THE NEW BAVARIAN METEORITE MACHTENSTEIN – A H5 ORDINARY CHONDRITE FOUND AROUND 1956. R. Hochleitner[1], M. Kaliwoda[1], A. Günther[2], E. Schmidbauer[2], V.H. Hoffmann[2,3], Y. Yamamoto[4], T. Mikouchi[5], D. Heinlein[6]. [1]Mineralogical State Collection, Muenchen, Germany; [2]Fac. Geosciences, Dep. Geo- and Environmental Sciences, Univ. Muenchen; [3]Dep. Geosciences, Univ. Tuebingen, Germany; [4]KCC-Jamstec/Univ. Kochi, Japan; [5]Dep. Earth & Planetary Science, The Univ. of Tokyo, Japan; [6]Augsburg, Germany.

Introduction

The stone was found by a landowner during farming in his field around 1956 near Machtenstein, South Bavaria. Because of its unusual appearance, the stone was kept by the finder until it was rediscovered and recognized as a meteorite in 2014 [1]. The total mass of the meteorite is 1422 g, type specimen mass is 21.7 g. Type specimen and 1 polished thin section, 1 polished thick section and one EMP sample are deposited in the Mineralogical State Collection Munich (MSCM) The ownership of the main mass is open at the moment.

Petrography and mineralogy

The total mass of the Machtenstein meteorite is 1422 gr, fusion crust is mostly absent due to terrestrial weathering (fig. 2). Dominant mineral phases are olivine, orthopyroxene, troilite, feldspar, olivine ($Fa_{18.7}$), orthopyroxene ($Fs_{16.5}Wo_{0.01}$), and metal (kamacite / taenite with 7.0±0.23 wt% Ni and 0.46±0.1 wt% Co) [1], see figs. 1, 3, 4, and 5.

The size of the chondrules was found to be around 0.2 to 1 mm, the recrystallized matrix is mostly hypidiomorphic with grains of 0.01 to 0.5 mm in size. Dominant matrix minerals are olivine and pyroxene, feldspar grains up to 50 μm, and metal (kamacite and taenite up to 50 wt% Ni, Co in kamacite 0.46±0.1). Metal (esp. kamacite) is generally altered to goethite/limonite (up to 40%). Massive veining of iron oxides in cracks is visible, and the outer parts of the stone are heavily weathered, with up to 70% altered kamacite.

Density was determined to 3.39±0.05 g/cm^3, and the shock stage was found to be in the range of S2 with uneven darkening of olivines. Weathering grade is W 2/3.

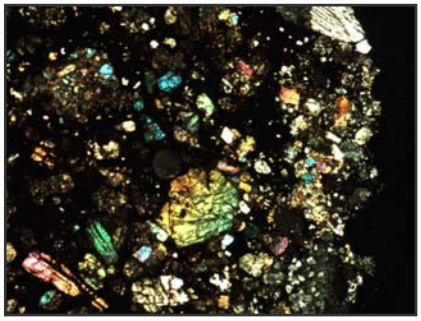


Fig. 1: Optical microscopy: thin section overview of Machtenstein showing olivine, pyroxene, opaques and several chondrules of different types. Magn: 100x.

Figure 2: Main mass of Machtenstein (left), and interior views after cutting off the type mass (right).

(a)

(b)

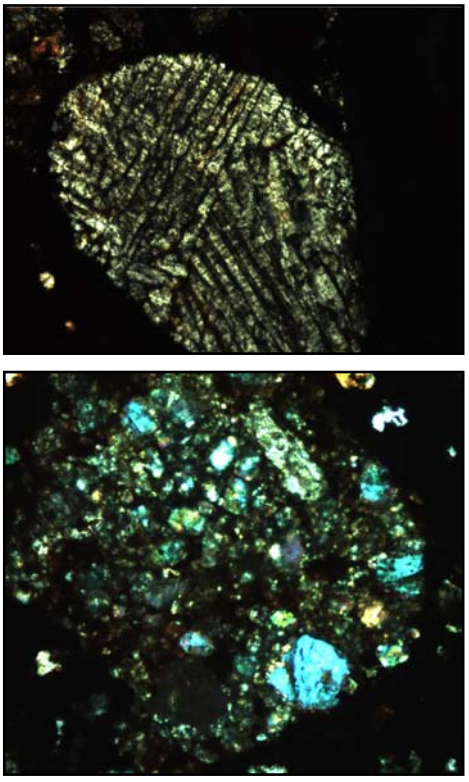
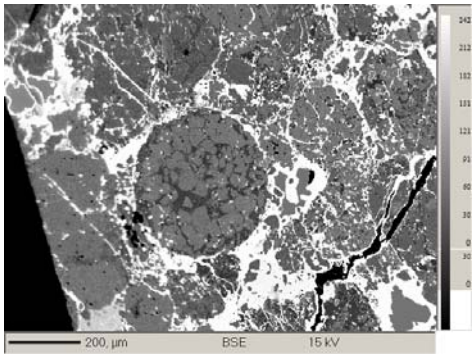
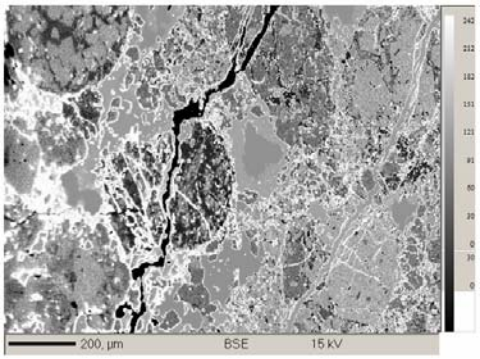


Fig. 3: Detailed view of (a) a pyroxene chondrule, and (b) a porphyritic chondrule. Magn: 100x.



(a)



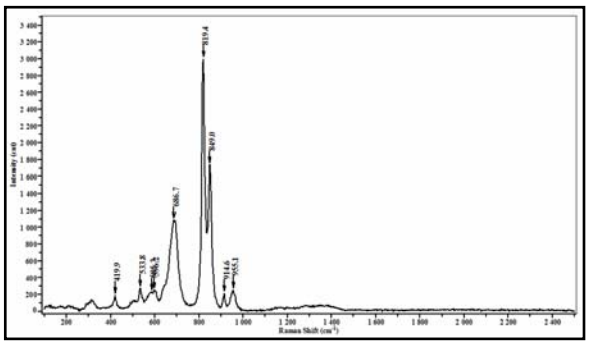
(b)

Fig. 4: SEM backscatter images showing typical features of terrestrial weathering in the Machtenstein meteorite such as cracks (in a and b), and the presence of iron-hydroxides (white colour).

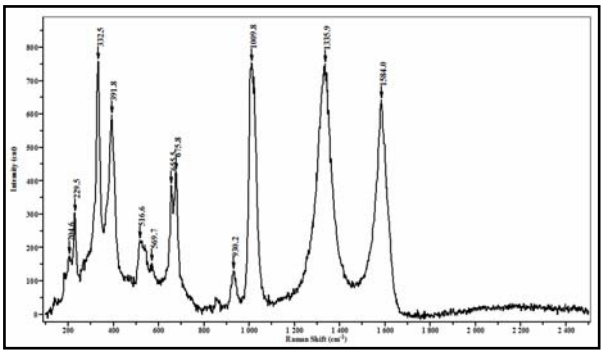
Raman Spectroscopy

Preliminary investigations by LASER Micro Raman Spectroscopy revealed the presence of the following phases, see figs. 5a-c:

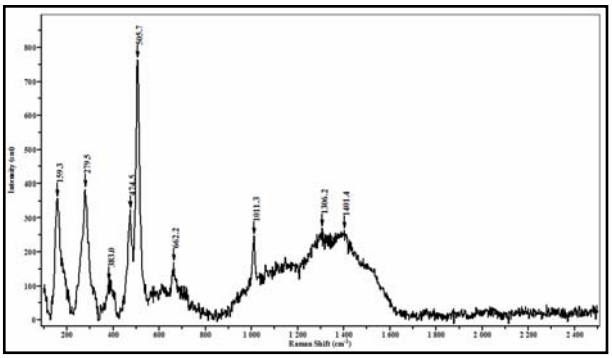
- Olivine
- Pyroxene (OPX)
- Troilite
- Plagioclase (low-intermediate shock)
- Chromite
- Graphite
- Fe-oxides / hydroxides



(a)



(b)



(c)

Fig. 5: Typical Raman spectra showing (a) olivine and chromite, (b) pyroxene (opx) and graphite, and (c) plagioclase indicating a low – intermediate shock stage (preliminary).

Physical properties

Further results of Moessbauer spectroscopy and magnetic signature will be reported on our poster.

References

[1] Machtenstein, in: Meteoritical Bulletin 2014.

Acknowledgements

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