**BULK CHEMISTRY OF THE NEUSCHWANSTEIN (EL6) CHONDRITE – FIRST RESULTS.** J. Zipfel[1], B. Spettel[1], T. Schönbeck[2], H. Palme[2] and A. Bischoff[3], [1]Max-Planck-Institut für Chemie, Abteilung Kosmochemie, Postfach 3060, D-55020 Mainz, Germany, zipfel@mpch-mainz.mpg.de, [2]Insitut für Mineralogie und. Geochemie, Universität zu Köln, D-50674 Köln, Germany, [3]Institut für Planetologie, Universität Münster, D-48149 Münster, Germany.

**Introduction:** On April 6, 2002 a meteorite fell near the castle of Neuschwanstein, Southern Germany. After careful evaluation of photographs taken by the European Fireball Network a single stone of 1.75 kg was recovered at the predicted fall site (position: 10°48.5' E, 47°31.5' N) in July 2002 [1] – in a location in the Northern Alps that was still covered by snow at the time of the fall. Based on its mineralogy and petrography this meteorite is classified as an enstatite chondrite of petrographic type 6 which is little weathered (W0/1). Petrography and mineral chemistry is published in a companion abstract by Bischoff and Zipfel [2]. Since enstatite chondrites contain phases (e.g., oldhamite) that are readily weathered each new fall bears the opportunity to recover pristine material. Their bulk compositions are essential for defining characteristics of chemical groups. Here we report first results of the bulk chemical composition of Neuschwanstein. It is shown that Neuschwanstein is a typical member of the EL subgroup.

**Methods and Analyses:** A sample of a total weight of 2.38 g consisting of many small chips was ground dry to a fine powder in a commercial agate mill (Fa. Fritsch, Germany). Afterwards aliquots for Ínstrumental Neutron Activation (INAA) and XRF analyses were taken from this powder. A recommended bulk composition for selected elements is shown in Table 1.

Two aliquots of the powder of 130 mg and 168.8 mg, respectively were analyzed by INAA. For XRF analyses two aliquots of ~120 mg were taken. A comparison of major elements analyzed by both methods are also shown in Table 1. The agreement between the two methods for Cr and Mn is reasonably good. The lower Fe, Ni and Co concentrations analyzed by XRF samples are due to sample heterogeneity rather than due to analytical bias. Although the bulk powder appears optically homogeneous it cannot be excluded that metal was incompletely homogenized.

**Lithophile elements:** In enstatite chondrites lithophile refractory element abundances normalized to Si are sub-chondritic. These abundances are similar in both, EH and EL chondrites, except for a slight La depletion in the latter (Fig. 1). In contrast, abundances of moderately volatile lithophile elements are distinct in EL and EH chondrites. Silicon and CI normalized element abundances of elements with condensation temperatures of Mg and lower are sub-chondritic. From Si to Mn abundances decrease with increasing volatility. However, Na and K abundances are only slightly lower than in CI and higher than expected for purely volatility controlled element abundances. This distinction becomes even more obvious in EL chondrites. EL chondrites have low Mn/Cr weight ratios of 0.53 in comparison to EH chondrites (Mn/Cr = 0.70). But again, K and Na abundances are higher than Mn abundances. The most volatile element of the moderately volatiles, Zn, is extremely depleted in EL chondrites. Element abundances in Neuschwanstein clearly follow the lithophile element abundance trend typical of EL chondrites. The meteorite has a bulk composition characterized by a lower La abundance if compared to other refractory element abundances, by minor depletions in K and Na, by low Na/Mg ratios and low Mn/Mg (Fig.2). EL chondrites show a wide range in Mn/Mg ratios, indicating successive loss of moderately volatile Mn. In addition, Neuschwanstein has a very low Zn concentration (< 12 ppm).

**Siderophile elements:** Figure 3 shows Si and CI normalized moderately volatile siderophile element abundances in average EH and EL chondrites and Neuschwanstein. Typically, EH chondrites are Fe-richer and contain more metal than EL chondrites, as reflected by higher element abundances (Fig. 3). Moderately volatile siderophile element abundances in Neuschwanstein are higher than in average EL chondrites, reflecting an unusually high metal content of this meteorite. The relative abundances of these elements in EL and EH chondrites indicate that they are not controlled by volatility (high Au).

**Implications:** Neuschwanstein is a typical member of the EL subgroup as based on its bulk chemical composition. Minor differences between Neuschwanstein and averge EL-chondrites include a low Mn/Mg ratio and a somewhat higher metal content than typical of EL chondrites. Relative abundances of moderately volatile lithophile and siderophile elements support the interpretation that they are not purely volatility controlled.

**References:** [1] Spurny P. et al. (2002) *Proc. Asteroids, Comets, Meteors Conf.,* ESA SP-500, in press. [2] Bischoff A. and Zipfel J. (2003) *this volume.* [3] Wasson J. T. and Kallemeyn G. W. (1988) Phil. Trans. R. Soc. Lond. A 325, 535-544.

**Table 1. INAA and XRF results for aliquots of powdered "Neuschwanstein".**

| label | 1A | 1E | s.d. | 1C | 1C2 | **recommended** |
|---|---|---|---|---|---|---|
| method | INAA | INAA | | XRF | XRF | **bulk** |
| [mg] | 168.8 | 128.85 | | ~120 | ~120 | **composition** |
| Na ppm | 6120 | 6200 | 3 | | | **6160** |
| Mg wt. % | | | | 13.48 | 13.29 | **13.40** |
| Al wt. % | | | | 1.02 | 1.01 | **1.02** |
| Si wt. % | | | | 19.53 | 19.31 | **19.40** |
| P ppm | | | | 1300 | 1239 | **1269** |
| K ppm | 693 | 718 | 5 | | | **705** |
| Ca wt. % | | | | 0.93 | 0.92 | **0.92** |
| Sc ppm | 7.35 | 7.46 | 3 | | | **7.40** |
| Ti ppm | | | | 500 | 470 | **485** |
| V ppm | | | | 53 | 51 | **51** |
| Cr ppm | 2710 | 2820 | 3 | 2876 | 2816 | **2765** |
| Mn ppm | 1480 | 1440 | 4 | 1400 | 1297 | **1460** |
| Fe wt. % | 29.0 | 28.3 | 3 | 25.7 | 26.03 | **28.6** |
| Co ppm | 919 | 882 | 3 | 753 | 812 | **900** |
| Ni % | 2.00 | 1.97 | 4 | 1.12 | 1.70 | **1.98** |
| Zn ppm | < 20 | < 12 | | | | **< 12** |
| Ga ppm | 15 | 14.4 | 7 | | | **14.7** |
| As ppm | 3.2 | 3.05 | 4 | | | **3.12** |
| Se ppm | 16.2 | 16.0 | 4 | | | **16.1** |
| Re ppm | 0.063 | 0.067 | 10 | | | **0.065** |
| Os ppm | 0.930 | 0.900 | 7 | | | **0.915** |
| Ir ppm | 0.779 | 0.745 | 3 | | | **0.762** |
| Pt ppm | 1.45 | 1.80 | 12 | | | **1.59** |
| Au ppm | 0.308 | 0.299 | 3 | | | **0.303** |

s.d. = standard deviation; < upper limit.

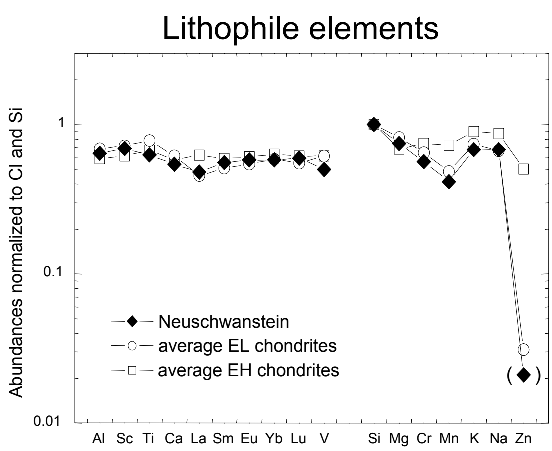


Fig.1 Lithophile element abundances in Neuschwanstein in comparison to average EL and EH chondrites [3].

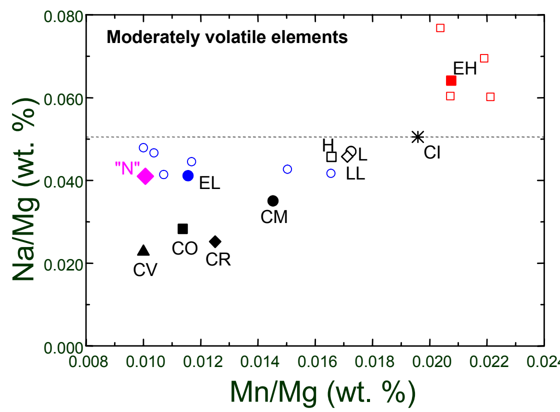


Fig. 2. Na/Mg versus Mn/Mg in falls of EH (red open squares; average: filled red square) and of EL chondrites (blue open circles; average: filled blue circle) and Neuschwanstein (filled magenta diamond). In comparison shown are other carbonaceous and ordinary chondrite groups. Data taken from [3].

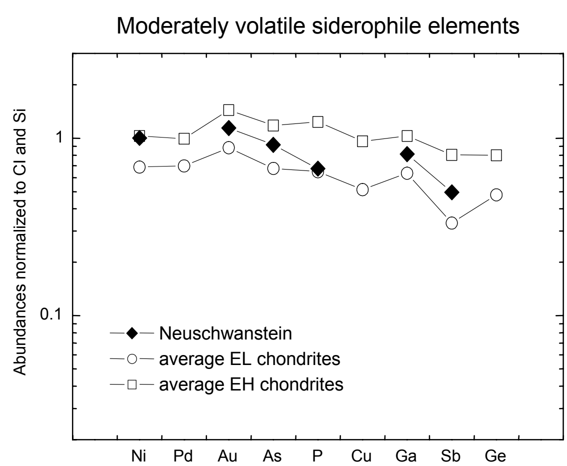


Fig. 3. CI and Si normalized abundances of moderately volatile siderophile elements in Neuschwanstein compared to average EH and EL chondrites [3].