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# TECTONICS OF THE ORE DEPOSITS AND SOROKINSKAYA GRABEN-SYNCLINE OF THE NEAR-AZOVIAN MEGABLOCK OF THE UKRAINIAN SHIELD

The results of investigations for the large structural Surozh ore cluster located within the Sorokinskaya graben – syncline of the Near-Azovian megablock of the Ukrainian Shield are presented. The features of fault-block tectonics and its influence on forming the ore cluster are defined. The Sorokinskaya graben-syncline and other fault zones of the orthogonal and diagonal systems and their significance in the localization of the Surozh Gold Deposit and Balka Kruta rare-metal deposit are characterized. The manifestation features for magmatism, metasomatosis, mineral and ore genesis are studied.

*Key words*: tectonics, faults, geoblocks, graben-syncline, dikes, metasomatites, gold, rare-metals, ore deposit.

**Introduction.** A lot of gold deposits were found on our planet. Over the last 30 – 35 years the large high-grade gold deposits of the world are discovered in the geological formations of the different types such as greenstone, black-shale ones, etc.

Of particular interest is the greenstone [Глевасский, 1996] Sorokinskaya graben-syncline structure mapped within the Western Azov geoblock Ukrainian shield (Ush). Within its boundaries, and in close proximity to each other (no more that 1 km) explored two industrial fields – Surozhsky gold and rare metal “Balka Kruta” [Кравченко, 1999; Лисенко та ін., 2005; Розанов, Лавриненко, 1979; Чорнокур, Яськевич, 2010; Шаталов и др., 1982; Шаталов, 1986]. Both deposits are located in rather picturesque place – in the valley Byrd, near Berdyansk reservoir, 30-31 km north of the city of Berdyansk. Deposits of Sourozh and “Balka Kruta” tectonically confined to the eponymous structural and ore sites in the central part of the Precabrian graben-synclinal structure. It is important to note that the unique field “Balka Kruta” – a vivid example of complex rare metal objects. Besides beryllium the industrial contents of tantalum, lithium, and cesium have been found here [Розанов, Лавриненко, 1979; Чорнокур, Яськевич, 2010].

**Geologic-structural position and Sorokinskaya graben-syncline structure**

This original geo-tectogene [Глевасский, 1996] is the tectonic boundary between the two large plicative Precambriant structures having a different age from the Near-Azovian - Manhush synclinorium and Saltychansk anticlinorium, in the center of which same-name dome fold is identified. Some investigators describe this structure as the deep linear zone of rifting embedded

in the Achaean (more 3.3 Ga.) on the Precambrian granulite-gneissic basement. In the plan this is the narrow local strip of the Precambrian supracrustal units continued down to 35-40 km at the maximum width (in the bulges) to 2 km. Graben-syncline is cut off from the “frame” of rocks by subparallel deep faults having North-Western spread direction (320-330°) and South-West steep dip (75-85°). In its northern part the strike of structure changes from the north-western direction to sub latitudinal one and there its knee-band is created. The level of erosion truncation within the structure can reach up to 5-6 km. Thus at the present time only the abyssal features remained on the comparatively large fissure-like, fosse-shaped trough-suture (graben-syncline) (Fig. 1, 2).

Sorokinskaya graben-syncline has revived multiply. This is proved by the numerous predominantly concordant dykes, compression zones, as well as cataclasis and milonitization ones. In addition to the longitudinal (against the structure) fault tectonic zones, here there are also the transverse (north-eastern) and transcurrent (sub-meridional and sub-latitudinal) faults. Graben-syncline is dissected by the systems of orthogonal and diagonal faults into the discrete small-sized blocks (Andriievskiy, Sorokinskiy, Osipenkovskiy, and Sadovyi ones), which have undergone the shift along the lateral and vertical directions. As a result it turned into the peculiar

“keyed” structure, where the rock complexes of the different depths (density) appear at the recent erosion truncation level. Such block structure is a base of atypicality for its anomalous gravitational and magnetic fields (Fig. 3). In the direction from north-west to south-east the erosion truncation depth within the graben-syncline considerably decreases that can be seen from the compositions of metamorphic rocks of the different its parts, as well as on the degree of their metamorphism. Thus, within the Andriievskaia magnetic anomaly manifested to the most elevated block the relics of highly-metamorphic volcanosedimentary formations of granulite facies are defined, and in south-eastern graben-syncline at the Sadoviy site (downthrown block) the most complete section of low-metamorphic rocks (epidot-amphibolitic facies) are revealed. Geo-blocks occupy the intermediate position at which the Surozh deposit and Sorokinskiy site are located, where diaphthorites are well represented along the rocks of amphibolites facies [Глевасский, 1996; Кравченко, 1999].

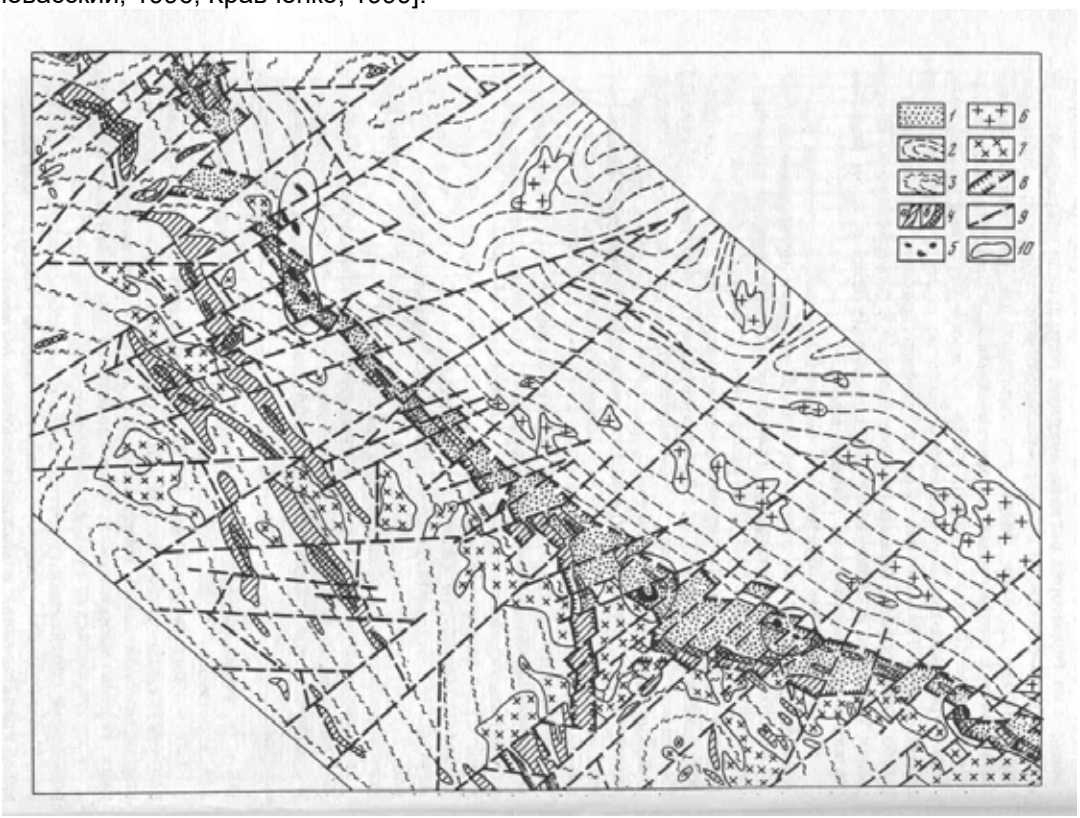

Fig. 1. Geologic-structural position and Sorokinskaya graben-syncline structure of the Near-Azovian area [Розанов, Лавриненко, 1979]

1 – rocks of the Osipenkovian suite; 2 – gneiss; 3 – migmatites; 4 – metabasite and metaultrabasite; 5 – pegmatite veins; 6 – granites; 7 – granodiorites; 8 – Sorokinskaya graben-syncline structure; 9 – faults; 10 – pegmatite zones

The thickness of rocks building up the graben-syncline is 1.2 km [Глевасский, 1996]. In the present stratigraphical sectional planes they are divided into the Lower and Upper Osipenkovian suite associated with the Achaean and Lower Proterozoic. The thickness of the lower “greenstone” suite is 700 m. It is composed of amphibolites, green sheets, metaultrabasites, ferruginous quartzites and intruded by numerous metamorphosed dykes of ultrabasite – basite and acidic compositions (Fig. 4). In the north-eastern slope of graben-syncline in the section of Lower Osipenkovian suite the high alumina and two-mica gneisses are wide-developed. The Achaean age of Lower Osipenkovian suite is proved by geological and structural data and the dating on the mineral zircon from both the Osipenkovian granodiorites having the sharp active contacts with amphibolites and metamorphosed quartz porphyrys, i.e. 2.79 and 2.66 b.y.a. [Глевасский, 1996; Кравченко, 1999].

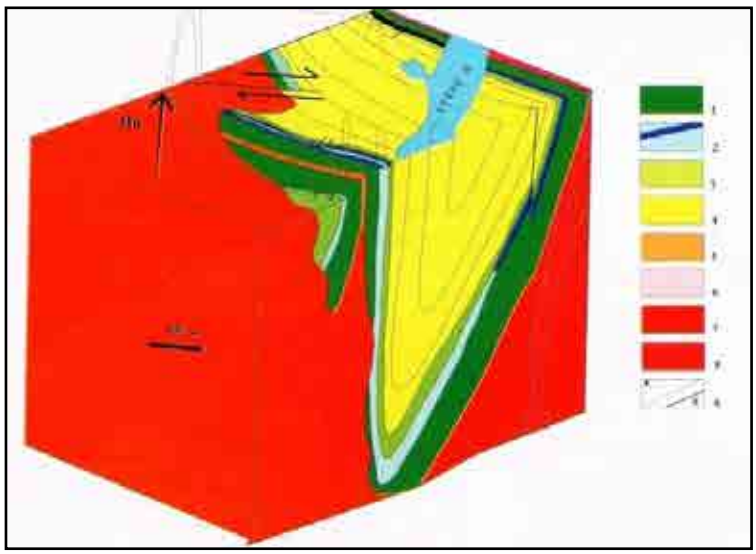

Fig. 2. Three-dimensional map for the Surozh part of Soronskaya graben-syncline [Чорнокур, Яськевич, 2010]
1 – metabasites; 2 – metaultrabasites; 3 – upper metabasite part; 4 – metaconglomerates, sandstones, alumina slate; 5 – lava – subvolcanic material of the Surozh Formation; 6 – hypabyssal material; 7 – intrusive plagiogranitoids from the Shevchenkovsky complex; 8 – two-feldspar granites; 9 – junctions and structural lines

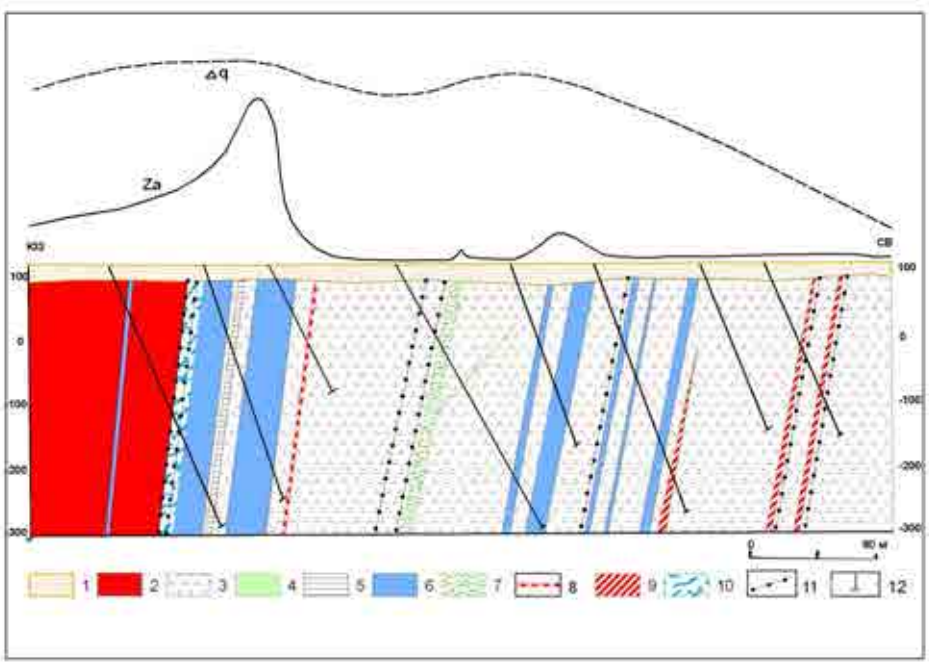


Fig. 3. Geologic-geophysical cross section for the Sorokinskaya trough structure drowned by the author according to the Artiemovsk Geological Survey Expedition data (N.F. Rusakov et al., 1981)
1 – sedimentary rocks; 2 – gneiss and migmatite of the Western Near-Azovian, Archaean series; 3 – gneiss and migmatite of the Central Near-Azovian series; 4 – rocks of the Osipenkovian suite; 5 – ferruginous quartzite; 6 – metabasite dykes; 7 – dolerite dykes; 8 – quartz veins; 9 – pegmatite veins; 10 – cataclasis and mylonitization zones; 11 – faults; 12 – boreholes

The Upper Osipenkovian suite at the thickness of about 500 m is composed essentially of terrigene formations and broken by the dykes of lamprophyres, diabases, and younger dolerites. Its rhythmic structure can be observed at the exposed areas of graben-syncline along the Berda

River as an alternating two-mica gneisses or schists with the relicts of meta-detritus structures and high aluminous (staurolite-, andalusite-, cordierite-, and sillimanite-bearing), garnetiferous, graphitic and other gneisses and schists.

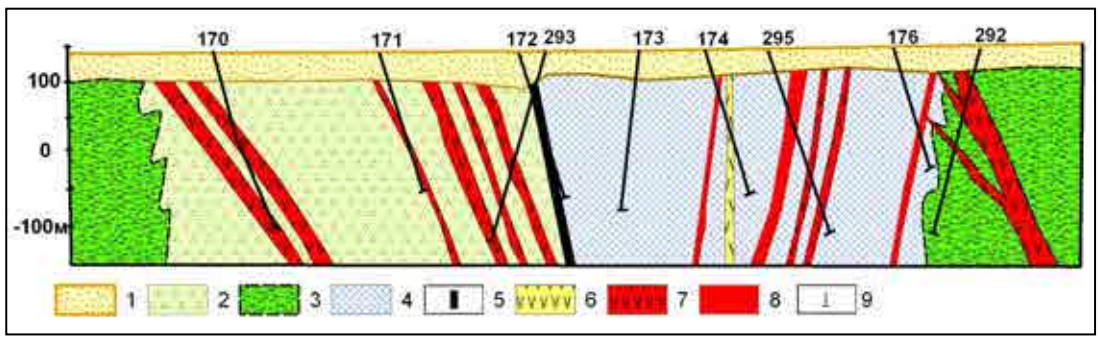


Fig. 4. Geologic-geophysical cross section for the Sorokinskaya trough structure drowned by the author according to the Artiemovsk Geological Survey Expedition data (N.F. Rusakov et al., 1981)

1 – sedimentary rocks; 2 – gneiss and migmatite of the Central Near-Azovian series; 3 – gneiss and migmatite of the Western Near-Azovian, Archaean series; 4 – rocks of the Osipenkovian suite; 5 – metabasite dykes; 6 – dolerite dykes; 7 – pegmatite veins; 8 – metasomatic; 9 – boreholes.

In the southern Sorokinskaya graben-syncline the low-thickness (about 200 m) sedimentagenous package including marbles, meta-conglomerates and grafite-bearing schists ("Sadovaia suite") lies at the rocks of the lower and upper Osipenkovian suite (Fig. 5). In the graphitic schists of Sadovaia suite the geologists have determined the complex of microphytofossils typical of the rocks of the Hdantsevian suite for the iron-ore Krivoy Rog belonging to the early Proterozoic.

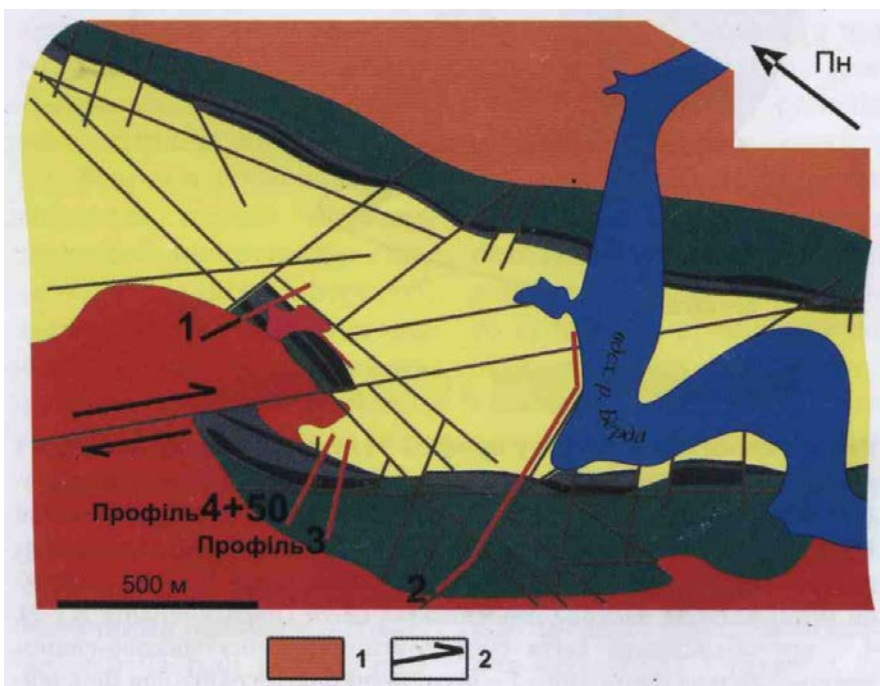


Fig. 5. Tectonics of the Surozh ore knot of the Near-Azonian area [Лисенко, 2005]

1 – rocks of the Osipenkovian suite and Archaean series; 2 – faults.

The characteristic feature for the lower and upper Osipenkovian suite and particularly "Sadovaia suite", developed within the Sorokinskaya graben-syncline is weak metamorphism (epidote – amphibolitic stage) relatively to Achaean – Proterozoic kratogen and a lot of dykes with the different compositions and ages indicated the certain stages of tectonomagmatic activation and destruction of the Earth's crust [Шаталов и др., 1982; Шаталов, 1986, 1990, 1991, 1993].

**Conclusions.** Surozh deposit is especial, because it was found within the unique, exclusive, no equals in the world the ancient Precambrian structure. This structure is known as "*Sorokinskaya graben*", "*Sorokinskaya fault tectonic zone*", and "*Sorokinskaya greenstone structure*". Gold deposit was formed at the depth of about 5 km within the rather complicated Surozh ore cluster. The significant feature is not only tectonic position of this deposit, but also the duration of evolutionary development of this graben-syncline, i.e. at least 1.5 billion years. Within the boundaries of the structure in addition to Surozh gold deposit it was discovered the large deposit of rare metal pegmatites "Balka Kruta" [Розанов, Лавриненко, 1979; Чорнокур, Яськевич, 2010].

Thus the data presented in the article give ground to categorize the Sorokinskaya graben- syncline and confined to her Balka Kruta rare metal deposit and Sourozh Beam Steep gold deposit, as the ***geological exclusive***. Such exclusives include, for example, the geological structure and the largest Witwatertsrand gold-uranium field in South Africa, the analogues of which so far haven't been found on the Earth. The formation of these exclusive structures and deposits in the author's opinion are connected with the long and unique evolutionary and geodynamic development of our planet, resulting in the unique geological structures occurred in certain its parts and consequently the exclusive deposits.

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**М.М. Шаталов**

**ТЕКТОНІКА ТА РУДОНОСНІСТЬ СОРОКИНСЬКОЇ ГРАБЕН-СИНКЛІНАЛІ ПРИАЗОВСЬКОГО МЕГАБЛОКА УКРАЇНСЬКОГО ЩИТА**

Наведені результати досліджень Сорокинської грабен-синкліналі та великого структурного Сурозького рудоносного вузла, розташованого в межах Приазовського мегаблока Українського щита. Визначені закономірності розломно-блокової тектоніки та її роль у формуванні рудного вузла. Охарактеризовані Сорокинська грабен-синкліналь та інші розломні зони ортогональної та діагональної систем і їх значення в локалізації унікального Сурозького золоторудного родовища та рідкіснометалевого родовища «Балка Крута». Досліджені особливості прояву магматизму, метасоматозу, мінерало- і рудогенезу.

*Ключові слова*: тектоніка, розломи, геоблоки, грабен-синкліналь, дайки, метасоматити, золото, рідкісні метали, родовище.

**Н.Н. Шаталов**

**ТЕКТОНИКА И РУДОНОСНОСТЬ СОРОКИНСКОЙ ГРАБЕН-СИНКЛИНАЛИ ПРИАЗОВСКОГО МЕГАБЛОКА УКРАИНСКОГО ЩИТА**

Приведены результаты исследования Сорокинской грабен-синклинали и крупного Сурожского рудоносного узла, расположенного в границах Приазовского мегаблока Украинского щита. Определены закономерности разломно-блоковой тектоники и ее роль в формировании рудного узла. Охарактеризована Сорокинская грабен-синклиналь и другие разломные зоны ортогональной и диагональной систем и их значение в локализации уникального Сурожского золоторудного месторождения и редкометалльного месторождения «Балка Крутая». Исследованы особенности проявленного магматизма, метасоматоза, минерало- и рудогенеза.

*Ключевые слова*: тектоника, разломы, геоблоки, грабен-синклиналь, дайки, метасоматиты, золото, редкие металлы, месторождение.

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