PRELIMINARY X-RAY DIFFRACTION EVIDENCE OF HYDROTHERMAL ALTERATION IN THE BOSUMTWI IMAPCT CRATER. M. T. Petersen[1], H. E. Newsom[1], D. M. Moore[1], M. J. Nelson[1], [1]Institute of Meteoritics, University of New Mexico, Albuquerque, NM 87131 mikepet@unm.edu.

Introduction: The Bosumtwi Impact Crater in Ghana, Africa (6°32'N, 1°25'W) is a large complex crater. The crater is 10.5 km in diameter, with a central uplift 2 km in diameter. It is the source of the Ivory Coast Tektite field, found to the southwest of the crater over 200 km away. This study investigates the mineralogy, the petrology, and the geochemistry of drill core samples taken near the center of the crater. In preliminary studies, X-Ray Diffraction (XRD) and petrographic analyses proved to be most conclusive and interesting.

Crater Structure & Core Sites: This study focus on two drill cores taken in 2004. Drill core 7 is located on the floor of the crater at the base of the central uplift. Basement rock has been covered by lake sediments and crater collapse. Drill core 8 is located well onto the central uplift. Artemieva [1] has modeled the formation of the crater and has determined that the meteor that made this impact weighed 400-1100 kg and impacted the ground at a high velocity (~20 km/sec) at an angle of 30-50°, creating pressures of 30-50 Pa, thus presumably high temperatures. The 1 Ma crater was emplaced in the 2 Ga Birmian Super group, a sedimentary gray-wacke [2]. Major geologic processes have not affected the crater or the surrounding area after the impact occurred.

Mineralogy: Preliminary XRD analysis found chlorite, quartz, and feldspars as the major mineralogical components of the samples. The chlorite peaks are asymmetrical meaning the heavy ions are unevenly distributed throughout the chlorite structure. Major peaks are quartz, feldspar, and chlorite (**Fig 3, 4)**. In most samples analyzed, Illite was discovered in a 2M (**Fig 1, 2**) stacking pattern. The 2M structure forms only at temperatures greater than 200° C [3]. Illite has also been found at the Manson crater in Iowa [4] which has other mineralogical evidence of hydrothermal alteration. Illite and other clay minerals were discovered in impactites in the 1973 drill core near the center of the Ries Crater [5]. In contrast, only Montmorillionite was found in ejecta outside of the Ries crater [6].

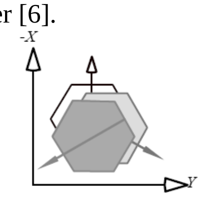

Fig 1: 2m stacking pattern using 3 sheet phyllosilicates. 120° offset between layers.

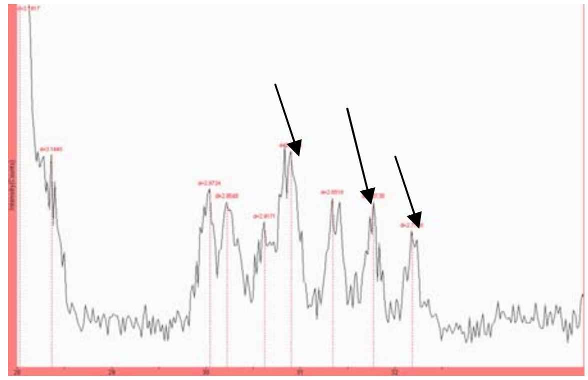

Fig 2: XRD plot showing peaks that distinguish 2M stacking (30.0, 31.3, 32.1). Note descending pattern of peaks.

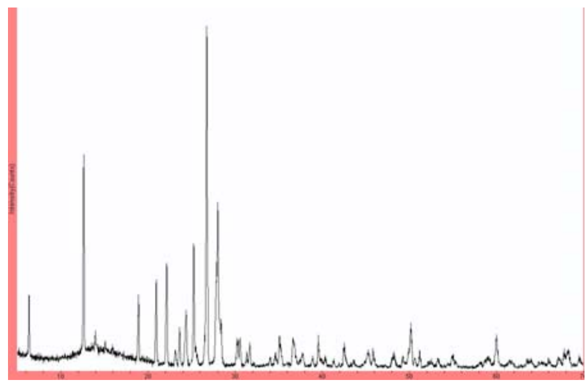

Fig 3: Full XRD analysis for sample taken for core taken from base of uplift. B7-14-11

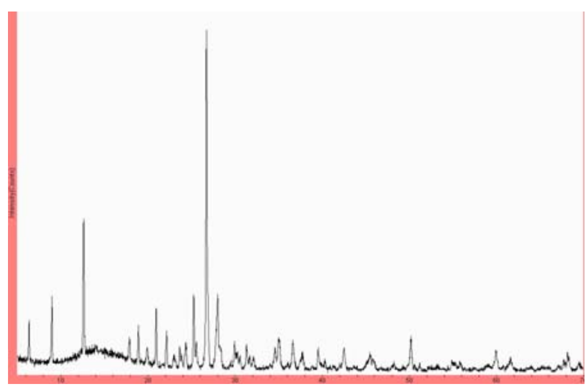

Fig 4: Full XRD analysis taken from sample taken from central uplift. B8-62-69

Petrology: The upper part of the drill cores exhibit much more evidence of impact than the lower parts. The very top of the cores include melts (**Fig 6a**), melt clasts (**Fig 5a**), breccias, and mica and alteration veins, presumably illite, which formed at the time of impact, exhibited by the flow texture in **Fig 5b** and **Fig 6b**. Although brecciation is less common as the depth increases, the impact still shocks mineral grains and fractures them (upper left **Fig 6b**). **Fig 5c** shows a vein that has been cross-cut by heated clays and other minerals, suggesting that this vein was in place before the impact, and that the impact disrupted the vein. The lower parts of the core contain less brecciation, and little to no grain fracture. Clays are also found in the lower portions of the core, though in lesser abundance and only fill the smaller gaps between minerals.

Core 7 **Core 8**

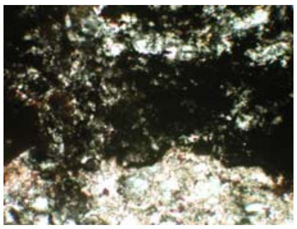

Fig 5a: B7-1-1:

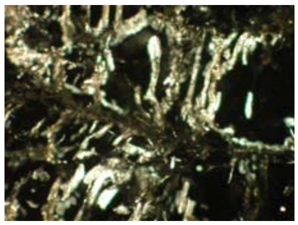

Fig 6a: B8-1-1:

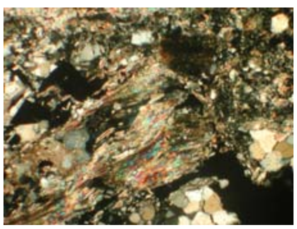

Fig 5b: B7-4-3:

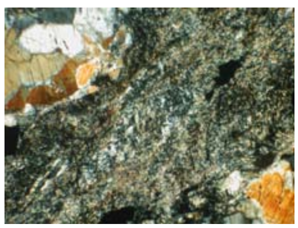

Fig 6b: B8-13-13:

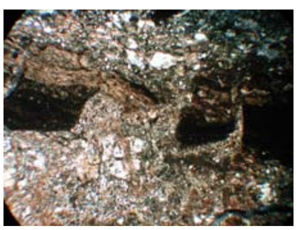

Fig 5c: B7-9-7:

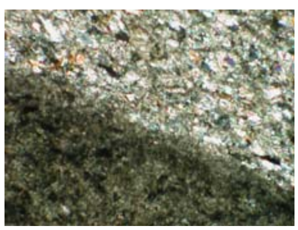

Fig 6c: B8-62-64:

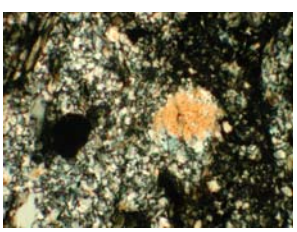

Fig 5d: B7-14-11

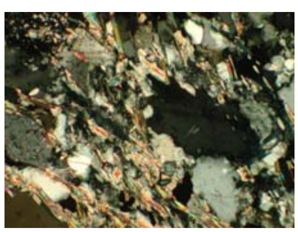

Fig 6d: B8-71-77:

Fig 5: Petrography from drill core 7 with samples in descending order of depth. Node the decrease of clays and shock features as depth increases.

Fig 6: Petrography from drill core 8 with samples in descending order of depth. Note how melt features and clay abundances decrease as depth increases.

Paragenitic features found in the overall petrology imply that hydrothermal alteration occurred. Deformation and fragmentation are results of the massive shock from the collision, and post-impact clay minerals filled in the gaps around these deformed rocks.

Geochemistry: The bulk chemistry was examined through X-ray fluorescence (XRF). Samples from the top of core 8 are silica-rich and iron and aluminum-poor, while the samples from the bottom are depleted in silica and iron and aluminum rich. Samples from the top of core core 7 are silica-poor and aluminum and iron-rich, while samples from the bottom are silica-rich and iron and aluminum-poor.

Initial geochemistry results are comparable with the basement target phyllite-graywacke series analyzed in [2]. Silica, aluminum, and iron are highest in abundance, there is notable variation in potassium and calcium. Calcium increases in concentration as depth increases, which is surprising considering the calcite alteration veins found in the upper portions of the core, but not the lower portions.

Discussion & Interpretation: The paragenic petrological data and the high-T XRD data indicate that post-impact hydrothermal alteration occurred in the upper layers of the crater. These observations are consistent with observations made during the drilling of core 8 [5]. Calcite alteration occurs in the upper portions of the cores. In the lower portions, the vugs are smaller and less dramatic, and are filled by clay minerals.

Conclusions: The chemistries and structures found in the drill cores of the Bosumtwi Crater are formed by the shock metamorphism of the collision, and subsequent hydrothermal alteration. Extreme temperatures and pressures from the impact are recorded in mineralogical and petrographical data.

References: [1] Artemieva, N., et al. (2004) *Geochem. Geophys. Geosys., 5.* [2] Koeberl, C., et al. (1998) *Geochim. Cosmoschim. Acta, 62*, 2179-2196. [3] Moore, D., et al. (1997) *X-Ray Diffraction and the Identification and Analysis of Clay Minerals,* Oxford Press. [4] McCarville, P., et al. (1996) *The Manson Impact Sturcture, Iowa.* GSA, 347-376. [5] Stöffler, D., et al., (1977) *Geologica Bavarica, 75,*163-189. [6] Newsom, H., et al., (1986) LPSC XVII, E329-E251.

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