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Vibrational spectroscopic study of minerals in the Martian meteorite ALH84001

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ABSTRACT

Micro-Raman spectra of carbonates, silica and amorphous plagioclase, and both micro-Raman and IR reflectance spectra of phosphates in ALH84001 are reported. Data from these vibrational techniques combined with electron microprobe analyses show that (1) the carbonates exhibit complex compositional heterogeneity on a sub-micrometer scale, (2) the phosphates, chlorapatite and merrillite, are largely anhydrous, (3) amorphous silica and plagioclase experienced peak shock pressures >32 GPa and >50 GPa, respectively, and (4) vitreous plagioclase was quenched from a shock-induced melt after relaxation of the peak shock pressure. The observed general Raman band broadening of lattice and internal modes of carbonates in ALH84001 indicates complex sub-microscopic compositional heterogeneity and possibly structural disorder. Any search for biogenic markers in ALH84001 must recognize the complex shock and thermal history of these minerals.