A new Zr-Ti-silicate related to rosenbuschite from the agpaitic rocks of Norra Kärr, southern Sweden

Andreas Karlsson[a], Fabrice Dal Bo[b,c], Henrik Friis[b], Erik Jonsson[d,e], Thomas Zack[f] and Axel S.L. Sjöqvist[f,g]

[a]Department of Geosciences, Swedish Museum of Natural History, Stockholm, Sweden, andreas.karlsson@nrm.se; [b]Natural History Museum, University of Oslo, Oslo, Norway; [c]Département de Géologie, University of Liège, Liège, Belgium; [d]Department of Mineral Resources, Geological Survey of Sweden, Uppsala, Sweden; [e]Department of Earth Sciences, Uppsala University, Uppsala, Sweden; [f]Department of Earth Sciences, University of Gothenburg, Gothenburg, Sweden; [g]Axray Scientific, Vårgårda, Sweden

A new member of the seidozerite supergroup and rinkite group with the ideal formula $Na_6Ca_6Zr_2Ti_2(Si_2O_7)_4O_2F_6$ has been discovered at Norra Kärr. The new mineral is triclinic (P-1) and occurs macroscopic pale yellow to straw yellowish radiating prismatic laths in a matrix mainly composed of albite, microcline, arfvedsonite and minor aegirine, along with accessory phases such as nepheline, mosandrite-(Ce), catapleiite and analcime. It exhibits a pale green to yellowish green fluorescence under short wave UV-light. The new mineral is closely related to rosenbuschite, ideally $Na_6Ca_6Zr_3Ti(Si_2O_7)_4O_2F_6$ via the homovalent substitution $Zr^{4+} \rightarrow Ti^{4+}$ on the M5a site, and to kochite, $Na_6Ca_4Mn_2Zr_2Ti_2(Si_2O_7)_4O_2F_6$ through $2Mn \rightarrow 2Ca$ on the M1b site. An empirical formula derived from WDS and single crystal XRD (on the basis of 36 anions) is: $(Na_{4.84}Ca_{0.84})_{\Sigma 5.68}(Ca_{5.76}Y_{0.22}REE_{0.02})_{\Sigma 6.00}(Zr_{1.69}Mn_{0.18}Ca_{0.07}Fe_{0.05}Mg_{0.01})_{\Sigma 2.00}(Ti_{1.86}Zr_{0.09}Nb_{0.05})_{\Sigma 2.00}(Si_{2.01}O_7)_4(F_{5.65}O_{2.35})_{\Sigma 8.00}$.

The Norra Kärr alkaline complex is a classical locality of agpaitic rocks in southern Sweden, which was first described by Törnebohm (1906). Agpaitic rocks are peralkaline igneous rocks that are defined by their content of complex volatile-bearing Zr–Ti–HFSE silicate minerals, such as eudialyte group minerals, catapleiite and rosenbuschite, which occur instead of common minerals like zircon and titanite. The complex is approximately 0.5 by 1.5 km at the surface and consists of different varieties of peralkaline silica-undersaturated syenites, which intruded and caused fenitisation of the surrounding granitic bedrock at 1.49±0.01 Ga (Sjöqvist et al. 2017).

The specimen that instigated the current investigations was collected by Lage Karlsson in the 1990s in the northern part of the complex, near the western contact to the granite. A closer re-examination of similar material in the collection of the Swedish Museum of Natural History resulted in the recognition of additional samples of the new mineral. One of these very rich specimens was almost certainly collected by Axel Hamberg and investigated by Törnebohm (1906) in his pioneering work on the Norra Kärr complex. These samples originate from a domain in Norra Kärr that contains large rounded “lakarpite” and “pulaskite” enclaves surrounded by strongly foliated fine-grained “grennaite”.

The new mineral does not occur in association with eudialyte-group minerals. Our new observations are consistent with those made by Adamson (1944) and Sjöqvist et al. (2013) and confirm that the “lakarpite” in the western part of the complex is devoid of eudialyte group minerals, the absence of which could be an important factor in the formation of this new mineral. It is the fourth seidozerite supergroup mineral confirmed from the Norra Kärr alkaline complex after mosandrite-(Ce) (Sjöqvist et al. 2013), jinshajiangite (Holtstam 1998) and rosenbuschite (*s.s.*; Törnebohm 1906).

References

Adamson, O. J., 1944: The petrology of the Norra Kärr district: An occurrence of alkaline rocks in southern Sweden. *GFF 66(2)*, 113-255.

Holtstam, D., 1998: Jinshajiangite from the Norra Kärr alkaline intrusion, Jönköping, Sweden. *GFF 120(4)*, 373-374.

Sjöqvist, A. S. L., Cornell, D. H., Andersen, T., Erambert, M., Ek, M. & Leijd, M., 2013: Three compositional varieties of rare-earthelement ore: eudialyte-group minerals from the Norra Kärr alkaline complex, southern Sweden. *Minerals 3*(1), 94–120.

Sjöqvist, A. S. L., Cornell, D. H., Andersen, T., Christensson, U. I. & Berg, J.T., 2017: Magmatic age of rare-earth element and zirconium mineralisation at the Norra Kärr alkaline complex, southern Sweden, determined by U–Pb and Lu–Hf isotope analyses of metasomatic zircon and eudialyte. *Lithos 294–295*, 73–86.

Törnebohm, A. E., 1906: Katapleiit-syenit, en nyupptäckt varietet af nefelinsyenit i Sverige. *SGU Serie C 199*, 1–54.