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Drilling at impact structures: The case of the Bosumtwi impact structure, Ghana

L. Ferrière (1), C. Koeberl (1) and W. U. Reimold (2)

(1) Center for Earth Sciences, University of Vienna, Althanstrasse 14, A-1090 Vienna, Austria, (2) Museum of Natural History (Mineralogy), Humboldt-University, Invalidenstrasse 43, D-10115 Berlin, Germany (ludovic.ferriere@univie.ac.at)

About 35% of the known impact structures are not exposed at the Earth's surface. Geophysical techniques can provide general information about an impact structure, but drilling (i.e., coring) operations are necessary to obtain ground truth for geophysical interpretations and to recover samples for detailed petrographic/geochemical/geochronological investigations. Geophysical investigations in conjunction with drilling permit to study impact structures in three dimensions, which is useful for numerical modelers and, thus, for a generally better understanding of the cratering process. Drilling of impact structures may also be interesting for paleoclimate reconstruction studies due to the potentially long records of crater-fill sedimentary rocks (i.e., varves) accumulated in the crater since the time of impact.

The 1.07 Ma old, 10.5-km-diameter Bosumtwi impact structure in Ghana is a well-preserved complex impact crater with a pronounced rim and small central uplift [e.g., 1-2]. The 2004 International Continental Scientific Drilling Program (ICDP) project led to the recovery of 16 drill cores, including 14 sediment cores and two impactite cores, LB-07A and LB-08A. The latter were drilled in the deep crater moat and on the outer flank of the central uplift, respectively [3]. Here we present a summary of observations on lithostratigraphy, mineralogy, shock petrography, and geochemistry of drillcore LB-08A, and a comparison with samples from drillcore LB-07A as well as with samples from outside of the crater rim. Drillcore LB-08A, recovered between 235.6 and 451.33 m below lake level, consists of approximately 25 m of polymict, clast-supported lithic breccia intercalated with suevite, which overlies fractured/brecciated

basement composed of metasediment. The suevites have a fine-grained fragmental matrix and contain a variety of lithic clasts. Suevites from borehole LB-08A differ in their petrographic characteristics from suevites outside of the crater rim. The metasediment section (i.e., bedrock) is mainly composed of shocked meta-greywacke that displays quartz grains with planar fractures (PFs; usually 1 set) and planar deformation features (PDFs; 1, 2, or rarely 3 to 4 sets). Some of the quartz grains show PDFs decorated with abundant tiny fluid inclusions and some of the shocked grains have a "toasted appearance". The decoration of the PDFs, somewhat surprising for a young structure, argues for a rapid post-impact alteration or an impact into a water- or volatile-rich target.

The vertical variation of shock characteristics in quartz along core LB-08A clearly illustrate shock-wave attenuation in the uplifted target. Our study provides an indication of the shock history of the rocks uplifted (and collapsed?) to the actual position of their occurrence, and may be useful for modeling of the zone of origin of these rocks in the target prior to crater modification.

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