

A SEARCH FOR SHOCK-METAMORPHOSED QUARTZ AT THE K-T BOUNDARY; B. F. Bohor, P. J. Modreski, and Eugene E. Foord, U.S. Geological Survey, DFC, Box 25046, Denver, CO 80225

Bohor et al. (1,2) reported finding shocked quartz in a claystone at the K-T (Cretaceous-Tertiary) boundary in continental rocks near Brownie Butte in Garfield County, Montana. The same authors reported observing what appeared to be shocked quartz in samples of K-T boundary clay from 5 sites in marine rocks from Denmark, Italy, and Spain. We have now confirmed the presence of shocked quartz at two sites in Umbria, Italy (Pontedazzo and Petriccio) in amounts and with observable characteristics similar to those from Brownie Butte. However, only trace amounts of shocked quartz have been found at three other European sites (Stevns Klint and Nye Kløv, Denmark, and Caravaca, Spain) and at a K-T site in marine rocks in New Zealand (Woodside Creek).

After the clay minerals (which constitute the bulk of the K-T boundary samples) were removed from the samples by water washing, the remaining coarse, granular fraction (mostly quartz) was examined microscopically for shocked minerals as revealed by planar features. Quartz grains showing multiple sets of planar features were mounted on a spindle stage and the orientation of the poles to the planar features was measured relative to the quartz c-axis and plotted on a stereographic net. A histogram of the orientations of 46 sets of planes from 10 shocked quartz grains from Pontedazzo (Fig. 1) shows a predominance of lamellae along the $\omega \{10\bar{1}3\}$ crystallographic planes, plus a lesser abundance of lamellae along other rational planes. The distribution is similar to that which we observed in quartz from Brownie Butte (2) and to that of quartz from known impact craters (3). These Pontedazzo quartz grains also exhibit lowered refractive indices (Table 1) and exhibit streaking of reflections (asterism) in X-ray diffraction photographs, both of which features are characteristic of shock-metamorphosed quartz. The refractive indices (mean = 1.5455) are very similar to those of shocked quartz from Brownie Butte (mean = 1.5445).

Table 2 summarizes our observations to date on the size range and abundance of shocked quartz, based on counts of at least 500 grains per sample. Shocked quartz is present at the Pontedazzo site in amounts comparable to that found in Montana; the Petriccio site contains a somewhat smaller amount of shocked quartz. So far we have found only trace amounts of quartz grains showing somewhat questionable shock lamellae from the other 4 sites. This may be due to sample heterogeneity or dilution by other detrital sediment. If all the shocked quartz grains were deposited as fallout from a worldwide layer of impact-derived dust (4), their general appearance and the nature of their shock-produced lamellae should be similar. Quartz from the 7 sites studied is mixed with variable, subordinate amounts of similar-sized grains of plagioclase and potassium-feldspar; at least a few of these feldspar grains also exhibit what appear to be shock-deformation lamellae. The Woodside Creek site contains a prominent layer of Fe-rich microspherules at the base of the K-T boundary layer (5); a similar layer at Caravaca contains sanidine-rich microspherules and euhedral, skeletal microcrystals of magnesioferrite spinel, both apparently of impact-related origin (6).

Our preliminary data indicate that shocked quartz does occur at some widely separate K-T boundary sites, reinforcing the hypothesis of Alvarez et al. (4) of a world-encircling dust cloud caused by an impact event.

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Figure 1 Orientation relative to c of 46 sets of planar features in 10 quartz grains from Pontedazzo, Italy, plotted at 2-degree intervals

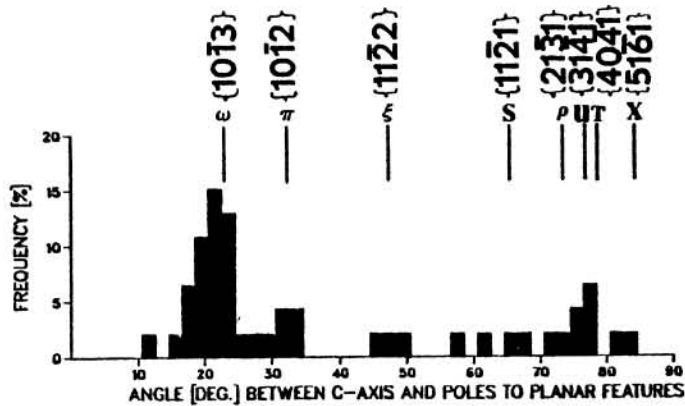


Table 1 Refractive indices of shocked qtz, Pontedazzo, Italy

No. of grains	n(o)	n(e)	mean value
normal quartz	1.544	1.553	1.5485
1	1.542	1.551	1.5465
1	1.542	1.550	1.546
2	1.541	1.550	1.5455
2	1.540	1.550	1.545
4	1.540	1.549	1.5445

Table 2 Size distribution of quartz grains and abundance of grains showing definite or possible shock lamellae from 7 K-T boundary sites

site	approx. size range of all qtz, μm	definitely shocked qtz (percent)	possible shocked qtz (percent)	size range of shocked qtz, μm
Brownie Butte	15-80	3	12	20-80
Pontedazzo	10-90	4	12	20-90
Petriccio	15-100	2	3	50-100
Stevns Klint	15-100	0	1.6	50-100?
Nye Kløv	20-150	0	0.6	50-100?
Caravaca	10-50	0	0.4	30-50?
Woodside Ck.	20-140	0	0.6	40-100?