THE SEARCH FOR A METEORITIC COMPONENT IN IMPACTITES FROM THE FLYNN CREEK IMPACT CRATER. K. A. Milam[1] and B. Deane[2], [1]Department of Geological Sciences, 316 Clippinger Laboratories, Ohio University, Athens, OH 45701, milamk@ohio.edu [2]Department of Earth and Planetary Sciences, 1412 Circle Drive, Knoxville, TN 37996, wdeane@utk.edu.

Introduction: Here we examine impact-generated breccias from the Flynn Creek impact structure for evidence of a chondritic or iron-rich meteoritic component. The 3.8 km diameter Flynn Creek impact structure (36˚17'N, 85˚40'W) is a partially-buried complex crater located in the Highland Rim physiographic province of north-central Tennessee, U.S [1,2]. The ~360 Ma impact occurred in flat-lying limestones, dolostones, and shale of the Lower Ordovician Knox Dolomite, Middle Ordovician Stones River Group, and Middle-Upper Ordovician Bigby-Cannon and Leipers-Catheys Formations [2]. The impact was later buried by Devonian mud that would lithify to form the Chattanooga Shale. Prior to burial, fallback and resurge from the impact event would deposit poorly sorted breccias on the crater floor and along the rim [3]. Breccias are not exposed (and may not remain) very far outside the crater rim.

An impact origin was confirmed for Flynn Creek with the identification of rare small shatter cones by [4], but other supporting evidence has been lacking. Here, we examine impact-generated breccias from within the structure for traces of a meteoritic component.

Methods: Samples of breccias were collected from several locations in the Flynn Creek impact structure. Three sites were chosen for geochemical analyses. The first site lies in southeastern quadrant of the crater interior along the main entrance road and northeast of Flynn Creek itself. Here, a matrix-supported polymict breccia (sample FCB03F) was collected from an irregularly-bedded roadside exposure. This breccia is predominantly limestone, with some dolostone clasts present. Angular lithic clasts appear to represent examples of the target rock exposed along the crater rim and possibly a minor component of shale clasts from the Chattanooga Shale [5]. A second sample (FCS6-1) was collected for analysis in the northwestern portion of the crater inside the crater rim and just below the disconformable contact (Figure 1) with the Chattanooga Shale [6]. This carbonate sample is also a polymict, matrix-supported breccia that contains curious voids reminiscent of vesicles. [6] interpreted this texture to be the result of weathering of carbonate clasts. The final site lies along the western flank of the central uplift. Here a bedded, matrix-supported polymict breccia (Figure 2) has been superposed on the central uplift. The thickness of the unit and an overlying fine-grained limestone does not vary with distance from the central uplift, suggesting that this unit was deposited and structurally coherent prior to rise of the central uplift. The Chattanooga Shale immediately overlies the fine-grained limestone and laterally thickens to the west, providing evidence of post-impact deposition. We interpret this sequence to represent initial fallback (polymict breccia), followed by gravitational settling of fine-grained carbonate (limestone), and finally resumption of deposition. Three samples were taken here for analysis, one from each of these units (FCWF-2, FCWF-FG, and MDs in order of description above). Shale samples were collected from just above the limestone-Chattanooga Shale contact, where one might suspect higher concentration of PGEs if deposition of the Chattanooga Shale immediately followed impact.

Specimens were crushed, split, and pulverized with mild steel for analyses. Major, trace, and platinum group elements were measured using standard XRF, ICP/MS, and INAA techniques. Co, Cr, and Ni were measured in to 0.1, 0.5, and 1 ppm respectively. Au, Ir, Os, Pd, Pt, Re, Rh, and Ru were measured to 1, 0.1, 2, 0.1, 0.1, 5, 0.2, 5 ppb respectively.

Results: Initial results show an enrichment of Au, Co, Cr, Ni, and Pd in the Chattanooga Shale (sample MDs) compared to the average upper continental crust. Ir is <1 ppb. Only sample FCB03F shows an enrichment in Ir (1 ppb) compared to upper continental crust (0.03 ppb) [7]. Samples FCS6-1, FCWF-2, and FCWF-FG were all enriched in Au (3-6 ppb) relative to continental values (0.40 ppb). We are currently awaiting final INAA results for Os, Ru, Rh, and Re and higher resolution results for Ir for all samples.

A comparison of interelement ratios shows elevated Ir/Au values (>1) for breccias deposited in the southwestern portion of the crater (FCB03F). Breccia in the northwest has an initial Pd/Ir ratio of <0.3 and a Pt/Pd ratio of 1.33.

Discussion; Our preliminary results suggest a lack of chondritic or iron meteoritic component remaining in the breccias or post-impact fill of the Flynn Creek impact structure. Elemental concentrations in the Chattanooga Shale immediately above the post-impact surface are consistent with concentrations found in other black shales, which can be explained by endogenic mechanisms [e.g. 8]. Most of the breccias, however, only show elevated levels of Au, which can also be explained by terrestrial processes. [6] has even

Figure 1. Disconformable contact between the bedded breccia (FCS6-1) and the overlying dolomitic sandstone (just beneath the Chattanooga Shale. (Image courtesy of J. C. Evenick

noted field evidence for hydrothermal activity in the southern portion of the crater. It is presently unclear if elevated Ir/Au in FCB03F and elevated Pd/Ir and Pt/Pd ratios in FCS6-1 indicate an meteorite signature. Forthcoming analyses of Os, Ru, Rh, and Re and higher resolution results for Ir may resolve this and will be reported at this meeting.

Figure 2. Polymict breccia overlying the western flank of the Flynn Creek central uplift.

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