SHOCK-METAMORPHIC EFFECTS IN SAMPLES FROM CORE LB-O8A: FIRST MATERIAL RECOVERED FROM THE CENTRAL UPLIFT OF THE BOSUMTWI IMPACT CRATER, GHANA. Ludovic Ferrière[1], Christian Koeberl[1] and W. Uwe Reimold[2], [1]Department of Geological Sciences, University of Vienna, Althanstrasse 14, A-1090 Vienna, Austria. (ludovic.ferriere@univie.ac.at); [2]Mineralogy, Museum of Natural History, Humboldt-University, Invalidenstrasse 43, D-10115 Berlin, Germany.

Summary: Borehole LB-08A was drilled into the crater fill and underlying bedrock of the Bosumtwi impact structure, on the outer flank of the central uplift. Here we present mineralogical observations and shock petrography of drillcore LB-O8A. We find that suevites from this core show a lower proportion of melt particles and diaplectic quartz glass than suevites from outside the northern crater rim. Some PDFs in quartz grains are strongly decorated and the amount of shock deformation of the metasediment (bedrock) decreases with depth (also a shock heterogeneity related to different lithologies).

Introduction: The 1.07 Ma old Bosumtwi impact structure, centered at 06°30´N and 01°25´W, with a rim-to-rim diameter of 10.5 km, is a well-preserved complex impact crater with a pronounced rim and small central uplift [1-2]. The crater is almost entirely filled by a lake. The LB-O8A borehole, recovered between 235.6 and 451.33 m depth, was drilled as part of the 2004 International Continental Scientific Drilling Program (ICDP) [3]. This drillcore consists of approximately 25 meters of typical suevite (suevite definition according to [4], Fig. 1) overlying fractured/brecciated metasediment that displays a large variation in lithology and grain size (fine-grained to gritty). The metasediment is intercalated locally with suevite or granitoid dikes (see [5] for details). For this study we examined more than 150 thin sections representing 20 suevite and 100 metasediment samples and selected some of them for additional investigations (e.g., universal stage measurements, point-counting, SEM study).

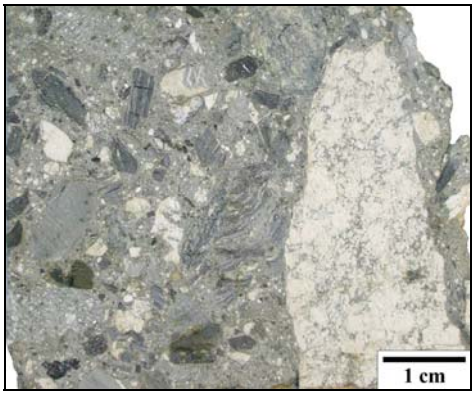

Fig. 1. Core photograph of suevite with clasts of various lithologies (mainly quartzite and greywacke, mica schist and impact melt), shapes and sizes (sample KR8-003, depth = 239.15 m).

Mineralogical observations and shock petrographic study: Partially or completely melted particles are present (abundance up to ~15 vol%) in the suevites and are mostly devitrified and subrounded to irregular in shape (Fig. 2). They have sizes between 100 µm and 1 cm. Rare diaplectic quartz glass particles have been observed only in the uppermost 5 m of suevite. A detailed study of two diaplectic quartz glass fragments (2 and 8 mm in size, see Fig. 3), from sample KR8-01 at a depth of 235.94 m, is in progress with respect to the composition and regarding nanoscale texture. Some quartz clasts with PFs and PDFs (common: 1, 2 or 3 sets; rare: 4 sets) are present in the suevite, and some of these grains have a toasted appearance. Universal stage measurements of 151 PDF orientations in 82 grains of five thin sections of suevite indicate that planes parallel to $\{10\bar{1}3\}$ are most common (between 60 to 68% of all measurements); $\{22\bar{4}1\}$, $\{11\bar{2}2\}$, $\{10\bar{1}1\}$, and $\{10\bar{1}2\}$ are also present (between 2 and 6%) and ~15% of all measurements could not be indexed. Secondary electron imaging of the surfaces of quartz grains with PDFs (Fig. 4) illustrate an alteration of the originally amorphous material of the PDFs.

Concerning shock effects in the bedrock, some quartz grains display PFs and PDFs (1, 2, or rarely 3 sets), some of which are decorated (presence of numerous small fluid inclusions, Fig. 5). Semi-quantitative evaluation of the number of shocked quartz grains (with PFs and PDFs) in ~100 bedrock samples illustrate that shock effects in quartz grains decrease with depth. Also variations of shock effects related to different lithologies have been observed. Two greywacke units, similar in grain size and in composition, have been investigated by point-counting of ~1000 quartz grains (shocked and unshocked) in four thin sections. Of the quartz grains 38% are shocked in the greywacke unit between 273.73 and 275.54 m, and only 20% in the greywacke between 352.91 and 354.99 m. Some feldspar grains display shock effects, fractures or polysynthetic twinning displaced along tiny faults. Calcite shows also planar features.

Summary: Traditionally decorated PDFs are considered secondary features, formed by annealing and aqueous alteration of non-decorated amorphous PDFs (see [6-7]). The Bosumtwi impact structure is just 1.07 Ma old and yet decorated PDFs are present. Recent shock experiments (A. Deutsch and T. Kenkmann, personal communication 2006) show that it is possible

to produce decorated PDFs in "wet" experiments. These observations of decorated PDFs argue for impact at Bosumtwi into a water-bearing target or, possibly, rapid post-impact alteration. This study confirms also the presence of melt particles and diaplectic quartz glass in polymict breccias (i.e., suevites) and shows a decrease of the amount of shock effects in quartz grains with depth in the brecciated bedrock of the central uplift.

Acknowledgments:
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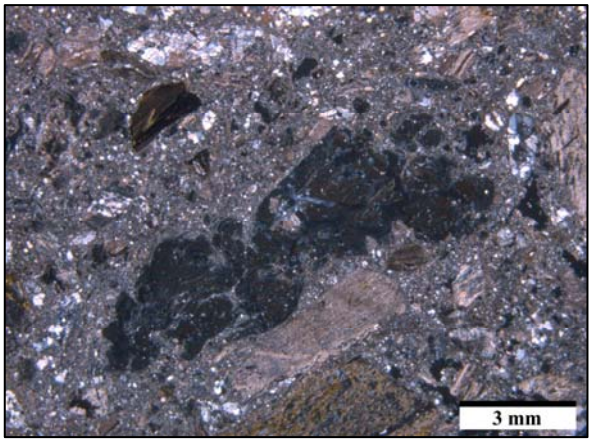

Fig. 2. Thin section microphotograph in cross polarized light of melt particle in suevite
(sample KR8-004, depth = 240.65 m).

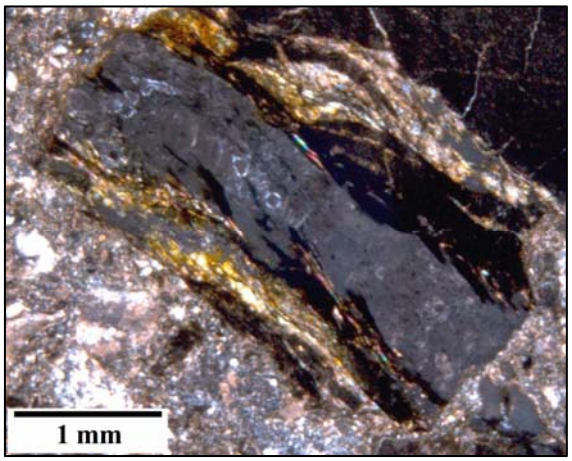

Fig. 3. Thin section microphotograph in cross polarized light of diaplectic quartz glass in suevite
(sample KR8-001, depth = 235.94 m).

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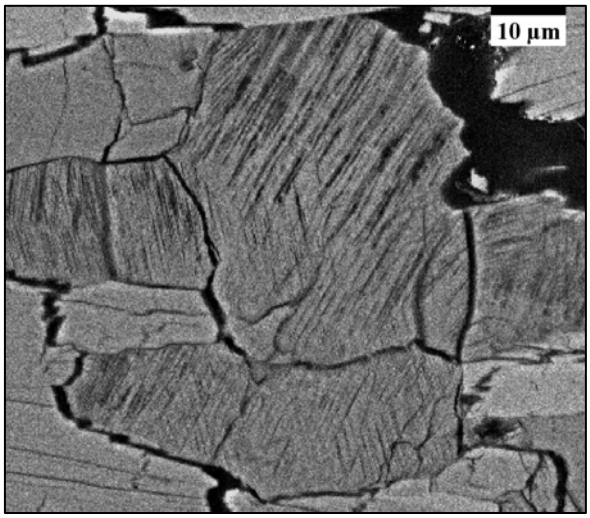

Fig. 4. SE image of quartz grains with PDFs in suevite (sample KR8-001, depth = 235.94 m).

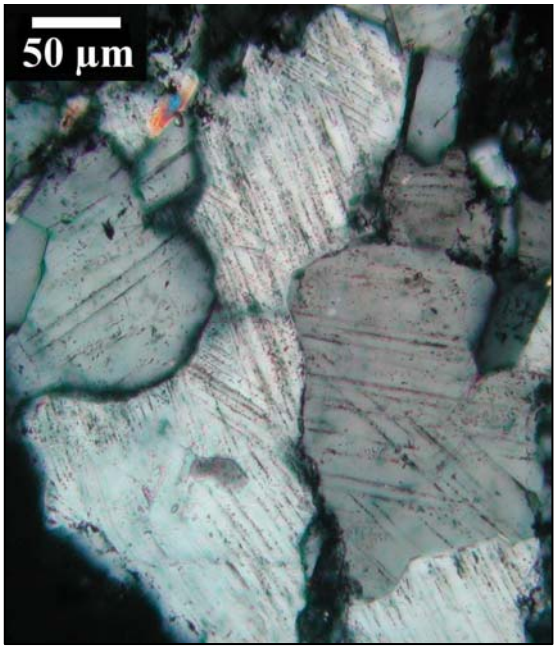

Fig. 5. Thin section microphotograph of quartz grains with decorated PDFs in greywacke
(sample KR8-070, depth = 364.42 m).