ORIGIN OF THE SERPENT MOUND CRYPTOEXPLOSION STRUCTURE, SOUTH-CENTRAL OHIO: XRD AND Re-Os ISOTOPE EVIDENCE. S.J. Gaddis[1], C. E. Angerman, E. Widom, and J. Hughes, [1]Miami University, 7 Shideler Hall, Oxford, OH 45056, gaddissj@muohio.edu.

Introduction: The origin of the Serpent Mound cryptoexplosion structure in south-central Ohio has been the center of debate for many years. At issue is whether a bolide impact or an explosive release of volcanic gases created the structure. Evidence supporting an impact hypothesis includes the discovery of shatter cones [1], the unconfirmed presence of coesite, a high pressure polymorph of quartz [2], the observation of planar deformation features (PDFs) in quartz grains and elevated siderophile element abundances [3].

Samples from drill cores taken from the central uplift area of the Serpent Mound cryptoexplosion structure and the surrounding area were obtained from the Ohio State Geological Survey. The samples chosen for the following studies include undeformed country rock, brecciated units, shatter coned carbonates, and quartz grains that contain PDFs.

The first component of our study involves the characterization of Serpent Mound carbonates using XRD to observe the differences in the width of individual calcite reflections or full width in half maximum (FWHM) by single peak profile fitting. Examination of Serpent Mound samples that represent a range of shock induced deformation may result in an estimation of the pressures present at the time of formation.

Also using XRD, several grains from Serpent Mound containing PDFs have been examined for the presence of coesite. Coesite was reportedly found in Serpent Mound samples in 1961 [2], but these results have not been reproduced in subsequent studies. The confirmation of coesite mineralization would uphold previous studies that suggest an impact origin since coesite has not been found in association with volcanic rocks [4].

The Re-Os isotope system, based on the decay of $^{187}Re \rightarrow {}^{187}Os$, is an important tool for the recognition of impact structures as well as for determining the amount of meteoritic material that has been incorporated into impacted rocks [5]. We analyzed Serpent Mound samples for Re and Os isotopes to detect the presence of meteoritic material in deformed rocks and to determine the percent of meteoritic material that may be present in the structure.

Results: *Powder XRD.* Representative samples of shatter coned, brecciated, and undeformed carbonates from Serpent Mound were analyzed in this phase of our study. "Iceland spar" was also analyzed for comparison. Preliminary results of single profile peak fitting revealed that peak widths are greater in the shatter coned carbonates relative to the undeformed samples. Increases of peak width in shatter coned carbonates relative to undeformed carbonates are consistent with analyses from confirmed impact structures including Kara Structure in Russia, the Steinheim and Reis craters in Germany [6]. Further work will include analyses of Serpent Mound breccia samples.

Single crystal XRD. XRD analyses of selected Serpent Mound quartz grains show two coesite lines (100% and 30%) suggesting the presence of coesite in each of the grains. However, analysis of an ordinary beach sand resulted in a single coesite line (100%) indicating that this particular line may be an artifact resulting from x-ray tube contamination. The 30% coesite line observed in the Serpent Mound samples may be permissive of coesite.

Re-Os Data. Incorporation of meteoritic material in continental crust results in a mixing trend between high $^{187}Os/^{188}Os$ continental crust and low $^{187}Os/^{188}Os$ meteoritic material. Deformed rocks in impact structures, such as breccias, often contain much lower $^{187}Os/^{188}Os$ than surrounding undeformed rocks. Serpent Mound analyses, however, do not show a clear mixing trend between undeformed country rock and breccias found within the structure. Instead, it is likely that the variations in $^{187}Os/^{188}Os$ and Re/Os reflect an isochron yielding absolute ages of these Ordovician carbonates rather than a line indicating the mixing of continental crust with meteoritic material.

Conclusions: Preliminary XRD results suggest that the Serpent Mound cryptoexplosion structure resulted from a bolide impact. Increasing peak widths that are congruent with increasing shock metamorphism are consistent with results from confirmed impact craters. Additionally, the presence of coesite suggested by XRD results of quartz grains would uphold an impact origin. Coesite requires >30 GPa for formation [7].

Re-Os data from the Serpent Mound cryptoexplosion structure do not show clear evidence of meteoritic material. This may be attributed to the small impactor created the Serpent Mound structure or to erosion of approximately 300m [8] of deformed material.

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