New data on the Braunschweig meteorite (L6) - a recent fall in Germany (2013). R. Hochleitner[1], V.H. Hoffmann[2,3], M. Kaliwoda[1], R. Bartoschewitz[4]. [1]Mineralogical State Collection, Muenchen, Germany; [2]Fac. Geosciences, Dep. Geo- and Environmental Sciences, Univ. Muenchen; [3]Dep. Geosciences, Univ. Tuebingen, Germany; [4]Bartoschewitz Meteorite Laboratory, Gifhorn, Germany.

Braunschweig meteorite fall

It was reported that in the morning of April 23rd, 2013, a fragmented rock was found by the owner of a private yard in Braunschweig, N Germany, [1]. It could be reconstructed that most probably the fall happened around 2.10am at the same day and was registered in the neighborhood by a loud crash. Additionally, a fireball could be registered in the region around that time. The rock was identified as a meteorite and classified as an L6 ordinary chondrite [1] with a total mass of 1300 gr (see fig.1).

Further properties of the new German meteorite have been determined as follows by [1]: shock degree S4, weathering degree W0; main phases found were olivine (with ca. 25mol% fayalite), pyroxene (ferrosilite ca. 21mol%, wollastonite ca. 1.6mol%), kamacite, troilite and feldspar (plagioclase). The magnetic susceptibility value was 4.75 (log spec. 10^{-9}). First results of a set of investigations have been presented at the 6th German Meteorite Colloquium [2].

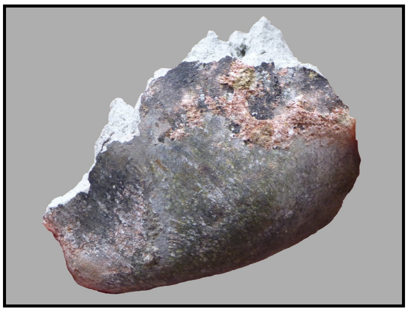

Fig. 1: Main mass of meteorite Braunschweig [from 2] which is now presented in the Museum of Natural History in Braunschweig.

Here we report some more results of our experiments on mineralogy, phase composition and physical properties of the Braunschweig meteorite.

Samples

A sample with a mass of about 24gr and a set of smaller fragments could be used for our investigations. The larger piece was covered by fusion crust on one side. The interior part, cutted and finely prepared, was dominated by a very well developed large barred-olivine chondrule (details see below) of a size of nearly 1cm which seems to be quite extraordinary for an L6 chondrite (see fig. 2a,b).

Methods and techniques

Optical microscopy was performed on a stereo-microscope and in polarized light on Zeiss and Leitz optical microscopes.

Fig. 2a and b: A 24gr sample, (a) the fusion crusted outer side, (b) the interior with a large chondrule.

Raman spectroscopy was also performed on non prepared surfaces which has the advantage of avoiding any cutting or preparation effects. A Horiba Xplora Integrated confocal LASER micro Raman system was used for our studies (mostly the 532/638 nm LASERs). Magnifications were between 100 and 1000x (LD) with acquisition times of 3-10 sec and accumulation numbers of 2-5.

Physical properties such as Moessbauer parameters have been studied by using the fragment set, details will be reported in our poster.

Results

The following phases could be identified so far: olivine (Fo 65-75 in average), pyroxene (orthopyroxene – Mg/Mg+Fe) ≈ 0.78, ca. Fs20), plagioclase and feldspar glass, chromite (with some Mg and Al), kamacite (and taenite), troilite (with some Cr), phases of the whitlockite–merrilite series, calcite and a graphite component. Some typical Raman spectra can be seen below (fig. 3). The likely presence of daubreelite will have to be tested by additional experiments. We also found a diamond phase by Raman spectroscopy on a number of spots, the origin, however, remains unclear at present.

The interior of the large fragment under investigation looks quite fresh, however, typical effects of terrestrial weathering can be seen not only on our sample but also on some others (internet): the presence of (terrestrial) Fe-oxide-hydroxide components (rusty spots) on the surface/interior of kamacite/troilite particles should not be typical for a fresh meteorite fall and quick find. A number of chondrule relicts of various types can be recognized amongst the large, cm-sized barred olivine chondrule (Raman spectrum see fig. 5). Fe-sulfide veins, consisting of (Cr-) troilite are frequently found, also in the large chondrule.

Shock stage

Raman spectroscopy was used for obtaining additional data for the determination of the shock stage. We have mapped and investigated a number of plagioclase grains of various sizes.

Figs. 4a and b show typical Raman spectra of plagioclase whereby all peaks are well and sharply developed. The pattern are typical for weakly shocked feldspars (range of 5-20 GPa), some feldspar glass is also present as can be seen by the presence of broad Raman bands around 1000/1100 cm^{-1}. A few feldspar grains showed features which might indicate a higher shock stage of about 26-32 GPa. From the Raman features the shock stage can be determined to S1-2 in generally, some areas show higher peak shocks.

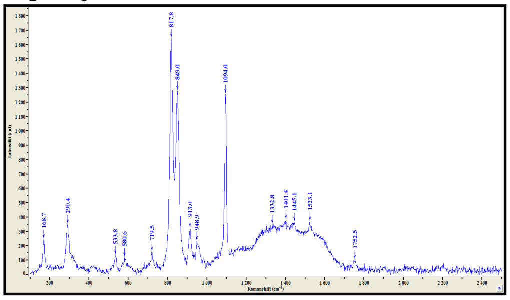

Fig. 3a: Matrix: Raman spectra of olivine and calcite, and some graphitic component.

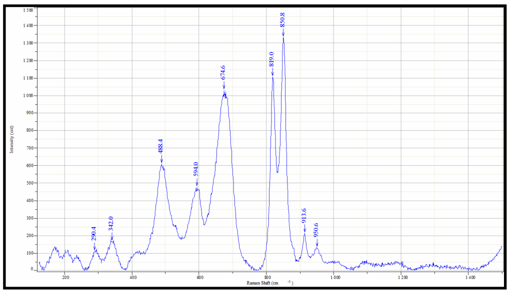

Fig. 3b: Matrix: Raman spectrum of olivine with chromite.

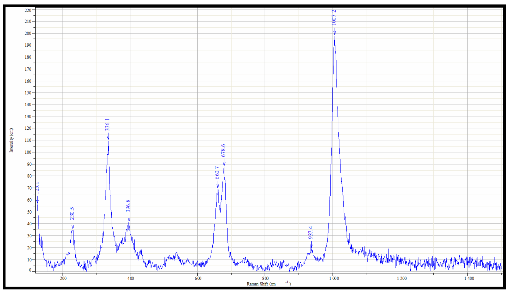

Fig. 3c: Matrix: Raman spectrum of pyroxene (opx).

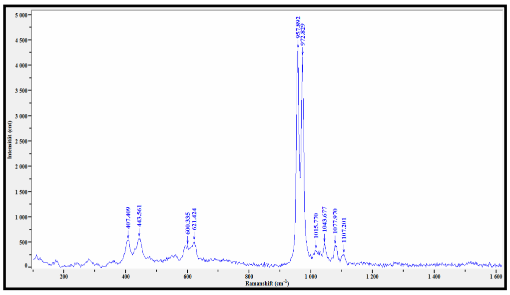

Fig. 3d: Matrix: Raman spectrum of a whitlockite-merrilite phase.

References

[1] Meteorite Braunschweig, in: Meteoritical Bull. Database 3/2014.

[2] 6th German Meteorite Colloquium, april 2014, Braunschweig.

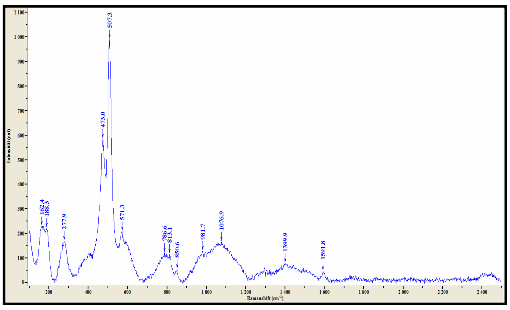

Fig. 4a: Matrix: Raman spectrum of plagioclase and some feldspar glass.

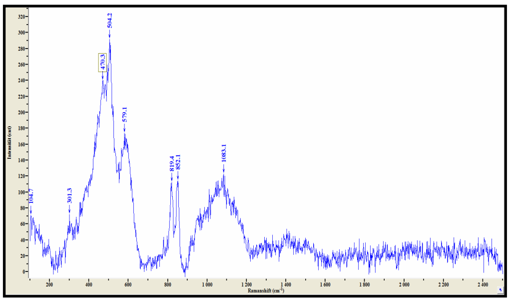

Fig. 4b: Plagioclase grain revealing a higher shock stage.

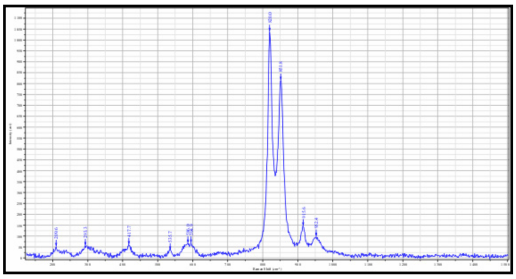

Fig. 5: Olivine - Raman spectrum of the large chondrule of a barred-olivine type.