

A chevkinite and astrophyllite-bearing monzonite, tales from a 1330 Ma alkaline rift in SW Sweden

ANDREAS KARLSSON¹ AND MR. THOMAS ZACK²

¹Swedish Museum of Natural History

²University of Gothenburg

Alkaline rocks have long been a prime target for REE-exploration. Linking *in situ* geochronology to detailed petrography and mineralogy aids our understanding of the cryptic effects that metamorphism exhibit on alkaline rocks, and thus HFSE and REE mobility.

Whole rock data from a monzonite in Balltorp, SW Sweden indicate a strong enrichment of Zr, Ti and LREEs. Even though monzonitic rocks are usually less enriched in desirable elements than agpaitic rocks, they tend to be more widespread. New studies show that the mineralogy is dominated by albite, microcline, arfvedsonite, aegirine, fluorite and zircon, additional minerals include monazite-(Ce), chevkinite-(Ce) ($\text{Ce}_4(\text{Ti,Fe}^{2+},\text{Fe}^{3+})_5\text{O}_8(\text{Si}_2\text{O}_7)_2$), ilmenite, astrophyllite ($\text{K}_2\text{NaFe}^{2+}_7\text{Ti}_2\text{Si}_8\text{O}_{26}(\text{OH})_4\text{F}$), aenigmatite and bastnäsite-(Ce).

Preserved zircon cores yield a magmatic age of 1322 ± 10 Ma, coeval with rocks of the Kungsbacka bimodal suite [1], which consists of both granitic and gabbroic intrusive magmas. However, the majority of zircon grains yield metamorphic ages at 1035 ± 8 Ma (see Figure 1). A similar age is also obtained from monazite-(Ce) from the same rock.

Chevkinite-(Ce) usually occur as large grains, commonly metamict and have broad rims of glass (enriched in LREE, Ti and F). This glass also infiltrates fractures in the common silicates. Astrophyllite generally occurs as a primary phase in silica-undersaturated rocks [2], however at Balltorp, the astrophyllite tend to form fanlike aggregates of up to a few mm in size which consists of numerous small individual crystals of a few μm each usually intergrown with albite. Due to the breakdown of silicates and fluorite, and by the process of metamictization of chevkinite-(Ce). This process liberates Ti and F to the fluid and facilitates late astrophyllite crystallization (see Figure 2).

In situ single spot Rb-Sr dating [3] in microcline yields an age of 898 ± 6 Ma indicating conditions of slow cooling during the Sveconorwegian orogeny. These observations also confirm the presence of alkaline intrusive rocks associated to the anorogenic magmatism at around 1330 Ma in SW Sweden.

References:

[1] Hegardt, Cornell, Hellström & Lundqvist (2007), *GFF* 129(3), 227-234.

[2] Macdonald & Saunders (1973), *Mineralogical Magazine* 39(301), 97-111.

[3] Rösel & Zack (2022), *Geostandards and Geoanalytical Research*, 46(2), 143-168.

