# Bulk chemical analysis of iron meteorites by LA-ICP-MS

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Iron meteorites are Fe-Ni alloys with minor elements such as Co, P, S, and C. They are classified on the basis of textures (e.g., Widmanstatten pattern) and bulk chemical compositions (e.g., Ni, Ge, Ir). We performed bulk chemical analysis of iron meteorites by using an LA-ICP-MS and compared with the data obtained by INAA.

We measured five iron meteorites, Canyon Diablo (IAB, coarse octahedrite), Toluca (IAB, coarse octahedrite), Cape York (IIIAB, medium octahedrite), Muonionalusta (IV, fine octahedrite) and Dronino (ungrouped, ataxite) by using an LA-ICP-MS and INAA. Polished thick sections are prepared for LA-ICP-MS analysis. Polished thick sections of the meteorites were examined using an optical microscope, a scanning electron microscope, and an electron microprobe analyzer to observe the textures. A Thermo Element XR ICP-MS coupled to a CETAC LSX-213 laser was operated in low resolution mode (R = 300). The peaks monitored are $^{31}P$, $^{34}S$, $^{57}Fe$, $^{59}Co$, $^{60}Ni$, $^{65}Cu$, $^{69}Ga$, $^{74}Ge$, $^{95}Mo$, $^{99}Ru$, $^{103}Rh$, $^{105}Pd$, $^{182}W$, $^{185}Re$, $^{189}Os$, $^{193}Ir$, $^{194}Pt$ and $^{197}Au$. Analyses in line and/or scanning modes were performed on a representative area of polished sections, using a 100 $\mu$m beam spot at 20 $\mu$m/sec., 20 Hz repetition rate. Typical analytical time was several minutes. Elemental abundances were obtained using Hoba (IVB, ataxite) and North Chile (IIAB, hexahedrite) iron meteorites as standard reference samples.

In INAA, samples weighing about 150 mg were firstly irradiated for 10 sec. at a neutron flux of 4.6 x 1012 $cm^{-2}s^{-1}$ at Institute for Integrated Radiation and Nuclear Science, Kyoto University 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 1012 $cm^{-2}s^{-1}$ at Institute for Integrated Radiation and Nuclear Science, Kyoto University for the determination of Cr, Fe, Co, Ni, Ga, As, Mo, Ru, Sb, W, Re, Os, Ir, Pt and Au.

We determined twenty elements (P, S, Fe, Co, Ni, Cu, Ga, Ge, As, Mo, Ru, Rh, Pd, Sb, W, Re, Os, Ir, Pt, and Au) for the five iron meteorites. Our results obtained by using two analytical methods were generally consistent with each other. However, our data of Muonionalusta are slightly different from literature values due to the large-scale heterogeneity of the meteorite (e.g., due to magmatic process). The abundance of some elements (e.g., Ru, Rh, Re, Ir) obtained from LA-ICP-MS data are higher than those from INAA due to the sample heterogeneity. It is possible to avoid this problem by choosing representative areas of the surface. Our study demonstrates that LA-ICP-MS has the potential to analyze a large number of iron meteorites.

Keywords: Iron meteorites, Bulk chemical analysis