REEXAMINATION OF QUARTZ GRAINS FROM THE PERMIAN-TRIASSIC BOUNDARY SECTION AT GRAPHITE PEAK, ANTARCTICA. F. Langenhorst[1], Frank T. Kyte[2], and G.J. Retallack[3]. [1]Institut für Geowissenschaften, Friedrich-Schiller-Universitaet Jena, Burgweg 11, D-07749 Jena, Germany; Falko.Langenhorst@uni-jena.de, [2]Center for Astrobiology, Institute of Geophysics and Planetary Physics, University of California, Los Angeles, CA 90095-1567, USA (kyte@igpp.ucla.edu), [3]Department of Geological Sciences, University of Oregon, Eugene, Oregon 97403 (gregr@darkwing.uoregon.edu).

Introduction: The Permian-Triassic boundary records is greatest mass extinction in Earth hiistory. Various causes have been proposed to explain this mass extinction, including eruption of the Siberian trap basalts and the impact of a large asteroid or comet. The asteroid impact hypothesis has been bolstered by studies reporting the discovery of shocked quartz grains from Permian-Triassic boundary sections in Antarctica and Australia [1, 2]. Since the possible presence of shocked quartz in Permian-Triassic boundary sediments is a critical data point for these hypotheses, we have reexamined quartz grains from the Graphite Peak section, Antartica. These grains were previously studied by optical microscopy and the orientation of planar features were measured using a detent spindle stage [1].

Methods: To examine the physical nature of the optically visible features in quartz from Graphite Peak, transmission electron microscopy (TEM) was used as the tool of choice. Originally, almost 50 quartz grains analyzed by [1] were provided by G. Retallack. These grains were glued to needles with molasses and Elmer's glue. They were removed from needles and then inspected in immersion oil using polarizing microscopy. The 12 most suitable quartz grains were then made into thin sections that were then thinned by ion beam bombardment. TEM observations were then carried out on the CM20 FEG TEM of the Bayerisches Geoinstitut at the University of Bayreuth, Germany. Weak-beam TEM imaging was employed to study the microstructures in quartz grains.

Results: Optical inspection of thin sections reveals that a large fraction of the quartz grains show a patchy extinction behavior between crossed nicols when rotated under the polarizing microscope. This observation suggests that the quartz grains are composed of numerous subgrains. Additionally, quartz grains contain mostly curved to subplanar deformation features with variable spacing ranging from 10 to 50 µm (Fig. 1a and b). These deformation features are decorated with voids and are sometimes crossing.

TEM observations show that quartz grains contain tangled free dislocations in a moderate density of 10^{12} m^{-2} (Fig. 2a). Most dislocations are out of contrast with the diffraction vector g=0003 but are well visible with g=101, i.e. the Burgers vector *b* of dislocations is *a*. Dislocation nodes attest that interactions between dislocations took place during plastic deformation.

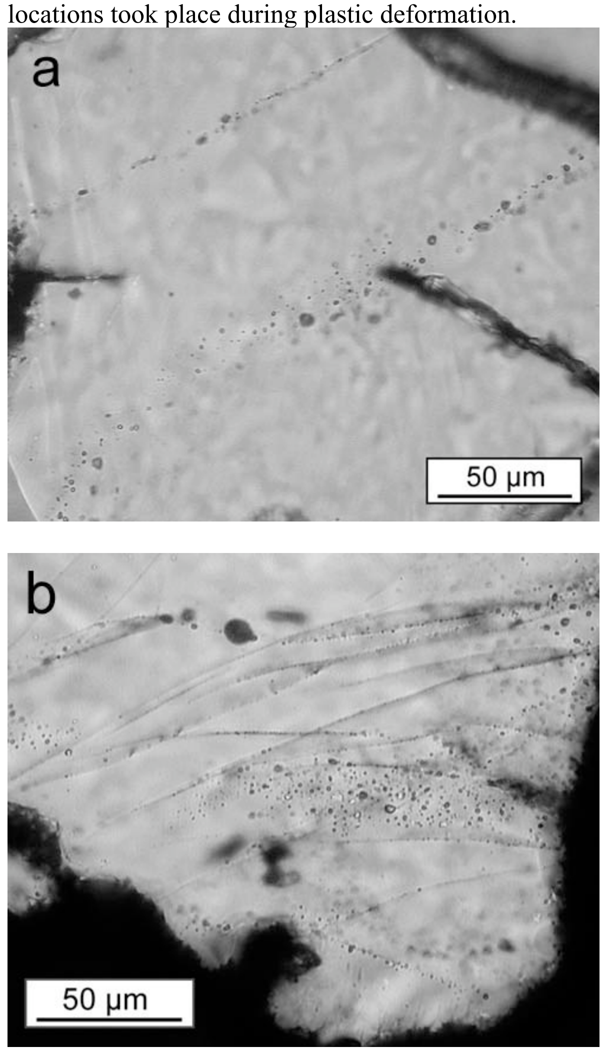

Fig. 1. Optical micrographs of quartz grains no. 16 (a) and 20 (b) from Graphite Peak, Antarctica, provide by [1].

Besides this, most dislocations are organized in sub-grain walls that are composed of one or two dislocation systems. The sub-grains separated by the walls are tilted by 2-3° with respect to each other (Fig. 2b). The sub-grain walls are commonly decorated with voids and bubbles, which is the reason for their visibility at the optical scale. In other word, the optically visible deformation features are decorated subgrain walls and not shock-induced planar deformation lamellae.

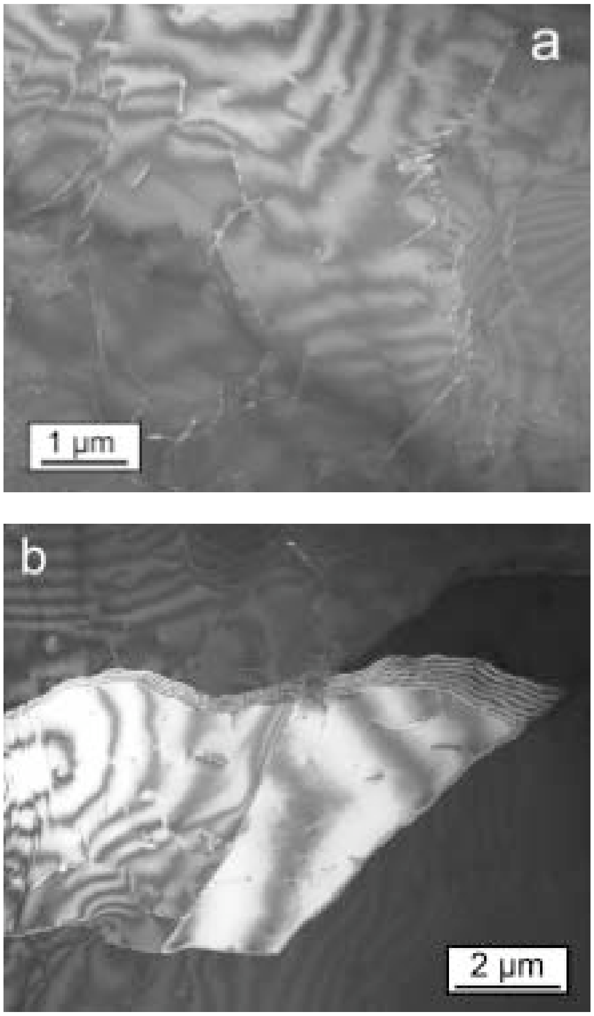

Fig. 2. Dark-field TEM images of quartz grains from Graphite Peak, Antarctica.

Discussion: In conclusion, microstructures in previously studied quartz grains from Graphite Peak, Antarctica, are clearly inconsistent with an impact origin. Neither fresh amorphous PDFs nor the decorated type of PDFs could be identified [3, 4]. Instead, the microstructures prove that quartz grains have undergone slow plastic deformation, possibly in a tectonic environment. Water has thereby assisted the deformation (so-called hydrolytic weakening). Due to the enhanced temperatures prevailing during deformation, most dislocations recovered in the form of sub-grain walls to which water bubbles are pinned.

References: [1] Retallack G. J. et al. (1998) *Geology* 26, 979-982. [2] Becker L. et al. (2004) *Science* 304, 1469-1476. [3] Langenhorst F. (2002) *Bull. Czech Geol. Surv.* 77, 265-282. [4] Grieve R. A. F. et al. (1996) *MAPS* 31, 6-35.