

Geology and Mineralisation of the Verkhnee Espe REE-RM Deposit, East Kazakhstan

Alla Dolgoplova,* Reimar Seltmann, Galiya Bekenova, Oleg Gavrilenko, Akmaral Baisalova,
Olga Frolova, Alexander Stepanov, and Indira Mataibayeva

Natural History Museum, London, United Kingdom, *e-mail, a.dolgoplova@nhm.ac.uk

The Verkhnee Espe rare earth-rare metal (REE-RM) deposit is located in the Ayagoz district of East Kazakhstan region. It is spatially and genetically related to alkaline granitic rocks outcropping in the middle of the Tleumbet-Saur Belt of alkaline felsic rocks. This belt extends for >2,000 km from East Kazakhstan to NW China and south Mongolia. Verkhnee Espe represents one of the largest manifestations of RM mineralisation in this belt. Many of the metallogenic characteristics of Verkhnee Espe resemble those of the much larger Strange Lake peralkaline granite REE-Zr-Nb deposit.

The RM mineralisation at the Verkhnee Espe deposit is related to altered alkaline granitic rocks of the “Greater” and “Lesser” cupolas, exposed in areas of 3.0 and 1.5 km² and extending into the fenitized host rocks. The granitic cupolas are separated by a screen of host rocks of 0.4 km width; drilling data indicated that both cupolas merge at a depth of 70 to 130 m. Apical parts of cupolas underwent intensive high-temperature post-magmatic metasomatic alteration leading to a change in composition and texture of primary rocks and to the formation of albite-riebeckite granites with elevated concentrations of Li, Rb, REE, Y, Nb, and Zr. The altered alkaline rocks are characterized by mostly porphyroblastic microstructures. Phenocrysts are represented by prisms of riebeckite and rosettes of aegirine. The micro-granoblastic matrix is composed of albite, microcline, quartz, and riebeckite aggregates.

The main REE-RM minerals-carriers include: (1) *Ce-bearing*: Pb-REE pyrochlore, bastnaesite-(Y), gagarinite, fluorite-(Y), and rowlandite; (2) *Dy-bearing*: gagarinite, F-bearing thalenite, rowlandite, keiviite, yftisite, fergusonite, pyrochlore, synchisite, xenotime and caysichite; (3) *Er-bearing*: gadolinite, synchisite, fergusonite, and caysichite; (4) *Yb-bearing*: xenotime, fluorite-(Y), gadolinite, keiviite, yftisite, and fluorapatite; and (5) *Y-bearing*: zircon, natrotitanite, and thorite (Baisalova *et al.*, 2016).

Ta, Nb, REE, and Zr are of primary economic value; the ratios of the reserves of these metals are 1:17:22:122, respectively. Grades of major metals are (wt %): Nb₂O₅ – 0.14, Ta₂O₅ – 0.008, ZrO₂ – 1.01 (Belov and Ermolov, 1996). The rare metal contents gradually increase from the inner parts of the pluton to its upper edge, especially in the areas of cupola- and ridge-like elevations of the granites. Vein-like orebodies, which set off from the metasomatically altered lodes near the granite contact, are enriched in rare metals. Considerable amounts of REE are contained in riebeckite and aegirine. These minerals are common, however, their TR₂O₃ contents are low (0.18 and 0.14 wt %, respectively; Belov and Ermolov, 1996). Accompanying elements in the ore include: U, Th, Be, Sn, Li, Pb, and Zn.

Challenging geometallurgical parameters of the complex ore, specifically high concentrations of radioactive elements, contribute to the current sub-economic status, so far preventing mining of

this deposit; however, its unique mineralogy continues to excite and challenge the academic community worldwide with new minerals being discovered almost every year.

References

Baisalova, A., et al., 2016, *Applied Earth Science*, 125(2), 76-77.

Belov, V.A., Ermolov, P.V., 1996, The Verkhnee Espe RM Deposit in East Kazakhstan, *in* Shatov et al., eds., *Granite-related ore deposits of Central Kazakhstan and adjacent areas*: Glagol, St. Petersburg, p. 219-228.