MAGNETIC CLASSIFICATION AND SHOCK STAGE (OF PLAGIOCLASE BY RAMAN SPECTROSCOPY) OF THE SARIÇIÇEK METEORITE (HOWARDITE)

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Introduction

At September 2, 2015, a large meteorite fall was observed and documented near Sariçiçek in Turkey. Detailed results on the meteorite fall, find and laboratory investigations have been published from a large consortium study [Unsalan et al., MAPS 2019, 1]. The meteorite was shown to be a howardite, a complex breccia which belongs to the HED clan. HED meteorites are believed to originate from the asteroid Vesta, see [1] for all further details.

In extention of our consortium study [1] we have investigated the magnetic signature, focusing on magnetic susceptibility (MagSus) as a fast stony meteorite classification tool. Magnetic susceptibilities were measured on two stones at the Universities of Tuebingen and Munich (#22 and #182). The investigations were done using both SM 30 and SM 100 Magnetic Susceptibility Meters manufactured by ZH Instruments, Czech Republic. The measurements were done at a frequency of 9 kHz. In some cases, two or more fragments of the same stone were measured, in which case the magnetic susceptibility values for the same stone were averaged.

The following magnetic susceptibility values have been found (log X [10^{-9} m^3/kg]):

# 22	3.08
#182	3.36
Mean	3.22

The MagSus values are within the range of 3.06–3.60 for howardites reported by [2] and of 3.11–3.62 reported by [3]. The relatively large range in values may arise from heterogeneity in the parent body of the Sariçiçek meteorite. On the other hand, there is a suggestion that the lower magnetic susceptibility values are associated with samples that are more fully covered with fusion crust. A possible interpretation of this result is that the conversion of iron into iron-oxides in the fusion crust is accompanied by a decrease in magnetic susceptibility.

The shock stage of the Sariçiçek meteorite was investigated by LASER Raman spectroscopy on selected plagioclase grains. Polished thick sections of #182 have been prepared and first observed by optical microscope. LASER Micro Raman Spectroscopy was applied in order to study mineral phase composition and shock stage of the Sariçiçek stones. A Horiba Xplora Integrated confocal LASER micro Raman system was used with a Nd-YAG Laser (532nm) and a low laser power of less than 6mW. Magnifications were between 100 and 1000x (LD) with acquisition times of 5 to 10 sec and accumulation numbers of 2–5. An additional series of Raman experiments were performed on non-prepared specimen, pristine material that excludes any effects of sample preparation/polishing or sputtering (coating). High resolution mappings were performed in order to really detect and identify all present, including accessory, phases and also exolution- /zonation-effects. Varying the LASER energy allows to investigate sub-surface mineral phases.

Shock classification was performed by Raman Spectroscopy on plagioclase grains. The shock distribution was found to be quite inhomogeneous which should be expected in a regolith breccia. Most plagioclase Raman spectra point to quite low shock stages, S 1–2, but also severely shocked feldspar grains have been detected, revealing maskelynite or even recrystallization effects (S 4-5). We also have some indication for the presence of ringwoodite, which would point to a minimum shock of at least 22 GPa.

References:

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