RE-EXAMINE LUNOKHOD SITES: OLD AND NEW GEOCHEMICAL DATA. A. M. Abdrakhimov, Vernadsky Institute, Russia, 119991, Kosygina 19, albertabd@gmail.com

Introduction: New data of Clementine, Lunar Prospector missions; Lunar-Globe, Lunar Reconnaissance and other are coming. It is interesting to find correlations between new remote data and the data obtained from the Moon surface. For these purposes we work on Lunokhod -1 and -2 panoramas digitizing. And geochemical comparing of soviet lunar vehicles and Clementine data were executed.

On November 17, 1970, the automatic spacecraft Luna 17 deposited the remotely controlled rover Lunokhod-1 on the western side of Mare Imbrium, near 38°17' N, -35°00' W. Lunokhod-1 studied the lunar mare surface. The extreme breadth of investigated area is about 4 km [1].

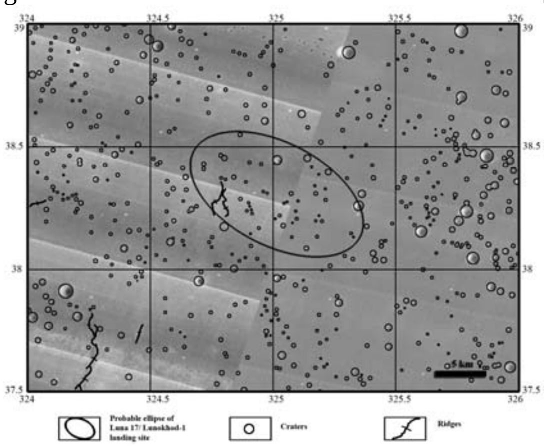

Fig.1 Luna17/Lunokhod-1 working area(Lunar Orbiter mosaic)

On January 16, 1973, the automatic spacecraft Luna 21 deposited the remotely controlled vehicle Lunokhod 2 on the eastern side of Mare Serenitatis, crater Le Monnier, at coordinates 25°51' N, 30°27' E. The main purpose of the mission was the study of the transitional zone between mare and highland [2,3]. Lunokhod 2 also investigated the southern part of a moderately sized linear furrow Fossa Recta located on the mare surface in the south-eastern part of the floor of crater Le Monnier (Fig. 3,4).

Each vehicle was equipped with a wide-angle panoramic camera, a "piloting" camera, XRF (RIFMA) spectrometers and other instruments.

Lunokhod-1 worked 10 months and covered about 9 kilometers. Lunokhod 2 worked 4 months (5 lunar days) and covered 37 kilometers.

The detailed panoramas were obtained during these missions. Lunokhod 2 689 images were digitized into grayscale mode and with resolution 300 dpi and composed into digitized panoramas. Each panorama is a mosaic of 5-8 images. Lunokhod-1 image digitizing work is now in progress.

The Lunokhod-1 XRF analyses in several places (about 15 measurements [1]) of studying area had shown that the mare regolith chemical composition was nearly constant: 20±3 - 22±2 wt.% Si, 9±1 - 12±1 wt.% Fe, 7±1 - 8±1 wt.% Al, <4 wt.% Ti, <1 wt.% K. These abundances are typical for mare basaltic regolith. The estimated depth of regolith of Lunkhod-1 area is 2-6 m.

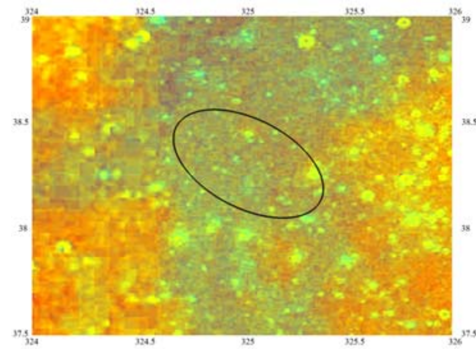

Fig.2 Clementine UVVIS Ratio data for Luna17/Lunokhod-1 working area.

Using the Clementine UVVIS Ratio ("false color") image mosaic for the lunar maria mostly iron-rich basaltic materials of variable titanium contents could divide in iron-rich, lower titanium material (shades of yellow/orange) and iron-rich, higher titanium (shades of blue) regolith material [4].Clementine UVVIS ratio data revealed that iron-rich, higher titanium material is dominating in the Lunokhod-1 working area and it is correlated with Lunokhod-1 XRF data.

Lunokhod 2 studied transitional from mare to highland zone.

On the first lunar day Lunokhod 2 moved to south on the bottom of Le Monnier Crater, which is covered by mare regolith (Fig. 1).The depth of regolith 1-6 m. Chemical composition of the surface of the regolith is revealed by the XRF spectroscope RIFMA [5]. At the landing point (6 km from the highland shores), the Al content is 9 ± 1%, and the Fe content is 6 ± 0.6%. This composition were interpreted that a thin supply of highland material mixed in the upper layer of the mare regolith [2].

On the second lunar day Lunokhod 2 reached the south edge of Le Monnier Crater and rose into highland area (Fig. 3). .The depth of regolith ran up to 10 m [1]. The XRF analyses had shown that the Fe content in the most "highlandic" regolith went down to 4.9 ± 0.4 wt.%, and Al went up to 11.5 ± 1.0[3].

On the third lunar day Lunokhod 2 turned to the east and returned into mare area. The Fe abundances went up to 6% [3].

On the forth day the vehicle reached joint fissure Fossa Recta and investigated both sides of this tectonic structure during two last lunar days. The depth of Fossa Recta is 40-80 meters. Drawing near the joint fissure the depth of regolith went down emerging pristine magmatic 'mare' rocks. The slope of Fossa Recta walls is about 30-35° and covered by basaltic boulder talus [3]. The XRF analyses had shown that the Fe content reached more "mare" values: 7.5 ± 0.9 wt.% Fe, 8 wt.% Ca on the west side and 8.0 ± 1.0 wt.% Fe on the east side of Fossa Recta [3].

We compared the Lunokhod-2 XRF compositions with available geochemical data derived from Clementine orbital spectral measurements for the studying area [6]. In spite of bad resolution (~200 m) it looks like the systematic discrepancy of Fe abundance values exists: 6±0.6% and 12-14% Fe at the landing site; 4.0±0.4% and 10-8% Fe at most "highland" point; 8±1% and 10-14% at the most "mare" point. The reason of this discrepancy required further investigation (Fig.5).

By Clementine spectral crude data (~700 m) the TiO_2 abundance could change along the Lunokhod 2 route from 4-6% at mare parts to 0.5-2% at highland parts (Fig. 5).

Conclusions: Clementine UVVIS ratio data showed up that Lunokhod-1 XRF had measured the mare iron-rich, higher titanium regolith. Geochemical comparing of crude Clementine orbital and Lunokhod 2 surface data revealed the systematic discrepancy, requiring further examinations.

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References: [1] Perdvijnaya laboratoriya na Lune Lunokhod-1(in Russian). *Nauka.* (1977). [2] Florensky K. P. et al. (1978) *LPSC IX*, 1449-1458. [3] Florensky K. P. et al. (1976) *Int. Geological Congress*, XXV Session, 205-234 (in Russian). [4] Pieters et al., (1999) *Science*, 266, 1844-1848. [5] Kocharov G. E. and Victorov S. V. (1974) *Dokl. Acad. Nauk. SSSR*, 214, 72-74 (in Russian). [6] Lucey P. G. et al. (2000) *JGR*, *105*, 20297–20305.

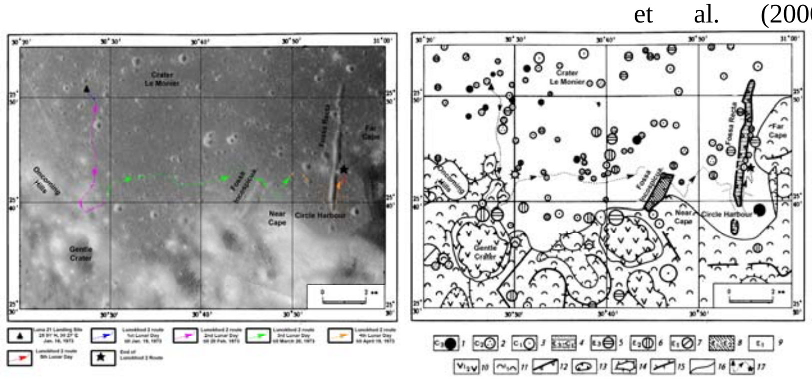

Figure 3. Photo mosaic Lunokhod 2 route site (NASA AS15-M-0392, AS15-M-0394, AS15-P-9294).

Figure 4. Scheme geomorphologic map of Lunokhod 2 working site[2]: 1-3 – Late, Middle and Early Copernican craters; 4 - joint fissure Fossa Recta; 5-7 –Late, Middle and Early Eratosthenian craters; 8 - joint fissure Fossa Incospicua; 9 - Le Monnier lava-flooded crater floor; 10 – Late Imbrian craters; 11 –Le Monnier crater rim; 12 –tectonic reaps; 13 – large crater edges; 14 – hill slopes; 15 - ridges; 16 – geomorphologic boundaries; 17 - Lunokhod 2 route.

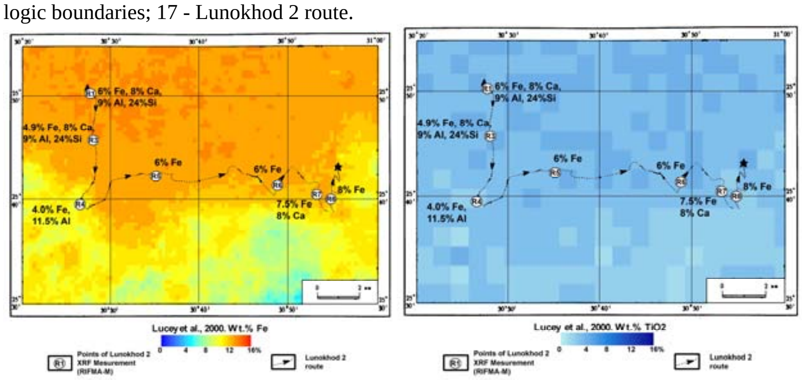

Figure 5. RIFMA XRF measurements [3] and remote geochemical data on Fe abundances[6] (left) and on Ti abundances [6] (right).