

SIMS U–Pb constraints on the origin of 1.89 Ga marble- and skarn-hosted Zn-Pb-Ag sulphide deposits, Sala area, Bergslagen, Sweden

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Polymetallic sulphide deposits of Bergslagen in the Fennoscandian shield belong to the globally significant c. 1.9 Ga event of orogenic activity, crustal growth and metallogensis. Recent secondary ion mass spectrometry (SIMS) U–Pb dating zircon dating by Jansson et al. (2023) indicate that age differences exist between the two principal types of Bergslagen sulphide deposits, namely 1) syngenetic Zn-Pb-Ag and Cu deposits such as Zinkgruvan (formed c. 1.90–1.89 Ga) and 2) carbonate-replacement/skarn-type Zn-Pb-Ag-(Cu-Au) deposits such as Garpenberg (formed somewhat later at c. 1.89 Ga). In this contribution, we present new geochronological data from key igneous units at the Sala Zn-Pb-Ag deposit, one of the most important members of the 2nd type.

Concordant zircon analyses (N=17, in situ secondary ion mass spectrometry, SIMS) from a metavolcanic interbed with relict accretionary lapilli in the marble host to the Sala deposit provided an average ²⁰⁷Pb/²⁰⁶Pb age of 1889±4 Ma. This age overlaps within error but is slightly younger than a previously reported age of 1894±2 Ma for the same unit (multigrain discordia age, Stephens et al., 2009). The new age is a more accurate age constraint for the deposition of the limestone precursor to the marble host and sets a maximum age of the carbonate-replacement and skarn Zn-Pb-Ag mineralization hosted by it.

The marble host is intruded by subvolcanic feldspar±quartz-porphyrific dacite and granodiorite. A porphyritic granodiorite dyke intrudes and truncates the ore zone and hydrothermally altered carbonate wall rock at the Bronäs Zn-Pb-Ag deposit. Concordant zircon analyses (N=13, SIMS) from the Bronäs granodiorite define an average ²⁰⁷Pb/²⁰⁶Pb age of 1887±6 Ma for igneous crystallization of the dyke. Stephens et al. (2009) calculated a discordia age of 1892+5/-4 Ma for another subvolcanic intrusion north of Sala (Stråbruken porphyry). Mapping by Jansson et al. (2021) shows that it crosscuts both the contact of the alteration envelope in the marble host, and its contact to overlying felsic pyroclastic metavolcanic rocks in the stratigraphic hangingwall. Again, concordant zircon analyses (N=22) from the Stråbruken porphyry define a slightly younger average ²⁰⁷Pb/²⁰⁶Pb age of 1889±3 Ma and provide a minimum age of the hydrothermal Zn-Pb-Ag mineralization in the marble.

The new results are consistent with other geological evidence suggesting an early, pre-D₁ (c. 1.87 Ga) age for sulphide deposits at Sala (Jansson et al. 2021). A transition from volcanism and plutonism combined with intense magmatism, regional extension, and local caldera subsidence at c. 1.89 Ga is inferred as critical for the formation of replacement-style Zn-Pb-Ag-(Cu-Au) deposits, not just at Sala but also at Garpenberg and Falun. In contrast, geochronological constraints for syngenetic Zn-Pb-Ag deposits such as Zinkgruvan indicate that these deposits formed distal to active volcanic centers or during pauses in volcanism during the build-up of the stratigraphic succession.

References

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