RAMAN STUDIES OF SHOCKED DUNITE, ENSTATITE, AND AUGITE. D. Hejmann, Dept. Geology and Geophysics, Rice University, Houston, TX 77251; T. A. Cellucci, Shell Development Company, Houston, TX 77251; and H. Boyer, Instruments S.A., Jobin-Yvon, Paris, France.

The Raman process is inelastic scattering of light. Raman Spectroscopy (RS) yields information on the vibrational inventory of the scatterer. RS is, thus, complementary to Infrared Spectroscopy. Sources of laser light, when these became available, have greatly stimulated the application of RS to the study of minerals (1). Microtechniques are available when microscopes are used. Samples for studies can be chips, powders, or petrographic thin sections.

It has long been known that the Raman spectra of certain minerals change in response to compression within the regime of elastic deformation, but Raman studies of shocked, hence inelastically compressed minerals have begun only recently (2,3). Thin sections of rocks and minerals experimentally shocked for optical and X-ray studies do exist and are sometimes readily available for Raman work. Dr. F. Hoerz of NASA-JSC has made available for our study one set each of unshocked material and thin sections of shocked Twin Sisters Peak dunite (range 20.1 - 70.9 GPa), Stephenville enstatite (10.2-59.6 GPa) and Harcourt augite (5.0-70.9 GPa). The Raman vibrational data were obtained with a Jobin-Yvon Ramanor 2000 HG spectrometer. An Ar ion laser provided the primary radiation either at 457.93 nm or 514.53 nm. Most scans were done in the range of wavenumbers 200 – 2000 reciprocal cm in steps of 4 reciprocal cm. We cannot present every spectrum here. The figures which we report are selections. All bands with wavenumber shifts greater than 1250 reciprocal cm in the figures are due to the epoxy resin of the thin sections, hence may be ignored.

Figure 1 presents olivine spectra from the shocked dunites. One is an unshocked bulk piece, three others are shocked bulk pieces, and the fifth sample (20.1 GPa) is a shocked powder. No detectable change is seen in the piece shocked to 22.0 GPa, but the powder, shocked to only 20.1 GPa shows considerable formation of glass. Olivine shocked to both 59.5 and 69.7 GPa has partially decomposed to very finegrained MgO and a glass, possibly containing MgO and, or FeO. Figure 2 presents a selection of enstatite spectra (enstatite is a very weak scatterer). Decomposition to finegrained MgO and a glass is clearly seen in the sample shocked to 22.0 GPa, and may have occurred in the samples shocked to higher pressures. Figure 3 shows that augite does not decompose detectably, but loses scattering power with increasing shock pressure.

The decomposition of olivine at high shock strains has been reported earlier (4,5), but the decomposition of enstatite was not known to occur (6). Our results confirm earlier reports about the great resistance of augite to shock.


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Figure 1

Figure 2

Figure 3