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Raman Spectroscopic Investigation of Almahata Sitta Combined with Electron Microprobe Analyses

Alexander M. Gigler (1,2), Melanie Kaliwoda (1,3), Rupert Hochleitner (1,3), Takashi Mikouchi (4), Wolfgang W. Schmahl (1,2,3), and Viktor H. Hoffmann (5)

(1) Section Crystallography, LMU-München, Theresienstr. 41, 80333 Munich, Germany, (2) CeNS, LMU-München, Schellingstr. 4, 80799 Munich, Germany, (3) Mineralogical State Collection, Theresienstr. 41, 80333 Munich, Germany, (4) Earth and Planetary Science, Graduate School of Science, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan, (5) Geophysics, LMU-München, Theresienstr. 41, 80333 Munich, Germany

The Almahata Sitta (AS) meteorite fall took place in October 2008 and since that time numerous fragments and individuals could be identified [1]. The meteorite itself was classified as a polymict ureilite and recently found to consist of a multicomponent breccia composing of different meteoritic lithologies like ureilites and chondrites [1, 2].

The investigation of minerals by Raman spectroscopy is a suitable method to typify minerals within planetary material. Raman measurements can be used to classify the structure and composition of pyroxenes, olivines, and other materials in meteorites. In combination with electron microprobe mappings, Raman spectroscopy is an excellent tool to characterize different polytypes and polymorphs as well as their lateral distribution. Therefore it was possible to distinguish between graphite, graphene, and diamond inclusions in the AS samples. Moreover Raman could be used to identify possible inorganic, as well as organic inclusions [3].

Minerals identified within our AS samples by means of confocal Raman spectroscopy include: graphite, diamond, graphene, suessite, schreibersite, cohenite, kamacite, troilite / Cr-troilite, pyroxene, plagioclase, and olivine. It turned out, that graphite, graphene, and also diamond occur in clusters within the sample. Especially graphene and graphite change within diminutive areas. Furthermore it was possible to acquire the first suessite Raman data. Up to now Raman spectra of suessite were not reported. In addition, we used both electron microprobe and confocal Raman microscopy to map out areas where the local chemical composition as well as mineral content vary over short distances.

Micro-Raman spectroscopy proved to be a quick and valuable tool for the investigation of extraterrestrial material. No special sample treatment is needed, with the exception of a polished surface. Therefore it is a good method to characterize different minerals and polytypes within one sample and allows for a direct comparison with electron microprobe measurements. Furthermore, compositional mapping by Raman spectroscopy is a valuable tool of our investigations on the magnetic phase composition of Almahata Sitta [4].

References

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