MOESSBAUER AND RAMAN SPECTROSCOPICAL DATA OF THE NEW GERMAN METEORITE BRAUNSCHWEIG (FALL 2013, L6 ORDINARY CHONDRITE). R. Hochleitner[1], V.H. Hoffmann[2,3], M. Kaliwoda[1], Y. Yamamoto[4], T. Mikouchi[5], A. Günther[2], K.-Th. Fehr[2†]. [1]Mineralogical State Collection, Muenchen, Germany; [2]Fac. Geosciences, Dep. Geo- and Environmental Sciences, Univ. Muenchen; [3]Dep. Geosciences, Univ. Tuebingen, Germany; [4]Jamstec / Univ. Kochi, Japan; [5]Dep. Earth & Planetary Science, The Univ. of Tokyo, Japan.

Introduction

A fragmented rock was found by the owner of a private yard in Braunschweig, N Germany, in the morning of April 23rd, 2013. 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). Most likely, 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 main characteristics of the new German meteorite have been determined as follows [1]: main phases - olivine (with about 25mol% fayalite), pyroxene (ferrosilite about 21mol%, wollastonite about 1.6mol%), kamacite, troilite and feldspar (plagioclase); shock degree S4 and weathering degree W0; the magnetic susceptibility value was determined to 4.75 (log spec. 10^{-9}) with SM30. Recently, further results of a set of investigations have been reported by [2-5].

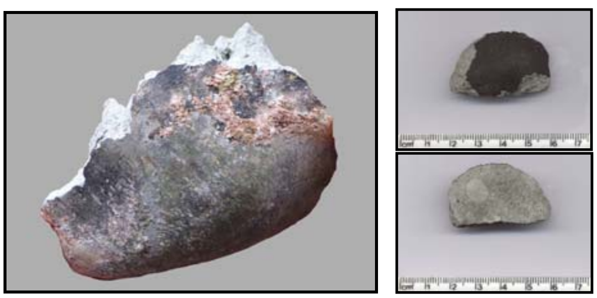

Fig. 1: (a) Main mass of meteorite Braunschweig [from 2] which is now presented in the Museum of Natural History in Braunschweig, and our 24gr sample showing (b) the fusion crusted outer side, and (c) the interior with a large chondrule.

In our contribution, we will report detailed results about our experiments by Moessbauer and Micro Raman Spectroscopy on mineralogy, phase composition and physical properties of the Braunschweig meteorite.

Sample material

A large chip with a mass of about 24gr and a set of smaller fragments could be used for our investigations, see fig. 1. 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 ordinary 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.

Raman spectroscopy was performed on the large sample whereby in most cases non prepared surface areas have been selected 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 (532 nm LASER wavelength). Magnifications were between 100 and 1000x (LD) with acquisition times of 3-10 sec and accumulation numbers of 2-5.

Moessbauer spectroscopy was performed on a system of the Dep. of Geo- and Environmental Sciences, Univ. Muenchen), for technical details see [6]. A set of selected fragments was used for these experiments. The obtained data were compared with typical Moessbauer spectra of ordinary chondrites such as Zag [7].

The magnetic signature of the Braunschweig meteorite is investigated at the paleomagnetic laboratories of NIPR and Jamstec/Kochi University, and will be reported in our poster [see 8 for technical details].

Results

The following phases could be identified in the meteorite Braunschweig:

- Olivine (Fo 65-75 in average)
- Pyroxene (opx – Mg/Mg+Fe) $\approx$ 0.78, ca. Fs20)
- Plagioclase and feldspar glass
- Chromite (with some Mg and Al)
- Kamacite (and taenite)
- Troilite (with some Cr)
- Components of the whitlockite–merrilite series
- Calcite
- A graphitic component

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 is not 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. Fe-sulfide veins, consisting of (Cr-) troilite are frequently found, also in the large chondrule.

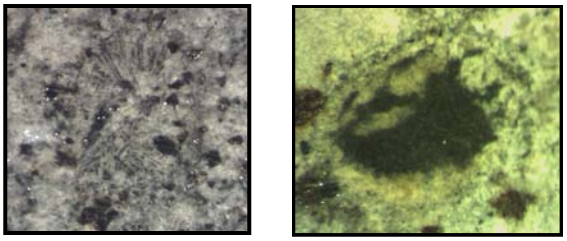

Fig. 2: (a,b) A number of chondrule relicts of various types can be recognized amongst the large, cm-sized barred olivine chondrule. Magn: 100x.

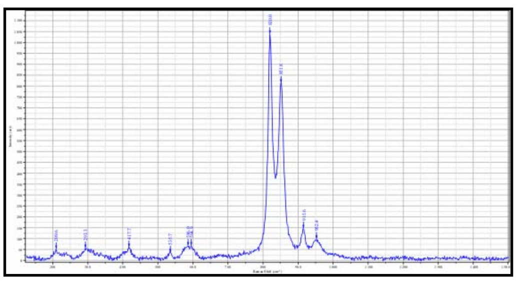

Fig. 3: Typical Raman spectrum of the large chondrule of a barred-olivine type.

Raman spectroscopy was also used for determining the shock stage of Barunschweig L6 [see 5 for more details]. For that purpose we have mapped a number of plagioclase grains of various sizes in high resolution. The obtained Raman pattern are typical for weakly shocked plagioclase (in the 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 reveal higher peak shocks.

Moessbauer spectroscopy revealed the presence of two sextets, indicating metallic phases (kamacite/taenite) and troilite (FeS), and two doublets indicating the presence of the paramagnetic silicates olivine and pyroxene. These features are typical for ordinary chondrites such as Zag [7]

Evaluating the Moessbauer spectroscopy results, see figs. 4a and b, the metal/silicate and olivine/pyroxene area relationships (after [7]) allows to characterize the new meteorite as an L-petrographic type ordinary chondrite with intermediate shock stage.

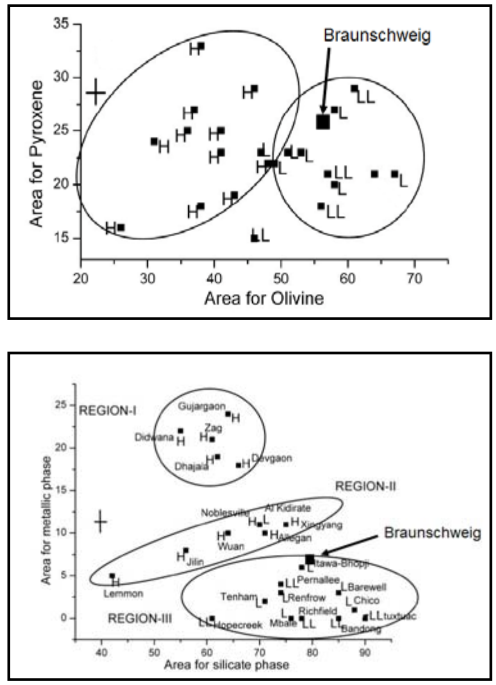

Fig. 4: (a) Olivine/pyroxene and (b) metal/silicate area relationship scheme after [7]: the respective positions of Braunschweig are indicated.

References

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