Petrography, Isotope and Fluid Inclusion Studies of the Late Cretaceous Au-Ag and Polymetallic Beqtakari Prospect: New Example of an Epithermal Volcanic System in the Bolnisi Mining District, Lesser Caucasus, Georgia

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Beqtakari is a Au-Ag-Zn-Pb ± Cu epithermal prospect located in the Bolnisi mining district of Georgia, Lesser Caucasus. It is hosted by intermediate to felsic calc-alkaline volcanic strata of Upper Cretaceous age. The importance of the Beqtakari prospect lies in its younger and higher stratigraphic position in regard to other deposits in the district and the Lesser Caucasus in general. It sits on the Eurasian margin in the Artvin-Bolnisi terrane, located between the Somkheto-Karabakh island arc to the east and the Eastern Pontides to the west. The host rocks are subaerial volcanic and volcano-sedimentary rocks deposited in a postcollisional geodynamic environment in contrast to the host rocks of the better-studied Madneuli polymetallic deposit that were deposited in a marine to shallow-water environment.

This study focuses on petrography, mineralogical observations, whole-rock geochemistry, stable and radiogenic isotope, and fluid inclusion analyses from detailed field work mapping, combined with drill core logging with 3-D modeling in order to characterize the volcanic lithofacies and the mineralizing fluid conditions. Mineralization is divided into two zones. The Au-Ag–rich zone is hosted in strongly silicified and fractured rhyodacite and the precious and polymetallic mineralization is hosted in hydrothermally altered autobreccia of the Au-Ag-rich unit. The latter unit is affected by alteration varying from illite-sericite to chlorite-rich. The mineralization type occurs in quartz-barite veins with sphalerite-chalcopyrite-galena ± tennantite-tetraherite and different stages of euhedral pyrite and spectacularly zoned colloform arsenian pyrite. Late dikes related to a rhydacitic dome crosscut the Au-Ag–bearing silicified rhyodacite unit. The later mineralization is covered by a welded tuff unit from the proximal subformation of Gasandami that shows abundant devitrification texture. The genetic relationship of this proximal subformation with the silicified rhyodacite has yet to be determined. The distal subformation of Gasandami is a resedimented autoclastic deposit that clearly shows transport of the proximal Gasandami formation and incorporation of nonvolcanic particles.

A sulfur isotope study has been carried out on sulfate and sulfide samples collected at the surface and in drill core. The sulfates have distinct sulfur isotope compositions. The sulfates yield $\delta^{34}S$ values from +12.5 to +18.5‰ with one gypsum sample at +9.2‰. The majority of the isotopic compositions of the sulfides range between 0 and +4‰, except one sample with a value of –5.2‰. Temperatures were calculated using a sulfur isotope geothermometer for various sulfate-sulfide pairs from veins in the hydrothermally altered autobreccia, in apparent textural equilibrium. The obtained temperatures range from 260°C to 461°C. They are anomalously high for a typical epithermal environment and likely reflect disequilibrium conditions of the sulfur isotope system.

A fluid inclusion microthermometry study is being done on quartz, barite and sphalerite from the polymetallic stage. Primary and secondary fluid inclusions in sphalerite have already been recognized during transmitted light petrography. Radiogenic isotopes (Nd, Sr, Pb) are also going to be analyzed on

the late rhyodacitic dome and compared throughout the Bolnisi district in order to characterize its petrogenetic and metallogenic evolution.