5027

THE SUBO 18 (ENKINGEN) DRILL CORE FROM THE RIES CRATER, SOUTHERN GERMANY

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The Ries Crater impact breccia deposits are accessible through a series of boreholes. In 2008, a further hole was cored near the village of Enkingen (SE Ries), accessing the crater breccias at the inner slope of the crystalline ring. The 100 m drill core comprises 21.2 m crater sediment above suevite to −86.24 m and a rather massive impact melt rock to end-of-hole [1].

Downhole, the abundance and size of melt particles, as well as the maximum size of crystalline clasts, all increase. Only the lowermost section contains a notable but very small component of sedimentary clasts. The suevite package is characterized by significant variation in melt particle content, with local accumulations of densely packed and frequently subhorizontally aligned melt particles. A complete transition from melt-poor to melt-rich and melt-agglomeratic impact breccia was recovered.

A detailed study by ASEM of the submicroscopic groundmass in suevite samples showed that it is largely composed of secondary phyllosilicate and carbonate, besides micro-clasts and rare recognizable melt micro-particles. Textural evidence from clasts in melt-poor, melt-rich, and melt-dominated sections demonstrates that thermal effects are limited in the former, enhanced in the second, and dominant in the latter type of breccia. This may indicate that typical melt-poor suevite originally had a groundmass dominated by clastic material (besides significant porosity), whereas the other two types contained more and more melt both in the clast content and in the fine-grained to submicroscopic groundmass components. Modal analyses show that the target volume excavated and mixed into these impact breccias was dominated by crystalline basement-derived material, with only a minor sedimentary component. The varied suevite types in the Enkingen drill core are all rather similar also with regard to dominant shock degree of the micro-clast fraction. The challenge now is to find a comprehensive model that would explain these data in terms of genesis of different varieties and occurrences of suevite.

Major and trace element, including PGE, analysis by XRF, INAA and ICP-MS was carried out. Some samples are distinctly enriched in PGE, which has implications for Ries projectile identification.

Reference: [1] Pohl J. et al. 2010. *GSA* Special Paper 465, in press.

5126

GRAPHITE AND ORGANIC MATTER IN ABEE ENSTATITE CHONDRITE

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Introduction: Abee is a EH4 enstatite chondrite. It has been described as an impact breccia, with some parts having been exposed to temperature over 880 °C [1]. The shock induced by the impact has likely resulted in the segregation of metal and enstatite, leading to an heterogeneous structure with metal-rich clasts included in enstatite sulfide assemblage. It contains 0.36% of carbon [2], mainly described as graphite, but some of the carbon is poorly organized, being likely organic matter [3]. We have extended the data we have already reported by using NanoSIMS and HRTEM [3], to precise the structure of both graphite and organic matter and to understand their relationship in Abee.

Results and Discussion: The organic matter in Abee is characterized by the lowest D content in extraterrestrial carbonaceous matter ($\delta D = -330 \pm 25\%$ by NanoSIMS, consistent with previous bulk measurements [4]), making it a unique organic component. It has a poorly organized structure like insoluble organic matter (IOM) in other chondrites, but it sometimes exhibits an intriguing porous microtexture, not observed in other enstatite or carbonaceous chondrites. This could be the result of the dissolution of encapsulated minerals during the chemical treatment to recover the residue. Graphite is found as single crystals, as revealed by electron diffraction patterns. They are almost pure C as indicated by very low H/C (< 0.2 at. %) and N/C (< 0.0001 at. %). Their $\delta^{13}C$ ($-11 \pm 35\%$) shows their solar origin, likely by processing of organic matter on the parent body or before accretion.

In other chondrites, such well organized pure carbon materials are often encountered in metal grains [5], formed by catalytic effect with the metal. SEM imaging of Abee does not reveal any inclusion of C material in metal grains. Some C-rich rims are observed around big metal grains. But C-rich grains are more abundant in metal-poor regions than in metal-rich regions. In the metal-poor ones, some elongated structures (up to 40 μm) embedded in enstatite and/or sulfides and similar to "laths" previously described [1] are observed. Nevertheless preliminary Raman measurements tend to indicate that they are constituted by poorly organized material, likely the IOM. More Raman measurements and SEM imaging are under progress to find C-rich grains in both lithologies and study the petrographic relations of the graphite vs organic matter and minerals.

Conclusion: Abee contains a unique assemblage of carbonaceous phases. Its IOM has likely been subjected to D-depleted regions of the solar nebula, to induce its unusual D/H ratio, even compared to other enstatite chondrites [6]. On the other hand, it contains perfect large graphite grains whose origin (thermal processing of the IOM? exsolution from metal?) needs to be clarified.

References: [1] Rubin A. E. and Scott E. R. D. 1997. *GCA*, 61:425–435. [2] Moore C. B. and Lewis C. F. 1966. *EPSL* 1:376–378. [3] Remusat et al. 2010. (Abstract #1400). 41st Lunar and Planetary Science Conference. [4] Yang J. and Epstein S. 1983. *GCA* 47:2199–2216. [5] Charon et al. 2009 *Meteoritics & Planetary Science Conference* 72:A5159. [6] Alexander C. M. O'D. et al. 2007. *GCA* 71:4380–4403.