Micro-elemental analysis of Transylvanian meteorites

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In the frame of some EU FP 5 ARI (Access to Research Infrastructure) missions, five Transylvanian stony-iron meteorites fragments (Mădăraş, Moci, Coasta, Vaida-Camaraş, Tauşeni) were investigated using the micro-PIXE (Particle Induced X-ray Emission) technique at the Forschungszentrum Rossendorf, Germany, using a 3 MeV proton beam provided by the Tandetron accelerator. The purpose of our investigation was to determine the lateral distribution of the minor and trace elements which could provide a more detailed knowledge of the processes that took place during the formation of the Solar System. The microstructure of these meteorites - the presence of the so-called "chondrules" - was investigated, together with the presence of the lithophile (Si, K, Ca, Ti, V, Cr, Mn), siderophile (Fe, Ni, Pt) and chalcophile (Cu, Zn, Ge, Pb, As, S) elements. The microPIXE data were added to the petrographical preliminary evaluation, which identified the presence of troilite (FeS), kamacite [2(Fe,Ni)], cohenite (Fe_3C), fayallite ($FeSiO_3$) – surrounded by magnetite, olivine, and pyroxene. Micro-PIXE provided information about the spatial distribution of the elements contained in the meteorite samples. In particular, it revealed areas with relatively important amounts of Pb, Cu and Zn. For the Moci meteorite, the most exciting result revealed by the microPIXE measurements was the presence of Pt grains, which suggested the existence of the metallic (rather than troilithic) phase for this stony-iron meteorite. The application of the GUPIX code on the PIXE data obtained for meteorite samples was sometimes difficult, mainly due to the important presence of light elements non-detectable by PIXE and to the superposition of various chemical forms for one element (e.g. oxides, sulfides, silicates, etc.). We considered as a first step only the oxides, obtaining preliminary compositions for all the analyzed meteorites. Possible geological identification of the minerals containing Pt, Pb, Cu, Zn, Ge and As are discussed.