PETROGRAPHY OF SHOCKED-QUARTZ SAND IN SLUMPBACK BRECCIA, CENTRAL WETUMPKA IMPACT STRUCTURE, ALABAMA. J. R. Morrow and D. T. King, Jr. 1,2 1Geological Sciences, San Diego State University, San Diego, CA 92182. E-mail: jmorrow@geology.sdsu.edu. 2Geology Office, Auburn University, Auburn, AL 36849.

Description: The Late Cretaceous, shallow-marine Wetumpka impact event excavated into an ~120-m-thick Upper Cretaceous sequence of siliciclastic, argillaceous, and marly sediments disconformably overlying gently south-dipping, pre-Cretaceous schists and gneisses of the Appalachian piedmont [1]. Roadcuts near the crater center expose slumpback deposits including chaotic polymict megabreccia and breccia composed of metamorphic blocks, comminuted metamorphic- and sedimentary-clast lithic gravel, sand grains, and argillaceous matrix. Point-count and universal stage analyses of 250–1000 μm quartz sand from the breccia matrix showed 69 vol. % monocrystalline quartz, 12 vol. % polycrystalline quartz, 5 vol. % quartz with sweeping, undulatory extinction, and 14 vol. % quartz with planar microstructures (PMs) and mosaic extinction. About 90 vol. % of the quartz grains showed rounded edges, indicating that they were sourced from the upper, sedimentary part of the target. Virtually all quartz grains with PMs also display a mosaic extinction pattern of patchy, blocky, and sharply divided crystal subdomains. This pattern is distinguished from the broad, sweeping, undulatory extinction noted in non-PM bearing grains, which is interpreted as the result of normal burial metamorphism.

The common quartz PMs, which match those from other proven impact structures [2,3,4], include both “P1” and “P2” types (cf. [4]). P1 planes are planar fractures (PFs) or cleavage occurring in multiple sets of open, parallel, flat to curvilinear forms aligned with distinct crystallographic orientations. They show 2–4 sets per grain, are ~3–5 μm wide, are ~10–50 μm or more apart, comprise 76 freq. % of the PMs, cross most or all of the grain, and display planes equivalent to c(0001), r/z{1011}, ξ{1122}, and m{1010}/a{1120} crystallographic orientations. P2 planes, which strongly resemble closed and partly decorated planar deformation features (PDFs), comprise 24 freq. % of the PMs, are about 1–3 μm wide, and are spaced <10 μm apart. The P2 sets are often developed off of or crosscut by through-going P1 planes, resulting in “ladder” or “feather” structures (cf. [4]). The P2 planes include c(0001), o{1013}, π{1012}, r/z{1011}, and ξ{1122} orientations. Such other shock-metamorphic indicators as reduced birefringence, diaplectic glass, or melt were not noted.

Discussion: The poorly consolidated, saturated, and porous upper target layers at Wetumpka probably played a critical role in the resulting greater abundance of P1 sets relative to P2 sets, as well as in the crystallographic orientations of these sets. The quartz PM development and the presence of both low- and high-index sets give evidence of the predicted heterogeneous distribution and impedance of shock energy through the target. Further, these target properties may have also hindered development of such other expected shock products as diaplectic glass and melt.