EFFECTS OF PLAGIOCLASE CHEMISTRY AND MODAL ABUNDANCE ON SPECTRAL PROPERTIES OF MULTIMINERAL FE,MG MIXTURES. G. Serventi[1], C. Carli[2], M. Sgavetti[1], L. Pompilio[3] [1]Department of Earth Sciences Università di Parma, Parco Area delle Scienze 157A, 43100, Parma, Italy (giovanna.serventi@unipr.it), [2]INAF-IAPS, via del Fosso del Cavaliere, 100, 00133 Rome, Italy, [3]D'Annunzio University, via Dei Vestini, 30 - I 66013 Chieti, Italy.

Introduction: Low contrast features are often observed in the reflectance spectra of terrestrial planets' surfaces. Among other causes we outline the interference of adjacent absorption bands due to different minerals. Plagioclase is an important component of the mineralogical composition of Lunar and Hermean terrains. Although the combined effects of Fe^{2+} absorptions in clinopyroxene (Cpx), orthopyroxene (Opx) and olivine (Ol) mixtures have been widely studied [e.g., 1,2], the spectroscopic effects of plagioclase (Pl) have been considered only for <0,26 wt% FeO-bearing compositions [3,4]. Here we show the effects that both modal abundance and chemistry of Pl have on the absorption bands of Fe, Mg minerals-bearing mixtures in the NIR spectral region.

Experimental approach: We measured the reflectance spectra (0.35-2.5 µm; *i*=30°, *e*=0°) of 63-125 µm-size intimate mixtures of Fe, Mg components+ Pl. All the minerals have been separated from cumulitic rocks belonging to Stillwater Complex anorthositic kindred. we used three different starting Fe-Mg assemblages, to which alternatively 0.36 (medium-iron Pl) and 0.5 wt% (iron-rich) FeO-bearing Pl (An_{80}) have been added in relative proportions of 30-50-70-80-90 wt.%: 1) Ol-free assemblage consists of ~44 vol.% Cpx (En_{45}-Wo_{46}) + ~56 vol.% Opx (En_{77}); 2) Ol-poor assemblage includes ~70 vol.% Opx (En_{86}) + ~30 vol.% Ol (Fo_{87}); 3) Ol-rich assemblage consists of ~28 vol.% Opx (En_{82}) + ~4 vol.% Cpx (En_{45}-Wo_{46}) + ~68 vol.% Ol (Fo_{84}).

Absorption features diagnostic of Fe-Mg minerals were analyzed via decomposition with Exponential Gaussian Model-EGO algorithm [5,6] to determine band spectral parameters such as center position, band intensity, width and asymmetry, particularly in the 1.2 µm spectral region.

Results: Figure 1 shows the reflectance spectra acquired on the enmember plagioclases. The spectra show a prominent CF band centered at ~1.2 µm which is diagnostic of Fe-bearing Pl [7] and two possibly vibrational absorptions in the IR region likely due to alterations in Pl. The CF feature moves to longer wavelengths and become more asymmetric toward the IR with increasing the Fe content in Pl. Band depth slightly varies.

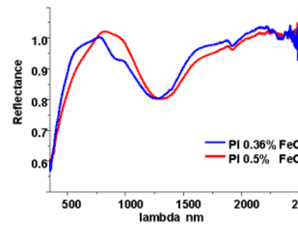

Fig. 1 VIS-NIR plagioclase reflectance spectra (63-125 µm grain size) normalized to 750nm for comparison.

Ol-free mixtures

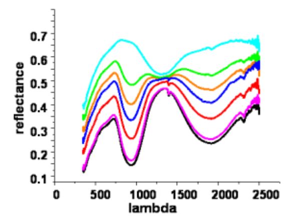

Fig. 2 Ol-free+ iron-rich Pl mixture's reflectance spectra. Pl % increases from black to light blue.

Figure 2 shows that increasing Pl modal abundance in the Ol-free mixtures, albedo is higher, the 1.2 µm Pl band intensity increases, center band moves toward longer wavelength and asymmetry tends to remain unchanged.

In Ol-bearing mixtures, the 1.2 µm Ol band is in the same spectral region of Pl absorption band: at this wavelenght they create a composite band, whose spectral parameters give information about Pl chemistry and amount.

Ol-poor mixtures

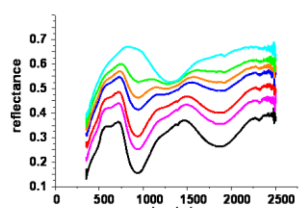

Fig. 3 Ol-poor+ iron-rich Pl mixture's reflectance spectra. Pl % increases from black to light blue.

Figure 3 shows that increasing Pl modal abundance in Ol-poor mixtures, albedo is higher, the 1.2 µm composite band intensity increases, center band moves toward longer wavelength and band asymmetry increases toward the IR region.

Ol-rich mixtures

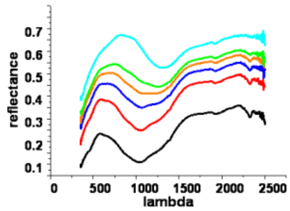

Fig. 4 Ol-rich+ iron-rich Pl mixture's reflectance spectra. Pl % increases from black to light blue.

Figure 4 shows that adding Pl in Ol-rich mixtures, composite band intensity decreases and center band and band asymmetry show the same behaviour as in olivine-poor mixtures.

Comparing the spectral parameters of the 1.2 μm composite band of different mixtures, we can see that, fixing Pl and Fe, Mg component content, center band moves to shorter wavelength, asymmetry increases toward the UV region and band intensity is deeper passing from an olivine-free mixture to an olivine rich one.

For the same Mg/Fe ratio, the 1.2 μm composite band intensities are very similar, center bands moves toward longer wavelength and band asymmetry increases towards the IR region, in both Ol-rich and Ol-poor mixtures, passing from medium-iron Pl to iron-rich Pl.

As this composite band features are due to both Pl and Ol, we also simulated the contribution of each minerals. Using a linear combination procedure (Fig.5) we observed the predomination of Ol contribution and the consequent underestimation of Pl in real mixtures.

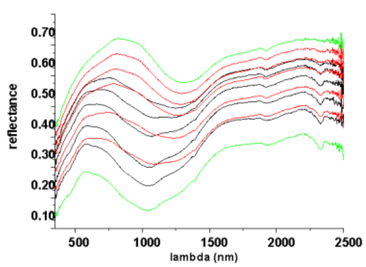

Fig. 5 End-member, iron-rich Pl, and Ol-rich mixtures are in green, in black are the real mixture spectra and in red the mixture spectra calculated as simple combination of end-members.

Furthermore, starting from the intensities of band 1 and band 2 of Ol, for the different olivine concentrations in the Ol-bearing mixtures, we recalculated the expected intensity of the band 3 of Ol. The difference between the measured 1.2 μm comp band intensity and the recalculated band 3 of Ol can be assumed as the Pl intensity for different concentrations (Fig. 6).

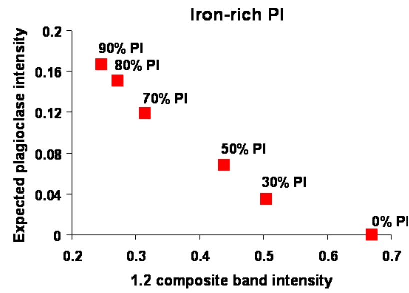

Fig. 6 Example of Pl intensity determination in iron-rich Pl+ Ol-rich mixtures. On x-axis are the intensities of the 1.2 comp band and on y-axis Pl intensity as difference beetwen 1.2 comp. band and calculated band 3 of Ol.

The same procedure was repeated for the center band position (Fig. 7).

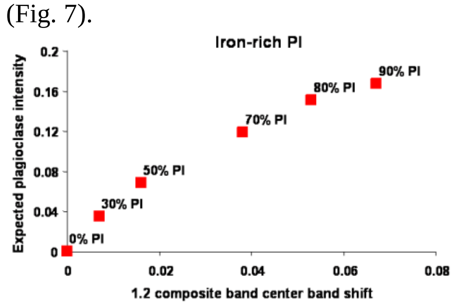

Fig. 7 Example of Pl intensity determination considering composite center band shift with respect to starting Pl-free mixtures.

Implications for planet: Adding Pl to Fe, Mg mixtures produces low contrast reflectance spectra, particularly when the Fe, Mg mixtures are composed by olivine. Composite band spectral parameters can give informations about the mineralogy and the composition of mixtures.

Future work: Ongoing work is focused on the analysis of very fine samples of the same mixtures and on analysis of Fe, Mg mixtures composed entirely by Ol. In particular we want to contribute to a better understanding of spectra such as those interpreted as ferroan anorthosites on the Moon, featureless spectra characterizing the Hermean surface, and perhaps other spectra observed on different small bodies.

References: [1] Cloutis E.A., et al. (1986) *JGR, 91*, 11641–11653. [2] Sunshine J.M., Pieters C.M. (1993) *JGR*, *98*, 9075-9087. [3] Crown D.A., Pieters C.M. (1987) *Icarus*, *72*, 492-506. [4] Nash D.B., Conel J.E. (1974) *JGR. 79*, 1615-1621. [5] Pompilio L., et al. (2009) *Icarus*, *201*, 781-794. [6] Pompilio L., et al. (2010) *Icarus*, *208*, 811-823. [7] Burns R.G. (1993) *Cambridge University Press*, pp.551.