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Geoeconomics of fluorspar as strategic and critical mineral in Iran

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ABSTRACT

Supply of strategic materials during the Cold War was under the influence of military competition between East and West. But after the cold war and turning of geopolitics and geostrategy to geoeconomics, the assessment method of criticality matrix with dimension of economic importance and supply risk has been commenced by the US National Research Council. It has spread based on conflict between north and south and security or economic power of the developed countries. In this paper it is attempt to study a mineral using various critical minerals assessment methods to verify its effectiveness in economic development and its geoeconomics importance of Iran. One of such materials is the fluorite strategic mineral with trade mark of fluorspar that its deposits are found in the carbonate rocks of Triassic and Elika formation in Central Alborz and Shotori formation in central Iran. It was shown that the assessment methods used by the US Geological Survey, the US Department of Defense, EU and German Industries, depicted the fluorspar as a critical and strategic mineral in the world. Fluorspar economic value is because of its use in steel, aluminum, hydro-fluorocarbons, Teflon, renewable and clean energy production. The results of this study show the rank of Iran is seven in the world in terms of production, but this country is one of the main importers for intermediate goods made from these mineral among its neighboring countries. So as a first step, investment on systematic exploration of fluorspar resources is necessary to increase the supply of raw materials for the country's aluminum industry. Exploration of new reserves can also reduce concerns relevant to supply risk at the international level for developed countries. It can also be concluded that the joint investment, cooperation and concurrently researches in relation to raw materials and minerals, may lead to a reduction in competition between North and South countries. Hence, the review and monitoring of evaluation methods of critical raw materials in the developed countries is very important and valuable for choosing the appropriate policies for those developing countries that own these resources.

1. Introduction

Supplying of the strategic minerals and the associated studies, before the Cold War, could be greatly analyzed as influenced by the military competition between the East and West. After the collapse of the Soviet Union and due to continuously decreasing commodity prices in the 1990s, the subject of minerals supply security lost attention for more than a decade (Humphreys, 1995). The increasing number of global suppliers is another issue, which is caused to increase the distance between producers and consumers of minerals. In the post-WWII period, the focus of conflict shifted more towards the level of the state and was marked by inter-state conflicts over ownership and control of mineral resources. Subsequently, the focus shifted more towards the regional or community levels and towards environmental issues, including the issue of the use of minerals (Humphreys, 2010). North/South conflict might result from a large number of issues but the most likely factor providing potential for conflict is thought to be resources and the new world order has also been seen as the era of resource geopolitics (Anderson, 1993). Resources not only financed, but in some cases motivated conflicts, and shaped strategies of power based on the commercialization of armed conflict and the territorialization of sovereignty around valuable resource areas and trading networks. As such, armed conflict in the post-Cold War period is increasingly characterized by a specific political ecology closely linked to the geography and political economy of natural resources. The potential for political conflicts in these countries is high and poses a latent threat to raw material supplies (Le Billon, 2001). The strong economic development of China and other emerging economies has helped to a rapidly increasing demand for metals and minerals fears of physical scarcity. This, in turn, has brought the issue of securing supply

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and reasonable prices (Buijs et al., 2012). Therefore, the assessment methods after the Cold War were mostly based on the confrontation between north and south and providing the economic security or the economic power and the procurement of the required goods and protecting the environment. The main reason is the changes in geopolitics and geostrategy trends to geoeconomics and economic priority to militarism. The developed and industrial countries concerns on this issue, so it has caused an extensive studies to evaluate them. Several working groups around the world have made criticality assessments for metallic raw materials to analyze the driving impact factors and therefore criticality assessment methods are very heterogeneous (Achzet and Helbig, 2013). Considering vulnerability and supply risk as two dimensions of economic risks in raw material value chains follows the approach of classical risk assessment, where a potential scale of damage and the probability of occurrence of a scenario are considered to assess a risk level (Glöser et al., 2015). Environmental implications evaluate the damage caused by raw material extraction or their usage and thereby indirectly assess the likelihood of emerging environmental regulations or negative impacts on the public image of the material (Helbig et al., 2016). The dimension of environmental implications was introduced by Graedel et al. (2012) as an extension of previous matrix-based approaches (EU, 2014; NRC, 2007). According to the studies of Speirs et al., (2013), most remarkable evaluating studies for the strategic and critical minerals are based on the following major and minor factors (Desire, 2014) (Fig. 1):

- Supply factors (including geological availability, economic availability and recycling)
- Geopolitical factors (policy and regulation, geopolitical risk and concentrated supply)
- Demand factors (future demand and substitutability)
- Other factors (cost-reduction via technology and innovation, environmental issues, economic importance/ impact, and media coverage).

Criticality assessments may lead to policy recommendations for a more sustainable use of raw materials, and these recommendation scan vary between extended monitoring and reporting of material flows and utilization, the substitution of critical raw materials, or the search for secure raw material sources or increased material utilization in production (Helbig et al., 2016).

One of these important raw materials for the developed countries is fluorspar whose deposits can be found considerably in Iran. Fluorspar is the commercial name for the mineral fluorite (calcium fluorite) and it is most important raw material source of fluorine. Generally, there are

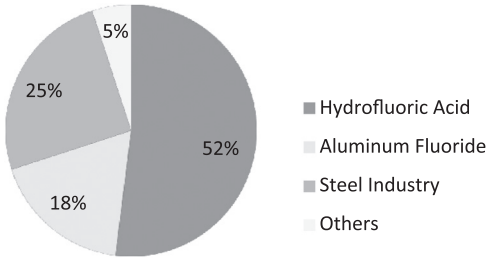

Fig. 2. World consumption of fluorspar (Data from EU, 2010 and 2014).

two different uses for this mineral such as acid-grade (so called: acidspar) and metallurgical-grade (so called: metspar). Acid-grade fluorspar is used in the production of hydrofluoric acid (HF), mostly within the US, Japan, China and Europe. About 52% of fluorspar is used worldwide as starting material for the production of hydrofluoric acid; another 18% is used for aluminum fluoride, the fluxing agent in the aluminum industry; and 25% for the steel industry as a flux (Fig. 2). Fluorspar is a starting material for the production of hydrofluoric acid, an important substance in many branches of the chemical industry. Hydrofluoric acid is used in the production process of electronics, computer chips, printed circuit boards, refrigerants and air-conditioning, and thermal insulation. Moreover aluminum fluoride is used as flux in the processing of aluminum. The remaining 5% is used in glass, glass fibers, cement, enamels and ceramic production.

Despite the fluorspar sources in Iran, this country cannot produce any intermediate products of this mineral. In the researches of the developed countries, the critically assessment of raw materials and minerals is performed for a group of selected materials with the use of an evaluation system (critical matrix) and the obtained results compared together. These assessments are based on the factors and economic indices which are interested for the developed countries. On the contrary, in this paper using of an analytical-descriptive method, we focus on a mineral in a developing country. In addition, different assessment methods of critical minerals which are used in the developed and industrialized countries are investigated for fluorspar to show its efficiency in economic development and geoeconomics of Iran. The other aim of this study is introducing one of these mineral sources in Iran that is critical for industrially developed countries according to their interests. This is a starting point for researches on the one hand led to security of supply of raw materials to the developed countries and on the other hand leads to investment and economic development of the developing countries such as Iran.

	Supply factors			Geo-political factors			Demand Factors		Other Factors			
	Geological Availability	Economic Availability	Recycling	Policy & Regulation	Geopolitical risk	Supply concentration	Future demand projections	Substitutability	Cost reduction via Technology Innovation	Environmental Issues	Economic importance	Media Coverage
NRC	■	■	■	■	■	■		■		■	■	
Oakdene Hollins	■	■	■		■	■	■	■		■		
Öko-institut (UNEP)	■	■	■			■	■					
ISI	■	■	■		■	■	■				■	
EU	■	■	■		■	■		■		■	■	
DOE (2011)	■	■	■	■	■	■	■	■	■	■		
AEA Technology	■	■			■	■	■	■				■
SEPA	■	■			■	■	■	■				■
JRC	■	■			■	■	■	■		■		
BGS	■				■	■						
BP	■	■	■		■	■		■		■		
Graedel (2012)	■	■	■	■	■	■		■	■	■	■	

Fig. 1. list of the factors and sub-indicators included in the criticality assessment studies (Speirs, 2013).