European Mineralogical Conference
Vol. 1, EMC2012-526-1, 2012
European Mineralogical Conference 2012

Origin of the Belo Brdo Pb-Zn (Ag) deposit in the Kopaonik metallogenic district of Serbia and Kosovo

P. J. Treloar (1), M. Veselinovic-Williams (1), A.H. Rankin (1), and A. Boyce (2)

(1) Centre for Earth and Environmental Sciences, Kingston University, Kingston-upon-Thames, Surrey KT1 2EE, United Kingdom (P.TRELOAR@KINGSTON.AC.UK, 0044-1815-), (2) Scottish Universities Environmental Research Centre, East Kilbride, Glasgow, Scotland, G75 0QF

The Belo Brdo Pb-Zn (Ag) deposit and nearby polymetallic deposits in the Kopaonik metallogenic district of Serbia and Kosovo evolved within a Tertiary volcano-magmatic complex. Regionally distributed, calc-alkaline andesitic-dacitic and quartz-latite rocks show a clear subduction-related character. Listwanites, as well as Cretaceous limestones, represent important host rocks to the carbonate-replacement type of mineralisation at the Belo Brdo deposit.

A genetic model for the origin and evolution of the Belo Brdo deposit involves three stages of mineral deposition, namely (1) pre-ore stage, characterised by hydrothermal alteration of host rocks (listwanisation, quartz-sericite-pyrite, quartz-tourmaline, propylitic and intermediate argillic) and evolution of Ni-Co-As mineral assemblage; (2) main-ore stage, represented by massive sulphides: sphalerite, galena, pyrite, arsenopyrite, chalcopyrite, Ag-tetrahedrite-tennantite, bournonite; and (3) post-ore stage (quartz, carbonates ±pyrite).

A combination of fluid inclusion microthermometry, sphalerite and arsenopyrite geothermometry, and oxygen-isotope geothermometry suggest that hydrothermal mineralisation was deposited from epithermal- to moderately high temperature (160–350°C), low salinity (6.5 eq. wt. % NaCl) fluids. Robust stable isotope data document a magmatic component during early stages of deposit evolution. These data include: (1) moderately high temperatures (∼420°C) for the quartz-sericite-pyrite alteration and magmatic δ^{18}O values of fluid in equilibrium with sericite and quartz (6.5 – 8.5‰); (2) δD values of fluid in equilibrium with sericite (-58‰; (3) δ^{18}O and δD values of fluid in equilibrium with tourmaline (10‰ and -38‰ respectively); (4) δ^{13}C value of carbon in silicified listwanite (-3.5‰); and (5) δ^{34}S values of pyrite hosted by andesites and massive listwanite (2.6-4.1‰). The calculated oxygen isotope composition of the main-ore fluid shows magmatic signatures of 5.9 to 7.7‰. Calculated isotopic compositions of water responsible for sulphide precipitation in late stage ore breccia show depletion in both oxygen and hydrogen values (δ^{18}O = 4.8 to 2.3 ‰ and δD = -93 to -96 ‰), indicating an increased role of meteoric waters. Gangue carbonates are depleted in both δ^{18}O (6.6 to 18 ‰ and δ^{13}C (2 to –4.4 ‰ compared with Cretaceous limestones, suggesting the influx of an external magmatic fluid. REE geochemistry of carbonates points to acidic, reduced, high-temperature hydrothermal fluids.

Uniform isotopic sulphur compositions of all the main-ore stage sulphides (3.4-5.4‰; average 4.4‰) are similar to those from nearby Cu-Au porphyry and skarn deposits, indicating a common source of sulphur for all deposits as well as a probable igneous source. The hydrothermal deposits in the Kopaonik district area have homogeneous lead isotopic compositions (^{206}Pb/^{204}Pb= 18.68 to 18.76, ^{207}Pb/^{204}Pb= 15.67 to 15.68, and ^{208}Pb/^{204}Pb = 38.87 to 38.91), similar to those of local calc-alkaline volcanic rocks (^{206}Pb/^{204}Pb = 18.76-18.82, ^{207}Pb/^{204}Pb 15.66-15.68 and ^{208}Pb/^{204}Pb 38.87-38.97) indicating a genetic link between mineralisation and magmatism.

The Belo Brdo deposit has the characteristics of an intermediate-sulphidation base-metal deposit, similar to those related to magmatic-hydrothermal systems located within the southern sectors of the Alpine-Balkan-Carpathian-Dinaride province. It shares many common features with the high-temperature, carbonate-hosted Pb-Zn-Ag (±Cu; ±Au), subduction related deposits of western North America and Mexico.