THE WOODBURY STRUCTURE: EVIDENCE FOR AN ANCIENT IMPACT CRATER IN WEST-CENTRAL GEORGIA, USA.

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Introduction: Located 6 km SSE of the town of Woodbury (Meriwether County, Georgia) is a feature known informally as "Cove Dome" (herein call the Woodbury structure). It lies at the eastern end of the Pine Mountain terrane along the southern edge of the Appalachian Piedmont. The structure, centered at 32°55'N; 84°32'W, is a 7 km diameter circular depression with a conspicuous rim (Fig. 1). Previously, we presented preliminary evidence suggesting that an impact event should be considered to explain the structure [1]. Here we present additional evidence that shock processes likely have played a role in its origin.

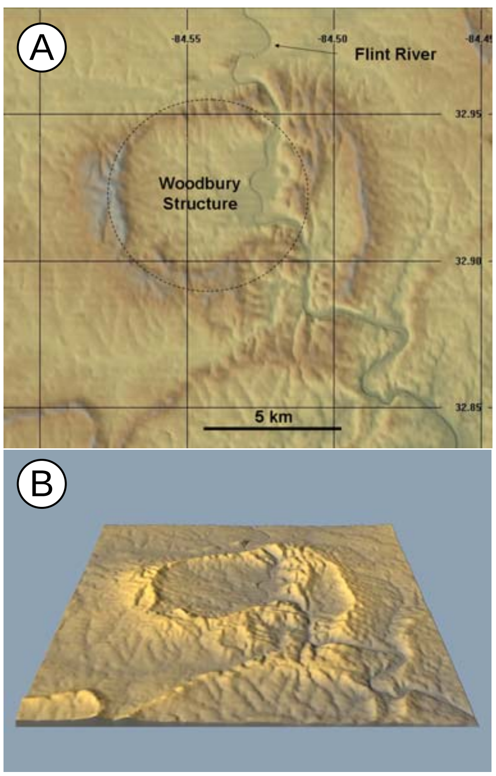

Figure 1. Relief map (A) and DEM topography model (B) of the Woodbury structure and vicinity.

Planar Microfrabrics in Quartz: Previously we presented orientation data for planar to sub-planar fluid inclusion trails in quartz grains observed in a pseudotachylitic breccia collected along the northern rim of the structure. All the breccia consists mostly of quartzite, the pseudotachylitic veins are associated with cm-scale polymict dikelets. Two of us (RSH and DTK) re-examined the quartz microfrabrics in this breccia and conservatively measured the orientations only of those planar features that could be agreed on as planar and continuous throughout the grains. The majority of the grains included contain more than one set of planes (e.g., Fig. 2A). An example of the results are shown in Figure 2B. If these microfabrics are relict decorated planar deformation features (PDFs), their distribution possibly is more consistent with an impact event in the sedimentary protoliths to these rocks than than the crystalline metamorphics [2, 3].

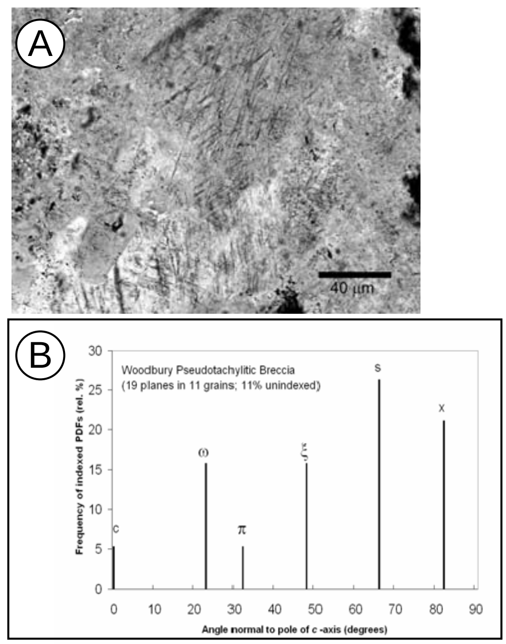

Figure 2. A) Photomicrograph (PPL) of a quartz grain from a pseudotachylitic quartzite breccia containing multiple intersecting sets of planar elements (planar fractures and possible PDFs). B) Histogram showing the frequency of orientations measured by Universal-stage for possible PDFs. Uncertainty is estimated as ± 4°.

Planar Microfrabrics in Zircons: We have discovered an approximately 2 meter thick breccia dike in the northeastern floor of the structure along the Flint River. The dike is composed of large quartzite clasts set in a relatively thick fine-grained polymict matrix containing small fragments of shtistose and gneissic rocks, quartzite, and possibly some carbonates. The matrix quartzite clasts sometimes contain small inclusions of detrital zircons. Several of these zircons contain planar microfabrics (Fig. 3) similar to those described as PDFs and attributed to shock deformation at known impact structures. Although the number of grains is small, the measured orientations of the planar features is consistent with those most commonly observed in natural and experimentally shocked zircons (e.g.,[4]). The lack of shock fabrics and the heavy recrystallization of the host quartz suggests that the zircons were deformed prior to Late Paleozoic metamorphism.

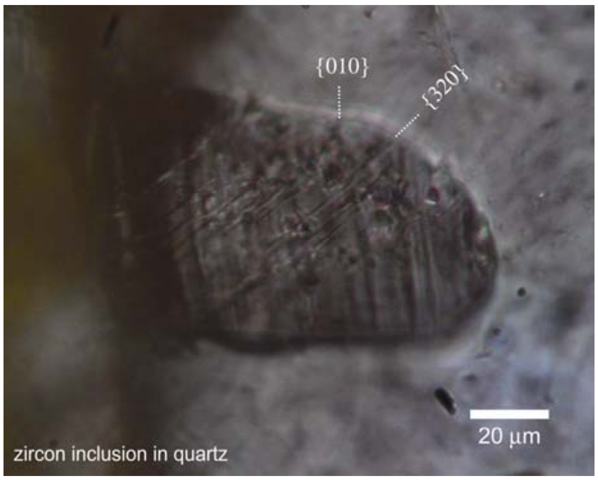

Figure 3. Photomicrograph (PPL) of a detrital zircon inclusion in a quartz grain. The zircon contains two sets of planar features with orientations (measured by Uiversal-stage) consistent with two of the most common PDF orientations in shocked zircons.

Coesite Occuurence with Shocked Zircon: While investigating these zircons with a micro-Raman spectrometer at Auburn University, we found that the spectra of quartz immediately around one of them (see Fig. 3) contains a relatively strong 521cm^{-} line diagnostic [5] of coesite (Fig.4).

Conclusions: The occurrence of zircons containing PDFs and their association with coesite strongly suggest that at least some of the rocks associated with the Woodbury structure experienced an impact event sometime between deposition of the quartzite protoliths and Alleghanian metamorphism. We continue to investigate the structure and currently are analyzing gravity and magnetic data.

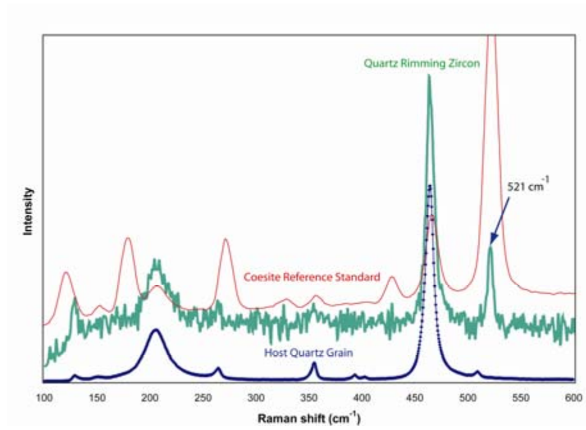

Figure 4. Micro-Raman spectra of quartz surrounding the shocked zircon in Figure 3 (green), quartz away from the zircon inclusion (blue), and a coesite reference standard. Note that the quartz near the zircon appear to contain a mixture of α-quartz and coesite.

References: [1] Albin E. F. et al. (2006) *LPS XXXVI,* abstract #2375. [2] Grieve R. A. F. et al. (1996) *MAPS, 31,* 6-35. [3] French B. M. (1998) Traces of Catastrophe; LPI, Houston, 120 pp. [4] Reimold W. U. et al. (1998) *MAPS, 33,* A93. [5] Boyer H. et al. (1985) *Phys. Chem. Minerals, 12*, 45-48.

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