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Petrological and Geochronological Peculiarities of Novoukrainka Massif Rocks and Age Problem of Uranium Mineralization of the Kirovograd Megablock of the Ukrainian Shield

Basing on the new and published data of isotopic dating, the ages of the rock complexes of the Novoukrainka granite massif (the Ukrainian Shield) and uranium mineralization in albitites with the complexes of the host rocks were compared. A sequence of the geologic events in the Ingul megablock of the Ukrainian Shield is marked: formation of the Kirovograd (2025–2060 mln. y. ago) and Novoukrainka (2025–2040 mln. y. ago) magmatic complexes — formation of the uranium deposits (~ 1800 mln. y. ago, but the age should be precised) — Korsun-Novomyrgorod magmatic complex (1730–1760 mln. y. ago). The Novoukrainka massif is presented by differentiated magma of the magmatic melt originated from the upper crust material.

Introduction. Novoukrainka massif occupies the area of about 3500 km^2 (75 × 63 km) in the southern part of Ingul megablock of the Ukrainian Shield. Massifs of the Kirovograd granites are situated eastward of the Novoukrainka massif, but the Korsun-Novomyrgorod massif bounds it to the north [9]. Numerous papers [2–9, 11–15] discuss the results of investigation of rock complexes of the Novoukrainka massif. Host rocks are represented by gneisses and migmatites of Ingul-Ingulets suite and granitoids of Kirovograd complex which are tectonically bordered on the massif. Westward the Novoukrainka massif is bordered by rocks of Bratsk synclinorium, eastward by granitoids of the Kirovograd massif, and northward — by the Korsun-Novomyrgorod pluton. Actually the rock complexes and their interrelations within the Novoukrainka massif are not sufficiently investigated by modern methods that demands making arrangements for some geological works which could solve important problems about its petrological and genetic features. Furthermore, the Novoukrainka massif draws much attention in that way since uranium deposits occur within the massif or close to its contacts. The source of uranium and origin of ore-forming fluids still remain obscure. It is quite probable, that somehow they are associated with the granitoid massifs of the Ingul megablock. This paper presents the results of investigations of some petrological features of magmatic rocks, and also the analysis of age relations between magmatic and metamorphic complexes flanking the Novoukrainka massif with rocks comprising the massif and also with uranium deposits of the Ingul megablock of the Ukrainian Shield.

Petrological characteristics of Novoukrainka massif rocks. Magmatic rocks of the Novoukrainka massif are represented by a wide spectrum of magmatic varieties of the Novoukrainka complex, from basic gabbro-norites and gabbro-monzonites to acidic garnet-biotite, biotite, porphyry, equigranular granites and aplite-pegmatitic granites. Garnet-biotite-pyroxene coarse-porphyroblastic granites of trachytoid structure and hypidiomorphic-granular texture are predominant. Porphyroblasts are represented by microcline-perthite (up to 70 %) and less often by plagioclase. According to the data of deep drilling the content of pyroxene in granites is increased with depth [6]. The most complete data on petrography and petrology of magmatic rocks of the Novoukrainka massif are presented in papers [4, 14]. Granites are related to *S*-type [14]. The value of $^{87}Sr/^{86}Sr$ ratio (0.72409 ± 2) in apatite of the Novoukrainka granites testifies to upper

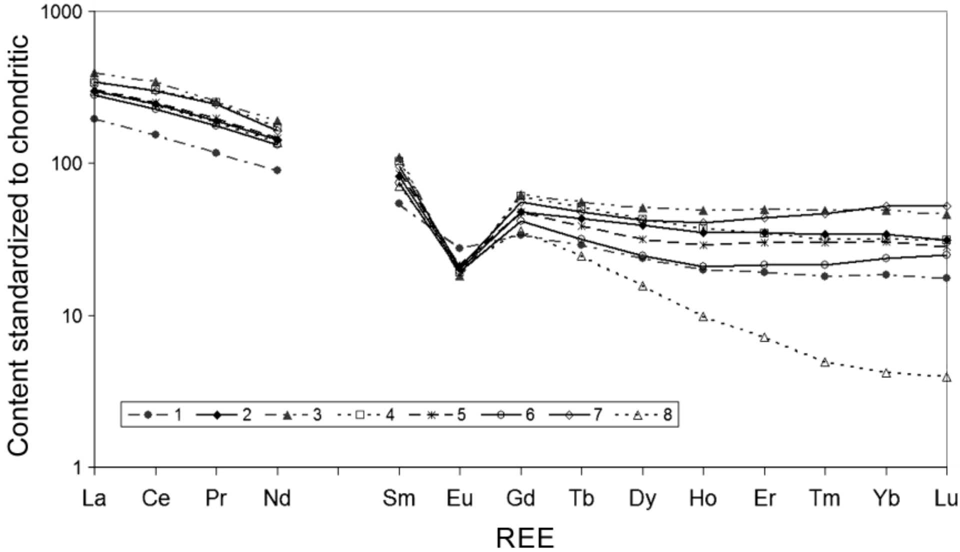

Fig. 1. A chondrite-normalised pattern of rare-earth elements in porphyraceous biotite granites (*1*) and biotite granites with restite (*8*) of Kirovograd magmatic complexes, red biotite-garnet granites (*4, 7*), transition zones from hypersthene-garnet (charnockitic) to biotite-garnet granites (*2, 3, 5, 6*), hypersthene-garnet granites (charnockite) (*7*) from Novoukrainka massif

crustal origin of magmatic melt [15]. However, for the present there is no sufficient isotopic data in order to make interpretation of the genetic origin of all the complex of magmatic rocks of the Novoukrainka massif. Among rocks of the massif the formations of four magmatic phases are distinguished [4].

Dike-similar bodies of norites, gabbro-norites and gabbro-monzonites are associated with the first phase. They are related to intrusion of the basic magmas from the depth into still unsolidified granitic magma [6]. The zones of gradual transitions comprised by hybridic varieties of rocks are observed between these rocks and host granites though in many cases sharp contacts are mentioned [14]. The share of the basic rocks in the Novoukrainka massif decreases from the south-west to the north-east in the direction of more elevated part of the massif.

The second magmatic phase is represented by pyroxene granitoids, quartz-monzonites, adamelites, quartz syenite, granosyenites and granites being distinguished among them. They are mostly distributed in the western elevated part of the massif. In the paper [5] hypersthene-containing rocks are described as charnockites.

The basic mass of the massif rocks represented by normal pyroxene and garnet-biotite of red and pink-grey colour predominantly trachytoid granites, are related to the third phase. On the whole, trachytoid structure of the magmatic rocks is conformable with textural orientation of the host gneisses and migmatites. With depth red granites are replaced by bright and dark grey granites of the same composition. Rocks of the third phase make over 50 % of the pluton rocks.

Leucocratic aplitic biotite-containing granites which form small (first kilometres) stocks and bed-like bodies that occur mostly in the zones of endocontacts are related to the fourth phase [4].

Beside the Novoukrainka massif, rocks of Novoukrainka complex also comprise some small massifs — Verbluzhsk, Bokovian, Mytrophaniv and Chygyryn.

We have investigated bodies of dark-green hypersthene-containing (charnockite-like) granites and monzonites of the second phase in red mainly coarse-grained porphyry trachytoid granites of Kapustianka and Voynivka open pits of the third phase. In open pit walls the bodies are characterized by thickness of about 10 m. Transition from normal red to charnockitic granites is gradual, with preservation of trachytic texture. Besides

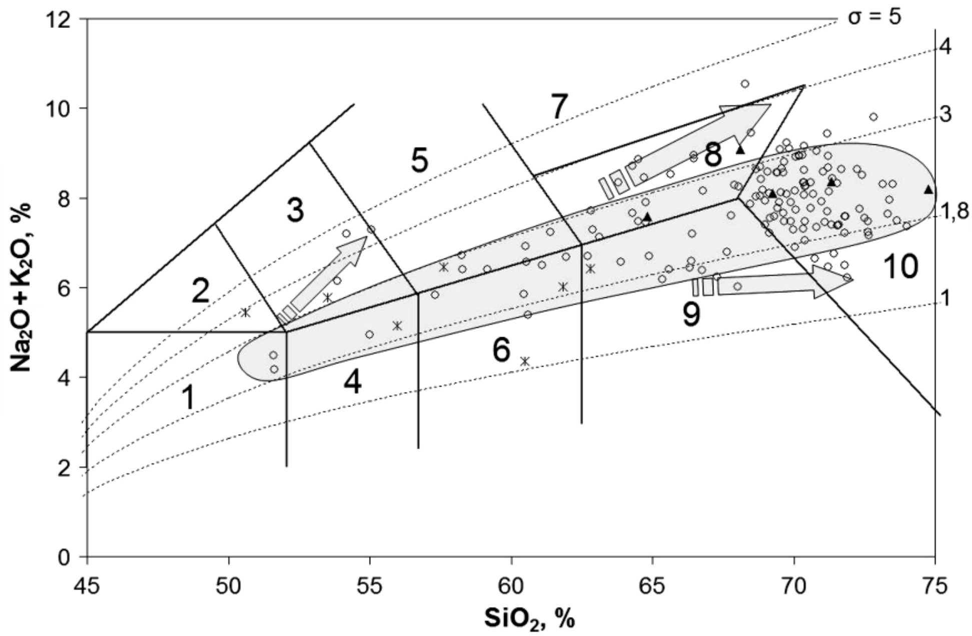

Fig. 2. The classification diagram in coordinates $K_2O + Na_2O$ — SiO_2 for magmatic rocks of the Novoukrainka massif (*circles*) and Kirovograd complex (*triangles*). Figurative points of metamorphic rocks of Ingul-Ingulets suite (*asterisk*) are plotted on the diagram. The area filled in grey indicates to the parabolic tendency of the general change of chemical composition of Novoukrainka magmatic rocks; arrows show deviation from this tendency. *Areas of rocks: 1* — gabbro, *2* — monzogabbro, *3* — monzodiorite, *4* — gabbrodiorite, *5* — monzonite, *6* — diorite, *7* — syenite, *8* — quartz syenite, *9* — granodiorite, *10* — granite. Curves of serial relationship (serial index of alkalinity) [10] $\sigma = (Na_2O + K_2O)_2/(SiO_2{}^{-43})$

the colour change that is caused by decolorization of potassium feldspar, hypersthene is the main femic mineral in charnockitoid granites and monzonites but in host granites it is biotite. The hypersthene-biotite ratio is ambiguous and there arises some impression about replacement of biotite by hypersthene. Hypersthene granites show the presence of potassic feldspar of the second generation and distribution of myrmekitic exsolution structures with potassic feldspar and quartz. According to chemical analyses of the rocks, garnet-hypersthene and host garnet-biotite granites are characterized by composition similarity. The difference is not significant and lies in insignificantly (< 1 %) low contents of Al_2O_3, Fe_2O_3, Na_2O, MgO and P_2O_5 and higher K_2O and SiO_2 contents in garnet-hypersthene granites. It is manifested only in comparison with directly hosting garnet-biotite granites. Such changes can be quite explained by disappearance of biotite and formation of hypersthene within the rocks.

According to chondrite-normalized distribution of rare-earth elements (REE), charnockite-like granites of the second phase and host red garnet-biotite granites of the third phase from the Kapustianka and Voynivka open pits are characterized by similar regularities of variations of REE contents with negative Eu anomaly and regular decrease of their concentration from light to heavy rare-earth elements with stable chondrite-normalised heavy elements distribution pattern (Fig. 1). Such a resemblance confirms similar mineral composition of the rocks and can be hardly associated with crystallization of garnet-hypersthene granites from melts of other phase. Probably, garnet-hypersthene granites and monzonites are charnockites that resulted from charnockitization of biotite-garnet granites in conditions of granulitic facies of metamorphism which parameters have been estimated on the basis of investigation of biotites from similar charnockite-like bodies of the Novoukrainka massif [5].

On $Na_2O + K_2O$ — Si_2O classification diagram (Fig. 2) figurative points of magmatic rocks of the Novoukrainka complex form the parabola-shaped zone extended from gabbro

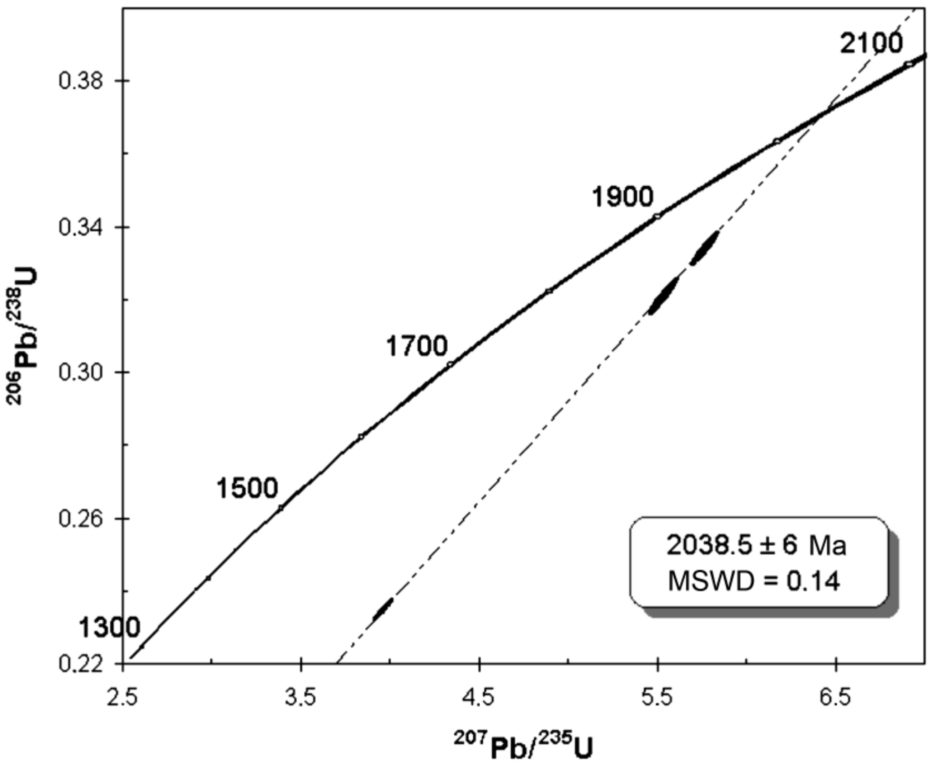

Fig. 3. U-Pb isochrone with concordia for synpetrogenic zircons from pegmatitic Novoukrainka granites (sample K-4)

to granite field, which approximately equally covers the rocks of normal series with high alkalinity and alkaline series with low alkalinity. The alkalinity variation in this zone is assumed to be constant, that according to data published in paper [10] testify to magma differentiation as a result of gravitational separation. Though such conclusion was made for the igneous rocks [10], the authors also think such pattern to be valid for large plutons. Moreover some deviations from this pattern occur with the increase of alkalinity as well as in the granite field and sometimes in granodiorites with its decrease. The former effect can testify to crystallizational segregation of minerals from melt. The

Table 1. **Results of uranium-lead isotopic investigation of zircons from the Novoukrainka massif granites**

Zircon fraction, mm	Content, g/t		Isotope rations					Age, mln. y.		
	U	Pb	206/204	206/207	206/208	206*r*/238	207*r*/235	206/238	207/235	207/206
Pegmatoid Novoukrainka granite (sample K-4)										
> 0.07 < 0.1	900	299	33.93.18	436.97	228.29	0.32124	5.5303	1975	1905	2027
> 0.05 < 0.07	593	195.5	6168.79	783.89	402.11	0.32015	5.5142	1790	1902	2027
> 0.1, e/m	883	303.2	4980.38	635.68	311.20	0.33397	5.7546	1858	1939	2028
> 0.1, e/m	1345	328.2	1918.53	248.30	138.46	0.23375	3.9471	1354	1623	1992
Trachytoid Novoukrainka granite (sample K-1)										
> 0.1	698	264	473.90	72.721	67.34	0.32614	5.63996	1820	1922	2035
< 0.1	782	88	2297.14	300.187	184.4	0.10712	1.84462	656	1062	2027
> 0.07	878	311	3696.85	473.859	320.47	0.32979	5.66492	1837	1926	2023
< 0.07	813	33	4993.83	636.786	357.78	0.03913	0.67363	247	523	2027
Trachytoid Novoukrainka granite (sample 557)										
Initial	849	276	3090	7.8551	14.175	0.31390	5.3230	1785	1872	2000
> 0.1	685	241	9280	7.8858	14.245	0.34113	5.8970	1890	1960	2039
< 0.1	773	253	2240	7.8879	13.053	0..31395	5.2300	1775	1858	1968
E/m general	782	239	3140	7.7390	5.0353	0.26603	4.5839	1525	1745	2028
E/m > 0.1	795	247	6860	7.8694	11.336	0.29650	5.1155	1675	1835	2031
E/m < 0.1	458	160	5060	7.8525	9.1992	0.32747	5.6309	1825	1922	2025

N o t e. Initial — zircon sample undivided into fractions; e/m — electromagnetic (here and in Table 4), *r* — radiogenic (here and in Table 2, 4).

Table 2. **Results of uranium-lead isotope investigation monazites from garnet-biotite-hypersthene (charnockite) Novoukrainka granite (sample K-2)**

Monazite fraction, mm	Content, g/t		Isotope rations						Age, mln. y.		
	U	Pb	206/204	207/204	208/204	206/238*r*	207/235*r*	207/206*r*	206/238	207/235	207/206
+ 0.1, lemon	707	898	13902.5	1779.72	170782.0	0.109059	1.91062	0.127061	667.3	1084.8	2057.7
– 0.07, "	748	2972	5325.11	681.919	68023.30	0.328460	5.68651	0.125563	1830.9	1929.3	2036.8
+ 0.07, "	828	2517	1193.01	160.111	12574.2	0.295701	5.01631	0.123035	1670.0	1822.1	2000.7
+ 0.1, red	849	2939	1223.59	165.725	13519.1	0.322959	5.54713	0.124572	1804.2	1907.9	2022.7
+ 0.07, "	845	2371	1699.58	225.607	18386.90	0.267837	4.61326	0.124921	1529.8	1751.7	2027.7

Table 3. **Content of uranium, lead and isotope composition in zircons and monazites from Novoukrainka massif rocks**

Mineral, fraction, mm	Content, ppm		Isotope rations					Age, mln. y.		
	U	Pb	$^{206}Pb/^{204}Pb$	$^{206}Pb/^{207}Pb$	$^{206}Pb/^{208}Pb$	$^{206}Pb/^{238}U$	$^{207}Pb/^{235}U$	$^{206}Pb/^{238}U$	$^{207}Pb/^{235}U$	$^{207}Pb/^{206}Pb$
Gabbromonzonite (sample Pl-4)										
Zr, 0.2 + 0.1	192	76.08	2874	7.6864	8.6963	0.36786	6.3713	2019	2028	2037.5
Zr, > 0.2	379	149.70	2870	7.6863	8.7010	0.36652	6.3480	2013	2025	2037.5
Zr, > 0.2	118	46.27	3522	7.7367	8.4272	0.36572	6.3342	2009	2023	2037.5
Zr, > 0.1	196	78.92	5870	7.8286	9.3155	0.37807	6.5477	2067	2052	2037.4
Gr-Bi granite trachytoid granite (sample A-5)										
Mnz, general	2525	8025	5721	7.8278	0.1183	0.38117	6.5989	2082	2059	2036.7
Subalkaline, vein granite (sample K-2)										
Mnz, general	2261	5465	3383	7.7393	0.10503	0.26023	4.5002	1491	1731	2034.7
Mnz, > 0.15	2861	9719	2446	7.6505	0.10540	0.36619	6.3326	2011	2023	2034.8
Mnz, 0.1–0.07	2569	8740	4940	7.8142	0.10483	0.36624	6.3333	2012	2023	2034.7
Mnz, < 0.07	2570	8771	3205	7.7261	0.10445	0.36557	6.3221	2008	2022	2034.8
Uniform, medium-grain, vein quartz sienite (sample HA-1)										
Zr, 0.04–0.02	473	212.9	1656	7.4951	2.8235	0.34818	6.0273	1926	1980	2036.6
Zr, < 0.02	570	247.4	1735	7.5199	2.1778	0.31310	5.4167	1756	1887	2035.5

N o t e. Zr — zircon, Mnz — monazite.

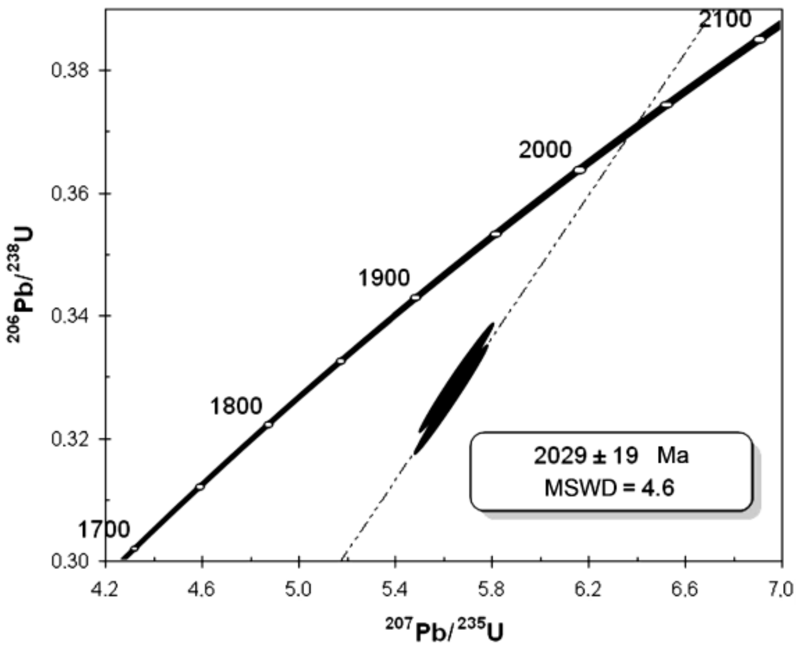

Fig. 4. U-Pb isochrone with concordia for synpetrogenic zircons from Novoukrainka trachytoid granites (sample K-1)

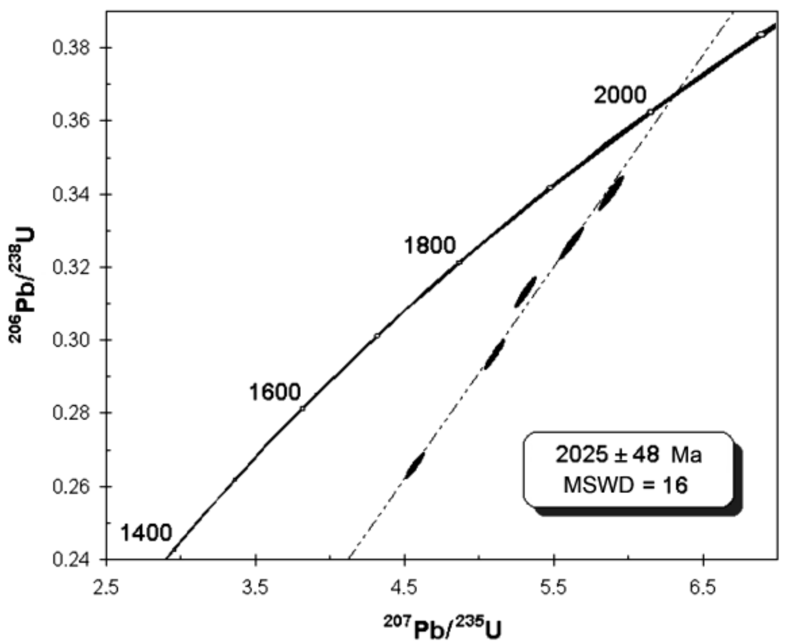

Fig. 5. U-Pb isochrone with concordia for synpetrogenic zircons from Novoukrainka trachytoid granites (sample 557)

latter one, that is characteristic of only normal granites and granodiorites, can testify to assimilation of sialic material by melt from the host rocks.

Age of Novoukrainka massif. The paper [15] shows results of detailed investigations and age datings of zircons from gabbro-monzonites of the first phase from outcrop on the left bank of the Pleteny Tashlyk river, north wards of Novooleksandrivka village, as well as monazites from subalkaline garnet-biotite porphyry-like granite that forms the vein in pyroxene-containing trachytic granites of the Kapustianka open pit. The

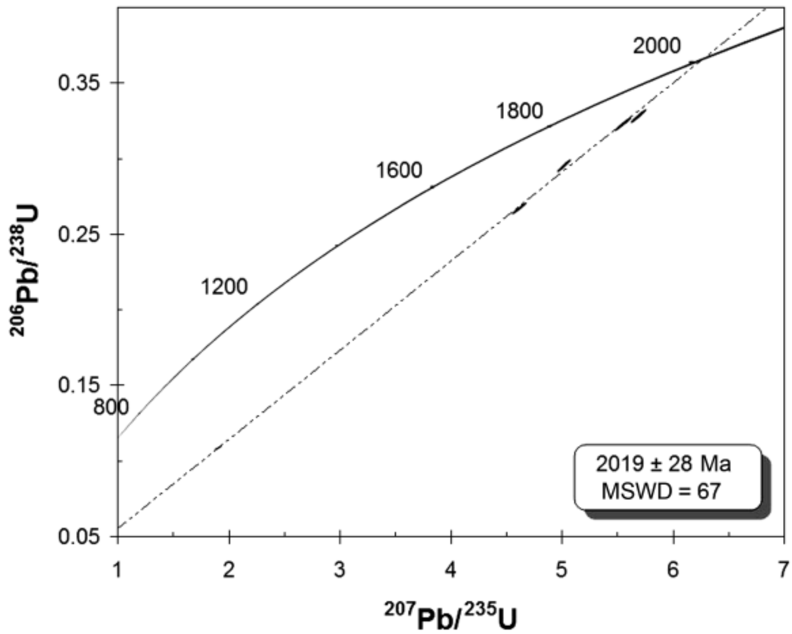

Fig. 6. U-Pb isochrone with concordia for synpetrogenic monazites from Novoukrainka garnet-biotite-hypersthene charnockitic granites (sample K-2)

results obtained were found to be similar, 2037.4 ± 0.6 and 2034.8 ± 0.6 Ma that allows the authors to say about narrow age interval of pluton formation.

We have carried out U-Pb isotopic investigations of synpetrogenic, mainly without nuclei, zircons from red pegmatitic granites (sample K-4) and host coarse-grained porphyraceous trachytoid granites (sample K-1, 557), as well as monazites from garnet-hypersthene-biotite charnockitic granites (sample K-2) from the Kapustianka open pit (Table 1, 2). The isochronous age of zircons is found to be 2038.5 ± 6 Ma (Fig. 3), 2029 ± ± 19 Ma (Fig. 4), 2025 ± 48 Ma (Fig. 5), and 2019 ± 28 Ma (Fig. 6; Table 3), accordingly. Such datings quite confirm results published in paper [15] and also, testify to formation of the Novoukrainka pluton within the age interval of ~ 2025–2040 Ma.

Age relations between the Novoukrainka massif and framing magmatic rocks. *Granites of Kirovograd (Kirovograd-Zhytomyr)* complex adjoin (along tectonic faults and, probably, by facial replacement) the Novoukrainka massif rocks on the east. They are represented by grey or pink-grey garnet-biotite, biotite, frequently porphyraceous and trachytic bifealspaar granites and granodiorites, aplite-pegmatitic granites, aplites and pegmatites. The statement about their formation in Early Proterozoic as a result of reworking of metamorphic rocks of the Ingul-Ingulets suite which contains everywhere migmatites substituted by granite bodies is generally accepted. Magmatic rocks of the complex form some small massifs — Kirovograd-Bobrynets, Chygyryn, Volyn, Mytrophaniv and others. Granites commonly include xenoliths of host rocks of the Ingul-Ingulets suite. Thus the trachytoid structure of granites completely coincides with schistosity of gneisses both in host rocks and in xenoliths. It indicates the formation of magmatic bodies by partial melting of host rocks. According to chondrite-normalised distribution of REE, the samples of Kirovograd granites do not essentially differ from Novoukrainka ones. One of them that represents biotite granite is characterized by lower negative Eu anomaly, and another sample that represents biotite granites with restite of the host rock is characterized by considerably lower contents of heavy REE.

Two samples of zircons from garnet-biotite medium-grained trachytic granites sampled from open pit in the territory of Bobrynets massif (village Bobrynets) (sample 740) and biotite grey coarse-grained porphyraceous trachytoid granites sampled from

Table 4. **Results of uranium-lead isotope investigation of zircon from Kirovograd granites**

Zircon fraction, mm	Content, g/t		Isotope rations					Age, mln. y.		
	U	Pb	206/204	206/207	206/208	206*r*/238	207*r*/235	206/238	207/235	207/206
Garnet-biotite Kirovograd granite (sample 740)										
> 0.1	1300	359	2880	7.6753	9.1525	0.25750	4.4620	1477	1724	2038
< 0.1	872	273	2690	7.7370	14.608	0.30210	5.1776	1702	1848	2018
E/m > 0.1	1250	409	3250	7.7552	18.607	0.32010	5.5104	1790	1902	2026
E/m < 0.1	1420	324	2090	7.6631	10.511	0.21474	3.6753	1255	1564	2016
Biotite Kirovograd granite (sample 757)										
Initial	1750	568	4850	7.8904	6.2369	0.29203	4.9926	1652	1817	2014
0.1–0.2	1780	617	4630	7.8319	7.0764	0.31632	5.4435	1771	1892	2026
0.07–0.1	1220	412	3900	7.8901	6.5045	0.30519	5.1896	1718	1851	2004
< 0.04	1460	533	8560	7.8584	5.8754	0.32630	5.6552	1820	1924	2038
E/m 0.07–0.1	1830	545	3660	7.9562	5.6828	0.26466	4.4533	1513	1722	1986

the outcrop in the territory of Dolinsk massif (sample 757) were analyses by isochronous U-Pb dating (Table 4). The obtained datings of 2026 ± 46 Ma (Fig. 7) and 2060 ± 42 Ma (Fig. 8) correspondingly define the age of granite formation which is similar to the age of the Novoukrainka massif. Considerable errors are caused by polygenic nature of the Kirovograd granite zircons. Based on the similarity between chondrite-normalised distributions of REE, it is quite possible, that the granites of Kirovograd complex (or at least a part of them) represent the same thermal processes which have caused formation of magmatic melt that has produced the Novoukrainka pluton, but of lower intensity.

Korsun-Novomyrgorod pluton adjoins the Novourkainka massif on the north along the system of differently oriented faults. It occupies the area of about 6000 km^2. The pluton is divided by Gorodysche-Smila gabbro-anorthosite massif into two almost equal in size areas, that are mainly composed by rapakivi granites and are bordered by gabbro-anorthosite massifs from the south. Zones of monzonites and quartz-monzonites occur along the contacts between rapakivi granites and basic rocks of the pluton. Metamorphic formations of Ingul-Ingulets suite and of Kirovograd complex granitoids are the host rock for Korsun-Novomyrgorod pluton and Novoukrainka massif.

Isotopic-geochronological data have obtained by syngenetic zircon (Table 5) [13]. At present these data most precisely display the age of formation of Korsun-Novomyrgorod pluton that does not leave any doubt about the age of its formation at 1730–1760 mln. y. ago, that is ~ 300 mln. y. younger than the formation of the Novoukrainka massif.

The age problem of uranium mineralization. The Novoukrainka massif and adjacent massifs of the Kirovograd complex as well as metamorphic rocks of the Ingul-Ingulets and Kryvyi Rig suites are known for their uraniferousness. Numerous deposits and ore manifestations of uranium ores are confined to the fault zones along which hydrothermal alterations of host rocks occurred intensively with formation of sodic metasomatites represented by thick zones of host rocks albitization. Uranium deposits in the banded iron formation of the Kryvyi Rig suites in the southern part of Ingul megablock are also related to the same type (uranium deposits in albitites). The last stage of their metamorphism occurred, according to $^{40}Ar/^{39}Ar$ dating, at ~ 1930–1945 mln. y. ago [3]. Results of isotopic dating that are in accordance with investigations of uranium-lead ratios of ore (uraninite and brannerite) and hydrothermal minerals (malacon

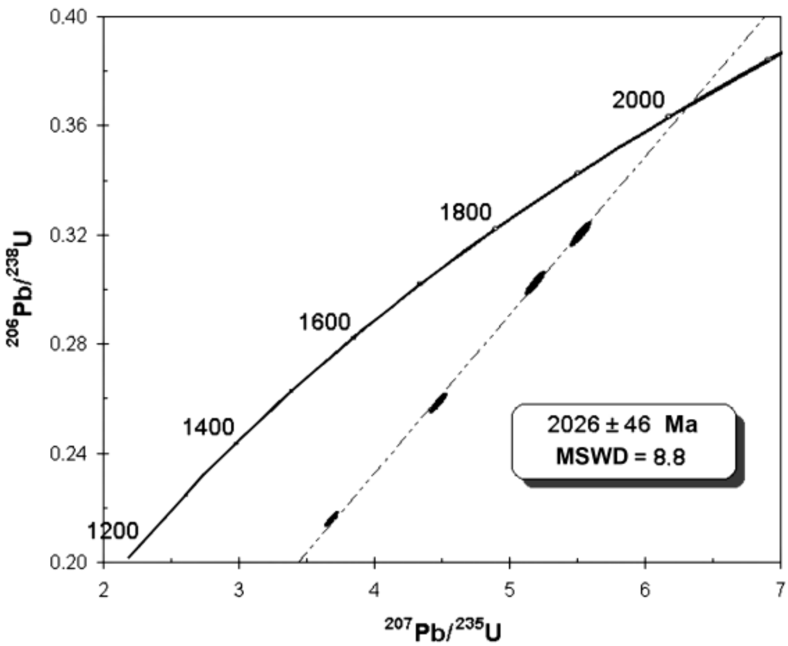

Fig. 7. U-Pb isochrone with concordia for synpetrogenic zircons from Kirovograd garnet-biotite granites (sample 740)

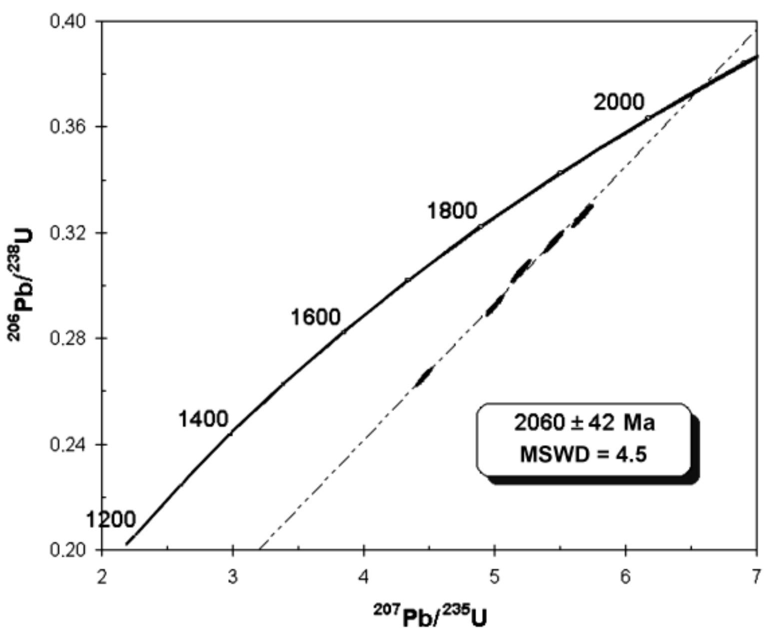

Fig. 8. U-Pb isochrone with concordia for synpetrogenic zircons from Kirovograd biotite granite (sample 757)

and sphene) formed during albitization from different deposits of uranium are summarised in Table 6. According to data presented, uranium deposits are the formations of similar age (about 1800 mln. y. ago) and, obviously, they were formed during one stage of tectonic activization of the Ingul megablock. Allowing for the large errors of isotopic dating, more old age is probable because of the mineral property to lose lead during the process of solid-phase diffusion. However there is no available data for precise dating of uranium mineralization. Considering the age of uranium mineralization of ~ 1800 mln. y., the rocks discussed in this paper contain no magmatic formations which could produce uranium

Table 5. **Results of uranium-lead isotope dating of zircons from the rocks of Korsun-Novomyrgorod pluton [13]**

Sample number	Rock	Sampling place	Age by isochrone crossing by concordia, mln. y.
1043/10	Anorthosite	Gorodyshche-Smila massif	1725 ± 11
2004	"	Host rock in respect of gabbroids	1754.3 ± 3.9
2008	Gabbro	Nosachiv ilmenite deposit	1749 ± 13
2006	"	" " "	1756 ± 3
748	Granite rapakivi	Central part of Korsun-Novomyrgorod pluton, Tashlyk village, open pit	1752 ± 12
1108	Monzonite	Open pit of Odessa railway	1749 ± 21

Table 6. **Results of uranium-lead isotope dating of minerals from uranium deposits in albitites of Kirovograd megablock**

Deposit	Host rocks	Mineral	Age by isochrone crossing by concordia, mln. y.	Reference
Novokostyantynivka, Novokostyantynivka zone	Novoukrainka granites	Uranium concentrate and uranium mineralization from albitites	1812 ± 42	[12]
	The same	Titanite	1800 ± 60	[11]
Partyzanske, Adabash zone	" "	Uraninite	1800 ± 5	[2]
	" "	"	1808 ± 27	[2]
Zhovtorichka	Metamorphic rocks of Kryvyi Rig series	Malakon	1795 ± 50	[2]
	The same	Nasturan	1785 ± 20	[2]
	" "	Various U minerals	1753 ± 42	[1]

mineralization within the territory of the Ingul megablock. More probably, the uranium deposit has been formed as a result of hydrothermal processes manifestation associated with prolonged plume evolution [9], a part of which, could subsequently be transformed into the Korsun-Novomyrgorod pluton formation.

Conclusions. Upon the similarity of chemical composition and the same distribution of REE in garnet-biotite and charnockite-like granites, nothing remains now but to divide the Novoukrainka complex into two formations that was offered in paper [4] with subdivision of magmatic formations into early gabbro-monzonite and monzo-charnockite-granite formations. For the time being the separation of four phases of magmatism for the Novoukrainka pluton is not proved petrologically. In accordance with the investigations carried out, the complex of magmatic rocks of the Novoukrainka massif is represented by magma differentiates which were, probably, formed as a result of melting of the Ingul-Ingulets suite rocks. Two ways of magma differentiation are supposed to take place in the Novoukrainka pluton: 1 — crystallization differentiation; 2 — assimilation of host rocks.

Actually the age of magmatic rocks of the Novoukrainka complex is possible to be precisely estimated at 2025–2040 mln. y. Similar age (2025–2060 mln. y.) is characteristic of granitoids of the Kirovograd complex. Korsun-Novomyrgorod pluton is considerably younger in age (1730–1760 mln. y.).

The age of uranium mineralization associated with albitization zones in Novoukrainka and Kirovograd granites, and also in metamorphic rocks of the Ingul-Ingulets and Kryvyi Rig suites is the same for many deposits and is estimated at about 1800 mln. y. The

Ingul megablock does not contain magmatic rocks of the age of 1800 mln. y. now (with the exception of dolerite dikes). Probably, hydrothermal formation of uranium was genetically associated with the beginning of the plume processes that occurred between the Novoukrainka and Korsun-Novomyrgorod plutons [7]. It is probable that the time of manifestation of these processes falls on 1800 mln. y. ago.

An extremely urgent task for prospecting of new deposits of uranium and investigation of conditions of localization and genesis of uranium mineralization in rock complexes of the Ingul megablock is more precise determination of the age of uranium mineralization by modern isotopic-geochronological methods. More precise determination of the age of uranium mineralization will promote to solve the problem of genetic nature of sodium and uranium sources in Paleoproterozoic albitites of the Ukrainian Shield.

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РЕЗЮМЕ. На основі нових та узагальнених літературних даних про ізотопне датування проведено вікові порівняння породних комплексів Новоукраїнського гранітного масиву та уранового зруденіння в альбітитах з комплексами вмісних порід. Визначено таку послідовність геологічних подій в Інгульському мегаблоці Українського щита: становлення кіровоградського (2025–2060 млн рр. тому) та новоукраїнського (2025–2040 млн рр. тому) магматичних комплексів — формування уранових родовищ (~ 1800 млн рр. тому, вік потребує уточнення) — корсунь-новомиргородський магматичний комплекс (1730–1760 млн рр. тому). Зроблено припущення, що Новоукраїнський масив представлений диференціатами єдиного магматичного розплаву, що утворився за рахунок плавлення верхньокорового матеріалу.

РЕЗЮМЕ. На основании новых и обобщенных литературных данных по изотопному датированию осуществлено возрастное сравнение породных комплексов Новоукраинского гранитного массива и уранового оруденения в альбититах с комплексами вмещающих пород. Установлена такая последовательность геологических событий в Ингульском мегаблоке Украинского щита: становление кирово-

градского (2025–2060 млн лет назад) и новоукраинского (2025–2040 млн лет назад) магматических комплексов — формирование урановых месторождений (~ 1800 млн лет назад, возраст должен быть уточнен) — корсунь-новомиргородский магматический комплекс (1730–1760 млн лет назад). Высказано предположение, что Новоукраинский массив представлен дифференциатами единого магматического расплава, образовавшегося вследствие плавления верхнекорового материала.