MÖSSBAUER SPECTROSCOPIC STUDIES ON MESOSIDERITES

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Iron phases are important constituents of meteorites and can give important information about their origin and the transformation that occurred during their preterrestrial period. Mössbauer spectroscopy turns out to be a very powerful method to study the Fe-phases produced by low temperature transformations since it can probe the structural, chemical and magnetic environment of the ^{57}Fe Mössbauer isotope.

In slow cooled meteorites, meteoritic metal contains a characteristic microstructure that is similar in stony, stony-iron and iron meteorites and their differences are most likely a function of Ni content and cooling history at low-temperature. Mössbauer spectroscopy has played an important role in the study of these phases. One of the most important features of this spectroscopy is that it makes possible an identification of the four common constituents of taenite fields: *tetrataenite*, ordered FeNi (40-52%Ni); *antitaenite*, disordered fcc Fe-Ni (<28%Ni); *martensite*, non-equilibrium bcc Fe-Ni (20-30%Ni); *kamacite*, bcc Fe-Ni (4-8%Ni). These components are therefore easily identified in a complex Mössbauer spectrum through their Mössbauer parameters derived from the best computer fit. The variation of these parameters constitutes an accurate and easy obtainable measure of the state of order of tetrataenite.

We have undertaken a systematic study on mesosiderites by Mössbauer spectroscopy analysing metallic samples of Estherville (8.57 wt.% Ni), Vaca Muerta (8.50 wt.% Ni) and Lowicz (7.52 wt.% Ni) meteorites. The Mössbauer spectra were taken using as absorbers the metallic Fe-Ni portion of the samples in untreated form and etched with HCl/HNO_3 in order to extract the tetrataenite/antitaenite intergrowth that is more resistant towards etching. The spectra were recorded at room temperature, using a conventional constant acceleration Mössbauer spectrometer with ^{57}Co radioactive source embedded in Rh matrix.

The Mössbauer spectra of untreated samples of the meteorites under study showed that the main component is *kamacite.* The taenite containing the intergrowth *tetrataenite/antitaenite* (TT/AT) [1] seen in ataxites, octahedrites and metal particles of chondrites is detectable in very low proportion in the case of Estherville and Vaca Muerta and is apparently not enough for Mössbauer detection in the untreated samples of Lowicz due to the very high proportion of kamacite. Estherville and Vaca Muerta have the same three spectral components: a symmetric hyperfine split sextet (i.e. without quadrupole splitting) due to *kamacite;* a hyperfine split sextet having narrow lines and a large quadrupole shift asymmetry, typical of well ordered *tetrataenite;* a broad singlet near zero velocity corresponding to *antitaenite.*

In order to better determine the relative proportion of tetrataenite/antitaenite and the degree of ordering of tetrataenite, we are also analysing taenite fractions from these mesosiderites in which the tetrataenite/antitaenite intergrowth can be enriched by etching. So, in these spectra tetrataenite and antitaenite are the main components allowing therefore a more accurate determination of the degree of ordering of tetrataenite. The corresponding hyperfine parameters obtained from the analysis of the spectra reflect the reported very slow cooling rate of this unique group of meteorites [2]**.**

[1] D.G. Rancourt, R.B.Scorzelli, (1995) J. Magn. Magn. Mater. 150, 30-36.
[2] W.D. Hupfe and J. I. Goldstein, (2001) Met. and Planet. Sci. 36, 135-154.