\delta$, $b=(\delta-1)$x1000, and $\gamma=(\alpha_{30}-1)/(\alpha_{26}-1)$, $\delta = \alpha_{30}\{(\triangle 30)_v{}^o/1000 + 1\}/[\alpha_{26}\{(\triangle 26)_v{}^o/1000 + 1\}]$. a and b are calculated as a=0.65 and b= 2‰ (broken line in Fig.1).

The evaporation residue is fractionated towards the heavy isotopes and $\triangle 26$=3‰. This value is considerably small compared to that of the previous results[5]. This is because the grain size of the source is more than 200 μm in the present experiment, and so enrichment of heavy isotope on the surface of the source is surpressed. Thus the enrichment of heavy isotopes in the evaporated gas is negligible compared to the large variation in the condensates.

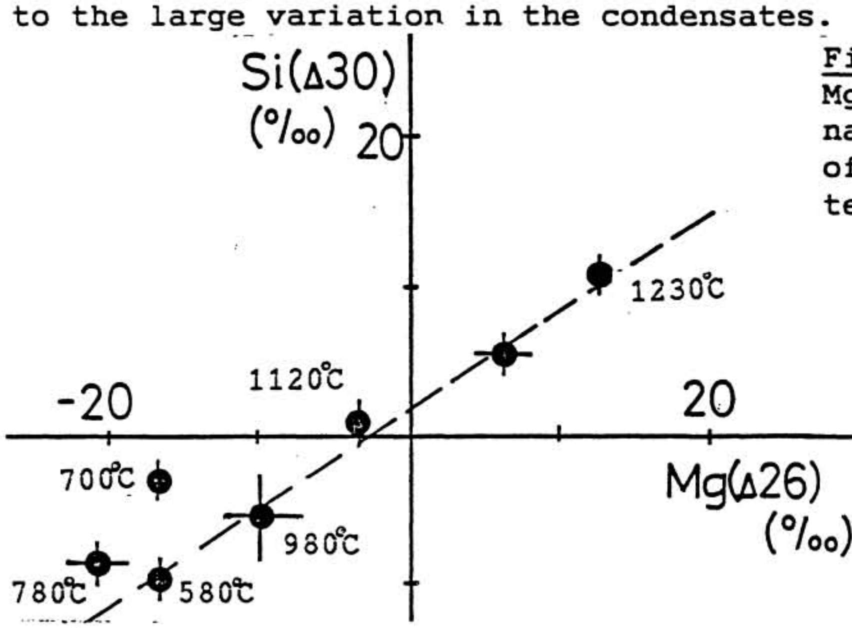

Fig.1 Relation between Mg & Si mass fractionation for condensates of various condensation temperatures.

$\triangle 26=\{(^{26}Mg/^{24}Mg)_{sample}/(^{26}Mg/^{24}Mg)_{initial} -1\}$x1000(‰)
$\triangle 30=\{(^{30}Si/^{28}Si)_{sample}/(^{30}Si/^{28}Si)_{initial} -1\}$x1000(‰)

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