Article

https://doi.org/10.1007/s12303-023-0008-7
pISSN 1226-4806 eISSN 1598-7477

Geosciences Journal GJ

Rare earth elements (REEs) investigation of fly ash placers in southwestern Taurides: footprints of alkaline potassic Gölcük volcanism, Turkey

Ali Tugcan Unluer[1]*, Zeynep Doner[1], Mustafa Kaya[1], Huseyin Kocaturk[1], Amr Abdelnasser[1,2], Mustafa Kumral[1], Murat Budakoglu[1], and Mehmet Sezai Kirikoglu[1]

[1]Department of Geological Engineering, Faculty of Mines, Istanbul Technical University, Istanbul 34460, Turkey
[2]Department of Geology, Faculty of Science, Benha University, Benha 13815, Egypt

ABSTRACT: The importance of Rare Earth Elements (REE) is consistently rising for industrialized countries due to their widespread usage in various applications. Production of REE heavily relies on carbonatite-ijolite complexes and other alkaline magmatic products. With this perspective, the potassic-alkaline volcanism related fly ash placers in Burdur and Isparta regions (SW, Turkey) are considered as a valuable prospecting target for REE. This work primarily focuses on the REE enrichment features (geochemistry, mineralogy, provenance and alteration processes) of Burdur and Isparta fly ash placers for construing the REE behaviour. At last, formation modeling of studied deposits was established and the similarities between studied deposits and some World class REE deposits were presented. Main REE-bearing minerals of studied deposits were identified as chevkinite, britholite and fluorapatite with considerable amounts of LREE as well as Th, Fe and Ti. The geochemical analysis results show that most of ∑REE values (up to 1109 and 1233 ppm, respectively) were comprised by La, Ce, Nd and Pr elements. The smaller grain size is a key factor in REE enrichment by the effect of combined factors such as REE-bearing mineral's average crystal size, distribution, and higher intensity weathering process. The interference of Ca from meta-sedimentary carbonate rocks have a negative effect on REE accumulation. Because of the good response for ore purification methods and promising results for some of the critical REE, Burdur and Isparta fly ash placers might be feasible in the future in case of tighter supply and increasing global demand.

Key words: fly ash placers, Taurides in Turkey, rare earth elements (REEs), chevkinite, alkaline magmatism

Manuscript received June 22, 2022; Manuscript accepted February 27, 2023

1. INTRODUCTION

Rare earth elements (REE) are strategic metals that are indispensable to developing of modern defense systems, electronic applications, and green technologies. These elements can be classified into three sub-groups: the light (LREE; La–Nd), middle (MREE; Sm–Ho), and heavy (HREE; Er–Lu) rare earth elements. The global demand for REE is consistentlyrising mainly caused by the increasing rate of usage in various industries including semiconductor production and renewable energy applications. For at least five decades this increasing demand is mostly met by carbonatite complexes and monazite placers, even though each type of REE deposit has different advantages and disadvantages (Verplanck et al., 2014; Goodenough et al., 2018). The REE enrichments are known to exist in a wide range of settings, and have been the subject of much recent exploration. There are several different types of natural (primary) REE resources (Castor, 2008; Charles et al., 2013; Goodenough et al., 2016, 2018; Elliot et al., 2018), including those formed by high-temperature geological processes (carbonatites, alkaline/peralkaline igneous rocks, vein and skarn deposits) and those formed by low-temperature processes (placers, laterites, bauxites, and ion-adsorption clays). In previous studies conducted by Dai et al. (2010, 2016, 2018) and Zhao et al. (2015, 2016a, 2016b) the hydrothermal fluids were concluded as the primary factor for REE enrichments. Furthermore, some key evidence showed that different types of

Editorial responsibility: Jung Hun Seo

*Corresponding author:
Ali Tugcan Unluer
Department of Geological Engineering, Faculty of Mines, Istanbul Technical University, Maslak, Istanbul 34460, Turkey
Tel: +90-5511115962, E-mail: unluera@itu.edu.tr