A discussion of “Anomalous quartz from the Roter Kamm impact crater, Namibia: Evidence for post-impact hydrothermal activity?”

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I DO NOT DISPUTE THE abundant evidence that Roter Kamm is an impact crater or that the residual heat from an impact may set up a hydrothermal system; I only dispute the statements of KOEBERL et al. (1989) that various differences between the quartz of the three studied quartz pebbles and the quartz of the pegmatites present in the basement rocks that were impacted can best be interpreted as evidence that the pebbles were formed (or “recrystallized”) by a post-impact hydrothermal system. The pebbles could well be merely fragments of pre-impact vein quartz.

KOEBERL et al. (1989) mention four types of quartz now present at the site: (1) from quartz-feldspar pegmatites (both “cloudy” and “clear—common”); (2) from “quartz veins” (common); and (3) from quartz pebbles (rare, about 12 found, 3 studied). They discuss differences between the quartz of the pegmatites and that of the pebbles but give no details about the quartz of the “quartz veins,” nor is it always clear which type of quartz is being compared to the pebble quartz.

I suggest here that most of the following data and lines of evidence that are given to support their thesis are either ambiguous or irrelevant, and that some of the data reported actually make a post-impact origin for these pebbles less likely.

A) Lack of shock features in the quartz pebbles. One must infer that the quartz of the three studied pebbles (apparently) does not show any of the planar features so commonly found in shocked quartz. If the quartz of the impacted rocks showed such features, but the pebbles did not, it would suggest that the pebbles were indeed post-impact in origin. But although the basement pegmatite fragments are said to show signs of deformation—(e.g., fracturing, brecciation), they also show “no characteristic petrographic shock effects” (e.g., planar features).

B) Pebble quartz shows “anomalous” blocky extinction and much less undulatory extinction. Quartz crystals frequently show such blocky or undulatory extinction, which varies with the degree of deformation for each individual crystal.

C) The pebble quartz is “anomalously biaxial,” but no equivalent statement is made concerning the pegmatitic quartz. They suggest that this difference “indicates that the pebble quartz formed under lower pressure.” I suggest that the degree of biaxiality is merely a measure of sligt metamorphic deformation since original growth and has nothing to do with the ambient pressure at the time of growth.

D) Pebble quartz shows less H₂O and fewer fluid inclusions than pegmatitic quartz. The differences in inclusion and water content (30 vs. 100 ppm) are trivial when compared with the normal variation in the amount of fluid inclusion water in natural samples, even in different parts of the same sample.

E) Pebble quartz shows no IR peaks for CO₂, but pegmatitic quartz does. Quartz from different samples and particularly from differing geologic sources can be expected to vary in CO₂ content.

F) Pebble quartz has primary inclusions and hence differs from the pegmatitic quartz, which has mainly secondary inclusions. Two kinds of proof are offered for a primary origin—negative crystal shape and two photomicrographs. My interpretation of the latter is that they are far from adequate to establish either origin, and most secondary inclusions change to a negative crystal shape with time, to minimize surface energy (ROEDDER, 1984, pp. 20, 45, 61).

G) The temperatures of homogenization and the salinities differ. The differences between the two sets of data are less than the normal intra-sample variation among either different zones of primary inclusions or different planes of secondary inclusions.

H) There are “no signs of any geological/igneous activity in the area.” But if the quartz pebbles were from a pre-impact hydrothermal quartz vein in the host rocks, all the evidence would be equally explicable. In fact, the great bulk of all fluid inclusions, both primary and secondary, are of hydrothermal origin and have properties in the ranges found here. An impact-generated hydrothermal system is not a necessary requirement.

Thus, I believe that little if any evidence has been presented to establish the formation of the pebble quartz from an impact-generated hydrothermal system, as opposed to a pre-impact hydrothermal system, i.e., normal vein quartz. However, two items of data presented suggest, in fact, that this quartz did not form from such an impact-generated system. First, in spite of the postulated contact of hydrothermal fluids at 165–250°C with disaggregated impact debris, no alteration of shocked feldspars or diaplectic glass to clay minerals is
reported by KOEBERL et al. (1989). Second, the fluid inclusion data presented require that these inclusions were trapped at elevated pressures. The ranges of homogenization temperatures and salinities reported, interpolating the data of HAAS (1976), yield vapor pressures between 6 and 34.3 bars for these fluids, and hence minimum depths of 50–350 m (HAAS, 1971), yet the quartz pebbles were collected at the surface, along the top rim of the crater. In view of the topography of this basin (their Fig. 1), one must resort to extensive wind erosion from inside the basin to keep this depression from being filled during the erosion of perhaps 350 m of impact debris from the surrounding rim necessary to provide the confining pressure.

If these three quartz pebbles are not from a post-impact hydrothermal system, how did they originate? I suggest that the most likely origin would seem to be pre-existing “vein quartz” of hydrothermal origin.

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REFERENCES


