Bulk elemental analyses of iron meteorites by using INAA and LA-ICPMS.

N. Shirai[1], A. Yamaguchi[2], M. K. Haba[2], T. Ojima[2], M. Ebiahra[1] and H. Kojima[2], [1]Tokyo Metropolitan University, [2]National Institute of Polar Research.

Introduction: Iron meteorites are made of Fe-Ni metal phases with such minor minerals as schrebersite, troilite, cohenite and other Fe-Ni carbides. As most iron meteorites are believed to be samples from the metallic core of differentiated planetesimals, petrological, mineralogical and chemical studies of iron meteorites are fundamental for unraveling the process of planetary differentiation.

Based on the structures, iron meteorites are originally classified into hexahedrites, octahedrites and ataxites. Hexahedrites and ataxites are nearly made of kamacite and taenite, respectively. Octahedrites consist of kamacite and taenite, and they are further divided into six subgroups on the basis of the width of the kamcite from finest (>0.2 mm) to coarsest (>3.3 mm). Almost all iron meteorites are classified into octahedrites. The chemical classification of iron meteorites is based on their trace element compositions (Ni, Ga, Ge and Ir). Bulk elemental abundances for iron meteorites have been obtained by using neutron activation analysis (NAA). Other analytical methods such as laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS) have not been very often applied to iron meteorites.

In this study, we present simple and effective procedures for the chemical classification of iron meteorites by using INAA and LA-ICPMS. Based on the analytical data obtained by two analytical techniques, we discuss the accuracy and the precision of our data and how promisingly our analytical methods can be applied to classification of iron meteorites.r 9, 2016 (12:00 pm, JST)

Experimental: Canyon Diablo (IAB), Toluca (IAB), Cape York (IIIAB), Muonionalusta (IVA) and Dronino (ungrouped) were analyzed by using two analytical methods (INAA and LA-ICPMS).

In INAA, samples weighing about 150 mg were firstly irradiated for for 10 sec. at a neutron flux of 4.6 x 10^{12} $cm^{-2}s^{-1}$ at Kyoto University Research Reactor Institute (KURRI) for the determination of Co, Ni, Cu, Ge and Rh. The same samples were reirradiated for 4 hrs at a neutron flux of 5.6 x 10^{12} $cm^{-2}s^{-1}$ at KURRI for the determination of Cr, Fe, Co, Ni, Ga, As, Mo, Ru, Sb, W, Re, Os, Ir, Pt and Au. In LA-ICPMS, analyses in line and/or scanning modes were performed on a representative area of polished chunk samples. A Thermo ElementXR coupled to CETAC LSX-213 was operated in low resolution (R=300). The peaks of ^{57}Fe, ^{59}Co, ^{60}Ni, ^{65}Cu, ^{69}Ga, ^{74}Ge, ^{95}Mo, ^{99}Ru, ^{103}Rh, ^{105}Pd, ^{182}W, ^{185}Re, ^{189}Os, ^{193}Ir, ^{194}Pt and ^{197}Au were monitored. Elemental abundances were obtained using Hoba and North Chile (Filomena) iron meteorites as standard reference samples.

Results and Discussion: Seventeen elements (Fe, Co, Ni, Cu, Ga, Ge, As, Mo, Ru, Rh, Sb, W, Re, Os, Ir, Pt and Au) and sixteen elements (Fe, Co, Ni, Cu, Ga, Ge, Mo, Ru, Rh, Pd, W, Re, Os, Ir, Pt and Au) could be determined by using INAA and LA-ICPMS, respectively. Our analytical results obtained by using two analytical methods were consistent with each other and literature values except for Muonionalusta.

Germanium is one of the key elements for the chemical classification of iron meteorites and has been mainly determined by radiochemical NAA (RNAA), which is time consuming. As both Ni and Ge abundances could be determined by INAA and LA-ICPMS. Our two analytical methods are more simple and effective than RNAA.