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Thermal infrared spectroscopy and modeling of experimentally shocked basalts

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ABSTRACT

New measurements of thermal infrared emission spectra (250–1400 cm^{-1}; ~7–40 μm) of experimentally shocked basalt and basaltic andesite (17–56 GPa) exhibit changes in spectral features with increasing pressure consistent with changes in the structure of plagioclase feldspars. Major spectral absorptions in unshocked rocks between 350–700 cm^{-1} (due to Si-O-Si octahedral bending vibrations) and between 1000–1250 cm^{-1} (due to Si-O antisymmetric stretch motions of the silica tetrahedra) transform at pressures >20–25 GPa to two broad spectral features centered near 950–1050 and 400–450 cm^{-1}. Linear deconvolution models using spectral libraries composed of common mineral and glass spectra replicate the spectra of shocked basalt relatively well up to shock pressures of 20–25 GPa, above which model errors increase substantially, coincident with the onset of diaplectic glass formation in plagioclase. Inclusion of shocked feldspar spectra in the libraries improves fits for more highly shocked basalt. However, deconvolution models of the basaltic andesite select shocked feldspar end-members even for unshocked samples, likely caused by the higher primary glass content in the basaltic andesite sample.

Keywords: Shock, infrared, spectroscopy, basalt, deconvolution, Mars