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On the prospects of hydrocarbon and hydrogen accumulations detecting within local areas of Ukrainian shield

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SUMMARY

The results of applying the technology of frequency-resonance processing and interpretation of satellite images on the Ukrainian shield with the aim of studying the deep structure of this structure and searching for hydrocarbon accumulations are presented. By conducted studies on the shield the presence of two layers of granites of different ages was revealed, and the deep channels of fluids, minerals and chemical elements vertical migration, filled with granite rocks of different ages, were found. The roots of the discovered channels were recorded at depths of 470 km and 996 km. In the cross-section intervals between the upper and lower granite strata, responses from sedimentary rocks, as well as oil, condensate and gas were recorded. This cross-section interval between two strata of granites deserves a detailed study in order to hydrocarbon accumulations detect and localize.

Introduction. During the geophysical measurements performing at the Ukrainian Antarctic Expedition of 2018 (*Yakymchuk et al., 2019a*) in the South Atlantic, a channel of deep fluids and mineral matter vertical migration, filled with granites, was discovered. The depths of the lower edge of granites in the channel at many points along the ship's trajectory were determined (estimated) by vertical sounding of the cross-section. It was also established by sounding that the root of the channel is located at a depth of 995 km.

In this regard, a frequency-resonance processing of satellite images of some areas of the Ukrainian Shield (USh) was carried out in order to assess the depths and thicknesses of granite complexes in the cross-section. The results of reconnaissance studies within the USh were unexpected: deep channels filled with granites were discovered, and the presence of a sufficiently thick stratum of sedimentary and metamorphic rocks between the upper (relatively "young") and lower ("old") granite complexes was established (*Yakymchuk and Korchagin*, 2019b).

In May 2019, the works began within the Ukrainian Shield along separate profiles with frequency-resonance methods for processing satellite images using in order to study the deep structure of its individual fragments and assess the prospects of accumulations of oil, gas and condensate detecting in the cross-section. The results of studies within the USh along the first profile are given in (*Yakymchuk and Korchagin*, 2019b). This report presents the materials of cross-section sounding in the separate point along the second profile.

Methods of research. Mobile technology include the modified methods of frequency-resonance processing and decoding of satellite images and photographs and vertical electrical resonance sounding (scanning) of the cross-*section (Yakymchuk et al., 2019a; 2019c; Yakymchuk and Korchagin, 2019b)***.** Separate methods of technology are based on the principles of the "substance" paradigm of geophysical research, the essence of which is to search for a specific (sought in each case) substance – oil, gas, gas condensate, gold, zinc, uranium, etc. At various stages of research in the different region of the globe, the technology of integrated assessment of oil and gas prospects and ore potential of large exploration blocks and license areas was purposefully used.

In mobile methods the collections of chemical elements, minerals, oil and condensate samples, as well as sedimentary, igneous and metamorphic rocks are used, whose resonant frequencies are used during the satellite images processing. Photographs of samples of the 6th group of igneous rocks (gabbro and basalts) are shown in Figure 1 and 11 groups (kimberlites and lamproites) – in Figure 2.

All photos of the used sets of samples of sedimentary, metamorphic and igneous rocks are taken from the site http://rockref.vsegei.ru/petro/.

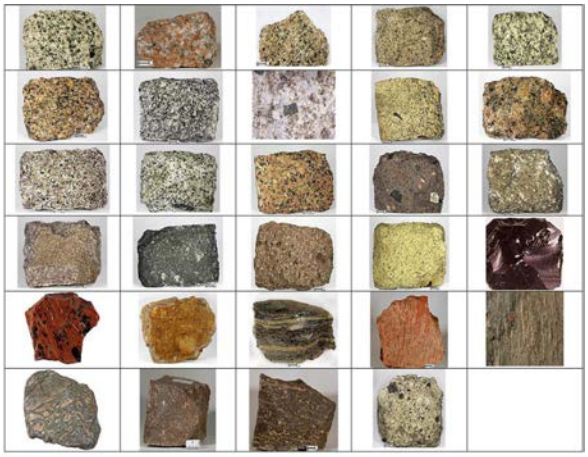

Figure 1 *A group of granites and rhyolites. 29 samples.*

Figure 2 *A group of kimberlites and lamproites. 20 samples.*

Results of research. To carry out detailed work within the Ukrainian Shield, several profiles were designed, located in its various regions (Figure 3). Studies along the first profile have already been carried out. The second profile begins in the Republic of Belarus, crosses the Zhytomyr and Vinnitsa regions of Ukraine and ends on the border with Moldova. Along this profile, 10 points for processing were recorded. The coordinates of the first point on the profile are 51°57'11.76 "N, 28°25'03.96" E, of tenth (last) – 47°54'55.693 "N, 28°39'43.79" E. The remaining survey points are evenly spaced along

the profile between the first and tenth. A satellite image of a site (approximately 2×2 km) in the region of the first profile point is shown in Figure. 4.

During the frequency-resonance processing of satellite images of local sites of the selected points, anomalous responses were recorded at the resonant frequencies of sedimentary and igneous rocks, oil, gas, condensate, amber, hydrogen, carbon, oxygen and coal. The results obtained in this case are reduced to the following.

Point 1. At the point, no responses were recorded at the frequencies of oil, condensate, gas, amber, coal, shale gas, gas hydrates, and ice. A water signal (not strong) is registered. Responses were received from 9 and 11 groups of sedimentary rocks, as well as 1 and 7 groups of igneous rocks.

By scanning the cross-section, signals from the 9th group of sedimentary rocks were recorded in the depth interval of 130-850 m, and of 11th group (salt) – 920-1800 m.

Responses from 1, 7, and 8 groups of igneous rocks were obtained from a surface of 1800 m. The following response intervals from these groups were established: 1 – 1840-23170 m; 7 – 23170-44450 m; 8 – 44500-194000 m.

Point 2. In this area, there were no responses from hydrocarbons and sedimentary rocks, only signals (strong) from 1 group of igneous rocks – granites – were recorded. The root of the channel (volcano), filled with granites, is set at a depth of 470 km, the upper edge of granites is located in the depth range of 40-50 m.

Responses were recorded from 1–9, 23, and 26 samples of granites ("young") in the collection of samples of the first group of igneous rocks (Figure 1).

On the surface of 50 km there were no signals from oil and water.

Point 3. At this point, no responses from hydrocarbons, amber, coal, ice, and sedimentary rocks were recorded. Water signals were obtained, as well as very intense responses from granites (1 group of igneous rocks). The root of the granite channel was determined at a depth of 996 km, the upper edge is in the range of 60-70 m. Signals from 10, 11, 12, 13, 14, 15, 16, 17 and 18 samples in the collection of granites ("old") (Figure 1) were received. At the survey site, water is present to a depth of 600 m.

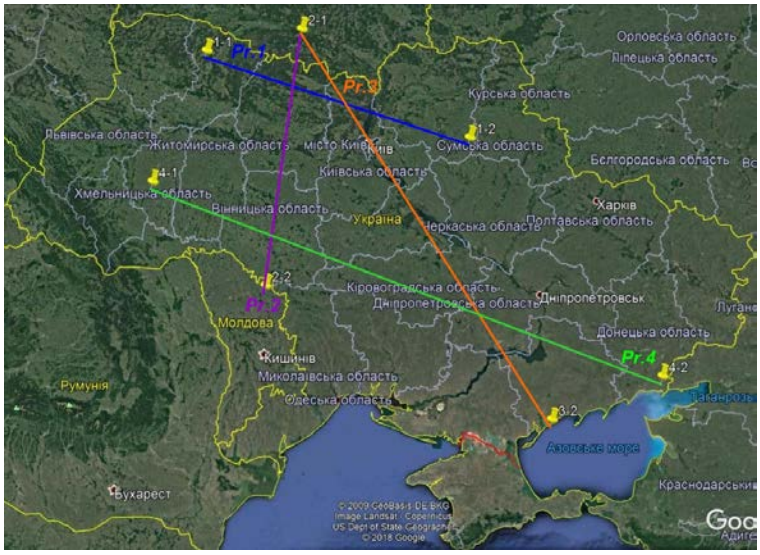

Figure 3 *The position of the vertical sounding profiles within the Ukrainian shield.*

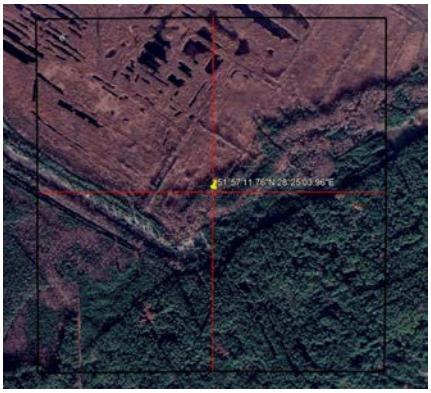

Figure 4 *Satellite image of a local area in the region of the 1st point of profile 2.*

Point 4. Signals from hydrocarbons, amber and sedimentary rocks were also not recorded on this site. Responses from water were recorded up to 600 m; on the surface of 68.9, they were absent.

Signals from granites were obtained immediately, the root of the granite channel was determined at a depth of 996 km, the upper edge is in the range of 40-50 m.

Responses from almost all granite samples from the collection (1–9, 10–19, 22–29, "young" and "old") (Figure 1) were received from the surface. The same situation was observed on the surface of 469 km. And already at a depth of 470 km, only 10-18 samples were recorded. This indicates that the root of the channel of "young" granites is located at a depth of 470 km.

Point 5. Within this region, there were no responses at the frequencies of hydrocarbons, amber, and sedimentary rocks. Water signals recorded up to 700 m. The presence of a granite channel with a root

at a depth of 996 km was determined; the top edge of granites is in the range of 40-50 km. Responses were received only from 10-18 samples of "old" granites (Figure 1).

Point 6. At the location of this point, responses were recorded at the frequencies of oil, condensate, gas, amber, shale gas, coal, anthracite and water. Signals were received from 1, 2, 3, 4, 5, 6, and 12 groups of sedimentary rocks, as well as 1, 6, and 7 groups of igneous rocks. On the surface and at a depth of 50 km, responses were recorded at hydrogen frequencies!

By fixing responses at various depths, the root of a channel (volcano), filled with igneous rocks of group 7, was determined at a depth of 723 km.

Signals from the upper granite layer are recorded in the depth interval of 40–2320 m; only from 1-9 samples of granites ("young") (Figure 1). The second layer of granites is recorded in the interval 19030-22900 m; there responses were received from 10–18 granite samples ("old") (Figure 1).

Responses from 1-6 groups of sedimentary rocks were obtained from the depth interval of 2320-19030 m. Signals from the 6th group of igneous rocks (basalts) were recorded up to 106500 m.

At a depth of 68.9 km, responses were recorded at water frequencies; water is present in channel 7 of the igneous rock group; there are no water signals in basalts.

The responses at the frequencies of oil were recorded by scanning from 2330 with a step of 1 m in the following depth intervals: 1) 2440-3500 m; 2) 3950-4560 m; 3) 4800-4900 m; from 5 km the step is 5 m, 4) 6620-8500 m. At the border of 10 km from the lower part of the cross-section, there were no signals at HC frequencies, from water the responses was recorded. From the upper part of the cross-section at this depth, responses at the frequencies of oil, condensate and gas were recorded.

Point 7. In the area of this point, signals from hydrocarbons, amber and sedimentary rocks were not recieved, and responses from water were recorded.

Responses from all granite samples were obtained from the surface (1–9, 10–18, 19) (Figure 1), the upper boundary of granites is in the range of 30–40 m, and the root of the granite channel is recorded at a depth of 996 km. It should be noted that signals from only 10-18 granite samples were recorded on a surface of 500 km, and from all samples on a surface of 450 km (1-9, 10-18, 19, 24, 28, 29) (Figure 1). This allows us to conclude that the root of the "young" granite channel is located at a depth of 470 km.

Signals at water frequencies were registered at this point up to 600 m.

Point 8. In this area, signals from hydrocarbons and amber were absent, from the water was recorded. Responses from 1, 2, 3, 4, 5, 6 groups of sedimentary rocks and 1 (weak), 11 igneous groups were recorded. Responses from 10–18 granite samples ("old") were obtained from a depth interval of 18–25 km.

Signals from the 11th group of igneous rocks (kimberlites) were recorded from 2 km (approximately) to 723 km (root of the kimberlite channel). Responses from 1-6 groups of sedimentary rocks were obtained above.

From the surface, as well as at a depth of 450 km, signals from all 20 kimberlite samples (Figure 2), available in the collection, were recorded. At depths of 470 and 550 km, signals from only 13–20 samples were received, and at a surface of 469 km, from all samples (Figure 2).

Water signals were received starting from a depth of 2400 m.

By scanning the cross-section from 2400 m with steps of 1 m and 10 m, responses at diamond frequencies were obtained in the depth interval 2500-33550 m. The second interval of responses from diamonds was determined at a depth of 97345 m (no further tracking was carried out).

Point 9. At this point location, responses were obtained from oil, condensate, gas, amber, shale gas, gas hydrates, coal, water, ice, anthracite and hydrogen. Signals from 1, 2, 3, 4, 5, 6, 12 groups of sedimentary rocks and 6 groups of igneous (basalts) rocks were also recorded.

On the surface of 50 km there are no signals from hydrocarbons, but from the water responses were received (at a depth of 68.9 km, including).

The responses at the frequencies of basalts and hydrogen were obtained from the depth interval of 1800–105000 m, and from the 7th group of igneous rocks in the interval of 105–194 km.

By scanning the cross-section in depth range 0-1800 m, the following response intervals were obtained: a) oil – 80-690 m and 980-1320 m; b) gas – 1470-1740 m; c) amber – 80-175 m; d) shale gas – 55-80 m; e) gas hydrates – 480-690 m; f) ice – 480-690 m.

We also note that a signal from water from the interval of basalts was received, but from the interval of the 7th group of igneous rocks – not.

Point 10. In this area, there were no responses from hydrocarbons and amber, signals from water were recorded, at a depth of 68.9 km including.
Responses were received from 9 and 10 groups of sedimentary rocks, signals from igneous rocks were not recorded. The presence of a channel (volcano) with a root at a depth of 470 km, filled with 9 groups of sedimentary rocks (marls), was established; the upper boundary of these rocks was determined by scanning at a depth of 180 m. Responses were obtained from 117, 118, 119 and 120 samples of marls, from 121-126 samples there were no signals.

Conclusion. As a result of the research conducted within the Ukrainian Shield, new information was obtained on the geological structure of this region and the areas adjacent to it. From this point of view, we focus attention on the following.
1. Additional facts have been obtained that make it possible to claim that there are two layers of granites of different ages ("young" and "old") within many areas of the Ukrainian Shield.
2. Studies have discovered deep channels of fluids, minerals, and chemical elements vertical migration, filled with granite rocks of various ages. The roots of the discovered channels were recorded at depths of 470 km ("young" granites) and 996 km ("old" granites).
At separate points of the profile, channels with roots at a depth of 723 km, filled with ultramafic rocks (group 7) and kimberlites (group 11), as well as a channel with a root of 470 km, filled with 9 groups of sedimentary rocks (marls), were found.
3. The facts of fixing anomalous responses (signals) at the resonant frequencies of oil, condensate, gas and amber in granite rocks, filling the channels, in almost the entire upper part of the cross-section up to 57 km are noteworthy. The same situation was also observed during additional studies with the aim of subsequently comparing the results obtained at the well-known White Tiger oil field (in granites) on the Vietnamese offshore (*Yakymchuk and Korchagin*, 2019b).
4. In the intervals of the cross-section (including those with small thicknesses), located between the upper and lower layers of granites, responses from sedimentary rocks, as well as oil, condensate, gas and amber, were recorded. There are grounds for allegations that the cross-section interval between two strata of granites at the USh deserves a detailed study with the aim of detecting and localizing possible accumulations of hydrocarbons in industrial volumes.
5. In the surveyed areas, additional to the previously described in *(Yakymchuk et al., 2019a; 2019c; Yakymchuk and Korchagin, 2019b)* evidence in favor of deep synthesis of hydrocarbons was obtained: this is the fixation of responses at the frequencies of oil, condensate, gas and amber in the range of depths from the surface up to 57 km, below this boundary the responses at hydrogen and carbon frequencies are registered.
6. Within many of the surveyed areas (site of point 9 including), along with recording responses at HC frequencies, signals at amber frequencies were also recorded. This feature also testifies in favor of the deep synthesis of this "mineral". Moreover, it can also be suggested that amber is a solid hydrocarbon.
7. The results of processing satellite images of local areas of visible hydrogen degassing of the Earth (site of point 9 including) once again showed that in these zones signals (responses) at hydrogen frequencies are recorded immediately. In such zones, hydrogen can be detected in the cross-section significantly higher than the level of 57 km, including at shallow depths.
8. On the examined sites of hydrogen degassing in the cross-section, the presence of channels of fluids and minerals vertical migration, filled with basalts, has been established. Additional surveys of some local areas of basalt rock outcrop to the surface showed that in these places responses (strong) are recorded at the resonant frequencies of hydrogen. It can also be assumed that the areas of of basalt rocks location can be considered as priority when conducting prospecting for hydrogen.

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