RAMAN SPECTROSCOPIC STUDY OF THERMALLY ANNEALED DIAPLECTIC ANDESINE GLASS.

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Raman spectra of melt-quench glasses of aluminosilicate compositions show distinct, albeit weak and broad lines (1). The widely accepted interpretation is that such glasses consist of three-dimensional networks of TO_4 (T = Si or Al) tetrahedra with 4- or 6-membered rings and some non-bonding oxygen. Two recent Raman studies of natural and experimentally shocked diaplectic glasses of feldspar composition show similar features (2).

There exist seemingly conflicting results about the annealing behavior of diaplectic feldspars (3). These results were all based on refractive index and infrared observations. Raman studies of thermal annealing of diaplectic feldspars might help resolve some of the conflicting issues and contribute in a general way to a better understanding of shock-metamorphism. With this in mind, I undertook a Raman study of the thermal annealing of ten andesine samples (An_{49}), experimentally shocked in the pressure range 24.9 to 39.3 GPa. The Raman spectra and X-ray diffraction patterns of the shocked, but unheated samples have already been published elsewhere (4).

The samples were annealed for one hour at 800, 900, 1000, and 1100 ^{o}C each. The following Raman observations were made (for experimental details see reference 4):

1. the annealing at 800 ^{o}C reduced the intensity of the green luminescence of the shocked, but unheated plagioclase by up to two orders of magnitude; little, if any additional reduction was observed upon treatments at the higher temperatures,

2. all Raman spectra of samples shocked in the range 30.5 to 39.3 GPa showed a gradual progression from "glass-like" to increasingly more "crystalline" upon annealing at increasingly higher temperatures,

3. the first Raman lines to become intense and sharp are the T-O-T symmetric stretch modes at 480 and 509 cm^{-1},

4. the "lattice-mode" lines (e.g. at 288 and 410 cm^{-1}) remain comparatively weak.

From these observations I conclude:

1. that the internal structures of the diaplectic glasses of andesine composition consist of compressed ("squashed"), deformed and occasionally ruptured double crankshafts of TO_4 tetrahedra with the Ca and Na ions still located at their original sites,

2. that the glasses apparently do not contain any 6-membered, but only 4-membered TO_4 rings,

3. that the pricipal response to annealing at 800 ^{o}C is the healing of such crystal defects responsible for the very strong luminescence of the shocked andesine,

4. that long-range order has not been completely restored even in the samples annealed at 1100 ^{o}C,

5. and that the effect of the thermal annealing can best be described as the progressive restoration of increasingly larger volumes with undistorted, i.e. "healed" double crankshafts (5).

REFERENCES: 1: Suggested readings: P. McMillan, American Mineralogist **69**, 622 (1984); J.E. Dickinson Jr. and C.M. Scarfe, Geochimica et Cosmochimica Acta **54**, 1037 (1990). 2: B. Velde and H. Boyer, Journal of Geophysical Research **90**, 3675 (1985); B. Velde, Y. Syono, M. Kikuchi and H. Boyer, Physics and Chemistry of Minerals **16**, 436 (1989). 3: M.B. Duke: in Shock Metamorphism of Natural Minerals (eds. B.M. French and N.M. Short), Mono Book Corporation, p. 613 (1968); P. M. Bell and E. C. T. Chao, Carnegie Institute of Washington Yearbook **68**, 336 (1970); J. Arndt, W. Hummel and I. Gonzalez-Cabeza, Physics and Chemistry of Minerals **8**, 230 (1982); 4: D. Heymann and F. Hoerz, Physics and Chemistry of Minerals **17**, 38 (1990); 5: this study was supported by Rice University only; I thank Professors Berry and Margrave for donating me time on their Raman facility.