LIBS technique, a useful tool for a rapid discrimination between meteorite and meteor-wrong

G.S. Senesi[1], P. Manzari[2], G. Tempesta[3], G. Agrosi[3], A.A. Touchnt[4], A. Ibhi[5], O. De Pascale[1]

[1] *CNR – Istituto di Nanotecnologia (NANOTEC) – PLasMI Lab, Bari, Italy*
[2] *Istituto Nazionale di Astrofisica - Istituto di Astrofisica e Planetologia Spaziali (INAF-IAPS), Roma, Italy*
[3] *Dipartimento di Scienze della Terra e Geoambientali (DiSTeGeo), University of Bari, Bari, Italy*
[4] *Department of Physics and Earth Sciences, University of Ferrara, Ferrara, Italy*
[5] *Petrology, Metallogeny and Meteorites Laboratory, University of Ibn Zohr - Agadir, Morocco*

In the last years meteorite hunting and business are increasing due to the high attention given to space materials studies and discoveries. In some cases, meteorites, in particular iron meteorites, sometimes can be confused with meteor-wrongs that may consist of artifacts or terrestrial rocks or minerals. With respect to traditional techniques used to analyze geological samples, laser induced breakdown spectroscopy (LIBS) shows significant advantages, including versatility, minimal destructivity, no carbon coating, low operating costs, rapidity of analysis and sensitivity to light elements. In particular, results of LIBS analyses showed no Ni presence in analysed fragments, thus confirming the high potentiality of this technique in discriminating a meteorite from a meteor-wrong.

Freshly fallen meteorites often stand out from the run-of-the-mill earth-rocks and typically show a fusion crust, i.e. a blackened, charred-looking exterior, which is the result of the meteor passage through earth atmosphere. Meteorite business is becoming progressively important in the Saharian area. For example, nowadays Morocco is one of the main exporters of meteorites in the world. Unfortunately, a number of natural or manmade objects exist, named "meteor-wrongs", which simulate some or all typical features of true meteorites, especially iron meteorites.

Visual methods used to identify a meteorite in the field are sometimes not fully exhaustive thus the use of sophisticated analytical laboratory techniques can be required to verify the extraterrestrial origin of especially iron meteorites. These techniques are generally based on the destructive and expensive analysis of the Ni content in the sample. In this study, some whole presumed meteorite fragments collected in a dry valley located half way from two villages, Imilchil and Agoudal, in the High Atlas Mountains in Morocco, where an iron meteorite named Agoudal was discovered recently [1], were analysed quantitatively by a portable double-pulse micro-laser-induced breakdown spectroscopy (DP-μLIBS) system associated with an optical microscope to verify if they were true meteorites [2]. The morphological and chemical analyses of the fragments were also validated by SEM-EDS.

No Ni presence resulted from LIBS analysis, which was confirmed by a further deeper SEM-EDS analysis and by chemical maps that showed the occurrence of spheroidal graphite. The microstructures were consistent with P bearing iron materials. These results suggested that the fragments studied consist of possibly ancient fragments of cast iron.

In conclusion, DP-μLIBS can represent a promising advanced analytical technique to obtain a fast and reliable chemical analysis able to discriminate between a true meteorite and a meteor-wrong.

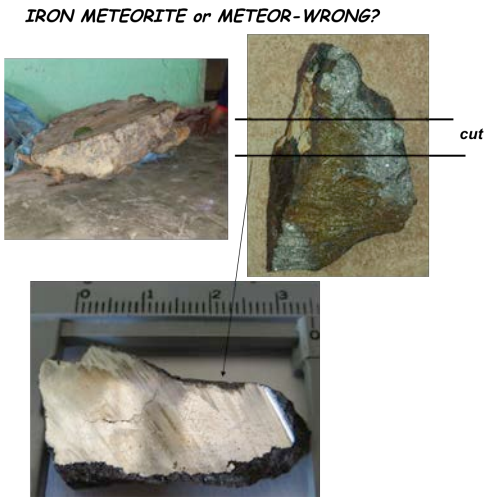

Fig. 1. Meteor-wrong fragment found in Morocco.

References

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