Eclarite from Bleka, Svartdal, Telemark county, Norway

Alf Olav Larsen[1] & Dan Topa[2]

[1]Bamseveien 5, N-3960 Stathelle, Norway (alf.olav.larsen@online.no)
[2]Zentrale Forschungslaboratorien/Mineralogisch-Petrographische Abt., Naturhistorisches Museum, Burgring 7, A-1010 Wien, Austria

Introduction

Eclarite, (Cu,Fe)$Pb_9Bi_{12}S_{28}$, was described as a new mineral species from Bärenbad, Achsel-Alm, Austria by Paar *et al*. (1983). It is regarded as a rare mineral, and apart from the type locality it has hitherto been reported in minute amounts from Felbertal, Austria (Topa 2001), from Hviezda, the Low Tatras, Slovak Republik (Pršek *et al*. 2008), from Turtman Valley, Wallis, Switzerland (Ansermet 2012), from Dragoons Mts., Cochise Co., Arizona, USA (Anthony *et al*. 1995) and Crabtree quarry, Wake Co., North Carolina, USA (http://rruff.info). Typically, the occurrences are sulphide and sulphosalt bearing quartz veins.

In the early 1970's one of the Bleka quartz veins which locally contained significant amounts of ore minerals was investigated by mineral collectors. In early 2014 one of the authors (AOL) was asked to identify a fibrous sulphosalt collected about 40 years earlier from the locality. This resulted in the identification of eclarite and subsequently the present description of this rare mineral as the first documentation of eclarite in Norway.

Occurrence

The gold-bearing deposit at Bleka, Svartdal in Seljord community, Telemark, was discovered in the 1870's. Mining was initiated in 1882 and continued until 1901. A second period of mining lasted 1933-1940 (Dons 1963, Åsbø 1975, Berg & Nordrum 1985). The mining was carried out along a few main veins.

The Bleka deposit consists of quartz veins with chlorite, tourmaline and carbonates (calcite, ankerite, dolomite, siderite) as the main minerals. About 20 veins are known within the Bleka area. They vary from a few cm to 2.5 m, have a general NE to ENE strike and dip rather steep. The Bleka vein system has been traced for 1100 m in the terrain and occurs in shear fractures of the Bleka metagabbro, which is a 1-2 km wide and more than 15 km long gabbroic sill emplaced within the Proterozoic Seljord group metasediments. The veins usually show strong zonation with quartz and chlorite close to the margins. Then follow inwards bands and zones of tourmaline (usually finely needleshaped), while the central part of the veins consists of carbonates. Some veins or parts of veins may, however, deviate from this pattern. Dahlgren (2015) reported that scheelite is a common accessory mineral in the gold bearing parts in the Bleka deposit. Ore minerals include chalcopyrite, bornite, pyrite, bismuthinite, cosalite, clausthalite, emplectite, lillianite, galenobismuthite, gladite, krupkaite, galena, silver and silver bearing gold (*electrum*) (Bugge 1935, Dons 1963, Selbekk 2010). However, no thorough study of the ore minerals has been carried out and some of the previous sulphosalt identifications may be questionable. In addition to eclarite, the present study confirms the occurrence of tsumoite at Bleka.

The eclarite-bearing quartz vein occurs in the E-adit, the westernmost adit in the Bleka main mining complex. At the entrance of the adit, where eclarite was collected, the quartz vein is 10-15 cm wide, strikes N70° and dips 70° NW (Fig. 1). Associated minerals include chalcopyrite, galena, tsumoite, gold, chlorite and ankerite. The sulphides and sulphosalts are mainly concentrated along the vein margins.

Fig. 1. The entrance of the E-adit at Bleka. The steeply dipping eclarite bearing quartz vein is visible on the right hand side of the adit. Photo: A.O. Larsen.

Physical properties

Eclarite from Bleka occurs as acicular crystals up to 5 mm in length, often as fan-shaped aggregates, embedded in quartz. The crystals are heavily striated parallel the elongation. The mineral has a bright tin-white colour and metallic lustre, but tarnishes relatively quickly when exposed to humidity. The hardness is 2.5, and calculated density (based on the unit cell dimensions and elemental composition) is 6.99 g/cm^3.

X-ray crystallography

The crystal structure of eclarite was first studied by Kupčik (1984) and later refined by Topa & Makovicky (2012). The mineral is orthorhombic, space group *Pmcn*. The Bleka eclarite was initially identified from its characteristic PXRD pattern. Indexing and least-squares refinement were done by the program CELREF (Laugier & Bochu 1999) using 27 diffraction lines with $I/I_0 > 10$ within the range 20º - 60º 2θ. Quartz was used as internal standard. The unit cell dimensions found are a = 4.0454(9) Å, b = 22.710(5) Å, c = 54.734(10) Å, V = 5028.5(1.8) Å^3. These data are very close to those given by Kupčik (1984) and Topa & Makovicky (2012).

Chemical composition

Quantitative chemical analyses of eclarite from Bleka were obtained with an electron microprobe. The 10 point analyses reveal that the mineral has a fairly homogeneous composition and the results are given in Table 1. The chemical formula, based on 20.85 large cations (Topa & Makovicky 2012), is $Cu_{1.46}Fe_{0.10}Ag_{0.13}Pb_{7.82}Bi_{12.64}Sb_{0.24}S_{27.69}$.

Table 1. Chemical composition (in wt.%, n.a. = number of analyses) of the Bleka eclarite

	wt.% (n.a.=10)	s.d.
Cu	1.75	0.04
Ag	0.27	0.10
Fe	0.11	0.02
Pb	30.64	0.27
Bi	49.88	0.28
Sb	0.55	0.07
S	16.76	0.12
total	99.97	0.11

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Conclusion

The present study shows that the complex Bleka deposit definitely has the potential of revealing interesting sulphosalts. Many of the previously reported Bi-sulphosalts need further investigation using modern analytical tools.

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