LABORATORY SIMULATIONS OF EXPLOSIVE VOLCANISM AND IMPLICATIONS FOR THE K/T BOUNDARY

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The discovery of shocked quartz at the K/T boundary has raised the question of whether shock metamorphic effects in quartz can also be produced by explosive volcanism. The outcome of this debate has important implications both for the history of life on Earth and for interpretation of material from other planets where explosive volcanism may be common. Recent shock recovery experiments (Gratz *et al.*, this volume) indicate that PDFs and other shock metamorphic features require ~10 GPa of shock pressure to form, regardless of the initial temperature. This result strongly argues against shock metamorphism by explosive volcanism, and no shock features have yet been confirmed at a volcanic site. However, the nature of effects caused by low-stress volcanic explosions remains to be determined explicitly, and direct simulation of an explosive volcanic event is required to completely rule out shock metamorphism during volcanism.

To explore these phenomena, we applied stress pulses of ~1 GPa to granite disks 1 cm thick and 5 cm in diameter preheated to 600°C. Stress pulses were generated by impact of lexan projectiles at velocities of 200-400 m/s. The stress amplitudes are somewhat larger than those produced by kimberlites and silicic volcanism. To approximate natural geometries, we studied material ejected from the rear of the specimen, which experiences a deformational history similar to rocks overlying a volcanic explosion. Target ejecta were recovered in CH foam and studied by optical and electron microscopies.

Our experiments show a remarkable degree of brecciation of the targets with limited production of ejecta. Breccia range from powder to mm-sized chunks. Nevertheless, fracturing was irregular and widely-spaced, *i.e.* almost entirely intergranular. Quartz and feldspar contained no PDFs, no amorphization or lowered birefringence, no melting, nor any undulatory extinction; micas also showed no deformation. The only effect obviously induced by the shocks was fracturing.

Penetration of breccia into the foam was also very shallow, indicating low ejection velocities, in agreement with simple spallation calculations. Such velocities allow ballistic distribution of sand-sized grains by at most a few kilometers, and cannot account for worldwide distribution of dense, >50 μm grains as observed at the K/T boundary.

Since our strain rates and stresses are somewhat larger than volcanic ones, our experiments are expected to produce an upper limit on volcanic effects. We therefore conclude that volcanic deformation, even at elevated temperature, is entirely brittle and markedly different than that produced by meteorite impact. Shock metamorphic effects cannot be produced by volcanic explosion unless some new, highly-energetic mechanism for volcanism exists on the Earth or on other planets.

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