

# Recent Problems of Developing a National Program on the Use Raw Mineral Resources and Environmental Safety Protection in the Republic of Armenia (Lesser Caucasus Segment of Geo-ecological Systems of the Black Sea Region)

Karapet Mouradian<sup>1,\*</sup>, Aida Hayrapetyan<sup>1</sup>, Lusine Muradyan<sup>2</sup>

<sup>1</sup>Laboratory Ore Deposits, Institute of Geological Sciences, National Academy of Sciences of Armenia, Republic of Armenia

<sup>2</sup>National Institute of Health MH, Scientific-training Center, Republic of Armenia

Copyright©2019 by authors, all rights reserved. Authors agree that this article remains permanently open access under the terms of the Creative Commons Attribution License 4.0 International License

**Abstract** The article considers recent problems of developing a national program on the use of raw mineral resources and environmental protection in the Republic of Armenia. These issues have many perspectives and are discussed in various aspects. The need for these studies is obvious in connection with the restoration of promising branches of the mining industry in the RA and development of the national and scientifically sound market programs for the Safety of Global environmental protection management. The raised matters related to the use of mineral resources and measures undertaken in the nature of our country must be under State Governmental control and should be studied thoroughly at a scientific and professional level, otherwise, the unnecessary interference of any individual or any foreign investor could cause ecological disbalance in the environment. For the prospective development of the economy, it is necessary to ensure that the Government should take all possible measures to ensure harmless use of mineral resources and other related actions that are undertaken not only by local but foreign investors as well. Amendments in the law of the Republic of Armenia on the protection of the environment and their appeals must strictly be solicited for the high-efficiency production of multipurpose units, anti-seismic monolithic constructions in the purpose to maintain mining and environmentally-friendly geological and ecological balance. Due to these measures, the present and future generations will also take the advantage of uncovering and using natural resources.

**Keywords** Republic of Armenia, Armenian Highland, Metallogeny, Lesser Caucasus of Geo-ecological Systems

## 1. Introduction

The purposeful use of non-renewable resources in the Republic of Armenia and ensuring of the protection and improvement of the environment - are the priority issues of strategic importance for public and state governance in terms of the prospective development of new administrative-territorial economy in the 21st century[1-9].

Armenian Highland and its northeastern part of the Republic of Armenia naturally occurring in the central part of the Alpine-Himalayan (Mediterranean) Metallogenic Zone are considered the most volatile minerally resourceful area being of the newest and oldest volcanic origin, and known for the diverse segments of their magmatic formations and minerals: being the classical samples of copper-pyrite and sulphur pyrite gold, barite-polymetallic silver and gold generating, copper-molybdenum gold-generating, iron ore gold, gold-sulfidic, etc.. That is the reason Armenia is known to the civilization as one of the world's oldest unidigging, extraction and processing sites of nonferrous metals, precious metals, black and rare metals, as well as other resources of natural construction materials, like basalt, andesite, etc., precious and semi-precious stones (turquoise, etc.). (H. V. Abikh, A. D. Ern, F. K. Oswald, Kh..F. Linch, L. K. Konyushevski, N. A. Morozov, A. A. Iessen, Ye. G. Bagratuni, H. T. Karapetyan, H. G. Maghakyan et al) [1-5, 7] fig. 1, 5.

Utilization of the internal part of the Earth and environmental safety issues, as well as the issues of maintaining different areas of the national healthcare are diverse and comprehensive, having different risk assessment aspects, which are discussed in this article from various aspects[1-9].

At the current level of revival and prospective development of the industry in the Independent Armenian state, it is of greater interest to explore the targets: in specific sectors of mining industry, in the management of economic, technical, industrial, administrative, socio-political and especially scientific aspects of the mentioned sectors. They are closely interconnected with the requirements and the needs of the allocation of internal resources, complex and efficient utilization, protection of the geo-ecological balance of the surrounding natural geographical-geological environment and creation of a competitive market economy [3-9].

Geonomy-ore depositional studies indicate that around two percent of world reserves of copper (Shamlugh, Alaverdi, Kapan and other mines), and seven percent of molybdenum (Kajaran, Dastakert, Agarak, Teghut, Hankavan, etc.), as well as gold (Sotq, Meghradzor, Shahumyan, Lichkvaz-Tei, Terterasar and other mines), iron (Koghb, Bazum, Hrazdan, Kaputan, Svarants, etc.) and other metals are located in the territory of Armenia, characterizing the national wealth of our country, the main criterion for the potential power and state independence of the Republic of Armenia[3-5, 7, 8, 9].

When analyzing the mining resources in terms of the future development of the Armenian economy and analyzing the ecological problems of improving new branch-related systems in the industry of RA, it is crucial to pay special attention to the following:

1. The natural territory of Armenia, formed on the northern slopes of the Arabian continent, is characterized by a wide network of relief – islandic arcs of volcanic origin, having multidirectional folded raptures, with a wide range of deep ruptures. Due to this complex geological structure, the nature of Armenian territory is highlighted for its high earthquake activity and multiphase volcanic eruptions, and diverse presence of ores (copper-pyrite, copper-molybdenum, polymetallic, iron, gold, silver, mercury, arsenic, etc.).
2. The difficulties generated by the volcanic mountain terrain and the high level and rates of earthquakes on the mainland ( $A_{max} = 0.4g$ , 9 and above) respectively affect the construction difficulties, further development of some sectors of the economy and the preservation of the geo-ecological balance of the surrounding natural environment.
3. The progressive development of the industries should mainly be based on the use of local natural resources focusing on basic resources of raw mineral materials of metallic and non-metallic origin, energy resources (should also be prioritized for future reproduction), mining industry, chemical and construction materials. Industrial wastes generated as a result of exploitation of large and

medium-sized mines adversely affect the environment.

## 2. Results & Discussion

Thus, currently, the most important state and market-related issues that Armenian economy faces in terms of targeted use of raw mineral materials and environmental protection could be:

1. **The complex use of extractable minerals** – despite the fact that all the natural resources of RA are diverse; their industrial processing is still primitive/one-directional/linear. During the enrichment and processing of molybdenum, copper, gold and sulphide, polymetallic, iron, wastes contain large amounts of zinc, iron ore, sulfur, rare and precious metals (selenium, tellurium, cadmium, rhenium, gallium, germanium, gold, silver, etc.) the value of the wasted materials may sometimes exceed the cost of the main components extracted from the ore.
2. **Securing the safe use of relatively poor ores in the deposits.** Poor minerals that is left in mines become waste or unusable. This specifically refers to the copper-molybdenum, copper pyrite, iron ore, gold-sulphide and other mines or ore deposits of our country. Such examples could be Sotk and Meghradzor almost exploited mines where only high content (6-10 gr/ t Au) mineral bodies have been processed and the remaining ore was closed ecologically degrading the surrounding natural environment. However, it was necessary to prolong the exploitation of the mentioned mines for a century or more, and to have full state sponsorship engaging geological services and opening jobs or positions for complex mode planning and optimal operating purposes including low gold content (0.5-1,5 gr/t) ore, as well as poor sulphid golden mines, secondary quartzites in 20-50 km radius.
3. **Accurate evaluation of secondary, common raw materials** (equal to uncovering new industrial mines). On behalf of State Executive bodies (Ministry of Economy, etc.), it must be strictly forbidden to export them from the Republic of Armenia. The deposits must be stockpiled or stored in the area of metallurgical factories of mining industry for further processing and complex use by future generations (fig. 1-5).
4. **Creating informative database of different types of extracted formations and wasteless extraction.** Therefore, classification of industrial technogenic wastes, risk assessment, utilization, removal of exhausted gases and industrial waters, investment, implementation and development of new technologies related to little or waste-free

procedures (related to the rate of being hazardous). The resolution of the mentioned problems is to ensure the state of cleanliness and security of the air basin, surface and groundwater, artesian waters that are known to be far away from being satisfactory. These issues are particularly crucial in the main cities of Armenia (Yerevan, Alaverdi, Vanadzor, Kapan, Kajaran, Ararat, Gyumri, etc.) in terms of air and surface water pollution, and highly affect the health of the population: especially dental (L. K. Muradyan), oncological (A. M. Galstyan) and other spheres [1-9].

5. **The importances to re-cultivate the lands used by the mining industry, such areas are:** Shamlugh-Alaverdi-Akhtala and Kapan copper-pyrite mines or Kajaran and Teghut copper and molybdenum mines, or tuff mines in Artik and Aruch and perlite mines in Abovyan.

For the purpose of further development of the state and market economy, the welfare of the population, and the improvement of health conditions, the need to expand and deepen scientific research on targeted use of mineral resources is of great importance, alongside with the call to preserve and maintain geographical and geological environment side by side with natural geological monuments, The state or governmental bodies should take measures and pose their active role in organizing and implementing definite action plan to cover basic environmental and safety principles in the pre-school, secondary and higher educational institutions nationwide, elaborating geotechnical education, developing educational and methodological programs to keep up the sustainable development in the Armenian social context.

It is high time to improve and develop strategic plans and methodologies in the education of Ecology, particularly, on behalf of the Ministry of Education and Sciences of Armenia, and the Ministry of Nature Protection

There are also more serious and important geo-ecologically risk-posing issues related to the safe survival of our future generations, like – closing down or safe operating Armenian Nuclear Power Plant (NPP), the long-term and safe removal of radioactive waste, as well as the construction of the second nuclear power plant in Armenia. It is worth restating that the national governmental and local authorities bodies should take into account the fact that the nature of our Republic is geophysically hyper-seismic (rating mostly 9-10 or more), geo-ecologically unbalanced; also tension exists in the geodynamic environment and the isolation of unfavorable radioactive waste (or even building more burial space).

In this aspect, to avoid future ecological catastrophe, and take the unwanted waste away from our country, we consider and look forward to further cooperation with the Russian Federation, as well as with other countries.

### 3. Conclusions

#### Therefore

1. The raised matters related to the use of mineral resources and measures undertaken in the nature of our country must be under State Governmental control and should be studied thoroughly at a scientific and professional level, otherwise, the unnecessary interference of any individual or any foreign investor could cause ecological disbalance in the environment. It is obvious that besides Yerevan, a number of places in the regions have also undergone the mentioned influence (particularly in Lori region - Alaverdi, Shamlugh, Akhtala, Teghut; in Syunik region (marz) - Kajaran, Kapan; in VayotsDzor – Jermuk (Mount Amul); in Kotaykmarz - Abovyan, Hrazdan, etc., fig. 1-5).
2. For the prospective development of the economy, it is necessary to ensure that the Government should take all possible measures to ensure harmless use of mineral resources and other related actions that are undertaken not only by local but foreign investors as well.
3. Ammendments in the law of the Republic of Armenia on the protection of the environment and their appeals must strictly be solicited for the high-efficiency production of multipurpose units, anti-seismic monolithic constructions in the purpose to maintain mining and environmentally-friendly geological and ecological balance. Due to these measures, the present and future generations will also take the advantage of uncovering and using natural resources [1-8].

Analyzing the peculiarities of the integrated use of mineral resources in bowels and securing their environmental safety protection at the present stage of the scientific and technological progress, the 21<sup>st</sup> century Armenia should release a scientifically profound strategic plan and scientifically formulated objectives to meet the complex needs of state and market industry in respect to its natural environment.



Figure 1. Oservational map of Armenian Highland



Figure 2. Copper-pyritic ore deposits Of Shamlugh (Alaverdi ore region)



Figure 4. Ore deposits mined waste in Akhtala (Alaverdi ore region)



Figure 3. Copper-pyritic ore deposits mined waste in Shamlugh (Alaverdi ore region)

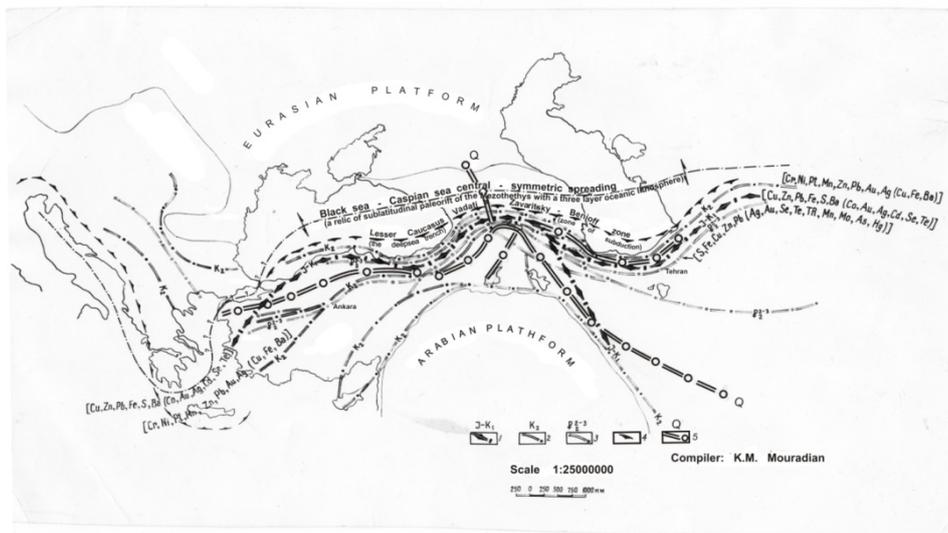


Figure 5. Metallogenic-paleovolcanological geodynamic model of the evolution of the earth's crust and lithosphere of the Republic of Armenia, the Lesser Caucasus and the Armenian Highlands against the backdrop of the development of the Central Mediterranean in the Mesozoic Cenozoic (composed of K. M. Mouradian). Lateral paleovolcanological and metallogenic zonation in the northern active periphery of the Gondwana-Mature island-arc system with phased belt-arc-shaped paleomorphic structural elements. Paleovolcanological - metallogenic reconstructions: 1. The axis of the volcanogenic zone - the island arc of the Jurassic - the Lower Cretaceous stage (Pontian - Transcaucasia: Pontian - Virahayots - Artsakh (Karabakh) - Elbursian), with volcanogenic copper pyrite, gold ore and plutogenic iron ore, copper - molybdenum formations. 2. The axis of the volcanogenic zone - the island arc of the Late Cretaceous stage with magmatogenic - volcanic pyrite, volcanogenic sedimentary manganese and plutogenic iron ore, chromite, platinum and other formations. 3. The axis of the volcanogenic zone - the island arc of the Paleogene stage with volcanic pyrite, gold ore, rare metal, volcanogenic sedimentary manganese and plutogenic karn-iron ore, copper-molybdenum formate. 4. Long-living Lesser Caucasian paleoseismofocal zone of Vadati-Zavaritsky-Benioff. 5. The axis of the volcanogenic zone - the island arc of the Neogene - Quaternary stage, with volcanic gold sulfide, iron ore, uranium, rare metal formations.

---

## REFERENCES

- [1] General plan of development of mining industry of Republic of Armenia (Master plan). Published: Mining engineering company Mitsui LTD, 2003, 123p. (in Russian).
- [2] Kirsten Hund, Narine Tadevosyan Armenia: Strategic Mineral Sector Sustainability Assessment, World Bank group. 2016, 147p. (In Armenian).
- [3] Maghakyan I.G. Metallogeny of Armenia. Published house of the Academy of Sciences of the Armenian SSR. Yerevan, 1954, 371 p. (in Russian).
- [4] Mrcrtchyan T.A. Armenia—the crib of mining and metallurgy. Mountainous journal. T. 2, 2003, p. 82-85 (in Russian).
- [5] Mouradian K.M. Minor (Lesser) Caucasus Volcanogenous formatins Metallogeny. Armenian National Academy of Sciences publishing house. Institute of Geological Sciences, Yerevan, 1994, 359p. (In Russian).
- [6] Mouradian K.M. Volcanism and earthquakes of Lesser Caucasus and Armenian Highland as the ecology-geological problems of the Black sea Region. Third Tuapse International Scientific conference “Volcanism, Biospheres and Ecological problems”. 2003, p. 44-45 (in Russian).
- [7] Mouradian K. M. RA Ore deposits usage effects on environment and their usage and planning analysis Armenian national strength needs self-assment for global ecological governance. Usage of natural resources intersectional integrated and generalized planning. 5th working group (workshop) expsert article. UN; Republic of Armenian department fund (UNDP/GEF/ARM/G31/A/1G/99). Yerevan, 2004, 16p. (in Armenian).
- [8] Mouradian K.M. Geodynamic Model of Lithosphere Evolution and Metallogeny of Armenia (Central Mediterranean Mezocenozoic Divergent and Convergent systems). Mineral Prospectivity, current approaches and future innovations conference – Orléans, France, 24-26 October 2017, p. 40-42.
- [9] Avagyan H. S. Estimation of ecological consequences of ore mining in the mining industry waste in RA. NAS RA, public. Gitutiun, Yerevan 2013, 272p.