Almahata Sitta Meteorite: Combination of Raman Spectroscopy and Electron Microprobe analysis within the ureilitic lithologies.

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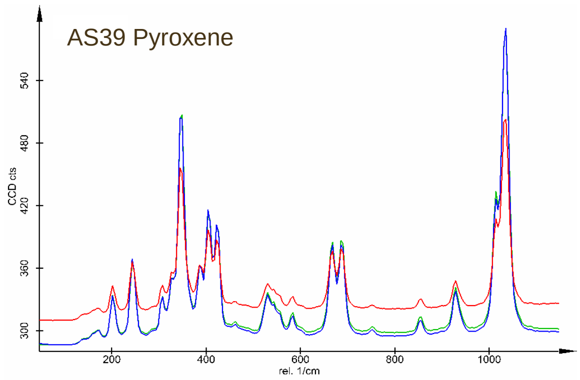
Introduction:

2008 TC_3 was the first meteorite previously observed as an asteroid in space and found afterwards. 2008 TC_3 fall took place on 7 October 2008 in the Nubian Desert (Northern Sudan). Its mass was around 3.95 kg.

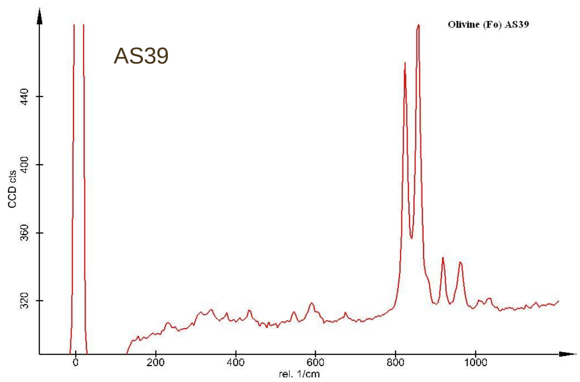
All specimen, belonging to this fall, were called Almahata Sitta (AS), and could be classified as a polymict breccia composing of different meteoritic lithologies, like anomalous polymict ureilites, different chondrites and iron meteoritic material [1,2,3,4]. Therefore the meteorite revealed to be a unique type of extraterrestrial material. Furthermore large amounts of carbonaceous grains could be found.



Raman spectra of pyroxene from AS 39

Raman research:

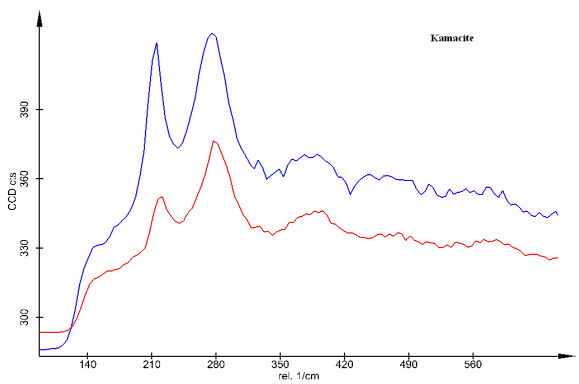
The investigation of minerals by Raman spectroscopy is a suitable method to typify minerals within planetary material. Raman measurements could be used to classify the structure and composition of quartz, pyroxenes, olivines and other materials within meteorites. In combination with electron microprobe, Raman spectroscopy is an excellent tool to characterize different polytypes and polymorphs. Therefore it is possible to distinguish between graphite, graphene and diamond within the investigated AS samples. In addition we could also map areas of 90 µm to 90 µm to determine mineral phases in rather inhomogeneous clusters within the AS meteorite.



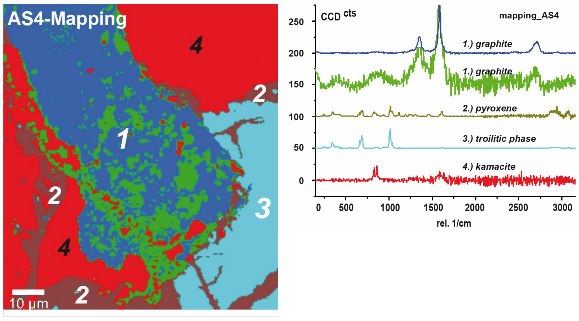
Raman spectra of olivine from AS 39

The following **mineral phases** could be classified within our AS samples due to Raman measurements:

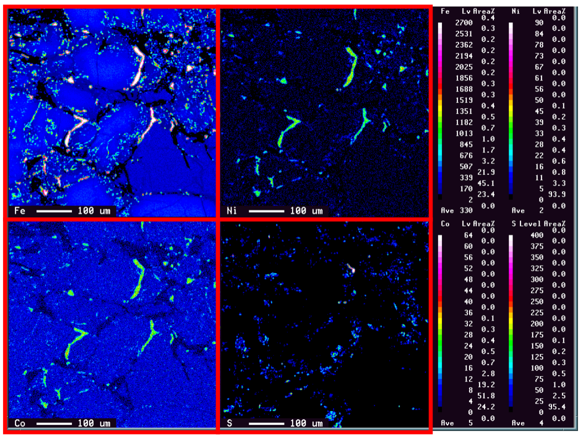
Graphite
Diamond
Graphene
Suessite
Schreibersite
Cohenite
Kamacites
Troilite/Cr troilite
Pyroxene
Plagioclase
Olivine



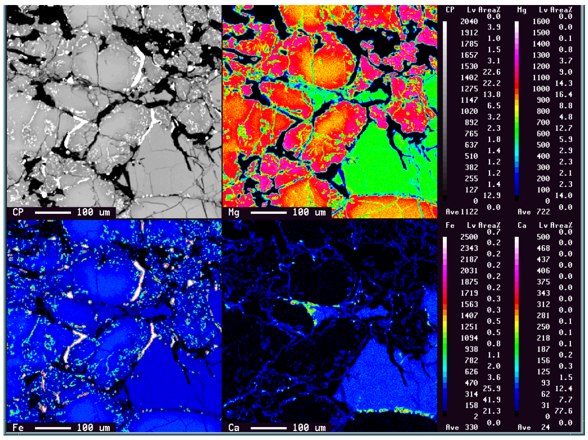
Raman spectra of Kamacite from AS 39



Raman mapping of AS4



Microprobe mapping of AS 39



Microprobe mapping of AS 39

Results:

By means of our Raman measurements it was possible to characterize graphite, graphene and also diamond [5]. To some extend, these three minerals occur in clusters within one sample. Especially graphene and graphite change within diminutive areas.

Moreover it was possible to acquire the first good suessite and schreibersite Raman spectra [5].

In addition we mapped areas, i.e. clusters and mineral inclusions within AS, to investigate mineral change and furthermore to classify chemical change of minerals within small zones.

Conclusion:

Micro-Raman spectroscopy proved to be a quick and valuable tool for investigation of extraterrestrial material. No special sample treatment is needed, with the exception of polished surface. Therefore it is a good method to characterize different minerals and polytypes within one sample and to make preliminary work for later microprobe measurements. Later on we measured the same positions with electron microprobe and combined the achievements.

References:

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[4] Hoffmann V. et al., MAPS, 2011, in press.

[5] Kaliwoda et al., Spectroscopy Letters, 2011, in press.