LUNAR MARE-HIGHLAND HORIZONTAL SPECTRAL VARIATIONS FROM TELESCOPIC CCD-IMAGING : S.CHEVREL and P.PINET , GRGS , Centre National d'Etudes Spatiales , TOULOUSE , FRANCE .

Absorption features characteristic of specific rock-forming minerals (feldspar , pyroxene , olivine) occur in reflected light in the spectral range from 0.30 to 2.50 µm (visible-near infrared) .
The comparison of earthbound telescopic reflectance spectra of the Apollo landing sites on the moon and the laboratory spectra of returned rocks from these sites shows a direct correspondence between the spectra and thus allows to determine the surface composition using remote sensing techniques .
Several basalt types have been identified and mapped within lunar maria (1) and several highland nearside rock types have been distinguished (2) from remote sensing measurements using spectral characteristics sensitive to mineralogical and chemical composition .
Detailed studies have been made in some regions of the moon such as the south part of Oceanus Procellarum (3) and mare Humorum (4).
Information about composition is generally obtained from reflectance spectra of small regions (3 to 10 km in diameter) of the lunar surface and from multispectral imaging (image ratios), the first method being so far more used than the second one as few detectors allow to get photometrically accurate near-infrared images . Multispectral imaging , hovewer , permits to directly map horizontal variations of some spectral characteristics within areas such as lunar maria (determination of the extent and composition of lava flow units) , mare-continental boundaries (characterization of the transition between mare and highland materials) , or craters (position and composition of excavated materials , giving access to the stratigraphy and composition of the target site) . This may help to derive the substructure and composition of either the highland crust or the maria .
We realized telescopic CCD images of the lunar surface (Charge Coupled Device : a sensitive visible-near infrared two-dimensional detector) using a set of interferential filters (bandpass = 100 Å) in the ultra-violet (0.40 µm), visible (0.56 µm) , and near-infrared (0.91 , 0.95 and 0.98 µm) part of the spectrum .These images have been obtained with the 1.20 and 2.00 meter aperture telescopes , respectively at the Haute-Provence and Pic du Midi french observatories (spatial resolution : 3 km and 0.5 km) . The investigation has been carried out in the following regions of the moon : mare Serenitatis , including the Apollo 15 and the Apollo 17 landing sites , and the Gassendi crater at the edge of mare Humorum .
Multispectral 0.40 / 0.56 µm coverage of the Serenitatis basin ,sensitive to TiO_2 content in mare basalts (1) , clearly shows the composition difference between mare Serenitatis and mare

Tranquillitatis in the southern part of the basin ,the latter having an higher TiO_2 content .

Dark mantle units in the Taurus-Littrow and Sulpicius Gallus regions also appear with an high TiO_2 content (high 0.40 / 0.56 um ratio) and some variations are identified within the infilling basin material.

Besides , two absorption bands (due to Fe^{2+}) occur in spectra near 0.91 and 0.98 µm , respectively attributed to orthopyroxene (a low Ca-pyroxene) and clinopyroxene (an high Ca-pyroxene) (5) . High spatial resolution 0.91 / 0.98 µm images of the Apollo 17 Taurus-Littrow landing site show the difference between continental and mare composition concerning the nature of the pyroxene , the mare material areas being characterized by a relatively higher content in clinopyroxene (higher 0.91 / 0.98 µm ratio) with regard to the continental material areas which are characterized by the orthopyroxene component (6)(2).Measurements , in the 0.91 / 0.98 µm image ratios ,of the floor of the Taurus-Littrow valley (mare material) and the South Massif (continental material) in the vicinity of the Apollo 17 landing site , well agree with previous spectral data (reflectance spectra) presented in (2) and (7).

Ultra-violet and near-infrared CCD-images of Gassendi crater have also been taken . Gassendi is a very old morphologically modified crater of which the topography has been affected by viscous relaxation processes (8) and its floor presents large-scale fractures . Due to its complex history , such a large crater may display various types of materials , originated from different depths and it is worth trying to relate spectral information to stratigraphy .

The interpretation of these spectral data in relation with the geology will be presented .

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