IMPACT MELT AND PALAEOREGOLITH DEPOSITS AS IMPORTANT SOURCES OF INFORMATION ABOUT LUNAR HISTORY. M. P. Sinitsyn, Moscow State University, Sternberg Astronomical Institute, Universitetsky prospect,13, Moscow 119992 Russia (msinitsyn.sai@gmail.com)

Introduction: It is well known that among the inner planets of the Solar system, only Mercury and the Moon are atmospherless bodies. This means that they are exposed to a wide range of external radiation. The rays, which leave traces in the lunar regolith can be divided into the following main components: galactic cosmic rays (GCR), solar cosmic rays (SCR) and solar wind (SW). As a consequence we expect that the lunar regolith contains information about the external radiation for the period of exposure. Each of these three types of radiation leaves traces in the form of tracks of protons and alpha particles. Moreover, these tracks are at different depths: SW penetrates to a depth of several microns; SCR – a few inches; GCR – a few meters. In addition, the regolith layer thickness of 1 meter builds up about 1 billion years.

Thus, making the vertical column of the lunar soil up to 4 meters may receive information about changing the content of external radiation in the history of lunar evolution. Unfortunately, in the process of meteorite bombardment (gardening) of regolith on the Moon thickness of 3-5 meters is largely homogenous. The column of regolith, delivered the spacecraft Apollo-12 demonstrated this. It consists of much of the mixed soil, which exposed a few times and then immersed as a result of gardening. Thus, to restore the history of the solar evolution and history of sun's rotation around the galactic center is very important to obtain a layer of the regolith, which was exposed only once in a certain historical period (palaeoregolith). So it is important to find a place where there is access to the palaeoregolith deposits. But now there is an opportunity to explore the surface layers, where gardening of the last 20-200 million years ago did not have time to play a significant role. Such places are apparently melts formed during impact processes.

Lunar immature impact formations

On the lunar surface there are a number of immature formations whose age is suitable to study the vertical cores of soil**.** Studies of impact processes have shown that at typical speeds of meteoroids (10-30 km/sec) impact melt is formed.

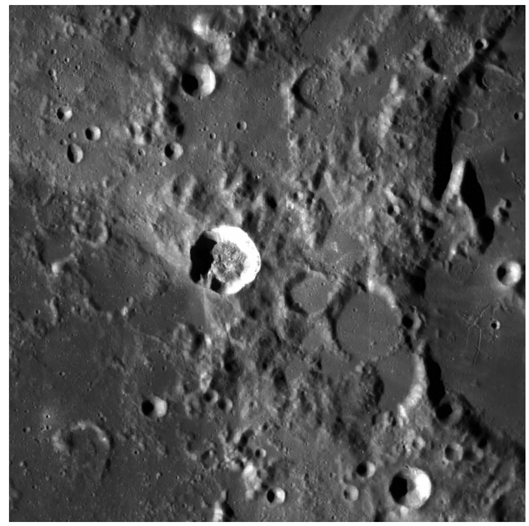

Fig.1 The area of the crater Proclus (LROC camera). Age of the crater is estimated at 20 million years. He is one of the extremely immature formations. Impact melt is visible at the bottom of the crater.

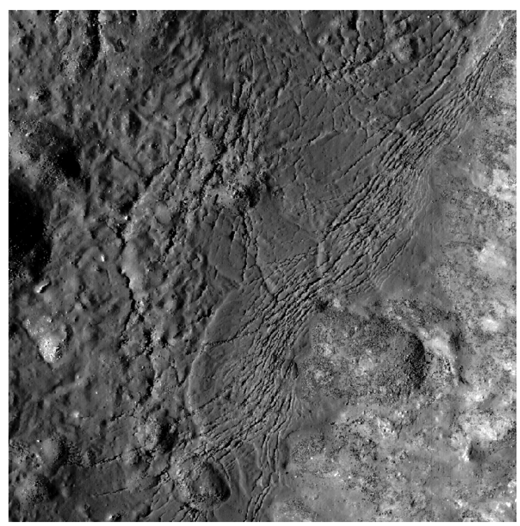

Fig.2 The characteristic form of impact melt on the crater Necho (LROC camera), located on the far side of the Moon.

Figure 2 shows the typical image of impact melt. The following well-known formations: Proclus (Fig.1), Aristarchus, Plinius and some other can be attributed for immature impact formations (up to age 200 million years). This limit due to the fact that the melt will not have time to undergo a large extent the process of mixing.

Hydrogen anomalies in areas of immature impact formations

It should be noted that immature impact craters on the lunar surface are extremely rare. Based on the distribution of hydrogen produced by Lunar Prospector Neutron Spectrometer (LPNS)[2], we found an abnormal correlation of increased concentration of hydrogen with many immature impact craters. Figure 3 shows the hydrogen anomaly corresponding to the location of the crater Aristarchus

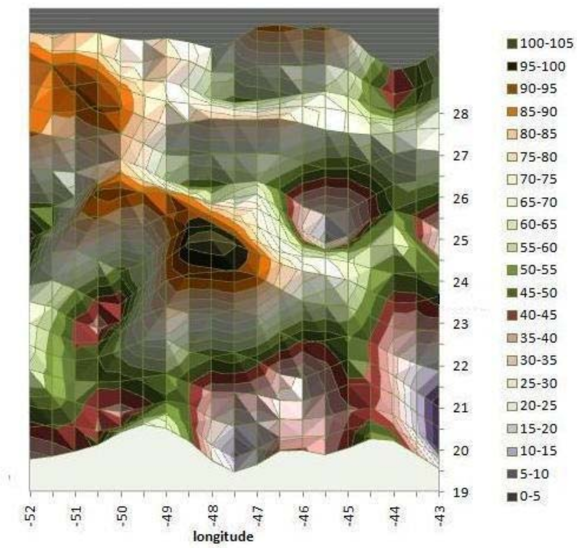

Fig.3 Concentration of hydrogen in the Aristarchus crater by LPNS data [2].

The figure clearly shows significant increased hydrogen content even up to 100 ppm. This is a large value not only for the equatorial region (where is the crater Aristarchus), but even for the polar regions.

We have several such correlations. They indicate that the immature surface formation may have a high concentration of hydrogen. For more accurate recording of these anomalies would be helpful to their confirmation by spectrometer LEND installed on the LRO spacecraft.

It is possible that these anomalies are the realy traces of any cosmic events that have occurred over the past tens millions years of lunar history. Obviously, the traces these events were reflected at the shock melt.

The potential scientific results from study of impact melts and palaeoregolith

In the study of GCR in the long-term scales (> 1 billion years) is possible to trace the rate of star formation in the Galaxy [1]. Traces of the SCR on time scales up to 4 billion years have important information about the early evolution of the Sun. Study the changes of the SW will provide an opportunity to confirm and adjust models of the evolution of the Sun as a main-sequence stars. Information obtained at shorter time intervals, especially reflecting the past 200 million years, can be an opportunity to trace the movement of the Sun through the spiral arms of the Galaxy and supernova explosions in the vicinity of the Sun [1]. Information received from all external radiation on the short and long time scales can be very useful for modeling the evolution of life on Earth.

Because with very high information content of the palaeoregolith deposits and impact melt we consider an important finding and cataloging of these objects for the sampling of them in the future space missions.

References: [1] Crawford, I. A. et al, 2010, Earth Moon Planets, 107, 75-85; [2] http://pdsgescences.wustl.edu/missions/lunarp/reduced_special.html