

Structural Evolution of the Björkdal Gold Deposit, Skellefte District, Northern Sweden: Implications for Early Proterozoic Mesothermal Gold in the Late Stage of the Svecokarelian Orogen

PÄR WEIHED,[†]

Division of Ore Geology, Luleå University of Technology, SE-971 87 Luleå, Sweden

JEANETTE BERGMAN WEIHED,[°]

Department of Earth Sciences, Uppsala University, Villavägen 16, SE-752 36 Uppsala, Sweden

AND PETER SORJONEN-WARD

Geological Survey of Finland, P.O. Box 1237, FIN-70211 Kuopio, Finland

Abstract

The Björkdal gold deposit is situated in the eastern part of the Paleoproterozoic Skellefte district in northern Sweden. The Skellefte district constitutes a 1.89 to 1.88 Ga volcanic arc with numerous volcanic massive sulfide deposits and lode gold deposits of which the Björkdal deposit is the largest, at ca. 20 Mt with 2.5 g/t Au.

The gold at Björkdal is associated with centimeter- to meter-wide, subvertical quartz veins at the northwestern contact between a quartz-monzodioritic to tonalitic intrusion and the surrounding supracrustal rocks. The main quartz veins strike north-northeast, and a minor set of veins strike east-northeast. The quartz veins terminate against a major thrust duplex at the contact between the intrusion and the structurally overlying supracrustal rocks. The mylonitic thrust zone has a 20° to 40° dip toward north and trends approximately east-west. A few kinematic observations indicate reverse to obliquely reverse slip on the thrust. Deformed quartz veins exist in lithons between thrusts within the duplex. In the mine, the quartz veins in the footwall to the thrust are spatially and temporally associated with moderately to steeply west dipping reverse shear zones with a northeast strike. It is suggested here that the quartz veins and the steep reverse shear zones are related to the thrust duplex and formed more or less simultaneously.

Fluid inclusion and isotopic results from previous studies indicate that juvenile magmatic fluids were responsible for the precipitation of quartz and sulfides at moderate temperatures and pressures. Furthermore, titanites from the quartz veins give ages of ca. 1.78 to 1.79 Ga, whereas the host pluton is dated at ca. 1.90 Ga, indicating a time gap of over 100 m.y. between the emplacement of the host rock and titanite growth in quartz veins. The regional deformation and metamorphism are poorly constrained in the area to some time between 1.87 and 1.80 Ga. As the quartz veins are virtually undeformed and do not exhibit metamorphic fluid inclusions or other evidence of premetamorphic origin, we interpret the titanite ages in the quartz veins as the age of emplacement of the veins. The ca. 1.78 to 1.79 Ga age is also constrained for the crustal-scale, north-south-striking shear zones in the area, and it is suggested here that the thrust duplex and steep reverse shear zones in the mine are third-order structures related to east-west shortening at ca. 1.80 Ga.

Gravity data from the Björkdal area indicate the presence of a less dense body at depth beneath the Björkdal pluton. The geophysical signature is best explained by the presence of a 1.80 Ga Skellefte-type intrusion at depth. Magmatic fluids from this S-type granite may have interacted with the host pluton and precipitated gold in the more competent pluton during the east-west shortening. The common occurrence of scheelite in the quartz veins is further evidence for magmatic fluids derived from a younger pluton at depth.

[†] Corresponding author: e-mail, par.weiheid@sb.luth.se

[°] Present address: Geological Survey of Sweden, Box 670, SE-751 28 Uppsala, Sweden.