
This is the third of a series of investigations on the application of Raman spectroscopy and soft x-ray spectroscopy to the structure and petrology of lunar glasses. Glass in the form of small shards, fused surfaces on bits of rock, and a few spheres were picked from Apollo 16 coarse fine samples 61222,4, 65902,7, 66083,2, 68502,18.

Raman scattering spectra taken at a 90°C scattering angle with an ionized argon laser source consist of three components: (i) A broad continuum falling off exponentially with increasing shift frequency, (ii) a few broad bands that characterize the glass, and (iii) a series of sharper bands related to associated mineral phases. It is shown that most of the sharp bands in previously reported Raman spectra are due to separation of crystalline phases, although not necessarily on a microscopic scale. There is evidence that the onset of crystallization in a glass will produce bands characteristic of the newly forming crystal structure when the crystallites are less than 50Å in size and therefore before they produce a well-defined x-ray diffraction pattern. The diagnostic bands occur at 853 and 821 cm⁻¹ for olivine, 1000-1010 and 660-680 cm⁻¹ for pyroxene (with a possibility of distinguishing enstatite, clino-pyroxene, and diopside) and 500-510 cm⁻¹ for anorthite. The source of the exceptionally broad Raman bands from the glass matrix has been associated with the aluminum content of these glasses. Glasses with mainly silica networks (of which fused silica is the end-member example) have moderately sharp bands due to local modes of the silica tetrahedra. Substitution of alumina tetrahedra into the framework breaks the average periodicity of the framework and broadens and weakens the bands. The breadth and intensity of the bands from 800 to 1200 cm⁻¹ can be related to the structural disorganization of the glass.

X-ray emission frequency shifts of aluminum, silicon and oxygen vary over wide limits from one glass sample to the next. Most valuable is the AlKα shift which measures the coordination number of aluminum in the glass. Most glasses are extremely heterogeneous often consisting of basaltic compositions interwirled with anorthositic compositions and it is difficult to probe the glass on a sufficiently small scale.