CRYSTAL-FIELD SPECTRA OF LUNAR PYROXENES AND GLASSES: A COMPARISON OF THE EFFECTS OF COMPOSITION, OXYGEN FUGACITY, AND METEORITE IMPACT. P. M. BELL AND H. K. MAO, GEOPHYSICAL LABORATORY, WASHINGTON, D. C. 20008.

A thorough analysis of the relation between the positions, energy, and intensities of crystal-field bands and charge-transfer absorption in lunar pyroxene crystals and the chemical composition, indicates that within the pyroxene compositional quadrilateral, there is a close correlation (1). Furthermore, the state of oxidation of the crystals can be discerned also from the spectra (2). The compositions are plotted in Fig. 1 [after Hazen, Bell and Mao (1)].

Lunar glasses of predominately pyroxene composition also have absorption spectra that have been related to composition and to the state of oxidation (2). The recent results of a study of the Luna 24 sample, however, show mashed spectral effects that were caused by shock impact. These effects are superimposed upon those caused by composition and structure alone, as shown in the examples given in Figures 2-4 [after Bell, Mao, and Hazen (3)]. In these spectra the bandwith can be used to connect for the superimposed effects.

The results of this study form a comprehensive base on which to interpret the history of oxidation/reduction of the samples, and by inference the rocks representing the landing sites. Subsequent alteration of the samples by later disturbances in the chemical atomsphere on the moon (and after return of the samples to earth) do not appear to have caused measurable changes (i.e. the Apollo 14, 16, and 17 samples that were observed to contain "rust," the oxy-hydrated numerical akaganeite, had pyroxenes whose spectra reflected a low P_{O2} of formation). Only major processes such as the crystallization, oxidation/reduction at or near the melting-temperature (or contact with molten rock), and impact phenomena have left a measurable imprint on the spectra.

The conclusions of this study address the probable relationship between the oxidation state of the moon's interior and the later (more reduced) state imposed by surface processes. The spectral data are reasonably complete and can be used to interpret telescope spectra of the lunar and planetary surfaces.

References

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CRYSTAL-FIELD SPECTRA

P. M. Bell

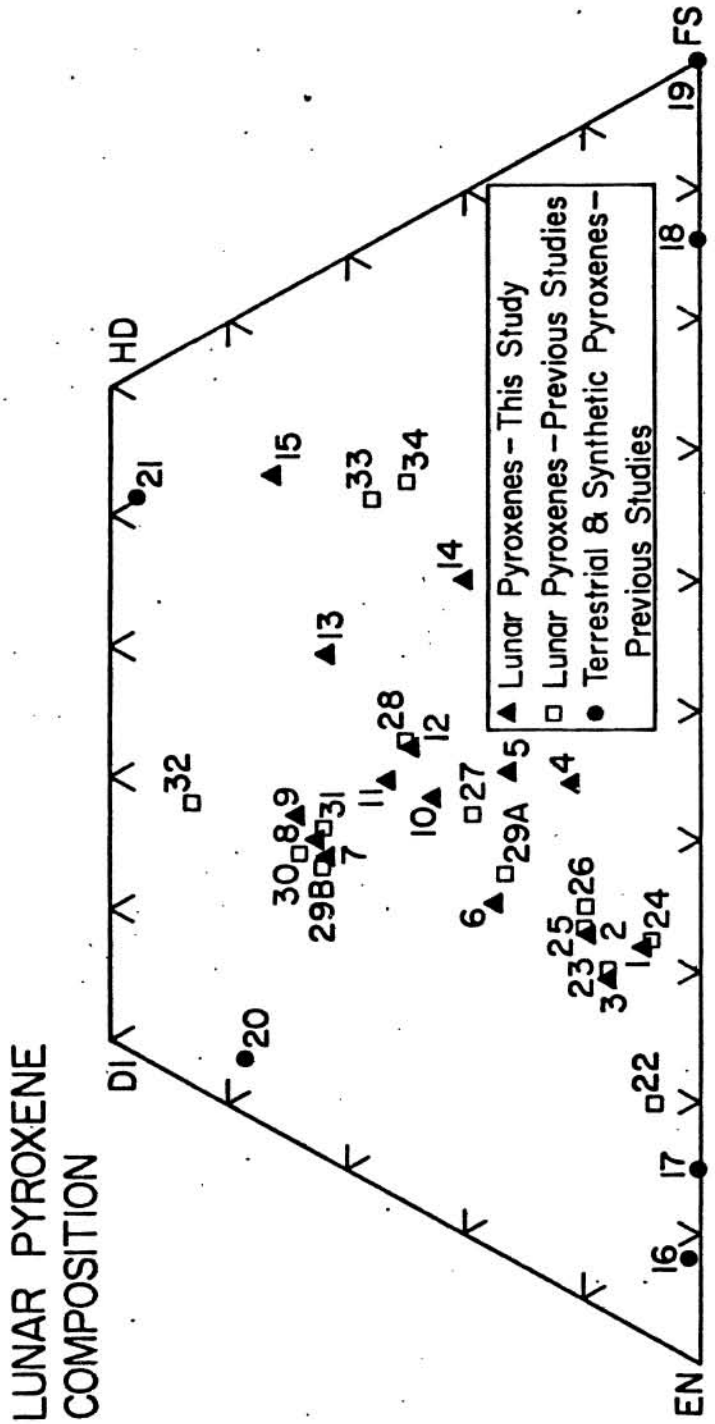

Figure 1. Pyroxene Compositions Studied

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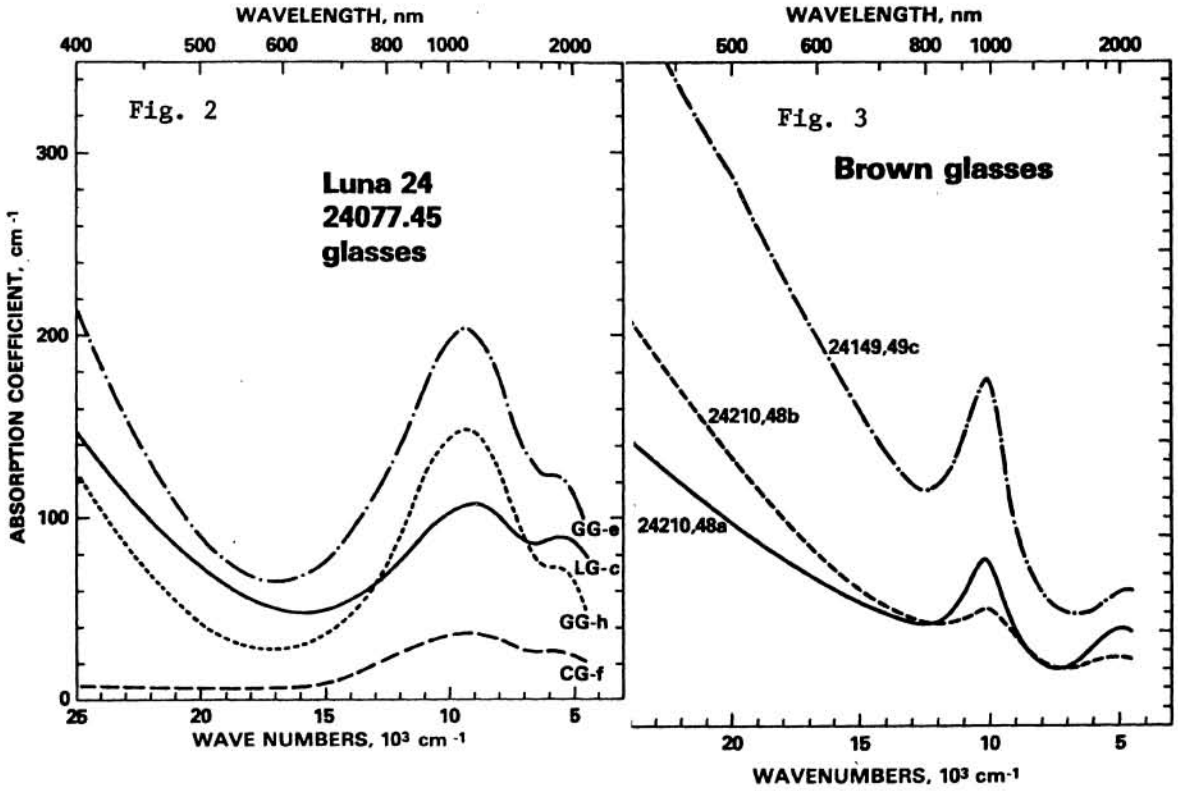

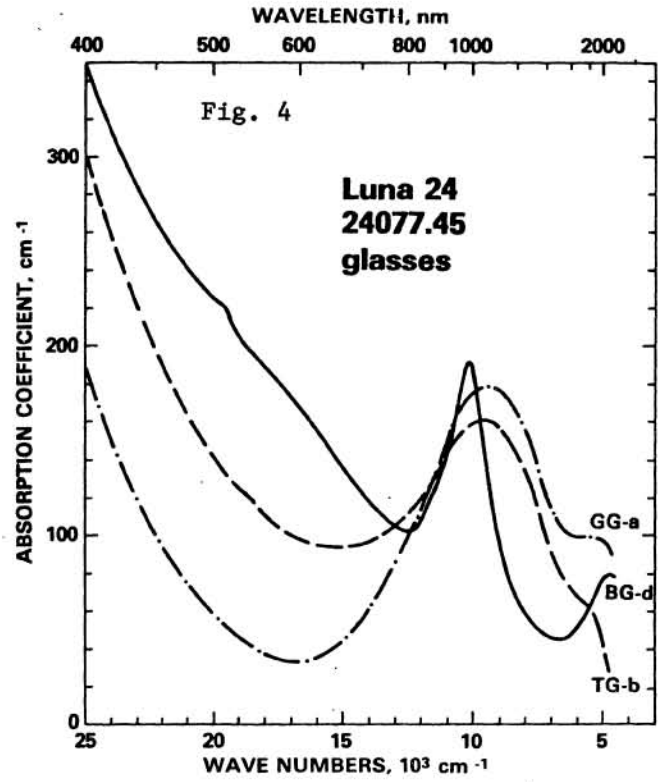

Fig. 2 These glasses have almost identical compositions.

Fig. 3 These glasses have identical compositions

Fig. 4 The compositions of these glasses correlate with their spectra

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