BEHAVIOR OF CHROMIUM IN CHONDRITIC MATERIALS
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To survey the existence forms and existence patterns of Cr and Ru in high-temperature condensate, we have continued to carry out elemental analyses of primitive meteorites particularly acid insoluble fractions and metal phases from them. In addition, condensation calculation, which assume ideal solid solution in the multicomponent alloy, by using thermodynamic data have been performed. Noting that acid residues would contain the high-temperature condensate component, we considered chemical compositions of acid residues by relating to the condensation process from the solar nebula. In this paper, we present the representative elemental compositions of some chondritic meteorites and discuss the implications of these data to consider the behavior of Cr in meteoritical samples.

Experimental
The chondritic meteorites used in this work are (1) Allende (CV3), (2) Murchison (CM2), (3) Nuevo Mercurio (H5), (4) Jilin (H5), (5) La Criolla (L6), (6) Qingzhen (EH3). The treatment to obtain acid residues is mentioned in the previous paper (Refer Kano and Imamura, this volume). The treatment to obtain metal phases is as follows. The meteoritic sample was crashed in an agate mortar, and magnet materials were separated from them with a hand magnet. And also in order to purify a metallic particles, conc. NaOH was treated at 100°C for a few weeks. In each meteorites, 15~20 particles were extracted. Elemental analyses of these acid residue samples and metal phases were mainly carried out by instrumental neutron activation analysis (INAA) at the TRIGAII reactor in Rikkyo University.

Calculation
The detailed calculation method and thermodynamic data list used in this work will be presented elsewhere. The calculation method was mainly based on those of previous workers [1,2,3]. Thermodynamic data were taken from Kelly and Larimer [4] (originally from Hultgren et al. [5]) and the JANAF Tables [6]. These calculations were used to model the manner in which 14 siderophiles (Au, Co, Cr, Fe, Ir, Mo, Ni, Os, Pd, Pt, Re, Rh, Ru, W) condense assuming ideal solid solution from a solar gas (P0, =10^5 atm), and Tc was also included in this calculation. Fig. 1 summarizes the results of the calculation assuming condensation of all these elements into a common alloy. The calculation results are not significantly different from those of previous workers [1,2,3].

Results and Discussion
The representative experimental results of acid residues from some chondrites are shown in Fig. 2 in the form of Fe/Ni and Cr/Ni correlation along with the ratios predicted in this condensation model calculation. On the other hand, comparison between elemental ratios for Ir/Ni, Co/Ni, Fe/Ni, Cr/Ni and Au/Ni in metal phases of a) La Criolla (L6), b) Jilin (H5), c) Allende (CV3) relative to CI chondrites are shown in Fig. 3.

Cr-rich components such as chromite (FeCr2O4) could be found abundantly in acid residues of chondritic meteorites except enstatite chondrite such as Qingzhen (EH3) considering chemical compositions of acid residues. It is suggested that chromite was not primary condensate from high temperature solar nebula gas from Fig. 2; and it is needed to consider that chromite was condensed forming solid solutions with spinel (MgAl2O4) and/or was formed by replacement reactions of spinel with Fe, Cr gas. Combing above-mentioned with the results of Fig. 3, it was further suggested as follows: La Criolla (L6) which suffered from large metamorphism has large proportion of chromite in its acid residue, and remarkable deficit of Cr in metal phases. On the other hand, in Allende (CV3), the enrichment of Cr in acid residue and deficit of Cr in metal phases are much smaller than that in La Criolla (L6).

Thus the existence forms of Cr in chondritic meteorites are closely related to the degree of thermal metamorphism, that is, elemental distribution due to diffusion. It is possible to think there are two kinds of chromites in acid residues: the chromite which was condensed forming solid solutions with spinel (MgAl2O4) and the one which was formed by getting rid of Cr from metal phases due to thermal metamorphism. And the former corresponds to chromites of primitive carbonaceous chondrites such as Allende and the latter corresponds to chromites of equilibrated ordinary chondrites such as La Criolla. They may have different origin, and the difference are reflected in the variation of Cr isotopic ratio (Refer Kano and Imamura, this volume).

It can be a good indicator for studying the evolution of the solar system to survey Cr behaviors in primitive meteoritical samples.
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1 Phase Condensation Model

Fig. 1. Condensation curves for 15 siderophiles (Au, Co, Cr, Fe, Ir, Mo, Ni, Os, Pd, Pt, Re, Rh, Ru, W, Te) considering into a common metal alloy [1 phase model] ($P_{tot}=10^4$ atm).

Fig. 2. Elemental correlation between Fe/Ni and Cr/Ni in acid residues of chondritic meteorites compared to ratios predicted 1 phase condensation model ($P_{tot}=10^4$ atm).

Fig. 3. Comparison between elemental ratios for Ir/Ni, Co/Ni, Fe/Ni, Cr/Ni and Au/Ni in metal phases of a) La Crotilla (L6), b) Jilin (H5), c) Allende(CV3) relative to CI chondrites. Elemental ratios are plotted in order of volatility of a numerator.