

OPTICAL ABSORPTION SPECTRA OF MAJOR MINERALS IN LUNA 24 SAMPLE 24170.
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Optical absorption spectra of grains of an olivine, a color-zoned pyroxene and a plagioclase were obtained from thin-section grain mounts provided by A. L. Albee (Albee et al., 1977). They were examined as received with a Cary 17I spectrophotometer at 24°C.

The orientation of a yellow olivine crystal (FQM-647) provided both α and γ spectra. The absorption spectrum (Figure 1) is dominated by an absorption band at 1069 nm in γ with shoulder at \sim 1335 nm which arise from Fe^{2+} in the M2 site. Overlapping absorption bands occur in α at \sim 884, 1097 and 1330 nm which arise from Fe^{2+} in both the M1 and M2 sites. The weak absorption bands at visible wavelengths, the most prominent of which are at 624, 497 and \sim 450 nm, arise from spin-forbidden electronic transitions of Fe^{2+} . The spectrum is very similar to that of terrestrial fayalites.

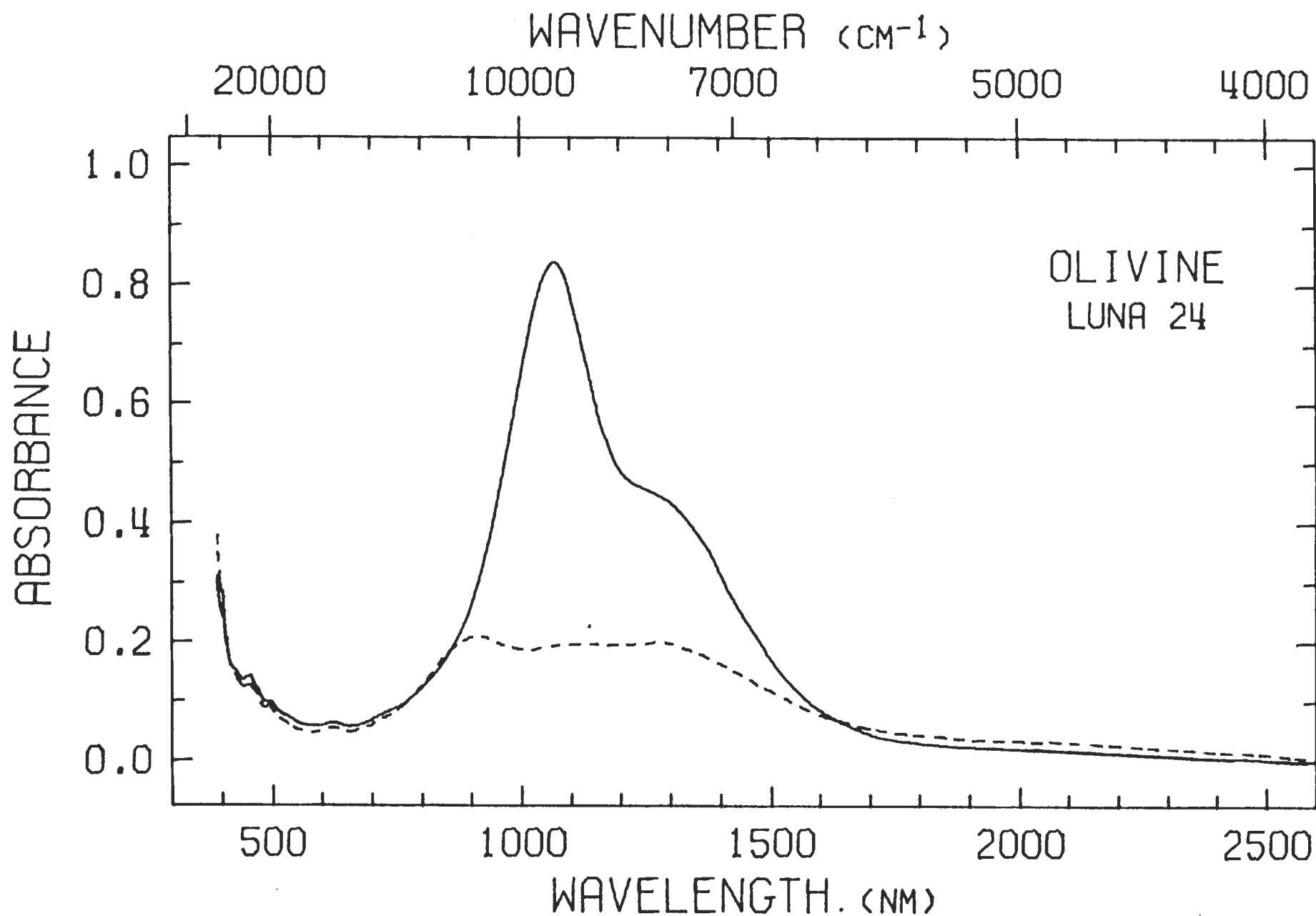


Figure 1. Optical absorption spectrum of the Luna 24 olivine, Fa 76
(γ = solid; α = short dash).

The orientation of the color zoned pyroxene (FQM-649) provided an excellent β spectrum in one direction and a mixture of primarily α with some γ in the other direction. The dominant features (Figure 2) are absorption bands in β at 963 nm and in α at \sim 2100 nm which originate from Fe^{2+} in the M2 site. Absorption from Fe^{2+} in the M1 site is observed as a shoulder in α at \sim 1190 nm. A weak, broad Cr^{3+} feature occurs around 640 nm and a sharp, weak Fe^{2+} feature is at 507 nm.

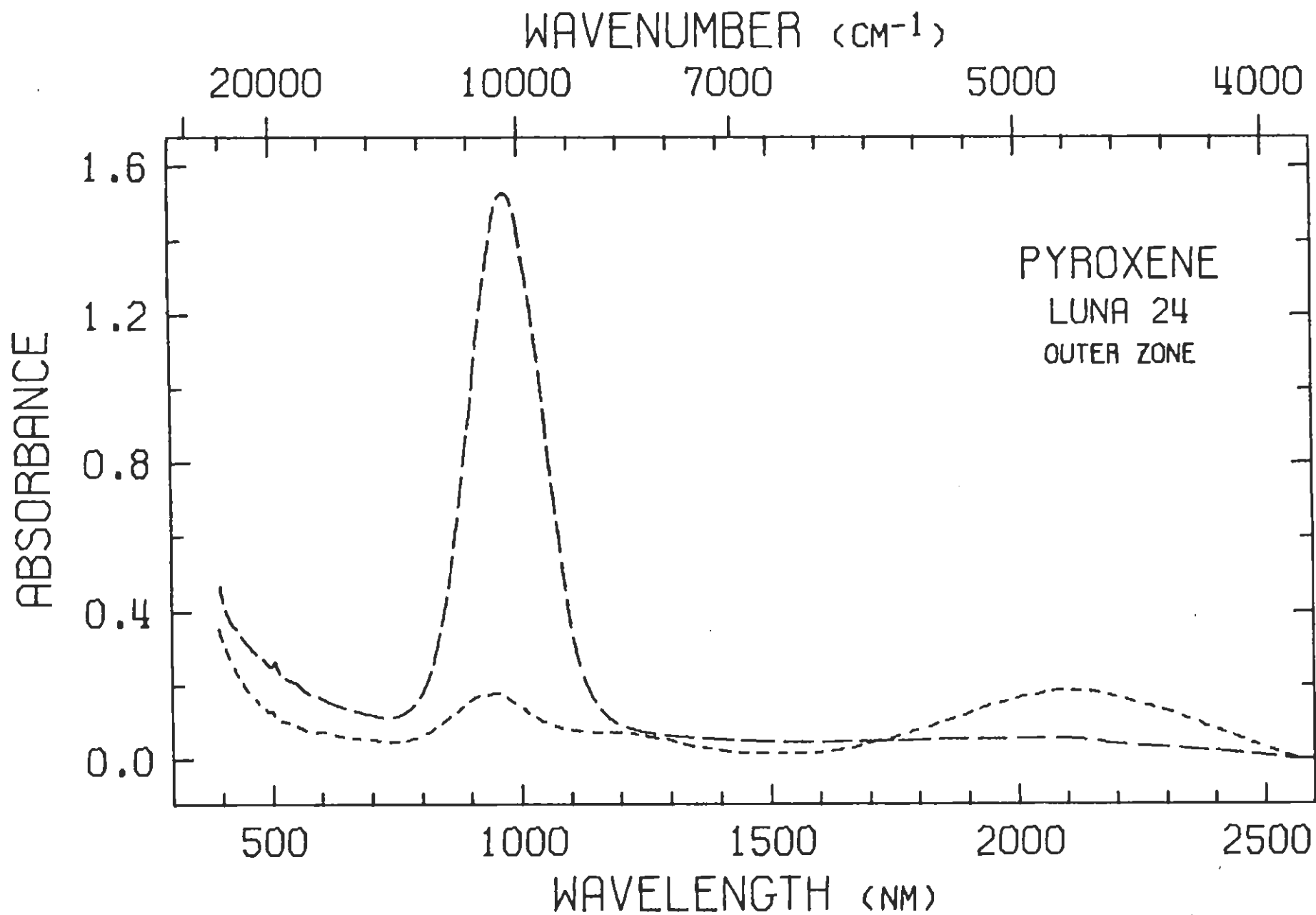


Figure 2. Optical absorption spectrum of the outer zone of Luna 24 pyroxene. The prominent absorption band at 963 nm in β (dashed line) and the broad band near 2100 nm in α (short dash line) are due to Fe^{2+} in the M2 site.

A comparison of the β spectra taken in the central colorless zone and the outer violet-brown zone is shown in Figure 3. The outer zone contains 1.7 times as much Fe^{2+} in the M2 site. Estimates of the average concentrations of Fe^{2+} in the M1 and M2 sites in the two zones can be made from the following assumption: sample thickness 40 μm , $\epsilon(\text{M2}) = 40$ (intensity of M2 band in orthopyroxenes), $\epsilon(\text{M1}) = 3.5$ (typical value for small six-coordinate sites). The results of the calculation are: central zone M1 site 4.3% FeO, M2 site 11.3% FeO; outer zone M1 site 8.8% FeO, M2 site 18.9% FeO. The calculated total FeO, 15.6% central zone, and 27.7% outer zone compare favorably with the electron

microprobe analysis (Table 1). The Cr^{3+} absorption band is more intense in the central zone. The absorption in the 400-600 nm region which rises toward shorter wavelengths is responsible for the color of the outer zone. Similar absorption has been observed in other lunar pyroxenes (Burns et al., 1973).

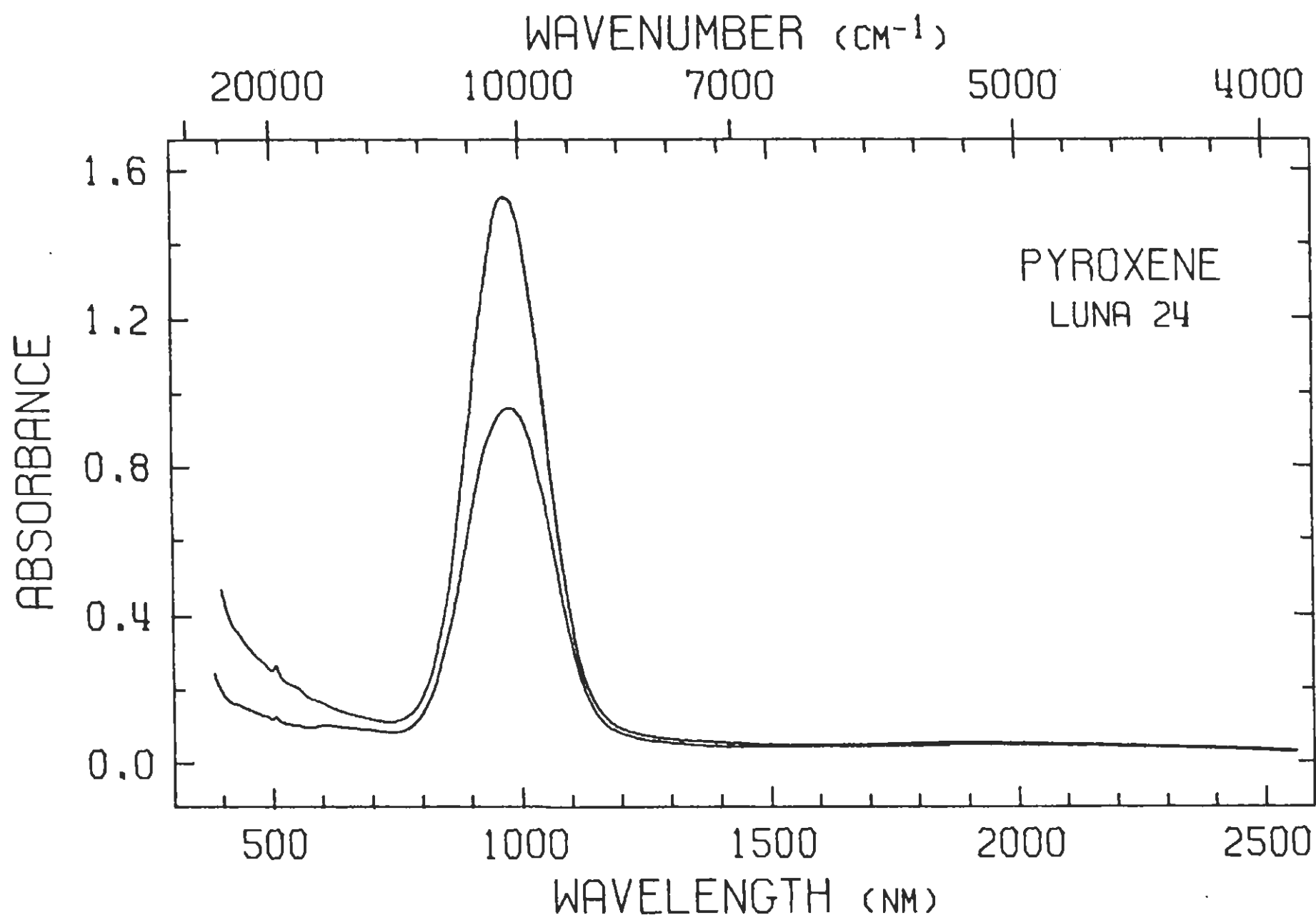


Figure 3. Comparison of the γ optical absorption spectra of the Luna 24 pyroxene, FQM-649, taken in the outer zone and in the central zone. The outer zone contains about 1.7 times as much Fe^{2+} in the M2 site as the central zone.

The orientation of the plagioclase grain was such that no principal direction could be examined. The spectrum showed an absorption band at ~ 1280 nm comparable to other Fe^{2+} -containing lunar plagioclases. (Bell and Mao, 1973).

OPTICAL SPECTRA

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Table 1. Electron Microprobe Analyses.

	SiO ₂	FeO	MgO	CaO	MnO	TiO ₂	Al ₂ O ₃	Cr ₂ O ₃	NiO	Na ₂ O
olivine	32.28	57.46	10.05	0.54	0.62	0.03	0.03	0.01	0.01	--
pyroxene outer zone	48.30	31.02	6.60	12.22	0.42	0.92	1.03	0.09	--	0.00
pyroxene central zone	51.47	15.44	14.95	15.04	0.36	0.34	2.01	0.79	--	0.03

Albee, A. L., A. A. Chodos and R. F. Dymek (1977) Petrology of Luna 24 sample 24170. This volume.

Burns, R. G., D. J. Vaughan, R. M. Abu-Eid and M. Witner (1973) Spectral evidence for Cr³⁺, Ti²⁺ and Fe²⁺ rather than Cr²⁺ and Fe³⁺ in lunar ferromagnesium silicates. Proc. Fourth Lunar Sci. Conf. Geochim. Cosmochim. Acta, Suppl. 4, Vol. 1, pp. 983-994.

Bell, P. M. and H. K. Mao (1973) Optical and chemical analysis of iron in Luna 20 plagioclase. Geochimica et Cosmochimica Acta, 37, 755-759.