Economics

Capitalization of Mineral Commodities – World and Georgian Experiences

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ABSTRACT. The recent world economic crisis had a huge impact on Georgia's social & economic framework. The sole possibility to avoid the negative influence of global deteriorating economic tendencies is to base economic and, first of all, industrial development of the country on national natural resources and commodities. However, extensive use of Georgia's mineral commodities is slowed down due to lack of possibility to capitalize them at early stages of exploration. The present article proposes a new economic method, which allows computing the Net Present Value of an eventual mining enterprise at the early stage of exploration. In turn, such analysis provides indicators not only for assessment of the volume of possible venture investment in exploration but also for immediate capitalization of eventual commodities on international commodity markets. © *2012 Bull. Georg. Natl. Acad. Sci.*

Key words: capitalizazion, mineral resources, Net Present Value (NPV).

The recent world economic crisis had a huge impact on Georgia's social & economic framework: the rate of economic development and volume of direct foreign investments significantly decreased; on the contrary, the inflation rate, volume of foreign debts, number of population under the poverty line increased dramatically [1]. Within the given realms the sole possibility to avoid negative influence of global deteriorating economic tendencies is to base economic and, first of all, industrial development of the country on national natural resources and commodities [2]. It should be noted that the same problem arose by the end on the 19th century, and the well-known national public leader Niko Nikoladze proposed the same remedy [3].

However, extensive use of Georgia's extremely rich natural resources [2] and, first of all, of mineral commodities is slowed down due to lack of the possibility to capitalize them at early stages of feasibility studies and exploration, namely, in case of so-called "greenfields", e.g. areas where deposits of mineral resources are still undiscovered but which according to geological criteria are prospective on certain kinds of mineral commodities. Thus, a mining company always has to solve a dilemma – either to perform a venture investment in regional exploration or to abandon a greenfield. Econometrics of venture investments in exploration was thoroughly investigated by P. de Verte Harris [4] and other researchers. However problems of capitalization of these poten-

tial commodities are still unexplored.

In this article we will try to solve the mentioned problem.

Any mining enterprise performs capitalization of their mineral resources pro rata the Net Present Value (NPV) of eventual mining activity [5-6]. According to the classical definition [7], NPV may be computed by the following equation:

$$NPV = \int_{n=1}^{t} \alpha_n \frac{\partial P^n}{\partial t}, \qquad (1)$$

where NPV means Net Present Value, a_n is discounting factor, P^n is annual nominal net profit of the year n, t - term of mining activity.

It is clear from the equation (1) that in a classical case computing of NPV is possible only in terms of feasibility studies and, according to the existing financial theory, is impossible for greenfilds. That is why early exploration of greenfields is a venture business and its financial viability greatly depends on the experience of the exploration team. Hence, there is a possibility to discount NPV even at the early stage of exploration. In this case calculations could be based on the so-called Price Index (I_p), which was introduced in 1995 [8]:

$$I_P = P_S Q_0, \qquad (2)$$

where P_s is specific price of 1 unit (e.g. t or m³) of a commodity, Q_0 - resources of commodities.
Then

$$P_S = \sum_i P_i C_i k_{Ei} - K_0, \qquad (3)$$

where P_i is specific market price of i constituent of ores, C_i is its grade in ores, K_{Ei} its extraction factor from ores, and K_0 operational cost of ore processing chain ranging from ore mining to production of the market commodity.
In this case

$$NPV = \int_{n=1}^{t} \alpha_n \frac{\partial I_p^n}{\partial t}. \qquad (4)$$

In course of economic assessment of greenfields all

resources of neighboring mineral deposits should be thoroughly registered. But in this case the reliability of estimated resources must be taken into account [9]:

$$Q_i = \sum_i Q_{iM} + k_{In} Q_{iIn} + k_{If} Q_{iIf} + k_{Sp} Q_{iSp}, \qquad (5)$$

where k_{In}, k_{If}, k_{Sp} are confidence factors of indicated, inferred and speculative resources, Q_{iIn}, Q_{iIf}, Q_{iSp} - amount of indicated, inferred and speculative resources of the ores' constituent i.

Now, for processing these primary data the Kriging method may be used [10]:

$$Q_{x+1}^{X,Y} = Q_i^{X,Y} + a(Q_i^{X,Y})^{-1} + b(Q_i^{X,Y})^{-2} + \\ ... + n(Q_i^{X,Y})^{-n}, \qquad (6)$$

where $Q_{x+1}^{X,Y}$ = resources in $i+1$ point, $Q_i^{X,Y}$ = resources in i point, X, Y - coordinates' matrix:

$$X,Y = \begin{pmatrix} x_1 y_1 & x_1 y_2 & ... & x_1 y_n \\ x_2 y_1 & x_2 y_2 & ... & x_2 y_n \\ ... & ... & ... & ... \\ x_n y_1 & x_n y_2 & ... & x_n y_n \end{pmatrix}. \qquad (7)$$

Type of mineralization

■ Madneuli Mine
■ Epithermal Au-Cu-Pb-Zn
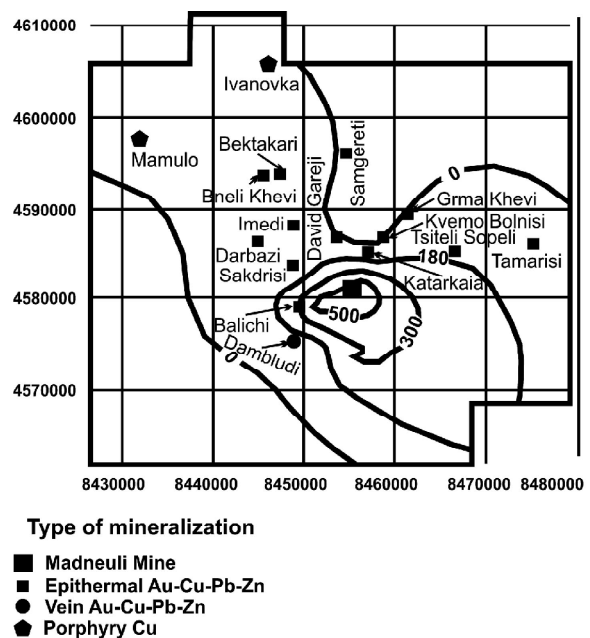● Vein Au-Cu-Pb-Zn
⬟ Porphyry Cu

Fig. NPV per Square Kilometer in Bolnisi Mining District, USD Million

This method may be used for computing NPV per square kilometer. Let us consider, for example, the case of Bolnisi Mining District where a number of gold-bearing polymetallic deposits is known but exploration of greenfileds is not yet scheduled. Computing resources of gold, silver, copper, lead and zinc in each deposit according to formula (5), identifying the specific price of each deposit according to formula (3), then, extrapolating the resources in two-dimensional space according to formula (6) and computing NPV in each $x_n y_n$ point according to equation (4), one would be able to provide a picture of NPV per square kilometer for the whole mining district. This information is provided in Figure.

Analysis of these data calls for exploration of the south-eastern part of the district, which has never been the subject of specific interest of the exploration teams. In addition, such analysis provides indicators not only for assessment of the volume of possible venture investment in greenfields but also for their immediate capitalization on international commodity markets.

ეკონომიკა

მინერალური ნედლეულის კაპიტალიზაცია — მსოფლიო და ქართული გამოცდილება

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ბოლო წლების მსოფლიო ეკონომიკურმა კრიზისმა მძიმე გავლენა იქონია საქართველოს სოციალურ-ეკონომიკურ გარემოზე. ერთადერთი შესაძლებლობა, დაძლეულ იქნას ნეგატიური მსოფლიო ეკონომიკური ტენდენციები, — ქვეყნის ეკონომიკური და, უპირველეს ყოვლისა, სამრეწველო განვითარებისთვის ეროვნული ბუნებრივი რესურსებისა და ნედლეულის რაციონალური გამოყენებაა. ამასთან, საქართველოს მინერალური ნედლეულის ინტენსიურ გამოყენებას ხელს უწყობს ძიების ადრინდელ ეტაპებზე მათი კაპიტალიზაციის შეუძლებლობა. ნაშრომში შემოთავაზებულია ახალი ეკონომიკური მეთოდი, რომელიც შესაძლებლობას იძლევა გამოითვალოს დასაპროექტებელი სამთო საწარმოს დისკონტირებული ღირებულება ძიების ადრინდელ ეტაპებზე. გარდა ამისა, შემოთავაზებული მეთოდი შეიცავს ინდიკატორებს არა მხოლოდ ძიებაში ვენჩურული ინვესტირების მოცულობის შესაფასებლად, არამედ მსოფლიო სანედლეულო ბაზრებზე აღმოსაჩენი ნედლეულის დაუყოვნებელი კაპიტალიზაციისთვის.

REFERENCES

1. *A. Tvalchrelidze and A. Silagadze* (2011), Central Asia and the Caucasus, **12**, 4 : 110-127.
2. *A. Tvlachrelidze, A. Silagadze, G. Keshelashvili and D. Gegia* (2011), Sakartvelos sotsialur-ekonomikuri ganvitarebis programa [Georgia's social & economic development program]. Tbilisi, 312 p. (in Georgian). English version available at http://www.ifsdeurope.com/presentation.html.
3. *N. Nikoladze* (1960-1962), Collected works. Vol. 1, 2. Tbilisi, (in Georgian).
4. *P. de Verte Harris* (1984), Mineral Resources Appraisal: Mineral Endowment, Resources, and Potential Supply Concepts, Methods, and Cases. London, 445 p.
5. The Economics of Primary Commodities: Models, Analysis, Policy (1994), David Sabsford (ed.), University of Liverpool, 192 p.
6. *Y. Chen and K. Rogoff* (2003), Journal of International Economics, **60**, 1: 133-160.
7. *M.Y. Khan and P.K. Jain* (1999), Theory and Problems in Financial Management. Boston, 441 p.
8. *A.G. Tvalchrelidze* (1995), Development of a Geological-Economic System for Governmental Management of Georgian Mineral Resources. Tbilisi, 87 p.
9. *A.G. Tvalchrelidze* (2006), Poleznye iskopaemye i mineral'naia resursnaia baza Gruzii [Mineral Resources and the mineral resource base of Georgia]. Moscow, 320 p. (in Russian).
10. *J. Sacks, W.J. Welch, T.J. Mitchell, and H.P. Wynn* (1989), Statistical Science, **4**, 4: 409–435.