

Study of deep underground structure of mud volcanoes in North-Western Caucasus by means of geological and geophysical methods

© L. Sobisevitch, A. Sobisevitch, 2010

Institute of Physics of the Earth, RAS, Moscow, Russia

sobis@ifz.ru

Results of complementary geological and geophysical studies of mud volcanic phenomena in North-Western Caucasus (Taman mud volcanic province) are presented. Geophysical field works have been carried out in 2005—2009 on the two different mud volcanoes: the Gora Karabetova and the Shugo mud volcano.

Usage of methods of vibroseismic sounding, traditional magneto-telluric sounding and relatively new method of low-frequency microseismic sounding allows obtaining several independent vertical cross-sections for the two different mud volcanoes down

to the depth of 25 km. For the two different mud volcanoes their deep subsurface structure has been revealed and discussed with respect to regional tectonic settings, geology and geomorphology.

The Gora Karabetova mud volcano is one of the most active mud volcanoes in the Taman peninsula with primarily explosive behaviour while the Shugo mud volcano's activity pattern is different, explosive events are rare and both types of phenomena may be explained by the configuration of their feeding systems, tectonic position and deep pathways of migration of fluids.

References

Gorbatikov A. V., Sobisevich A. L., Ovsyuchenko A. N. Development of the Model of the Deep Structure of Akhtyr Flexure-Fracture Zone and Shugo Mud Volcano // Dokl. Earth Sci. — 2008. — **421A**, № 6. — P. 969—973. — DOI: 10.1134/S1028334X0806024X.

Sobisevich A. L., Gorbatikov A. V., Ovsuchenko A. N. Deep Structure of the Mt. Karabetov Mud Volcano // Dokl. Earth Sci. — 2008. — **422**, № 7. — P. 1181—1185. — DOI: 10.1134/S1028334X08070428.

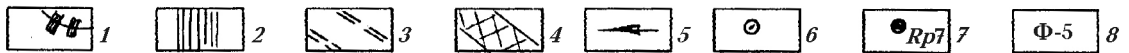
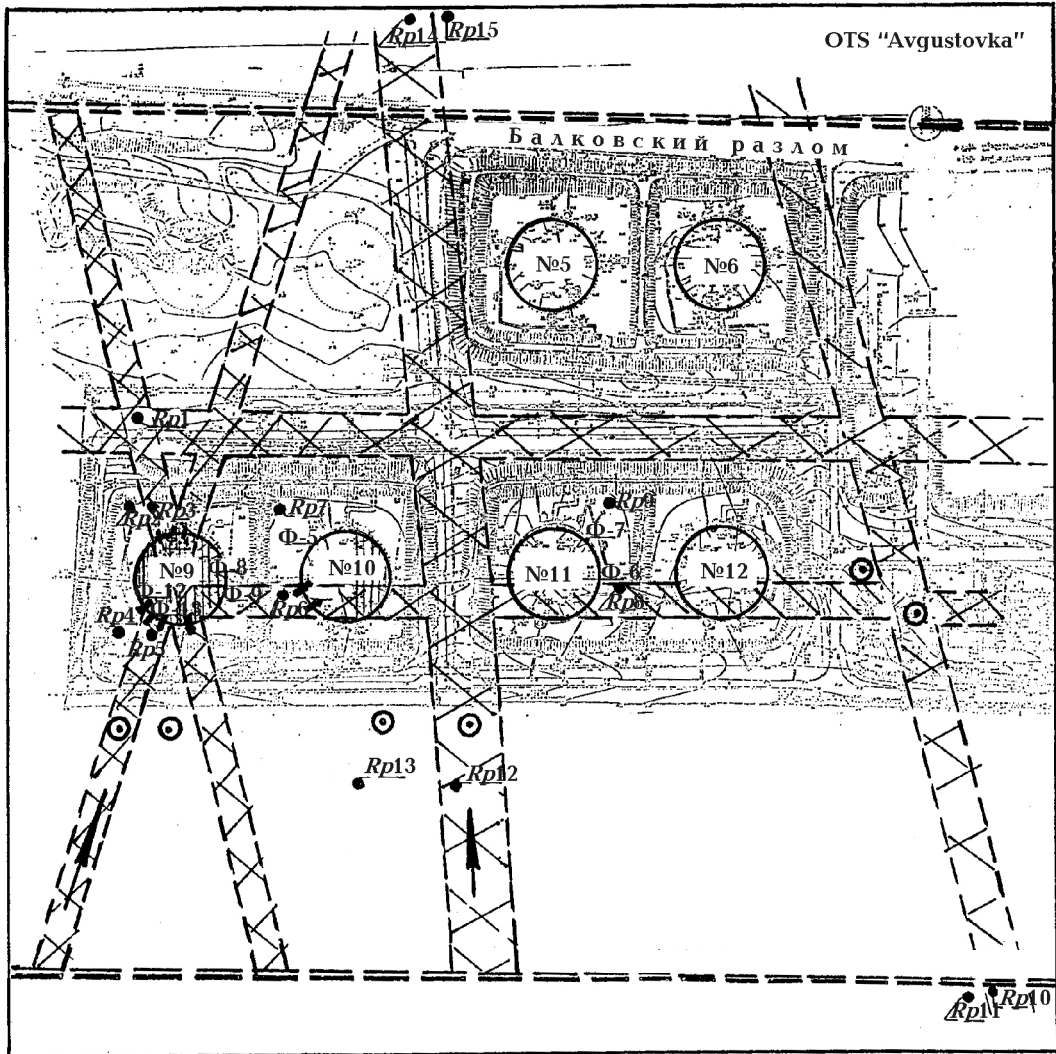
Current assessment and accounting of geodynamic phenomena in engineering geology with geological and geophysical methods of investigation

© E. Sobolev, V. Vysotyuk, 2010

SSIE "Mars", Komsomolsk-Donetsk region, Ukraine
mnvp_mars@ukr.net

Despite the apparent inconsistency of the existing theoretical views on many aspects of the tectonic processes in the lithosphere, no one no longer doubt the assertion that the entire Earth's crust

is divided into very difficult, though not devoid of certain laws, and a network of numerous raznorangovyh poligeneticheskikh faults. In addition, because of the continuous mobility of the earth's crust,



The results of the impact GDZ at the tank farm NPS "Avgustovka": 1 — strain of tanks; 2 — underflooded facilities; 3 — boundary effects Balkivs'ka faults; 4 — GDZ 1 category, 5 — channel revenue "perched" on GDZ; 6 — well "zaverchnogo" drilling; 7 — geodetic benchmarks; 8 — geodetic marks on the foundation.

occurring primarily by the forces of cosmo-planetary origin, it constantly with a certain cyclic deformation occurs not only fragile, but also plastic [Nikolaev, 1988]. Thus, by discharging accumulated stresses due to rotational modes of the Earth, which is one of the main factors governing its equilibrium state [Tyapkin, 1998]. At the Earth's surface, these strains are usually manifested in the form of relatively narrow elongated linearly geomorphological forms, called the Geological lineament. This is es-

pecially true of large deep-seated tectonic faults, which are usually well manifested in deciphering aerospace images.

However, in engineering geology are often confronted with manifestations not only of major tectonic disturbances of global or regional scale, but also with the influence of a very common and extensively ramified network of medium and small-scale violations of local, local values. Moreover, these violations are similar to large can be charac-

terized as disjunctive and plicative kinds of deformations. As shown by careful analysis of large-scale topographic maps, they also are reflected in the present relief of the Earth in the form of elongated negative forms — the lineaments of a lower order. In the countryside, as a rule, such "micro" morphologically expressed bends channels of small rivers, streams, gullies, ravines, or just minor depressions, often barely noticeable visually.

It should be noted that in terms of the impact of existing tectonic faults in stability and functioning of various engineering structures, in our opinion, is not that important to order, as their modern geodynamic activity. Moreover, fixed in geophysical fields geodynamical active zones on the Earth's surface can appear also outside the zones of influence of existing tectonic disturbances. Apparently, the main criterion here is not so much the presence of the already established structure of the impaired as a direct manifestation of the time of observation of abnormal mechanical stresses, concentrated in the surface layers crust. In other words — is a modern geodynamic effect on the investigated rock mass is confined to the space in the form of a linearly elongated narrow zones and temporary determinant of the cyclical nature of recent tectonic movements. One can not help noticing more and technogenic factors of critical stresses in the reclaimed man of the rock massif, an increasingly relevant in the study of geodynamic phenomena.

One of the first on the existence of geodynamical active zones in the surface layers of the crust and the possibility of their successful study and mapping of attention Donetsk geologist collier YS Ryaboshtan in studies of structural features rock mass within the mine fields [Ryaboshtan, 1969]. He developed and successfully implemented in practice of geological research reclaimed rock mass method of structural-geodynamic Mapping — SGKE [Gorbushina, Ryaboshtan, 1974, Ryaboshtan, 1975]. This method is based on the use of emanation (radon-toron) shooting, later found the widest application in solving many practical problems in mining, various branches of geology and seismology, even in the prediction of earthquakes.

In subsequent years, the work of various departments of the Institute of Geophysical DonNIGRI and UkrNTEC (Donetsk) method has been significantly upgraded through the introduction of new hardware development, methodological innovation and integrated approach to the study of the problem. As geodynamic processes are reflected also in the electromagnetic field, when studying them more actively in addition to radiometric methods has begun to attract magnetometry and electrical [Sobolev, 2004].

That emerged a set of methods has been successfully applied in studies of engineering and geodynamic conditions of various objects (underground mining, quarries, dumps, natural slopes, waterworks, dams, residential buildings and promsooruzheniya, slopes of canals and pipelines, etc.).

Continually refined over more than one decade set of ground geophysical methods has passed a reliable tested in the study of geodynamic situation in the different sites and in particular on industrial sites pumping stations "Snihurivka" and "Avgustovka" Odessa DIC (Figure). As a result, a specially made zaverohnogo drilling with core sampling and determination of physical and mechanical properties of rocks, was found that within the identified geodynamic zones (GDZ) rock mass is characterized by reduction of the strength, deformation and physical characteristics at 11—50 %. Level ground water is turned on 0,6—0,9 m above. Are also characteristic of them was the presence of "perched", which is outside the zone was absent [Minutes ..., 2000]. Thus justifying the concept of the geodynamic zone-block structure of an array of rock, which is already built, or only provides for the construction of engineering facilities for different purposes.

This concept as the basis of scientific and technical activities SSIE "Mars" (Komsomolsk Donetsk region), which is currently follower of these ideas in the annex to decision many of today's practical problems of Engineering Geology and Geo-ecology [Sobolev, Vysotyuk etc., 2007—2009].

Unfortunately, long recognized and accepted by many representatives of the scientific community views on the crucial role of the geodynamic factor in the occurrence of geological disasters (earthquakes, volcanic eruptions, landslides, mudslides, flooding, subsidence earth's surface et al), hitherto rejected by senior officials. That will depend on their adoption of building regulations, requiring designers necessarily and properly due consideration to the zone-block structure of reclaimed arrays. We believe this position is extremely irresponsible and totally inconsistent with today's challenges. As a result, those endless and often very tragic accident that occur in recent times more and more. In their series of Chernobyl [Strakhov et al., 1997], as well as the tragedy with passenger trains in the Urals [Divakov, 1998]. Their main reason for our firm belief is ignoring the importance of knowledge of the geodynamic setting near exploited very responsible engineering structures.

Recent advances in the study of geodynamic phenomena are pressing for an urgent review current building regulations. Necessary enter the appropriate additions and changes, requiring all participants in the construction and operation of criti-

cal facilities to identify the location of geodynamic zones on reclaimed tracts of rocks with the obligatory Map construction engineering and geodynamic

zoning and take into account the geodynamic effect on the stability and security operations engineering objects [Sobolev, Vysotyuk, 2007].

References

- Divakov V. I.* Mikrogeodinamika. — Moscow: Russian University Peoples' Friendship, 1998. — 24 p.
- Gorbushina L. V., Ryaboshtan Y. S.* Mapping of zones of contemporary movements with the help of radiometry // *Izv. universities. Ser. Geology and exploration.* — 1974. — № 6. — P. 36—39.
- Minutes of the Technical Meeting to review the work of OAO UkrNTEC and IGR of JSC "ITN" vol. In 2000, the NPS "Snihurivka" and NPS "Avgustovka" Odesa DIC.* — Kiev, 2000. — 3 p.
- Nikolaev N. I.* Contemporary tectonics and geodynamics of the lithosphere. — Moscow: Nedra, 1988. — 491 p.
- Ryaboshtan Y. S.* From experience of application of emanation survey in the Donetsk pool. — Donetsk, PO Ukruglegeologiya, 1969. — 22 p.
- Ryaboshtan Y. S.* Methodological manual on structural-geodynamic mapping emanation method (CFS—E). — Donetsk: PO Ukruglegeologiya, 1975. — 86 p.
- Sobolev E. G.* Theory and practice magnetodynamic introscopy in solving engineering-geological and environmental problems (monograph). — Donetsk: Chestnut, 2004 — 264 p.
- Sobolev E. G., Vysotyuk V. A.* Site Engineering geodynamic zoning be built array: geodynamic causes of accidents, destruction and flooding of civil and industrial facilities // *Ecology Environmental and safety.* — Kiev: Knowledge, 2007. — № 2. — P. 36—40.
- Sobolev E. G., Vysotyuk V. A.* Technological features geodinamicheskogo mapping of the surface layers of the Earth by the method SSIE "Mars" // *Proc. 6th NPC "Engineering protection of territories and objects in connection with the development of hazardous geological processes", 05—09.10.09, Crimea, Yalta.* — SPC Ekologiya. Nauka. Technika. — 2009. — P. 35—37.
- Sobolev E. G., Vysotyuk V. A.* The influence of geodynamic zoning—based successful monitoring of the coastal array of rocks // *Proc 4th RPC "Monitoring of the environment: scientific and methodological, regulatory, technical, software", 21—25.09.09, Crimea, Koktebel.* — SPC Ekologiya. Nauka. Technika. — 2009. — P. 12—13.
- Sobolev E. G., Vysotyuk V. A., Dolzhikov P. N.* One geodynamic mechanism of the processes of flooding and landslides, soil (rock) arrays // *Proc. 5th NPK Underflooding. 11—15.06.09, Berdyansk Zaporozhye region.* — SPC Ekologiya. Nauka. Technika. — 2007. — P. 22—24.
- Sobolev E. G., Vysotyuk V. A., Voyevoda B. I., Zhivora V. F., Schugorev V. A., Varvarovsky V. B., Klyuyko V. Ya.* The need for radical additions and changes in building construction regulations and "DBN" Ukraine // *Ecology Environmental and safety.* — Kiev: Knowledge, 2007. — № 3. — P. 56—59.
- Strakhov V. N., Starostenko V. I., Kharitonov O. M., Aptikaev F. F., Barkovsky E. W., Kedrov O. K., Kendzera A. W., Kopnichev Yu. F., Omelchenko W. D., Palienko W. P.* Seismic phenomena in the vicinity of Chernobyl // *Geophys. J.* — 1997. — **19**, № 3. — P. 3—15.
- Tyapkin K. F.* Physics of the Earth. — Kiev: Vishcha Shk., 1998. — 312 p.
- Vysotyuk V. A., Sobolev E. G.* Geodynamic factor and its role in the formation of landslides in the hillside areas of terrain // *Proc. 5th NPK impact of devastating floods, floods, dangerous geological processes on the functioning of utilities and life safety, 23—27.02.09, Yaremche Ivano-Frankivsk region.* — SPC Ekologiya. Nauka. Technika. — 2009. — P. 92—93.
- Vysotyuk V. A., Sobolev E. G.* On improving methods to predict emergencies caused by geodynamic processes // *Proc. Intern. NPK "Problems of Forecasting and prevention of natural disasters, natural and man-made and man-made origin, 05—09.10.09, Crimea, Yalta.* — SPC Ekologiya. Nauka. Technika. — 2009. — P. 62—64.