The Eichstädt meteorite, a historical fall in Bavaria from 1785 – revisited. V.H. Hoffmann[1,2], R. Hochleitner[3], M. Kaliwoda[3], D. Heinlein[4]. [1]Fac. Geosciences, Dep. Geo- and Environmental Sciences, Univ. München; [2]Dep. Geosciences, Univ. Tübingen, Germany; [3]Mineralogical State Collection, München, Germany; [4]Augsburg, Germany.

Introduction

The witnessed fall of a meteorite near Eichstädt in the year 1785 was topic of the 7th German Meteorite Colloquium which was held in February 2015 in the Ries Crater Museum in Nördlingen [1,2]. Because of the conference, the idea was born to perform a set of new and more detailed studies on still available samples of the Eichstädt meteorite.

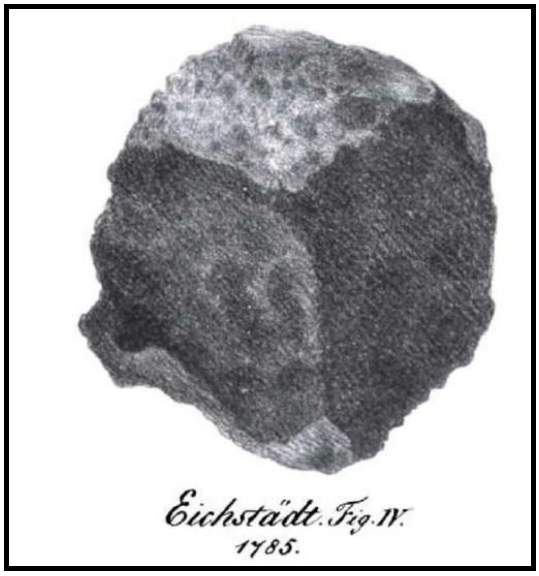


Fig. 1: One of the early pictures of an Eichstädt meteorite fragment, from J.F. Benzenberg, 1834: "Die Sternschnuppen sind Steine aus den Mond-vulkanen".

The fall of the Eichstädt meteorite

19th February 1785 shortly after noon time: a local worker in the forest of Wittmeß, several kilometers away from the town of Eichstädt, heard a strange noise like thunder or explosion and saw a stone falling from the sky nearby a building. He immediately found a blackish stone and took it to a physics teacher where the real nature of the stone was recognized. The original weight of the stone was determined to 2.9 kg. Details of the fall and early reports are found in [3, 4]. There are even some indications for a multiple fall. The meteorite was later classified as a H5 ordinary chondrite (see below). The main mass was split soon after the fall and the fragments were distributed to numerous museums and collections worldwide. The largest pieces went to the Mineralogical State Collection in Munich.

Material of the Eichstädt meteorite today

Only about 500 gr in total are left today from the original Eichstädt mass of 2.9 kg. Listings of the presently existing material are given in [5 and 6], larger fragments are found in the following collections and museums: NHM Vienna (123 gr), ETH Zürich (115 gr), NHM London (33 gr), Gifhorn (private, 101.5 gr), Zürich (private, 20 gr) (figure 2).

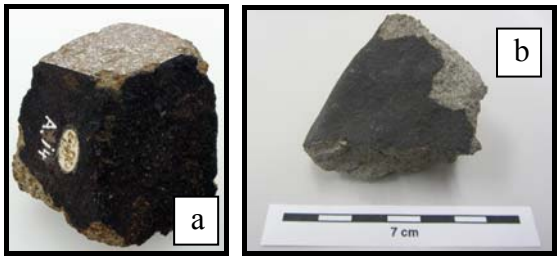


Fig. 2: Eichstädt meteorite fragments from (a) NHM Vienna and (b) ETH Zürich collection [2].

The Eichstädt meteorite in the Mineralogical State Collection Munich (MSCM) and early investigations

Nearly all stones of the famous meteorite collection of the MSCM have been destroyed during World War 2 by bombing. The loss included the largest reported masses (after the split) of the Eichstädt meteorite of altogether 621 gr (3 parts), see [7] for more details. Only one polished thin section (covered) from the original stone does still exist in the MSCM collection today (figure 3).

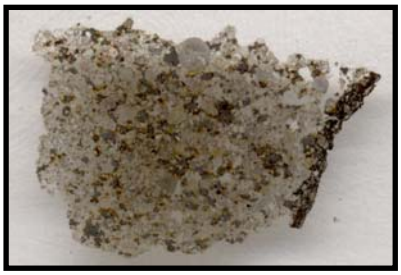


Fig. 3: Polished thin section (PTS, covered) from the Eichstädt mass of the MSCM (2 x 1.5 cm in size).

Early investigations on various fragments of the Eichstädt stone have been reported by H. Klaproth (1803, 1815), E. Chladni (1819) or C. v. Schreibers (1820), amongst others [see 2,5]. Later C.W. Gümbel published more detailed data on the mineralogy, petrology and phase composition of the meteorite. By summarizing all these early results the stone could be classified as a H 5 ordinary chondrite.

The Eichstädt meteorite - revisited

First results of our new investigations on Eichstädt material have been presented in the frame of the colloquium in Nördlingen [10]. The PTS of MSCM

could be used, however, due to the cover slide some limitations had to be accepted. A 4.85 gr fragment (without fusion crust) of the DH collection could be used for more detailed studies.

The PTS shown in figure 3 provides an overview of the matrix of the Eichstädt meteorite, some fusion crust is seen on the right side. Dominating phases are olivine and pyroxene, iron-sulfide (troilite) and iron-nickel metal (kamacite). Iron-sulfide and metal phases are surrounded by thin layers of iron-oxide like components. Generally, the material looks quite fresh with apparently only minor terrestrial alteration effects (weathering degree W 0-1). Numerous very well constrained chondrules of various types up to mm sizes are typical matrix components (see fig. 5).

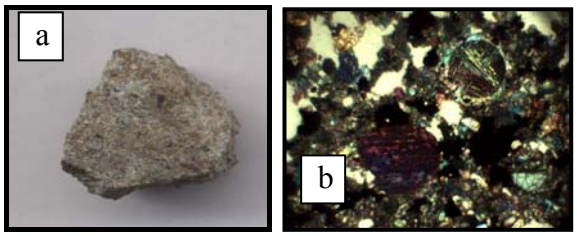


Fig. 4: (a) Eichstädt fragment (4.85 gr, DH collection) under investigation, (b) typical matrix characteristics (magn. 50x).

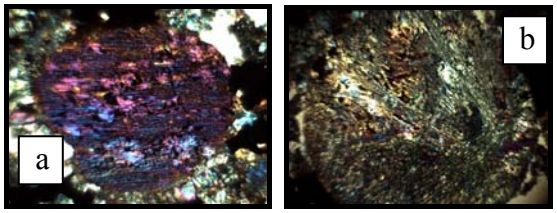
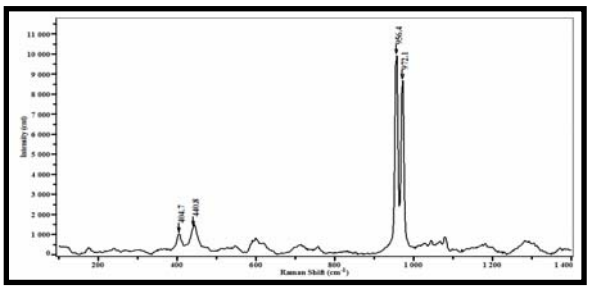


Fig. 5: Typical examples of (a) a barred olivine chondrule, and (b) a radial pyroxene chondrule (magn. 100x).

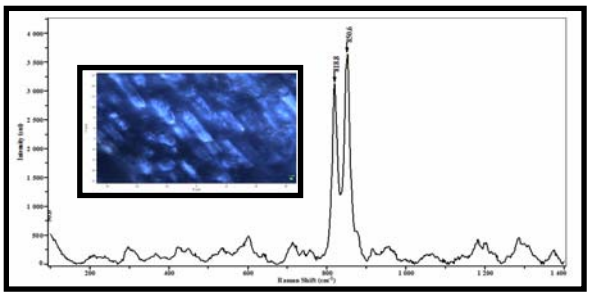
The results of optical microscopy and LASER Micro Raman Spectroscopy in terms of phase composition can be summarized as follows (typical Raman spectra are shown in figure 6):

- Olivine
- Pyroxene (OPX and CPX)
- Troilite
- Chromite
- Fe-Ni metal (Kamacite and Taenite)
- Merrilite – Whitlockite
- Plagioclase
- Calcite
- Graphite

Feldspar (plagioclase) was used for the shock classification by Raman Spectroscopy, Eichstädt is characterized by a low to medium shock degree (S 1-2).



(a)



(b)

Fig. 6: Typical Raman spectra obtained on Eichstädt material: (a) Merrilite-whitlockite, (b) barred olivine chondrule (inset, Ol composition about Fo60).

Magnetic susceptibility (MS) was determined to 5.37 (+/-0.01) (decimal log value of mass specific MS in 10^{-9} m^3/kg) in reasonable agreement to the value of 5.25 [11] obtained on the sample from NHM London. MS confirms Eichstädt as a typical H type ordinary chondrite. A grain density of 3.42 gr/cm^3 was reported by [11] (earlier published values 3.6-3.7, [4]) as well as a porosity of 26.6% for Eichstädt.

References

[1] Meteorite Eichstädt, in: Meteoritical Bull. Database 8/2015. [2] 7th German Meteorite Colloquium, February 2015, Nördlingen. [3] Wimmer K. (2015) in [2]: Der Meteorit von Eichstädt: Fallbericht und Interpretation. [4] Bayerisches Landesamt für Umwelt, LFU (2012): Nicht von dieser Welt – Bayerns Meteorite. LFU, 128pp. [5] Bartoschewitz R. (2015) in [2]: Das Eichstädt Sammlungsmaterial heute. [6] Nauber J. (2015) in [2]: Herkunft, Sammlungsbestand und Verteilung des Eichstädt Materials der ETH Zürich. [7] Hochleitner R. (2015) in [2]: Ehemaliges Material des Eichstädt Meteoriten in München (MSCM). [8] Bartoschewitz R. (2015) in [2]: Mineralogie, Petrographie und chemische Zusammensetzung. [9]: Hopp and Bartoschewitz R. (2015) in [2]: Edelgase und kosmische Geschichte. [10] Hoffmann V. and Hochleitner R. (2015) in [2]: Eichstädt (H 5) Meteorit – Fall 1785, revisited. [11] Macke R. (2012), PhD Thesis.