Journal of Applied Geochemistry
Vol. 22, No. 3 (2020). pp. 209-220

RARE EARTH ELEMENT GEOCHEMISTRY OF MONAZITES FROM BEACH SAND DEPOSITS OF INDIAN COASTS: IMPLICATIONS FOR CLEAN ENERGY

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Abstract

Monazite is a phosphate of light rare earths, and represents a group of minerals, with monazite-(Ce) being the dominant member. Variable concentrations of monazite occur in beach sand deposits of India. A coast line of more than 2100 line km long tract along the east and west coasts are of interest for heavy mineral concentrations, against the total Indian coastal length of about 6000 line km. At present,monazite is the main source of rare earth elements (REE) in India. Spread of REE consumption in various sectors in decreasing order is catalysts (24%), magnets (23%), polishing (12%), other applications (9%), 8% each in metallurgy and batteries, glass (7%), ceramics (6%) and phosphors and pigments (3%).During the coming decade, a large consumption of REE is predicted for the production of hybrid electric vehicles (HEVs) and full electric vehicles (EVs).This increased growth is likely to accentuate the demand for neodymium-iron-boron (NdFeB) magnets. Electric vehicles are expected to show the strongest growth in demand. Also, the other application for NdFeB magnets is in renewable energy generation, which would become progressively important, as governments and industries tend to meet stringent climate change and emission standards. Available data on monazites from beach sand deposits of Odisha, Andhra Pradesh and Kerala coast reveals high (10.4-12.4% La, 17.5-28.2% Ce and 9.8-11.3% Nd),and low to negligible (0.1% Dy, 0.2-1.3% Y, 0.1-0.61% Eu and 0.03% Tb) content of individual REE members that are required as ingredients for intermediate products used in clean energy. Accordingly, monazite from beach sand, with its estimated resource of 12.47 million tonnes (Mt), can play a key role in progressively more augmentation of clean energy, without causing environmental degradation, leading to sustainable development.

It is suggested that monazites from all the beach sand deposits of India should be comprehensibly characterised for individual rare earth elements to understand their relative abundance in monazites of various beach sand deposits along the eastern and western coastal stretches of India. It will help to regulate the supply of and cater to not only the increasing demand for Nd; but also other individual rare-earths, which would be needed progressively more but in small quantites (Dy), or in gradually decreasing (Y) to negligible (Eu, Tb) amounts, including La and Ce. This endeavour may also involve innovative groups at the interface of information technology and the minerals, metals and materials engineering domains. Huge resources of garnet (187.46Mt) and zircon (35.75Mt) known from beach placer deposits of India should also be characterised to assess their potentiality for possible additional REE resources.

Keywords: Monazite, REE geochemistry, Beach sand deposits, India, Clean energy

*Originally presented in National Symposium- 2020