21168

Results of frequency-resonance processing of images from spacecraft of NASA Perseverance rover landing site on Mars

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SUMMARY

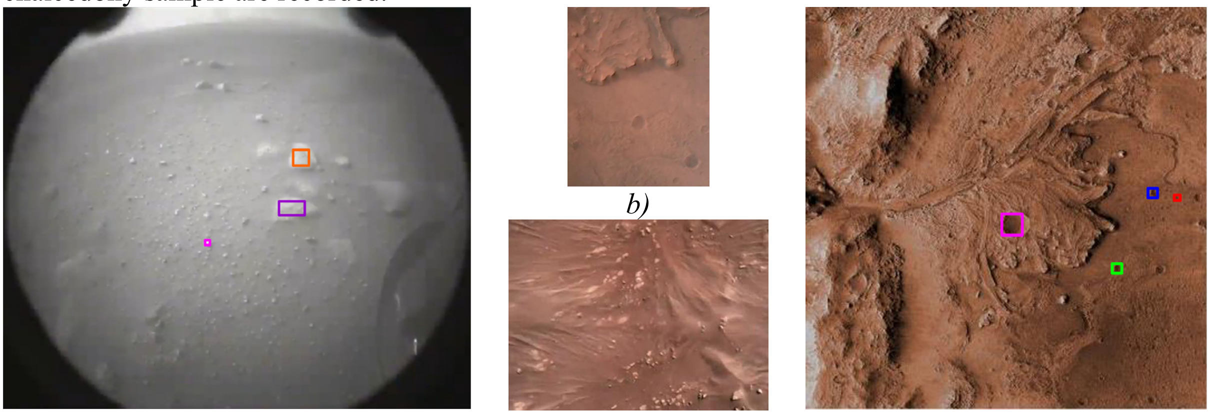
The results of experimental studies on Mars at the local landing site of the NASA Perseverance rover, in the Jezero crater area and in the northern part of planet are presented. Reconnaissance studies were carried out using methods of frequency-resonance processing and interpretation of images of survey sites from spacecraft in order to study the features of their geological structure. Instrumental measurements showed that the landing site of the rover is located within a volcanic structure, filled with marls. Fragments of siliceous rocks were found on the surface in the landing zone. In the vicinity of the Jezero crater, instrumental measurements have established (confirmed) the presence in the planet's cross-section of 8 types of volcanic structures, filled with 1) salt and samples from groups 2) limestones, 3) dolomites, 4) marls, 5) siliceous rocks, 6) basalts, 7) ultramafic rocks and 8) kimberlites. Examination of individual areas of the planet confirmed the presence on Mars only 27 chemical elements, known on Earth. Oxygen also belongs to the chemical elements, absent on Mars. The lack of oxygen in the composition of Mars indicates that there is no water on the planet, and, therefore, no ice in the Polar Regions. Large volcanic structures, filled with salt, have been discovered in the area near the north pole of Mars.

Introduction. The results of targeted testing in recent years of the mobile direct-prospecting technology of frequency-resonance processing and decoding of satellite images and photo images testified to the expediency of paying more attention to volcanic processes on Earth and their influence on the formation of the external appearance and internal structure of the planet (Bagdasarova, 2014). Experimental studies have confirmed the presence of deep channels (volcanic structures) of various types in different regions of the globe (Yakymchuk et al., 2019; Yakymchuk and Korchagin, 2020a; 2020b; 2020c; 2021). In this regard, recently, when conducting research with the aim of prospecting for minerals, additional measurements are being carried out aimed at establishing the presence (absence) of deep channels (volcanoes) within large and local survey areas.
The proven technology of frequency-resonance processing of satellite images and photographs also provides an opportunity to conduct experimental research in order to study the structural features of various objects in the solar system and deep space. At the moment, a significant amount of data of remote sensing of planets and satellites of the solar system has been accumulated from spacecraft, landing modules, as well as from space telescopes. The study of the internal structure of the planets and satellites of the solar system, based on the results of satellite images and photographs processing, can provide additional information for understanding the features of the geological evolution of the Earth and the formation processes of various structural and tectonic elements of the planet. Some results of already conducted experimental studies of this nature are presented in (Yakymchuk and Korchagin, 2020b; 2021). The article (Yakymchuk and Korchagin, 2021) presents the materials of the survey of the local landing site on the Moon of the Chinese lunar apparatus Chang'e 5 on December 1, 2020. This article presents preliminary results of the survey using the developed technology of the landing site of the NASA Perseverance rover in the Jezero crater on Mars on February 18, 2021.

Research methods. Experimental research on the Earth, as well as on the planets and satellites of the Solar System, is carried out using mobile direct-prospecting technology of frequency-resonance processing and decoding of satellite images, as well as photographs from descent vehicles and space telescopes in (Yakymchuk et al., 2019; Yakymchuk and Korchagin, 2020a; 2020b; 2020c; 2021). The individual components of the technology used are developed on the principles of the "substance" paradigm of geophysical research, the essence of which is the search for a specific (required in each case) substance. The developed methods are based on standing electric waves, discovered by Nikola Tesla in 1899. Mobile technology as a whole, as well as some of its methods, has been actively used recently to study the deep structure of the Earth and search for hydrocarbon accumulations at the initial stages of the exploration process, including for an integral assessment of the prospects for oil and gas content of large and hard-to-reach blocks and areas. Materials of testing and practical application of mobile technology are presented in many articles and conference materials, including (Yakymchuk et al., 2019; Yakymchuk and Korchagin, 2020a; 2020b; 2020c; 2021).
In modified versions of the methods of satellite images and photographs frequency-resonance processing, as well as vertical sounding (scanning) of cross-section, existing databases (sets, collections) of rocks are used. The collection of samples of sedimentary rocks of terrestrial origin (recorded in mud volcanoes, during processing on the Earth) includes 10 groups, and metamorphic and igneous - 18 groups. The photographs of the sets of rock samples, used in the process of instrumental measurements, were taken from the site http://rockref.vsegei.ru/petro/.

Local landing site of the rover. During frequency-resonance processing of the first image (Figure 1a) of the landing site from the NASA Perseverance rover (NASA's…) using the frequencies of chemical elements, minerals and rock samples, traditionally used in research on Earth, signals (responses) from hydrogen and sedimentary rocks of the 9th group (marls) were registered. Of the 10 marl samples used in the database, responses were recorded only from one of them - siliceous marl.
When processing the image from the surface, signals from hydrogen, deuterium and chlorine were recorded,
From a siliceous marl sample, signals were recorded at the frequencies of hydrogen, chlorine and from a combination of chlorine and hydrogen. Weak signals from iron were also recorded from this sample, as well as signals from a combination of chlorine-iron-hydrogen.
When processing the image in Figure 1a the responses at the frequencies of iron were recorded, as well as from a combination of the chemical elements chlorine-hydrogen and chlorine-iron-hydrogen.

When processing a local fragment of the image in Figure 1a (upper rectangle), only one sample of the 10th group of sedimentary (siliceous) rocks - silicon chalcedony - was detected.
Similar results were also obtained when processing a fragment of the image in Figure 1a in the center rectangle and also in the smallest, bottom one.
From a silicon chalcedony sample, responses were obtained from hydrogen, chlorine, iron (intense) and cobalt. Weak signals from the chlorine-hydrogen combination and intense signals from chlorine-hydrogen-iron were also recorded.
When processing the image in the central rectangle, the responses from hydrogen, chlorine, cobalt and iron we obtained.
During additional processing of the entire image in Figure 1a, weak responses from a silicon chalcedony sample are recorded.



b)

a) c) d)

Figure 1 *Photo images of the landing site (a) and area (b, c) (NASA's…) in the Jezero crater on Mars from the NASA Perseverance rover and from satellite (d) (Photo…)*

Figures 1ba and c show images of the surface of Mars from the rover as it approaches the landing site. When frequency-resonance processing of image in Figure 1c, responses from individual samples of the 9th (marl) and 10th (siliceous) groups of sedimentary rocks were recorded from the surface.
During the cross-section scanning with different steps, responses from marls were recorded from 0 cm and traced to 295.6 km (the root of the volcano of marls). The signals from siliceous rocks were obtained only from the depth interval 0-293 m.

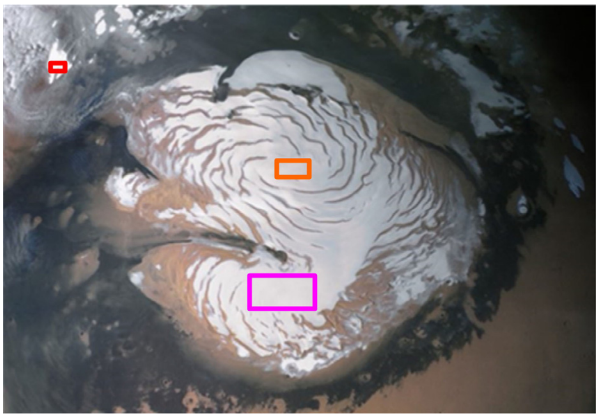
Landing area of the rover in the Jezero crater. The survey of the landing area of the rover was carried out until February 18, 2021. Photo images of the area used for frequency-resonance processing were borrowed from the site (Photo…). At the same time, we note that by instrumental measurements results have been established the information content (suitability for frequency-resonance processing) of the satellite image of area in Figure 1d.
During frequency-resonance processing of the image of the landing area from the satellite of Mars (Figure 1d), responses from the following chemical elements were recorded from the surface: hydrogen, deuterium, chlorine, iron, cobalt, lithium, beryllium, argon, nickel, potassium, scandium, calcium, titanium, helium, chromium, manganese, copper, vanadium, zinc, helium, germanium, arsenic, selenium, bromine, boron, nitrogen, sodium.
Signals from salt and individual samples of the 8th (dolomites), 9th (marls), 10th (siliceous) groups of sedimentary rocks, as well as the 6th (basalts), 7th (ultramafic), 11th (kimberlites) and 15th groups of igneous rocks were recorded in the surveyed area.
In Figure 1d, small rectangles indicate the outlines of four volcanic structures, fragments of the satellite image above which were processed separately.
When processing a fragment of the image in the left (largest) rectangle, responses from individual samples of the 8th group of sedimentary rocks (dolomites) were recorded. From the entire set of dolomite samples, signals were received from only one - dolomite cavernous.
During processing of a fragment of image in the lower rectangle, the presence of a volcano, filled with individual samples of the 10th (siliceous), in the upper rectangle - the 7th (limestones) and in the

rightmost rectangle - the 9th (marl) groups of sedimentary rocks, was established in the cross-section. On Figure 1b the volcano of siliceous rocks is located practically in the center.

Salt volcanoes in the north of Mars. Many publications and news reports, including (Deciphering…; Two…), provide information about the ice detection in the polar regions of Mars. In this regard, a certain amount of instrumental measurements was carried out, when processing satellite images of the northern part of Mars.

During frequency-resonance processing of the satellite image in Figure 2a (Deciphering…), signals from hydrogen, salt and individual samples of the 8th (dolomites) and 9th (marls) groups of sedimentary rocks, as well as the 6th (basalts) and 11th (kimberlites) groups of magmatic rocks were recorded from the surface. The lower edge of the salt volcano was determined at a depth of 295.6 km.

Within the lower rectangular contour in Figure 2a, on the surface of 295.6 km from the upper part of the cross-section, signals from salt and samples from the dolomite, marl, basalt, and kimberlite groups were recorded. The lower edge of the salt by scanning from the surface, step 1 m, was determined at a depth of 911 m. At this depth, from the upper part of cross-section, there were no responses from samples from groups of dolomites, marls, basalts, and kimberlites, but from the lower part were recorded.


a)

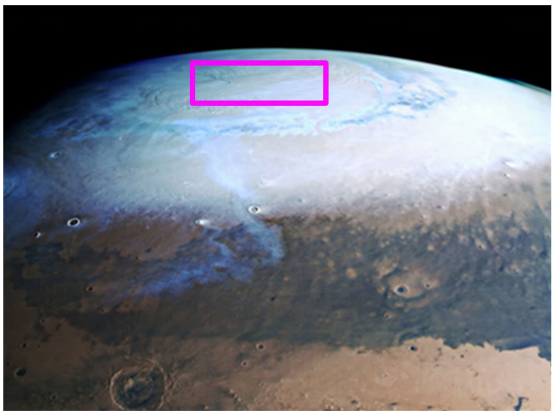

b)

Figure 2 *Fragments of satellite images of the North Pole of Mars including (Deciphering…; Two…)*

Signals from hydrogen were recorded on the 0 m surface from the upper part of the cross-section, which indicates its migration into space above the planet's surface.

By scanning the cross-section from 911 m, step 1 cm, the upper edges of dolomites, marls, basalts and kimberlites were determined in the depth interval of 912-913 m.

When processing a fragment of the image in the central rectangle (Figure 2a), only signals from salt were recorded. No responses from sedimentary and igneous rocks were obtained in this part of the image. The root of the salt volcano was determined by scanning at a depth of 295.6 km. Such processing results allow us to conclude that a salt volcano is located in this part of the survey area on Mars, salt from which overlapped volcanic structures of dolomites, marls, basalts and kimberlites, both within the lower rectangular contour and in other parts of the survey area.

When processing a small fragment of the image in a rectangular contour in the upper left part of Figure 2a the presence of a salt volcano with root at a depth of 295.6 km was also revealed.

Figure 2b shows another satellite image of the North Pole of Mars (Two…). Signals from salt and samples from the dolomite, marl, basalt and kimberlite groups are also recorded within the rectangular contour in this image. By scanning the cross-section from the surface, step 1 m, the lower edge of the salt was determined at a depth of 1513 m. At a depth of 1510 m, no responses from sedimentary and igneous rocks were obtained from the upper part of cross-section.

When scanning from 1510 m, a step of 1 cm, the upper edges of dolomites, marls, basalts and kimberlites were determined in the depth interval 1512-1516 m and the lower edges (roots) - at a depth of 295.6 km.

The results of the frequency-resonance processing of the image fragment of the north pole of Mars in Figure 2b also testify in favor of presence in this region of planet of a large salt volcano, the salt from which overlaps the volcanic complexes of dolomites, marls, basalts, and kimberlites.

Brief comments and conclusions. Experimental studies have demonstrated, first of all, the fundamental possibility of using data of remote sensing of planets and satellites of the solar system (images from spacecraft, landing modules and telescopes) to study the internal structure of research objects, as well as the composition of present on them rocks, minerals and chemical elements.

The results of the expeditiously carried out experimental studies made it possible to obtain the following information about the geological structure of the landing site of the rover in the region of the Jezero crater on Mars.

1. The landing site of the rover is located within the volcanic structure, filled with marls. From the used set of marl samples in the cross-section at the landing site, the presence of only one sample of these rocks - marl quartzite - was established.
2. At the landing site, on the surface the fragments of light-colored rocks - silicon chalcedony - are "scattered". It can be assumed that these are fragments from volcanic complexes located in this area, filled with siliceous rocks (individual samples of the 10th group of sedimentary rocks from the collection used for instrumental measurements).
3. In the area of the Jezero crater, the instrumental measurements have established (confirmed) the presence in the planetary cross-section of 8 types of volcanic complexes filled with 1) salt and samples from groups 2) limestones, 3) dolomites, 4) marls, 5) siliceous rocks, 6) basalts, 7) ultramafic rocks, and 8) kimberlites.
4. When examining individual areas of the planet, the fact of the presence in its composition of only 27 chemical elements, known on Earth, was confirmed. Oxygen also belongs to the chemical elements, absent on Mars.
5. The absence of oxygen in the composition of Mars also indicates that there is no (and was not) water on the planet, and, consequently, ice in the polar regions. The discovery of large volcanic complexes, filled with salt, in the region of the North Pole of Mars can be considered as additional evidence in favor of the absence of water (and, therefore, ice) on the planet.
6. The discovery on Mars of numerous volcanic complexes, filled with rocks of various compositions, can be considered as an important argument in favor of the volcanic model (Bagdasarova, 2014) of the formation of the external appearance of the planet.

Evaluating the results of promptly carried out experimental work, it can be stated that the mobile frequency-resonance technology of satellite images and photographs processing can be used to conduct detailed studies on planets and satellites of the solar system in the framework of large scientific projects to study them.

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