FIRST MINERALOGICAL OBSERVATIONS AND CHEMICAL ANALYSES OF CORE LB-O8A FROM THE CENTRAL UPLIFT OF THE BOSUMTWI IMPACT STRUCTURE, GHANA: COMPARISON WITH SUEVITE FROM OUTSIDE THE CRATER. L. Ferrière[1], C. Koeberl[1], W. U. Reimold[2] and R. L. Gibson[3], [1]Department of Geological Sciences, University of Vienna, Althanstrasse 14, Vienna, A-1090 Vienna, Austria (ludovic.ferriere@univie.ac.at and christian.koeberl@univie.ac.at), [2]Institute of Mineralogy, Museum for Natural History, Humboldt-University in Berlin, Invalidenstrasse 43, D-10099 Berlin, Germany (uwe.reimold@museum.hu-berlin.de), [3]Impact Cratering Research Group, University of the Witwatersrand, Private Bag 3, P.O. Wits, 2050 Johannesburg, South Africa.

Summary: Two boreholes (LB-O7A and LB-O8A) were drilled into the crater fill and underlying bedrock of the Bosumtwi impact structure, in the deep crater moat and on the outer flank of the central uplift, respectively. This drilling was performed as part of the 2004 International Continental Scientific Drilling Program (ICDP) [1]. Here we present lithostratigraphy, mineralogical observations, shock petrography, and first geochemical analyses of drillcore LB-O8A that represents the first material recovered from the central uplift. Suevites from this borehole and from outside the crater rim have different petrographic characteristics.

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 [2-3]. The crater is almost entirely filled by Lake Bosumtwi and has accumulated a 1 Ma paleo-climate record in the lake sediments since the impact event. The Bosumtwi structure is also associated with the Ivory Coast tektites [4].

Stratigraphy of Borehole LB-08A: From 235.6 to 261.0 m, the LB-O8A drillcore is composed of typical suevite (Fig. 1). Most of the core recovered from 261.0 to 404.6 m consists of an alternating sequence of greywacke (dominant) and other metasediment intercalations. Some suevite injections in between metasediment are present between 279.7 and 297.1 m depth, and a granitoid dike occurs at 360.15 meter depth. Over the last fifty meters (between 404.60 and 451.33 m) of drillcore, greywacke is dominant; some minor occurences of suevite (Fig. 1) and granitoid dikes have been noted there as well.

Mineralogical observations and shock petrographic study: At the microscopic scale, all breccia samples from this drillcore contain melt particles (Fig. 1), between 0.4 and 14.8 vol%. Devitrified melt particles, subrounded to irregular in shape, have sizes between 100 µm and 0.5 cm. The suevites have a fine-grained fragmental matrix, which accounts for 39 to 44.5 vol%. A variety of lithic clasts (see Fig. 3) occurs, including fragments of greywacke (some with strong mylonitic fabric, others containing much altered feldspar), phyllite, mica schist, impact melt and well-laminated organic shale. Lithic clasts are irregularly distributed throughout the suevite section; their population is dominated by greywacke throughout the section. The component of well-laminated, carbon-rich shale seems to decrease in abundance with increasing depth.

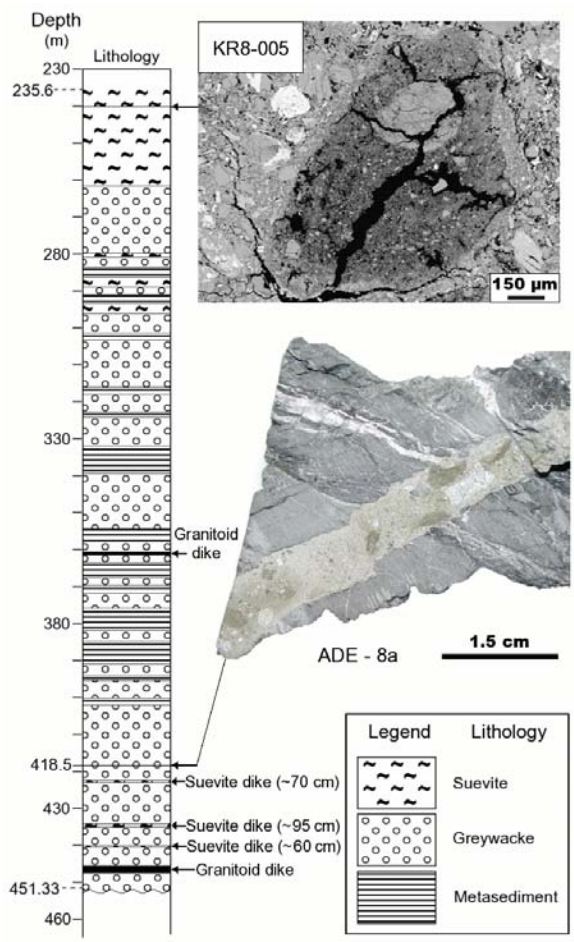

Fig. 1: Simplified stratigraphic column of LB-O8A with SEM micrograph of melt particle (sample KR8-005, depth = 240.14 m) and core photograph of a suevite dike in fine-grained greywacke (sample ADE-8a, depth = 418.48 m).

A shock petrographic study is currently in progress: some quartz clasts with PFs and PDFs (1 or 2 sets) are present in suevite; other quartz clasts are diaplectic glass.

The massive central uplift rocks are principally greywacke with large variation in grain size (fine-grained to gritty); in part these rocks are mylonitic. Other samples display extensive (even penetrative) fracturing or local brecciation. It is, however, not possible to state a definite trend of changing degree of deformation in relation to depth. Calcite veinlets or pods, iron oxides, and pyrite aggregates are present throughout the core (post-impact alteration products). Concerning shock effects in the bedrock, some quartz grains display PFs and PDFs (1 or 2 sets) and the number of grains with PDFs seemingly increases from the top to the bottom of the borehole. Two greywacke units show quartz grains with numerous PDFs, between 273.73 and 275.54, and between 352.91 and 354.99 m).

Geochemical results: Major and trace element concentrations have been measured by XRF for suevite and bedrock (INAA for further trace elements is in progress). Suevite samples have rather similar compositions for both major and trace elements. Some small variations of SiO_2 (59.24 to 68.43 wt.%), Al_2O_3, Fe_2O_3, MgO, CaO, and Na_2O abundances are readily explained as a function of the relative abundances of the different lithic components. Ni, Co, Cr, and V have concentrations from 24 to 62 ppm, 6 to 24 ppm, 77 to 199 ppm, and 92 to 153 ppm, respectively. Three suevite samples (KR8-039, 043, and 107, from 287.02, 297.39, and 422.51 m depths, respectively) have higher Cr and Ni concentrations (Fig. 2) that correlate with higher Co and MgO values.

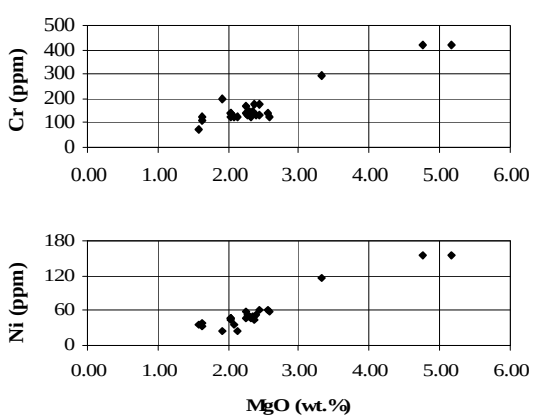

Fig. 2: Cr and Ni concentrations (ppm) versus MgO contents (wt.%) for suevites from LB-O8A drillcore.

Greywacke and schists have variable major and trace element concentrations, with higher SiO_2 contents in greywacke than in schists. One sample of greywacke (KR8-106; depth: 422.23 m) has very high Ni (355 ppm), Co (34 ppm), and Cr (814 ppm) contents. This sample is in contact with a suevite dike, but these concentrations are two times higher than the maximum values in the suevites. It is necessary to perform additional analyses on this part of the borehole.

Comparison of suevite from within the crater and from outside the crater: Suevite deposits from outside the northern crater rim (Fig. 3) show a higher degree of shock metamorphism (very melt-rich and presence of ballen structure in quartz) than the suevites in our core samples. See Fig. 3 for more detail about suevites from these two settings.

	LB-O8A suevite samples	Suevite deposits outside N crater rim [5]
Lithic components	- Variety of lithic clasts (see text). - Lithic components are subrounded to subangular in shape.	- Melt particles, greywacke, phyllite and mineral fragments. - More clasts are totally melted.
Melt particles and shocked components	- Up to 15 vol% of glass/melt particles. - Melt particles are subrounded to irregular in shape. - Few quartz grains with PDFs (1 or 2 sets). - A few diaplectic quartz grains.	- Melt particles up to 90 vol%. - Flow textures in melt particles and vesicular glass. - Devitrified glass melt inclusions. - Few quartz grains with PDFs (1 or 2 sets). - Quartz grains with ballen structure common.
Matrix	- Clastic matrix, fine-grained.	- Clastic + melt matrix (melt particles at the lower grain size).

Fig. 3: Some detail about suevites from within the crater (core LB-O8A) and outside the northern crater rim.

Conclusions: We found melt particles in all breccias and a variety of planar deformation features in samples from virtually the entire core LB-08A. Detailed studies of the shock record (PDF orientations and proportions, detailed study of melt particles...) are in progress.

Acknowledgments: Drilling was funded by ICDP, the U.S. NSF, the Austrian FWF, the Canadian NSERc, and the Austrian Academy of Sciences. Drilling operations were performed by DOSECC. This work was supported by the Austrian FWF (P17194-N10 (to CK).

References: [1] Koeberl et al. (2005) *LPS XXXVI*, Abstract #1830. [2] Scholz C.A. et al. (2002) *Geology*, 30, 939-942. [3] Koeberl, C., and Reimold, W.U. (2005) *Jb. Geol. B.-A. 145*, 31-70. [4] Koeberl C. et al. (1998) *GCA*, 62, 2179-2196. [5] Boamah D. and Koeberl C. (2003) *MAPS*, 38, 1137-1159.