Chapter 20
Practice-Oriented Approach to the Study of Economics to Students of Engineer-Geological Specialties:
Using the Example of Solving a Task Concerning the Processing of Technogenic Mineral Resources

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ABSTRACT

Practice-oriented models are essential when teaching economics to engineering students. This chapter will discuss how to set and solve the applied scientific task of processing technogenic mineral reserves. Tools will be offered relating to engineering geological, economic, and mathematical sciences, as well as to form a group of students with various specialties. Experiments will aim to find solutions to these tasks with a generalized gradient method. This chapter will use evolutionary algorithms to calculate ad valorem MET rates. Technogenic raw materials are of economic interest to extract valuable components and produce finished goods. Often, the content of valuable components in technogenic deposits (TD) exceeds the content in natural fields. While secondary mineral resources harm the ecosystem, it is impossible to prevent environmental risks due to the lack of subsoil use. Differentiated rates will be selected based on maximum MET capacity on all valuable components extracted from deposits provided that each deposit is considered an investment project for the stated problem.

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INTRODUCTION

Training students of engineering specialties is growing due to modern conditions. Graduates can apply their fundamental knowledge of basic economics and experience in making calculations in the following areas:

- Innovative entrepreneurship and technological start-up;
- Collaborative initiatives with economic agencies within large corporations;
- Integration into modern hi-tech businesses;
- High-level research and engineer studies, as well as their subsequent commercialization.

Aside from traditional workshops and lectures, practice-oriented teaching methods (i.e., a case study method, brainstorming sessions, etc.) are required. It is effective to conduct classes in mixed groups depending on their field specialization (i.e., merging engineers, technologists, economists, etc.). As Russian universities abolish the engineer-economist specialty, this approach will be valuable.

The following section will consider the extended example of interrelated application of engineering geological, economic, and mathematical tools to solve the applied scientific task concerning the processing of technogenic mineral reserves.

Statement of the Praktiko-Focused Task

The U.S. Geological Survey (USGS) collects information about the quantity and quality of all mineral resources. In 1976, the USGS and the U.S. Bureau of Mines developed a common classification and nomenclature, which was published as USGS Bulletin 1450-A—"Principles of the Mineral Resource Classification System of the U.S. Bureau of Mines and U.S. Geological Survey." Experience with this resource classification system showed that some changes were necessary in order to make it more workable in practice and more useful in long-term planning. Therefore, representatives of the USGS and the U.S. Bureau of Mines collaborated to revise Bulletin 1450-A. Their work was published in 1980 as USGS Circular 831— "Principles of a Resource/Reserve Classification for Minerals" (USGS Bulletin, 1976).

Domestic science gives several definitions of technogenic fields (TF). For example, K. Troubetzkoy and V. Umanets consider TF as the technogenic formations containing minerals, which are suitable for effective use in material production at the moment in quantity and quality (Troubetzkoy & Umanets, 1998). It should be noted that the research of K. Trubeckoy, V. Umanets and A. Tolumbaeva is very significant in science for the theoretical development of TF. According to their opinion, the comparative characteristics of technogenic objects should be evaluated using the criterion of the benefit maximization. From the standpoint of V. Chainikov and E. Goldman, TF is the accumulation of waste tonnage of mineral raw materials, which provides the economic effect by using (Chainikov & Goldman, 2000).

According to Pruss (2013), it was reasonable that the MET rate for mineral resources extracted from TDs should not be greater than 2%. Yet, no calculations or feasibility analysis of the indicated MET rate (Pruss, 2013) have been carried out. Other studies recommend to conduct MET differentiation in view of mining and geological, economic, and geographical peculiarities and the depleted status of deposits (Hung & Quyen, 2009; Lund, 2009; Pittel & Bretschger, 2010; Ponkrratov & Pozdnyaev, 2016). Bloshenko, Pozdnyaev, and Pozdnyaev (2016) and Ponkratov (2014) theoretically justified a method to identify the differentiated MET rates in relation to TDs.