At September 2, 2015, a large meteorite fall was observed and documented near the village of Sarıçık villagers. Detailed results on the meteorite fall, find, and laboratory investigations have been reported within 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. Howardites are believed to originate from the asteroid Vesta, see [1] for all further details. In extension of this consortium study [1] we have investigated the magnetic signature, focusing on magnetic susceptibility (MS) as a fast story meteorite classification tool. Magnetic susceptibilities were measured on several stones (#22 and #182 from the consortium). The investigations were performed 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.

### Magnetic Susceptibility Values

<table>
<thead>
<tr>
<th>Sample</th>
<th>Comment</th>
<th>Mass (g)</th>
<th>Log MS</th>
</tr>
</thead>
<tbody>
<tr>
<td>#22</td>
<td>Complete FC</td>
<td>3.81</td>
<td>3.08</td>
</tr>
<tr>
<td>#182</td>
<td>Part FC</td>
<td>3.60</td>
<td>3.36</td>
</tr>
<tr>
<td>Individual #1</td>
<td>Complete FC</td>
<td>3.57</td>
<td>3.30</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>3.25</td>
<td></td>
</tr>
</tbody>
</table>

Tab. 1: Magnetic susceptibility values of the investigated Sarıçık samples (MS in 10⁻⁹ m³/kg), FC – fusion crust.

### MS Classification – Conclusions

- The MS values classify the Sarıçık meteorite in the HED class.
- Sarıçık MS fits quite well in the howardite range (falls/finds), concerning the likely background of MS enhancement of howardites.
- Eucrite and diogenite MS value ranges overlap (falls and finds) – no simple discrimination by magnetic susceptibility alone.
- Howardite MS values do not reflect their petrology / formation processes – a regolith representing mainly a mixture of diogenites / eucrites – but howardite MS is significantly higher (falls and finds).

### Results of Raman Spectroscopy

- Input of clasts of ultramafic diogenite lithologies with much higher metal concentration and MS values (such as NWA 2968, MS = 4.28) which is significantly higher than for all other reported diogenites.
- Input of clasts or fragments of “exotic” meteorite lithologies in the Vesta regolith such as carbonaceous (CC) ordinary chondrites (OC) with higher concentrations of magnetic phases: the result would be enhanced MS values – CC clasts in howardites have been reported [5].
- Shock transformation of Fe-bearing phases – e.g. olivine alteration and nano iron particle neo-formation / exsolution (known from other meteorite lithologies such as ureilites – the result would be enhanced MS values.
- Influence of space weathering / interaction with interplanetary/cosmic radiation: neo-formation of native iron or iron/silicon nano particles in lunar regolith particles. The consequence of these processes would be also enhanced MS values.

### Shock Classification on Plagioclase

The shock stage of the Sarıçık meteorite was investigated by LASER Raman spectroscopy on selected plagioclase grains. Polished thin sections of #182 have been prepared and first observed by optical microscopy. LASER Micro Raman Spectroscopy was applied in order to study mineral phase composition and shock stage of the Sarıçık howardite. 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 0.5mW. Magnifications were between 100 and 1000x (LD lenses) 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 exsolution /zonation-effects (fig. 2, 3). Varying the LASER energy allows to investigate sub-surface mineral phases.

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 (fig. 5), but also severely shocked plagioclase grains have been detected, revealing maskelynite or even recrystallization effects (S 4–5) (fig. 6). We also have some indications for the presence of ringwoodite + (Mg,Fe)₂SiO₄·H₂O (here a very Fe poor member [6]), which would point to a minimum peak shock of at least 22 GPa (fig. 4).

### References


### Acknowledgements

The authors are members of the Sarıçık meteorite consortium. This investigation represents an extension of this project. We highly acknowledge the receipt of samples for our investigations from the consortium leaders, details are found in Unsalan et al., 2019.