Heliyon

Received:
20 November 2017
Revised:
22 January 2018
Accepted:
7 March 2018

Cite as: Gustavo A. Silva, Carlos O. Petter, Nelson R. Albuquerque. Factors and competitiveness analysis in rare earth mining, new methodology: case study from Brazil.
Heliyon 4 (2018) e00570.
doi: 10.1016/j.heliyon.2018.e00570

Factors and competitiveness analysis in rare earth mining, new methodology: case study from Brazil

Gustavo A. Silva [a,*], **Carlos O. Petter** [b], **Nelson R. Albuquerque** [c]

[a] *Division of Mineral Economy, Geological Survey of Brazil, CPRM, Brazil*

[b] *Federal University of Rio Grande do Sul, Brazil*

[c] *Independent Consultant, ROV-Brasil, RJ, Brazil*

[*] Corresponding author.

E-mail address: gustavo.alexandre@cprm.gov.br (G.A. Silva).

Abstract

Rare earths are increasingly being applied in high-tech industries, such as green energy (e.g. wind power), hybrid cars, electric cars, permanent high-performance magnets, superconductors, luminophores and many other industrial sectors involved in modern technologies. Given that China dominates this market and imposes restrictions on production and exports whenever opportunities arise, it is becoming more and more challenging to develop business ventures in this sector. Several initiatives were taken to prospect new resources and develop the production chain, including the mining of these mineral assets around the world, but some factors of uncertainties, including current low prices, increased the challenge of transforming the current resources into deposits or productive mines. Thus, analyzing the competitiveness of advanced projects becomes indispensable. This work has the objective of introducing a new methodology of competitiveness analysis, where some variables are considered as main factors that can contribute strongly to make unfeasible a mining enterprise for the use of rare earth elements (REE) with this methodology, which is quite practical and reproducible, it was possible to verify some real facts, such as: the fact that the Lynas Mount Weld CLD (AUS) Project is resilient to the uncertainties of the RE

https://doi.org/10.1016/j.heliyon.2018.e00570

sector, at the same time as the Molycorp Project is facing major financial difficulties (under judicial reorganization). It was also possible to verify that the Araxá Project of CBMM in Brazil is one of the most competitive in this country. Thus, we contribute to the existing literature, providing a new methodology for competitiveness analysis in rare earth mining.

Keywords: Earth sciences, Business, Economics, Industry

1. Introduction

Rare earths comprise a group of seventeen coherent metallic chemical elements, according to the classification of the International Union of Pure and Applied Chemistry – IUPAC (Connelly, 2005). They are widely distributed in the earth's crust, but in low concentrations. From this group, fifteen belong to the group of the lanthanides (those with atomic number Z between 57 and 71, going from the lanthanum – La to the lutetium – Lu); added to the scandium (Z = 21) and the yttrium (Z = 39) because they have physicochemical properties similar to those of the REE, they are therefore a group of 17 elements.

Considered as bearers of the future, the "third wave" REE are essential for the industrial development of a country. Nowadays, rare earth elements are considered strategic, along with gallium – a metal used in semiconductors, and manganese – a metal used in the manufacture of special steels (Ishee et al., 2013). One of the relevant factors responsible for the resumption of this sector in several countries of the world was the decrease in China's export quotas, which intensified at the end of 2010, causing a rise in international prices throughout 2011 and, consequently, interest in mineral exploration and rare earths (RE) production in a number of countries: the USA, Canada, Australia, Vietnam, South Africa, Brazil and others. The increase in international prices of rare earths, from this imposition of quotas, has also provoked in Brazil a return to the discussion of mining projects of rare earth minerals paralyzed in the 1990s, from both the federal government and private initiative. With the current market situation monopolized, the Chinese manage to manipulate not only the global supply of rare earth oxides (REO), but also prices. This high global dependence on Chinese production concerns mainly the economically developed nations, such as Japan, the United Kingdom and the United States, that have high value-added productions of industrial goods. This concern has also been demonstrated by other countries such as Germany, France, Austria, Estonia, China, South Korea, Russia and Brazil itself.

The world's largest officially known reserves are in China with 36.7% followed by Brazil with 22 Mt (18.34%), Australia with 3,4 Mt (2.84%) and the United States with 1,4 Mt (1.17%). China is also a leader in world trade, with 87.5% of rare earth

https://doi.org/10.1016/j.heliyon.2018.e00570