

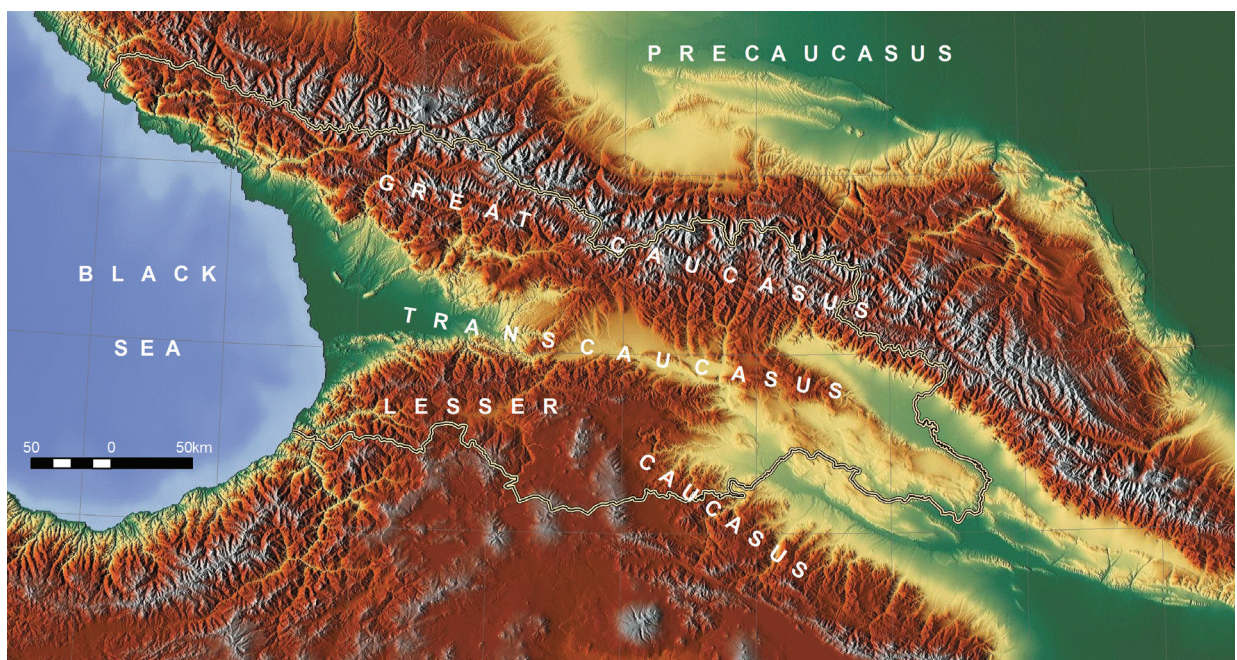


SHOTA RUSTAVELI NATIONAL SCIENCE FOUNDATION
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MIKHEIL NODIA INSTITUTE OF GEOPHYSICS
CAUCASIAN MINING GROUP LTD

GEOLOGY AND GEODYNAMICS OF THE LITHOSPHERE OF GEORGIA

1:200000-scale Digital Geological Map and Explanatory Note of Georgia,
2020

Sh.Adamia, N.Sadradze, V.Alania, G.Talakhadze, K.Khmaladze, G.Sadradze



Tbilisi 2022

*In memory of our cherished colleagues and beloved friends
Manana Lordkipanidze and Guram Zakariadze*

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ANNOTATION

The book sets out existing, available at present data on geology, deep structure, geodynamics and evolution of the lithosphere of Georgia and adjacent areas of the Eastern Black Sea – Caspian Sea region during Neoproterozoic - Phanerozoic time. Factual data are represented by interactive digital updated geological map of Georgia 1:200000 scale and its explanatory note, as well as by geological, geochemical and geophysical data obtained through scientific investigations of the last decades about structure of the lithosphere and upper mantle geodynamic processes occurring within the Earth crust and Upper Mantle of the region.

The book is designed for specialists in the field of the Earth sciences and students. They will have an opportunity to get familiar with Georgian research workers, their publications and current news in various fields of the Earth sciences at the portal geoscience.ge. The interactive digital 1:200000-scale map of Georgia and its explanatory note is available for each person through the portal geomaps.ge.

Acknowledgments

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INTRODUCTION

1:200000-scale interactive geological map and explanatory note of Georgia

Present-day development of geoinformatic systems in Georgia promoted emergence of interactive maps of different content within the Internet space. Most of them are used by state agencies in management operations to ensure publicity and accessibility of information (gisapps.n.reestri.gov.ge; maps.napr.gov.ge; rs.ge; tas.ge; auction.Tbilisi.gov.ge), also are interactive maps used by commercial institutions (mygeorgia.ge; pinpoint.ge; city24.ge; maps.ge). Global online maps are available for each concerned person through maps.google.com; maps.yahoo.com; bing.com/maps, openstreetmap.org. Currently, the mentioned internet-resources mainly serve for narrow institutional needs and for touristic-educational aims.

At present, there are no geoscientific interactive maps of Georgia. Researchers, university students, Master Degree and PHD students in the field of the Earth sciences have no opportunity to find online applications of diverse thematic maps. It is also impossible to exhibit in the Internet space thematic cartographic material resulted from their studies, not to say about online resources. Accessibility to the old Soviet-era topographic maps is limited even for students.

No digital state-of-art medium-scale (1:200000) scientific maps of Georgia exist, although, they represent the basic information source for various fields of the Earth-sciences thematic investigations, such as: 1) updating information on potential of mineral resources of Georgia; 2) correct management of prospecting of mineral deposits; 3) prediction of the sources of natural disasters (for example, earthquakes); and 4) identification of the areas prone to earthquake-related secondary events (landslides, avalanches, mudflows, floods etc.).

The process of compilation of State Geological Maps of the medium scale has considerably long- term history in Georgia. The first publications occurred in the 50 of the last century; in the 80 their new updated version was in preparation, but has not been realized. After the collapse of the Soviet Union, the state has terminated geological mapping, and, as a result, the information obtained within the last decades has not been reflected at the Geological Maps of Georgia, scale 1:200000.

The present work was designed to update the existing Geological Map of Georgia, scale 1:200000 and compile the corresponding explanatory note. This work was accomplished in the frame of the project № 217408, supported by Shota Rustaveli National Science Foundation. The project has resulted in compilation of interactive digital geological map (1:200000 scale) for whole Georgia and its explanatory note, which includes all the existing information on structure of lithosphere and its evolution for approximately 1-billion-year period. Based on the example of geologic history of Georgia, the lithospheric structure of the Black Sea-Caspian Sea region and general principles of pre-collisional and post-collisional evolution have been analyzed.

The interactive geological map of Georgia (scale 1:200000) and its explanatory note will become the basis for various thematic mapping in the field of the Earth sciences, for example: reconstruction of sedimentation basins and other geomorphological units of geological past of Georgia and adjacent areas; tectonic zoning of Georgia; paleotectonic reconstructions; distribution of magmatic, metamorphic and sedimentary formations within the region; structural; neotectonics and seismotectonics; seismic zoning; distribution of metallogenic and other mineral resources; paleomagnetic reconstructions; ecological issues; correlation of geological objects and events of adjacent areas; modelling of geodynamic processes.

During the project two web-applications were established: geomaps.ge and geoscience.ge. The applications allowed displaying geological geospatial vector-based graphics with corresponding textual descriptions in the Internet space, which made the information obtained during the project accessible for any concerned person.

Based on ArcGIS software, geological and specific vector-based images of different thematic content inserted in the database record fields as an attributive information were produced.

The interactive map application consisting of two parts has been created: 1) administrator's control panel; and 2) publicly-available web-panel. The information uploaded from the administrator's control panel was disposed on the publicly-available web-panel.

In the recent 30 years in Georgia, geological scientific activity was realized mainly through international projects: ISTC, No A-651 - *Caucasian Seismic Information Network for Hazard and Risk Assessment*; MEBE – *Middle East Basins Evolution*, CNRS - *Mezo-Cenozoic geodynamics of the Western Caucasus sedimentary basin*; INTAS - *Stress related geohazards in South Caucasus*; NATO - *Science for Peace Programme, Seismic Hazard and Risk Assessment for Southern Caucasus – Eastern Turkey Energy Corridors*; EMME - *Earthquake Model of the Middle East region: Hazard, Risk Assessment, Economics & Mitigation*; IRG - *Geodynamic evolution of the Minor Caucasus mountain belt: consequences on the natural resources, active tectonics and risks locations (Georgian part)*; GDRI - *International Research Group: "South Caucasus GeoScience (Georgia – Eastern Black Sea)*; Darius program; CGMME – *Commission for the geological map of the Middle East (compiled: digital map of magmatic formations of Georgia scale 1:500 000 and Quaternary map of Georgia)*, and, as a result, an abundant new information was obtained in the frame of these projects, which is incompletely reflected at the maps. The project generated an interactive digital map of Georgia (scale 1:200000) along with Georgian and English versions of its explanatory note based on the present-day knowledge over the structure of the Earth's crust of Georgia.

Development of GPS technologies in recent decades made possible much more accurate identification of geological bodies related to specific geographic systems. In the project frame, the field work was carried out with usage of GPS technologies (GARMIN GPS map 62stc), which assisted in making precise delineation of geological formations.

During the project, electronic database was established, which according to the classifier given below (Fig. 1.1.) incorporated already existing geological maps of Georgia (1:200000 scale) and their explanatory notes:

During the project the following activities were accomplished:

- Existing geological maps have been registered in GIS-format;
- Unified legends for upgraded geological maps have been created and digitized;
- Geological mapping, biostratigraphical study and petrochemical and geochemical study of magmatic formations have been carried out;
- Unified explanatory note (English and Georgian versions) of upgraded geological digital map of Georgia (1:200000 scale) has been produced;
- Paleotectonic and neotectonic reconstructions of the region have been updated;
- Server infrastructure and software and hardware configuration have been established;
- Web-applications geomaps.ge and geoscience.ge have been established.

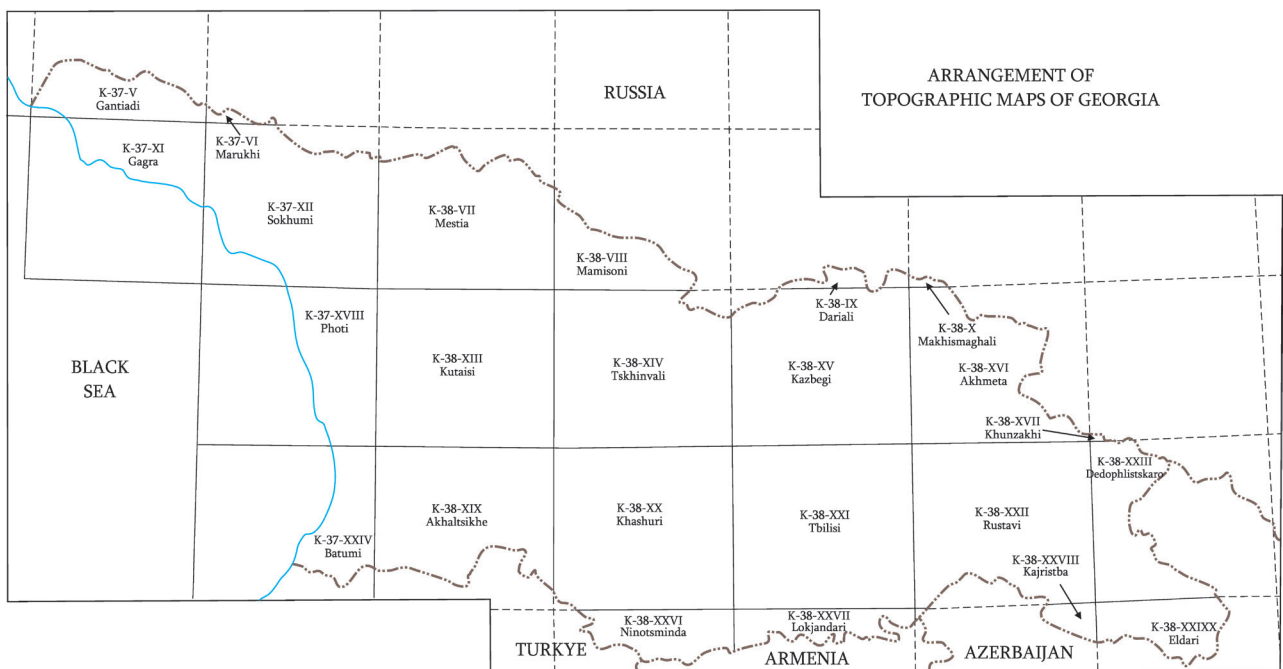


Figure 1.1. Arrangement of maps of Georgia of 1:200000 scale (classifier)

Compilation of geological maps of Georgia, scale 1:200000: brief overview

Geological survey and compilation of different-scale maps of various areas of Georgia goes back to the second half of the 19th century (for example, H. Abich, S. Simonovich, L. Vassoevich, and others). State geological mapping was undertaken by the Departments of Geological Survey of Georgia, Armenia, Azerbaijan and northern Caucasus, which then were

affiliates of the former Ministry of Geology of the USSR, and, as a result, the first 1:200000-scale geological maps of Georgia were published in 1950-1970, for example sheets: K-37-V and K-37-VI, 1967, authors - J. Potapenko & A. Gurbanov, editor - A. Dubinski; K-37-XI, 1956, au. - V. Kurochkin, ed. - A. Tsagareli; K-37-XII, 1956, au. - V. Edilashvili, ed. V. Kurochkin; K-37-XVIII, 1955, au. - N. Kandelaki, ed. - V. Kurochkin; K-37-XXIV, 1956, au. - P. Gamkrelidze & N. Kandelaki, ed. - V. Kurochkin; K-38-VII, 1957, ed. - G. Tvalchrelidze; K-38-VIII, 1966, au. - V. Melnikov & E. Popova, ed. - K. Paffenholtz; K-38-IX, 1957, au. P. Gamkrelidze & N. Kandelaki, ed. - V. Kurochkin; K-38-X, 1959, au. - V. Shelkhovskii & A. Zemchenko, ed. - K. Popov; K-38-XIII, 1955, au. - A. Janelidze & I. Kakhadze, ed. - V. Kurochkin; K-38-XIV, 1956, au. - N. Kandelaki & I. Kakhadze, ed. - V. Kurochkin; K-38-XV, 1956, au. - N. Kandelaki & I. Kakhadze, ed. V. Kurochkin; K-38-XVI, 1956, au. - V. Krestnikov, ed. - V. Kurochkin; K-38-XIX, 1957, au. - P. Gamkrelidze, ed. - A. Tsagareli; K-38-XX, 1957, au. - P. Gamkrelidze, ed. - A. Tsagareli; K-38-XXI, 1957, au. - P. Gamkrelidze, ed. - A. Tsagareli; K-38-XXII, 1955, au. - P. Gamkrelidze, ed. - A. Tsagareli; K-38-XXVI, 1971, au. - A. Aslanian, A. Veguni & A. Ptukhian, ed. - A. Aslanian; K-38-XXVIII, 1956, au. - R. Abdullaev, ed. - A. Aslanian; K-38-XXIX, 1957, au. R. - Abdullaev, M. Agabekov, & M. Gavrilov, ed. - K. Paffenholtz.

In 1970-1971, the Department of Geology of Georgia updated some sheets of geological maps of Georgia, scale 1:200000, which were not published: K-37-XVIII, 1971, G. Gujabidze; K-37-XXIV, 1971, D. Jigauri; K-38-VII, P. Gamkrelidze; K-38-VIII, 1970, Sh. Geguchadze; K-38-IX, 1971, J. Kandelaki; K-38-X, 1971, J. Kandelaki; K-38-XIII, 1971, G. Gujabidze; K-38-XIV, 1971, J. Kandelaki, E. Devdariani, & R. Torozov; K-38-XVI, 1971, J. Kandelaki, M. Pruidze; K-38-XVII, 1971, M. Pruidze; K-38-XIX, 1971, D. Jigauri; K-38-XX, 1971, D. Jigauri; K-38-XXI, 1971, E. Devdariani, R. Torozov, D. Jigauri & M. Pruidze; K-38-XXII, 1971, E. Devdariani, R. Torozov & M. Pruidze; K-38-XXIII, 1971, M. Pruidze; E. Devdariani & R. Torozov; K-38-XXVI, 1971, D. Jigauri; K-38-XXVII, 1971, M. Pruidze; K-38-XXVIII, 1970, E. Devdariani & R. Torozov; K-38-XXIX, 1970, E. Devdariani & R. Torozov;

In the 1970, slightly improved geological maps of 1:200000 scale of the above-mentioned sheets were compiled, but their completion and publishing has not been realized as well.

1:200000-scale Maps of Mineral Resources of Georgia were compiled on the basis of the mentioned geological maps. The following sheets were published: K-37-V, 1967, Y. Potapenko, A. Gurbanov & A. Dubinski; K-37-XI, 1956, M. Sorokina & G. Tvalchrelidze; K-37-XII, 1956, D. Chikhladze & V. Kurochkin; K-37-XVIII, 1955, D. Chikhladze & V. Kurochkin; K-37-XXIV, 1956, B. Kalandarishvili & V. Kurochkin; K-38-VII, 1957, D. Chikhladze & G. Tvalchrelidze; K-38-VIII, 1966, V. Melnikov, E. Popov & K. Paffenholtz; K-38-X, 1959, V. Shelkhovskii, A. Zemchenko & G. Popov; K-38-XIV, 1956, B. Kalandarishvili & V. Kurochkin; K-38-XV, 1956, B. Kalandarishvili & V. Kurochkin; K-38-XX, 1957, B. Kalandarishvili & G. Tvalchrelidze; K-38-XXI, 1957, B. Kalandarishvili & G. Tvalchrelidze; K-38-XXII, 1955, B. Kalandarishvili, A. Tsagareli & V. Kurochkin; K-38-XXIV, 1971, A. Aslanian, A. Veguni & A. Ptukhian; K-38-XXVIII, 1959, R. Abdullaev, A. Eriomina & A. Aslanian.

E. Tsereteli, D. Tsereteli, A. Volsky, M. Kurdadze, M. Kakhadze used available by the 1980 data of 1:200000-scale geological mapping of Georgia as a base to compile the “Engineering-Geological Map of Hazardous Geological Events Within the Territory of Georgia, scale 1:200000, 1985” edited by I. Gogitidze and E. Tsereteli.

In the following years, the work on upgrading maps of 1:200000 scale has not been continued and further terminated due to the collapse of the USSR and reorganization and liquidation of the State Geological Institutions of Georgia. However, on the basis of 1:200000 and 1:50 000 scale maps, there were compiled and published two 1:500 000-scale digital versions: in 2005 (author - Gujabidze) and in 2004 (authors - G. Abesadze, Sh. Adamia, S. Bukia, M. Gamkrelidze, Sh. Geguchadze, E. Devdariani, I. Vashakidze, V. Edilashvili, R. Torozov, N. Kandelaki, J. Kandelaki, I. Metreveli, D. Papava, O. Sepashvili, M. Pruidze, Y. Kipiani, G. Chichua, O. Shiriashvili & D. Jigauri).

Over recent years, State Geological Agencies have recommenced their work of geological mapping of 1:200000 scale, and in 2017-2018, the following maps were prepared: K-38-IX (Dariali), K-38-XV (Kazbegui), authors M. Gamkrelidze, O. Abutidze, M. Kordzadze, M. Gaprindasvili, R. Kumladze, D. Tevdoradze & Th. Gzirishvili, 2018 (supervisor E. Tsereteli; National Environmental Agency, Department of Geology); K-38-XX (Khashuri), authors: M. Gamkrelidze, O. Abutidze, M. Gaprindashvili, M. Kordzadze, R. Kumladze, D. Tevdoradze & Th. Gzirishvili, 2017, National Environmental Agency, Department of Geology.

The following maps were also compiled: K-37-XXIV (Batumi), K-38-XIX (Akhalsikhe), State Geological Map of Georgia, 1:200000 scale, authors: R. Beradze, A. Gavasheli & R. Nadirashvili, Georgian National Company of Geology and Mining; subdivision – Complex Geological-Geophysical enterprise).

Geological map of Georgia, scale 1:500 000, 2004. Digital Geological map of Georgia (scale 1:500 000), its explanatory note, and unified legend were compiled and issued in 2004 in Georgian and English mainly on the basis of the State Geological Maps of scales 1:200000 and 1:50 000. The mapping was realized in ArcGIS format based on GIS- and RS-observations at the topographic base of Gauss-Kruger projection. According to the existing traditions, various ages of formations are marked by different colors, while their composition, geological structure, and boundaries are demonstrated by different patterns and colored lines.

Geological maps of Georgia, scale 1:200000, 2019. The explanatory note sets out description of geological formations according to the main tectonic units (MTU) grouped according to their age (from older to younger): Pre-Cambrian-Paleozoic basement; Pre-collisional tectonostratigraphic units (TSU): Paleozoic; Mesozoic-Early Cenozoic; Syn- and post-collisional TSU. Structural formations of the main tectonic units are reviewed from north to south: 1. Fold-and-Thrust Mountainous Belt of Cavcasioni (FTMB): Main Range Zone; Southern Slope Zone; 2. Intermountain terrane: Transcaucasus-Georgian Block (GB); 3. The Achara-Trialeti Fold-and-Thrust Mountainous Belt (ATFTMB); 4. Artvin-Bolnisi Block (ABB); 5. Volcanic highlands and extinct volcanoes.