ON THE ORIGIN AND PRECURSOR MATERIALS OF GLASSY FALLBACK PARTICLES IN THE LAKE BOSUMTWI ICDP CORES - STATUS REPORT.

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Introduction: The 1.07 Ma Lake Bosumtwi impact structure, Ghana (06°32´N, 01°25`W) is considered as source crater of the Ivory Coast tektites (IVC) and the related microtektites. Within the ICDP Bosumtwi Core Drilling Project (BCDP) impact breccias and target lithologies were recovered from the flank of the central uplift and the annual moat [1]. In addition, so-called glassy fallback particles were discovered in the uppermost centimeters of the impact deposits [2].

Scientific aim of the study: Bosumtwi is the only (?) crater where all known species of impact-related glasses have been found, namely, fragments in suevites, tektites, microtektites, and fallback particles. Using Bosumtwi material, therefore, it should be possible to constrain the different formation processes by a geochemical and isotope geochemical characterization of the glassy materials, and potential target lithologies. Here we present (a) major element (XRF, electron microprobe) and Sr-Nd isotope for (i) target lithologies occurring in the ICDP drill cores LB-07A and LB-08A (meta-greywacke, phyllite, shale, and slate), and off the northern crater rim (gneiss, mica-schist, staurolite mica schist), (ii) suevitic as well as lithic breccias (matrix, separated lithic clasts), and (iii) 19 glassy fallback particles from core LB-05A, and (b) Rb-Sr and Sm-Nd isotope whole rock data (TIMS) for 23 target lithologies and impact breccias.

Major element data: 15 *core samples* of meta-sedimentary target lithologies, and two lithic impact breccias with a fine- to medium-grained matrix display a wide range in SiO_2 (56.3 to 80.6 wt%; Fig. 1). Compared to the meta-greywackes with an intermediate SiO_2 content (62 to 72 wt%), samples with SiO_2 >72 wt%, i.e., more mature meta-sediments, show a slightly lower Al_2O_3, and also a slightly higher CaO content; the latter tentatively interpreted as effect of cementation. The low silica samples have relatively low Al_2O_3 (12-14 wt%), high CaO and MgO (6.6 to 8.4, and 5.7 to 9.9 wt%, respectively), and varying K_2O and Na_2O contents (0.3 to 1.6, and 0.6 to 4.0 wt%, respectively); in addition, Ni and Cr concentrations are quite high (125 to 404, and 281 to 769 ppm, respectively). These rocks contain up to 4-mm-sized calcite grains, up to about 2 vol% of ore minerals and a fine-grained, chlorite-rich matrix. Obviously these lithologies contain a distinct volcanic component.

The meta-greywackes and the fine grained matrix of lithic breccias show the following composition: TiO_2 - 0.3 to 0.8, Al_2O_3 - 15.3 to 19.0, FeO_{tot} - 1.9 to 0.8, Na_2O - 0.2 to 5.5, and K_2O - 1.0 to 2.7 wt%. These results correspond well to data by [3,4], except for the higher CaO and MgO contents (<6.1, and <4.7 wt%, respectively). Compared to data by [5] for meta-greywackes from core LB-08A with an average SiO_2 content of 70.5 ± 3.4 wt%, our sample suite is less silica rich, and has significantly higher Al_2O_3, FeO, and K_2O values. This discrepancy may be due to some bias in the core sampling.

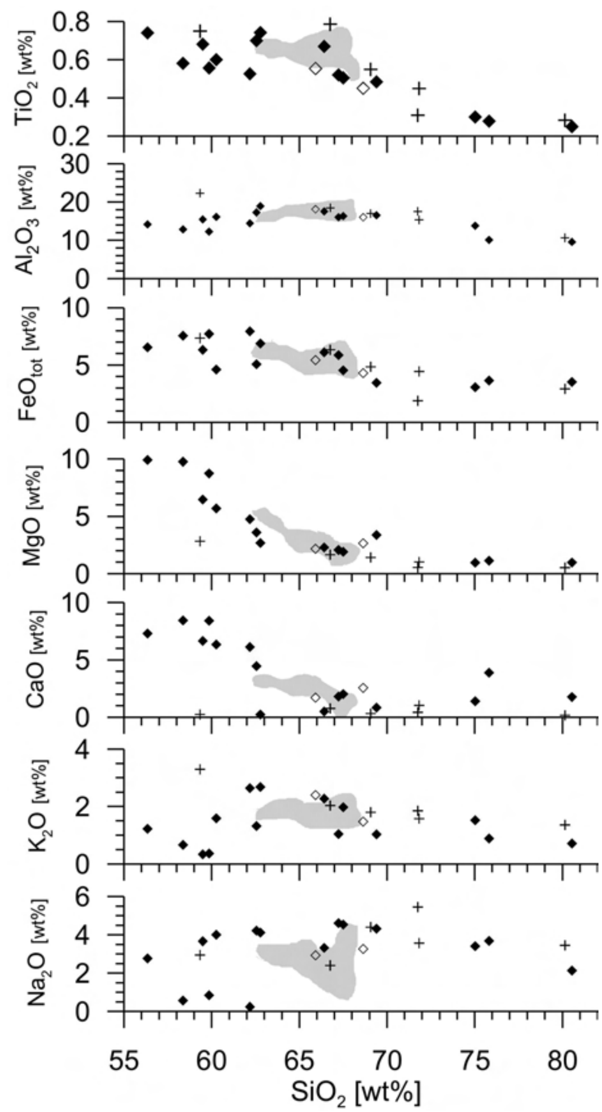

Fig. 1. Harker diagrams. Target lithologies: ◆ core, + surface samples; ◇ impact breccias; grey field: fallback particles.

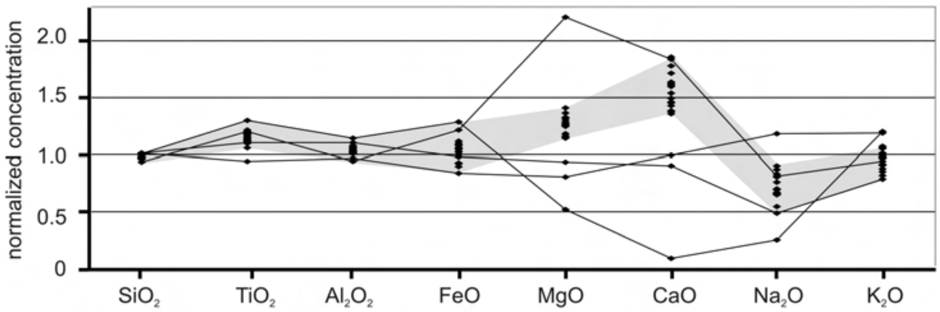

Fig. 2. Composition of fallback particles normalized to the average composition of target rocks with intermediate SiO2 content. The grey field corresponds to most common type of glassy spherules.

Surface samples. Except for the staurolite mica schist with 22.3 wt% Al_2O_3, the major element composition of target rocks from the N crater rim [6] fall into the range known from other investigations [3,4].

Fallback particles. The glassy spherules, analyzed by microprobe along profile lines (20 - 35 points each), show the following composition: SiO_2 - 64.7 to 67.9, TiO_2 - 0.59 to 0.73, Al_2O_3 - 16.3 to 19.4, FeO_{tot} - 4.3 to 6.6, MgO - 1.2 to 5.1, CaO - 0.2 to 3.2, Na_2O - 0.9 to 4.3, and K_2O - 1.5 to 2.2 wt%. This composition is similar to that one of the target rocks with an intermediate silica content (Fig. 1). Normalized to the average composition of target rocks with an intermediate silica content (Fig. 2), however, the fallback particles show significant differences in CaO (enrichment up to a factor of 1.8), MgO (enrichment up to 2.2), and Na_2O (general depletion). Two samples are slightly depleted in MgO, one is strongly depleted in CaO and MgO. As analytical totals range from 98 to 101 wt%, we interpret the chemical variation as primary feature of the glassy particles. Compared to IVC tektites & microtektites, the Ca contents in the fallback particles are significantly higher [7, 8]

Sr-Nd data: These are the first Sr-Nd isotope analyses for BCDP samples (target rocks, breccias). Their T_{DM} Nd model ages cluster at 2.3 to 2.4 Ga in good agreement with data for country rocks in the surroundings of the Bosumtwi crater [3 with refs.]; present day εNd varies from -24.3 to -14.0, and εSr from -20.3 to 562; the highest εSr values are found in shales, slates, and the staurolite mica schist. One light grey meta-greywacke ("granophyric-textured") displays εSr of -20.3, similar to εSr for a Pepiakese granite sample given by [3] yet another light grey meta-greywacke has εSr of 62.6. The reason for the strong Rb/Sr fractionation, needed to explain the data, is unknown, yet the process did occur long before the impact event. The range of εNd of our sample suite is larger than known so far [3].

Summary: The major element composition of fallback particles from the Bosumtwi structure is in fairly good accordance with that one of target rocks with intermediate SiO_2 content. Variations in CaO and MgO contents may reflect heterogeneous carbonate distribution in the precursor material, the sodium deficit may be a corollary of volatilization. Additional Sr-Nd isotope and trace element data of target lithologies are needed to better understand the formation processes of the different impact-related glassy materials.

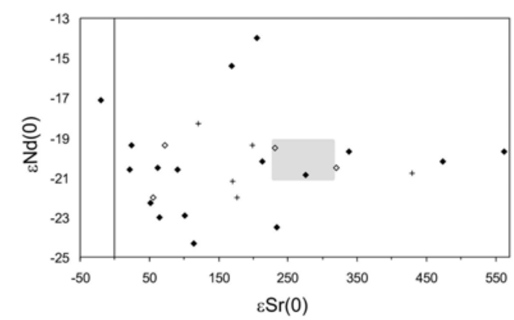

Fig. 3. Present day εNd-εSr diagram**.** Target lithologies: ◆ core, ✚ surface samples; ◇ impact breccias; grey field: IVC tektites [3].

References: [1] Koeberl, C. et al. (2007), Deutsch et al. (2007), Coney, L. et al. (2007) *MAPS, spec. vol. Bosumtwi*. in press. [2] Koeberl, C. et al. (2006) *LPS XXXVII,* Abstr. #1552. [3] Koeberl, C. et al. (1998) *GCA, 62*, 2179-2196. [4] Dai, X. et al. (2005) *MAPS, 40,* 1493-1511. [5] Ferrière, L. et al. (2007) *MAPS, spec. vol. Bosumtwi*. [6] Luetke, S. et al. (2006) *LPS XXXVII,* Abstr. #1811. [7] Koeberl, C. et al. (1997) *GCA, 61*, 1745-1772. [8] Glass, P.B. et al. (2004) *GCA, 68*, 3971-4006.

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