**REVISED STRATIGRAPHY AND SUEVITE CHARACTERISTICS OF ICDP BOREHOLE LB-07A, BOSUMTWI IMPACT STRUCTURE, GHANA BASED ON NEW PETROGRAPHIC AND GEOCHEMICAL RESULTS.**

L. Coney[1], W. U. Reimold[2], R. L. Gibson[1], and C. Koeberl[3]. [1]Impact Cratering Research Group, University of the Witwatersrand, Private Bag 3, P.O. Wits, 2050 Johannesburg, South Africa (ConeyL@science.pg.wits.ac.za), [2]Museum for Natural History, Humboldt-University in Berlin, Invalidenstrasse 43, D-10115 Berlin, Germany [3] Department of Geological Sciences, University of Vienna, Althanstrasse 14, A-1090 Vienna, Austria.

**Summary:** The Bosumtwi impact structure, Ghana, is one of the few craters known on Earth that retains a tektite strewn field and fallout suevites. In addition, ICDP borehole LB-07A has intersected three suevite packages ranging from 12.65 m to 21.89 m thick, and centimeter-thick intercalations within monomict breccias and basement rocks from within the crater. These suevites differ from the fallout suevite in having significantly less melt and a different clast population. No evidence for a meteoritic component has been found.

**Introduction:** The 10.5 km diameter, 1.07 Ma Bosumtwi impact structure, Ghana, is the youngest well-preserved complex impact structure known on Earth; it is associated with the Ivory Coast tektite strewn field. Bosumtwi was excavated in 2.1-2.2 Ga Birimian metasediments and metavolcanics [1,2]. The Bosumtwi structure was the subject of an interdisciplinary drilling effort by the International Continental Scientific Drilling Program (ICDP) from July to October 2004, which led to the recovery of a series of cores through the sedimentary crater fill as well as two cores through the impact breccia fill and underlying crater basement (LB-07A and LB-08A) [3]. First results on cores LB-07A and LB-08A were reported at LPSC in 2006.

**This study:** In borehole LB-07A a number of suevitic breccia units were identified in addition to polymict lithic and monomict breccias; these have been compared geochemically and petrographically. Ten samples of suevites and country rocks (with variable siderophile contents) were analyzed for their PGE contents using ICP-MS after Ni-sulfide fire assay with Te coprecipitation, using signal intensity calibration [4].

**Revised stratigraphy of LB-07A:** Following initial results [5], the LB-07A borehole was revisited and re-logged [6]. The core has been divided [6] into upper and lower impactite sections, and a predominantly metasedimentary basement. The upper impactites (333.38 –415.67 m) consist of alternating suevites and lithic breccias, which are similar in breccia characteristics (e.g., clast content, size) but differ by the presence or absence of melt particles. The lower impactites (415.67–470.55 m) represent monomict impact breccia after both metagreywacke and shale (metagreywacke >> shale). Two intercalations of suevite are found in this section, one of which contains significantly more melt fragments than the other suevite samples studied from LB-07A. The basement metasediments (470.55–545.08 m) consist of altered shale >> metagreywacke. Primary (stratiform bands) and secondary (thin veinlets and local pods) calcite is common throughout LB-07A. Two suevitic breccia intercalations also occur in this interval. After evaluating the proportions of lithic and mineral components in the breccias as well as the stratigraphic proportions of rock types, it was determined that core LB-07A comprises 43.6 vol% metagreywacke, 40.9 vol% shale, 5.9 vol% phyllite, 4.8 vol% quartz/quartzite, and 1.6 vol% carbonate. The remaining 3.2 vol% consists of a mixture of other components, including phyllosilicates, feldspar, granite (traces only), schist, and a rare impact breccia clast in impact breccia [6].

**Suevite characteristics:** The suevites of the upper impactite sequence, and suevite intercalations in the lower impactites and basement lithologies, are similar to each other in clast composition; they are dominated by metagreywacke, altered shale, phyllite, schist and quartz. Pyrite and chalcopyrite have been found as both primary and secondary phases – either as euhedral phases in shale clasts in the upper part of LB-07A and in shale bands of the intercalated basement strata, and as microscopic, network-textured aggregates in the breccias. The melt particles of the upper and lower suevites (mostly < 3.6 vol%, but up to 18 vol% in individual samples due to modal analyses involving rare large fragments in selected thin sections; [9]) are similar in terms of shape (mostly rounded to subrounded, rarely angular) and size (0.1 – 10 mm). The colors of the matrices and melt particles of the suevites vary with depth: In the upper impactites, the suevites are gray-brown, in the lower impactites they are moderate greenish-yellow, and in the basement they are either light or dark gray. The average size of melt particles is larger in the upper impactites, as is the mean size of the lithic and mineral clasts (~1 mm vs. 0.1-0.5 mm). In terms of shock deformation, the mean percentage of quartz grains with planar deformation features (PDFs) decreases from a maximum of 12 % in the upper impactites to 3 % in the lower impactites, and only traces occur in the basement suevites.

**Suevite matrices:** In order to determine a cause of color variation, XRD analysis was performed on a number of suevites as well as other lithologies from different depths. Besides comparable quantities (semi-quantitative) of chlorite, muscovite, and quartz in all samples, the major differences noted were that significant plagioclase and calcite occur in the upper impactites, lower impactite suevites and the upper suevite in the basement section, but not in the lowermost basement suevite, and that the lowermost basement suevite contains a minor amount of smectite. A number of basement metasediment lithologies contain significant proportions of orthoclase. It is probable that the color variation is caused by post-impact alteration.

**Geochemistry:** In terms of major and trace element compositions, the various lithologies of core LB-07A are well homogenized. CaO contents are most variable, likely representing hydrothermal alteration and the presence of variable carbonate amounts (0.5-16 vol%). $Fe_2O_3$ and MgO values are also variable, reflecting the respective phyllosilicates (supported by XRD data) rather than variation of shale proportion in the matrix, as little correlation between these elements and the amount of shale could be determined. Siderophile trace elements show variations similar to $Fe_2O_3$, with positive correlation of Fe with Ni, Co, and Cr contents. Several samples (all lithologies) show As enrichment – most likely concentrated in microscopic sulfide [7-8].

*Suevites*. The various suevites all have similar geochemical signatures throughout the core. The lowermost suevite intercalation in the basement metasediments has comparatively higher $SiO_2$ and lower $Al_2O_3$, $Fe_2O_3$, $Na_2O$, and $K_2O$ contents than the average suevite values (consistent with higher quartz contents). For most suevites, little variation for Rb, Zr, and V, but much scatter for Sr, Ba, Zn, and Cu values is observed. Normalized rare earth element contents show little variation between suevites and other lithologies in LB-07A.

**Distribution of shocked material:** In comparison to the suevite occurrences outside the crater [7-8], it is apparent that the most shocked (melted) material was ejected from the crater, leaving mostly moderately shocked material within the crater. The main difference between the fallout and fallback breccias is the significant presence (>3 vol%; [9-10]) of granite clasts in the fallout suevite, with only traces in the fallback and injected suevites of the drill core. Slightly higher amounts of metagreywacke and metapelitic material are present in the LB-07A suevites, though the relative proportions are similar to those of the fallout suevites. It is possible that the local presence of more granitoid-rich material in the northern part of the target volume could be responsible for the enhanced granite signature of the suevite from outside the northern crater rim. Further work on melt particle petrography (including quantitative analysis of melt compositions) is in progress and will be reported at the conference.

**Meteoritic component:** All normalized PGE abundance patterns are similar to each other, irrespective of lithology, and are non-chondritic [4]. Samples with the highest siderophile element (Ni, Co, Fe) contents yielded the highest PGE contents, as expected. Iridium values vary between 28 and 677 ppt. The highest Au abundances do not correlate with the highest PGE values.

**Conclusions:** Thick suevite packages are found in the upper part of the LB-07A borehole, with 2 thin suevite intercalations in the lower impactites and another 2 in the basement metasediments. The suevites of the LB-07A borehole are similar to each other both petrographically and geochemically. Their main clast component is derived from metasedimentary target rocks. The suevitic intercalations are thought to represent injections of material (similar petrographically and geochemically to the suevites in the upper impactite section) into the crater floor. The differences between the suevites are the color of the matrices and degree of shock with depth – XRD analysis of the matrices failed to provide a full explanation for the former, and this problem is still under investigation. No definitive evidence for a meteoritic component has been found, in agreement with other studies [11-12]. The main differences between the suevites from outside and inside the crater (clast population, amount of impact melt) are still being investigated. It is currently felt that the variability of rock types within the target volume could offer one explanation for the varied clast populations.

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