A NEW METHOD FOR THE EXTRACTION OF THE METAL PARTICLES OF ORDINARY CHONDRITES: APPLICATION TO THE AL KIDIRATE (H6) AND NEW HALFA (L4) METEORITES.

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The metal in iron, stony-iron, and the metal particles in chondrites is basically composed of two Fe-Ni minerals: *kamacite*, the (BCC) phase, with ~ 5-7 at% Ni and *taenite*, the (FCC) phase, normally with ~ 25-50 at% Ni. Taenite from slowly cooled meteorites contains in its microstructure some special Fe-Ni phases, which are formed at low temperatures (below ~ 400 °C). For example, the atomically ordered $Fe_{50}Ni_{50}$ phase (*tetrataenite*) and the paramagnetic phase or low-Ni taenite with ~ 25 at% Ni (*antitaenite*). Rancourt and Scorzelli [1] proposed the intergrowth of tetrataenite and antitaenite as a possible equilibrium state at ~ 20-40 at% Ni.

Mössbauer spectroscopy has been used extensively for studying taenite from iron and stony-iron meteorites [2]. However, the study of taenite from the metal particles of ordinary chondrites has, in part, been hampered by the presence of the silicates and troilite phases, which dominate the Mössbauer spectrum of the whole rock powdered samples. Furthermore, ordinary chondrites contain small amounts of taenite, which is more abundant in the LL chondrites and decreases in abundance through the L to H chondrites.

Recently, we have developed a simple magnetic separation method for the extraction of the metal particles of ordinary chondrites, then dissolved kamacite in conc. HCl to obtain taenite-enriched samples [3]. The whole rock powdered sample is first subjected to magnetic separation in acetone using a hand magnet. The magnetic fraction is then taken and submitted to further grinding and magnetic separation in acetone several times in order to purify the metal particles from silicates and troilite. The Mössbauer spectra of the metal particles extracted from the Al Kidirate (H6) and New Halfa (L4) chondrites, using the above method, contain kamacite (the dominant phase) and small amounts of taenite and antitaenite. In order to explore the presence of tetrataenite in these samples, the purified metal particles are chemically treated in conc. HCl at ~ 50 °C for a few hours. The Mössbauer spectra of the resulting taenite-enriched samples identify the following Fe-Ni phases: tetrataenite, disordered $Fe_{50}Ni_{50}$ taenite, antitaenite, and small amounts of kamacite/martensite. The Al Kidirate sample contains ~ 50 % of tetrataenite, which is surprizingly high for an H chondrite. The presence of abundant disordered taenite (~ 30 %) coexisting with tetrataenite (~ 29 %) in the metal particles of the New Halfa indicates that the parent body of New Halfa may have experienced shock and re-heating events, consistent with the shock stage S3 (~ 15-20 GPa) reported for this meteorite [4].

The application of high field Mössbauer spectroscopy to these samples at room temperature resulted in large induced magnetic moments in antitaenite. The results, when compared to synthetic Fe-rich Fe-Ni alloys [5], may be used to estimate the Ni content of antitaenite in meteorites, which depends on the cooling history of meteorites below 400 °C.

References: [1] Rancourt D. G. and Scorzelli R. B. 1995. *Journal of Magnetism and Magnetic Materials* 150:30. [2] Knudsen J. M. 1989. *Hyperfine Interactions* 47:3. [3] Abdu Y. A. et al. 2002. *Hyperfine Interactions (C)* 5:375. [4] Wlotzka F. 1995. *Meteoritics* 30:794. [5] Abdu Y. A. et al. 2004. *Journal of Magnetism and Magnetic Materials*. In press.