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Hurlbutite, the first Be mineral from Västanå iron mine, Skåne, Sweden

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Abstract: Hurlbutite has been identified as the first Be mineral from the Västanå iron mine, Skåne, Sweden. The mineral is yellowish to whitish and its microscopic habit is platy and porous. Associated minerals are pinkish apatite, hematite, quartz and svanbergite. The unit cell dimensions calculated from powder X-ray diffraction data are: $a = 8.321(8)$ Å, $b = 8.834(8)$ Å, $c = 7.881(7)$ Å, $\beta = 90.38(6)°$. Energy dispersive X-ray analyses of Ca, Sr and P indicated the formula $(Ca_{0.93}Sr_{0.07})Be_2(PO_4)_2$. The presence of Be and O was qualitatively confirmed by parallel electron energy loss spectroscopy, and traces of B were also detected.

Keywords: Västanå iron mine, hurlbutite, Be mineral, phosphate

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Hurlbutite, ideally $CaBe_2(PO_4)_2$, has been found in the hematite ore at the Västanå iron mine, northeast of Kristianstad, in northeastern Skåne, southern Sweden. This small mine produced minor amounts of iron ore between 1804 and 1916 (Kornfält & Bergström 1983), and is the type locality for the aluminium phosphate minerals attakolite, augelite, berlinite, and trolleite, described by Blomstrand in 1868. Minerals from the mine at Västanå, previously described in the literature, are listed in Table 1. Hurlbutite is a typical pegmatite mineral, which was described by Mrose (1952) from the Smith Mine, Newport, New Hampshire.

The only hurlbutite specimen currently known from Västanå iron mine was collected in July 1997 by Daniel Svensson and Lennart Svensson (specimen # 3451 in the mineral collection at the Center for Chemistry and Chemical Engineering). The original hurlbutite lens had a size of approximately 22 × 22 × 16 mm, but it was later cleaved into two pieces. There is a thin layer of pinkish manganoan fluorapatite, between the hurlbutite and the micaceous hematite. The hematite sporadically contains reddish svanbergite and larger lenses of quartz. The hurlbutite is yellowish to whitish and its habit is platy and porous, see the micrograph in Fig. 1. The platy habit gives the mineral a somewhat fibrous appearance to the naked eye when viewed from a certain direction, and the material is easily scratched with a metal object, despite the hardness of 6 reported for hurlbutite crystals (Mrose 1952). No fluorescence is observed in either long or short wave ultraviolet light.

Experimental

Chemical analyses were performed at 20 kV in a scanning electron microscope (Jeol JSM-840A) interfaced with an ISIS system for X-ray microanalysis and with a Jeol JEM-2000FX transmission electron microscope, operated at 200 kV and equipped with a Gatan parallel electron energy loss spectrometer (PEELS). X-ray powder diffraction data were obtained with a Huber G670 imaging-plate Guinier camera using $CuK_{\alpha 1}$ radiation (wave length 1.5405981 Å) and Si (a = 5.43088 Å) as an internal standard.

Results

The x-ray microanalyses (n = 7) were evaluated in the way that the molar ratios Sr/(Ca+Sr) and P/(Ca+Sr) were determined. The average Sr/(Ca+Sr) ratio was calculated to 0.07(2) and the average P/(Ca+Sr) ratio to 2.0(1). This indicates the formula $(Ca_{0.93}Sr_{0.07})Be_2(PO_4)_2$ for Västanå hurlbutite.

In the PEELS analyses the Västanå hurlbutite was compared to the hurlbutite from a pegmatite at Viitaniemi, Finland (specimen #2432), see Fig 2. In both specimens the Be, P, Ca and O peaks could be easily identified, but there is also a boron peak present in both spectra. Volborth (1952) has previously, with spectroscopic methods, detected traces of boron in the Vittaniemi hurlbutite, which confirms the interpretation of a boron peak in the PEELS spectrum.

Table 1. Previously described minerals from the Västanå iron mine.

Name	Formula	Reference
andalusite	Al_2SiO_5	1
attakolite	$(Ca,Sr)Mn^{2+}(Al,Fe^{3+})_4(HSiO_4)(PO_4)_3(OH)_4$	2
augelite	$Al_2(PO_4)(OH)_3$	3
bearthite	$Ca_2Al(PO_4)_2OH$	4
berlinite	$AlPO_4$	5
bjarebyite	$(Ba,Sr)(Mn^{2+},Fe^{2+},Mg)_2(Al,Fe^{3+})_2(PO_4)_3(OH)_3$	6
childrenite	$Fe^{2+}Al(PO_4)(OH)_2 \cdot H_2O$	7
fluorapatite	$(Ca,Mn)_5(PO_4)_3F$	8
hematite	Fe_2O_3	3
kaolinite	$Al_2Si_2O_5(OH)_4$	3
kyanite	Al_2SiO_5	3
lazulite	$(Mg,Fe^{2+})Al_2(PO_4)_2(OH)_2$	3
millisite	$NaCa(Al,Fe^{3+})_6(PO_4)_4(OH)_9 \cdot 3H_2O$	7
muscovite	$KAl_2(Si_3AlO_{10})(OH,F)_2$	9
pyrophyllite	$Al_2Si_4O_{10}(OH)_2$	10
quartz	SiO_2	3
rutile	TiO_2	11
svanbergite	$(Sr,Ca,Pb)Al_3(PO_4)(SO_4)(OH)_6$	12
trolleite	$Al_4(PO_4)_3(OH)_3$	3
zircon	$ZrSiO_4$	11

1. Weibull 1898, 2. Grice & Dunn 1992, 3. Blomstrand 1868, 4. Chopin et al. 1993, 5. Strunz 1941, 6. Thomasson 1983, 7. Hansen & Landa-Cánovas 1994, 8. Weibull 1886, 9. Harder 1956, 10. Sjögren 1848, 11. Geijer 1963, 12. Ygberg 1945.

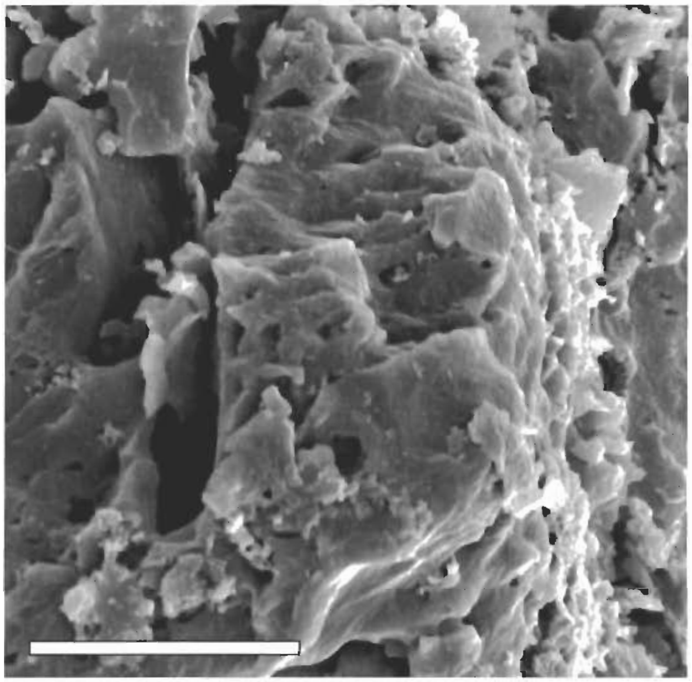

Fig. 1. Secondary electron image of hurlbutite from the Västanå iron mine. The scale bar is equal to 25 µm.

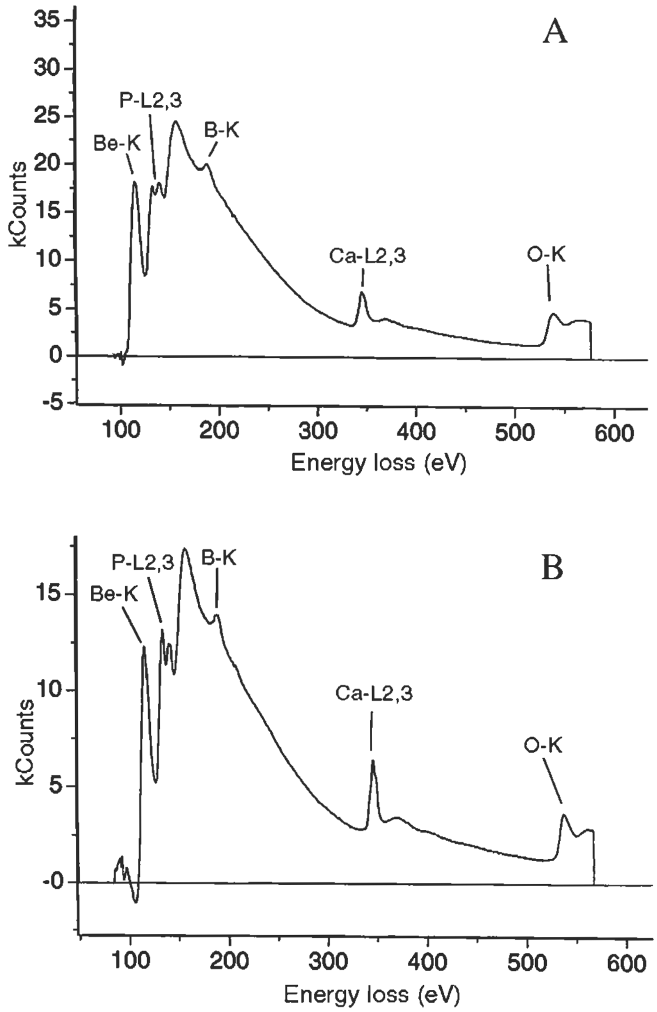

Fig. 2. Electron energy loss spectra of hurlbutite. **A.** Västanå iron mine, **B.** Viitaniemi, Finland.

The X-ray reflections of the hurlbutite from Västanå could be indexed on the basis of a monoclinic unit cell. The least squares refined unit cell parameters were: a = 8.321(8) Å, b = 8.834(8) Å and c = 7.881(7) Å, β = 90.38(6)° (V = 579.3 Å^3). The cell parameters determined by Lindbloom et al. (1974) on the hurlbutite from the Smith mine are: a = 8.299 Å, b = 8.782 Å and c = 7.798 Å, β = 90.5° (V = 568.3 Å^3). The larger unit cell volume of the Västanå mineral, compared to the Smith mine hurlbutite, can be explained by the greater substitution by Sr for Ca in the Västanå hurlbutite. The Smith mine hurlbutite is almost pure $CaBe_2(PO_4)_2$, with only trace amounts of Sr detectable by emission spectroscopy (Mrose 1952).

Discussion

The Västanå iron mine represents one of at least four Al_2SiO_5-lazulite-rutile mineralizations along the fault and shear zone in southern Scandinavia, named the Protogine zone (Andréasson & Rhode 1990). From north to south the deposits are Dicksberget, Hålsjöberg, Hökensås and Västanå. Several different geological models explaining the origin of this mineral paragenesis are proposed in the literature and they have been reviewed by Ek & Nysten (1990).

The identification of Be and B in a mineral from the Västanå iron mine indicates that a granitic magma has been involved in the formation process (Best 1982), either by forming a solid material later subject to extensive alteration, or as a source for hot gases or aqueous solutions inducing the alteration of some other type of rock. At Hålsjöberg, a gradual transformation of the host granite into a kyanite rock with lazulite and rutile has been described (Larsson 1996). At first sight, a similar mode of origin seems less likely for the mineralization at the mine in Västanå, since the surrounding rock is a quartzite exhibiting sedimentary features, with e.g. crossbedding and conglomerates. Nevertheless, we note with interest that a granite pegmatite dike, located close to the airport Stockholm Arlanda, Sweden, has been reported to contain a complex set of "normal" pegmatite minerals, including hurlbutite, but also zoned lenses with augelite and eosphorite in the center and scorzalite and allaudite at the margin (Nysten & Jonsson 1998). Similar, zoned phosphate lenses are well known from the mine at Västanå (Blomstrand 1868).

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References

Andréasson, P.-G. & Rhode, A., 1990: Geology of the Protogine Zone south of Lake Vättern, southern Sweden: a reinterpretation. *Geologiska Föreningens i Stockholm Förhandlingar 112*, 107–125.

Best, M.G., 1982: *Igneous and Metamorphic Petrology.* W.H. Freeman. 630 pp.

Blomstrand, C.W., 1868: Om Westanå mineralier. *Öfversigt af Kongliga Vetenskaps-Akademiens Förhandlingar 25*, 197–212.

Chopin, C., Brunet, F., Gebert, W., Medenbach, O. & Tillmanns, E., 1993: Bearthite, $Ca_2Al[PO_4]_2(OH)$, a new mineral from high-pressure terranes of the western Alps. *Schweizerische Mineralogische und Petrographische Mitteilungen 73*, 1–9.

Ek, R. & Nysten, P., 1990: Phosphate mineralogy of the Hälsjöberg and Hökensås kyanite deposits. *Geologiska Föreningens i Stockholm Förhandlingar 112*, 9–18.

Geijer, P., 1963: Genetic relationships of the paragenesis Al_2SiO_5-lazulite-rutile. *Arkiv för Mineralogi och Geologi 3*, 423–464.

Grice, J.D. & Dunn, P.J., 1992: Attakolite: New data and crystal-structure determination. *American Mineralogist 77*, 1285–1291.

Hansen, S. & Landa-Cánovas, A.R., 1994: Childrenite and millisite from Västanå iron mine, Skåne, Sweden. *GFF 116*, 92.

Harder, H., 1956: Untersuchungen an Paragoniten und natriumhaltigen Muskoviten. *Heidelberger Beiträge zur Mineralogi und Petrografi 5*, 227–271.

Kornfält, K.-A. & Bergström, J., 1983: Beskrivning till berggrundskartan Karlshamn NV. *Sveriges Geologiska Undersökning Af 135*, 1–173.

Larsson, D., 1996: *Proterozoic Hydrothermal Alteration and Mineralization along the Protogine Zone in Southern Sweden.* M.Sc. thesis, Lund University, Lund, Sweden. 45 pp.

Lindbloom, J.T., Gibbs, G.V., Ribbe, P.H., 1974: The crystal structure of hurlbutite: A comparison with danburite and anorthite. *American Mineralogist 59*, 1267–1271.

Mrose, M.E., 1952: Hurlbutite, $CaBe_2(PO_4)_2$, a new mineral. *American Mineralogist 37*, 931–940.

Nysten, P. & Jonsson, E., 1998: Mineralogy of a Late Svecofennian Granitic Pegmatite, Norrskogen, Uppland, Sweden. *17th General Meeting of the International Mineralogical Association in Toronto,* August 9–14, IMA, Abstracts, A150.

Sjögren, K., 1848: Pyrofyllit från Westanå öde jerngrufva. *Öfversigt af Kongliga Vetenskaps-Akademiens Förhandlingar*, p. 110.

Strunz, H., 1941: Isotypie von Berlinit mit Quarz. *Zeitschrift für Kristallographie 103*, 228–229.

Thomasson, R., 1983: *Bjarebyit, $(Ba,Sr)(Mn,Fe^{2+})_2(Al,Fe^{3+})_2(PO_4)_3(OH)_3$, ett nytt fosfatmineral från Västanå Järngruva, Skåne. – En undersökning av kristallstrukturen.* M.Sc. thesis, Lund University, Lund, Sweden. 30 pp.

Ygberg, E.R., 1945: Svanbergit from Horrsjöberg. *Arkiv för Kemi, Mineralogi och Geologi 20A*, 1–17.

Volborth, A., 1952: Phosphatminerale aus dem Lithiumpegmatit von Viitaniemi, *Annales Academiae scientiarum Fennicæ Ser. A. III. Geologica-geographica 39*, 1–90.

Weibull, M., 1886: Om manganapatit från Vestanå jemte några anmärkningar öfver apatitens sammansättning. *Geologiska Föreningens i Stockholm Förhandlingar 8*, 492–495.

Weibull, M., 1898: Om några Vestanåmineral. *Geologiska Föreningens i Stockholm Förhandlingar 20*, 57–66.