

The magmatic evolution of the Buchim-Damjan-Borov Dol ore district

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Introduction

This Project explores the Buchim-Damjan-Borov-Dol ore district with a detailed look on the Buchim porphyry Cu-Au deposit (Figure 1). The area, which is about 150 km² in size, is part of the Southern Balkan tectonic system (Serafimovski et al. 2010). The ore district is located in the eastern part of Macedonia, around the contact of the Vardar zone in the east and the Serbo-Macedonian massif in the west (Serafimovski et al. 2010). During Upper Oligocene, a lot of sub- and volcanic activities have occurred in this region resulted in numbers of intrusions with various magmatic compositions and age. The district includes the following intrusions which are specified in this research: Buchim (Central, Vrsnik, Bunazik), Borov Dol, Damjan and Black Hill. They are dated between 24.5-24.0 Ma with the U-Pb method in Zircon and have an andesitic to trachyandesitic composition. Further most of them consist of various magma generations. This leads to magma mingling and differences in mineralogical features, like phenocryst occurrence and grain size.

The Buchim deposit consists of four ore bodies: Central, Bunardzik, Vrsnik and Cukar. These ore bodies are spread over an area of approximately 10 km² (Čiflignane 1993). The Central, Bunardzik and Vrsnik ore bodies are related to andesitic porphyry intrusions, whereas the Cukar ore body consists of a supergene copper mineralization (Čiflignane 1993). All four ore bodies lay in different Precambrian Gneisses (Čiflignane 1993). The reserves of the Central ore body are 120 Mt with an average Cu content of .34% and an average Au content of .35g/t (Serafimovski et al. 2010). Nevertheless the low ore grade, the mining of the deposit started in 1979 (Serafimovski et al. 2010). A mineralized gneissic xenolith, in the Central porphyry andesite, leads to the conclusion that the current porphyry is an overprinting of an earlier porphyry stock. Further the present intrusion shows some magma mixing features. Crosscut relation at the contact of the Central and Vrsnik porphyry show that Vrsnik body is younger than the Central porphyry bodies. The Vrsnik porphyry contains 4 magmatic events. Two of them show also a magma mingling. The Bunazik intrusion contains two magma generations.

Results

Zr/Ti vs. Nb/Y (Pierce 1996), Si vs. Zr/Ti (Winchester and Floyd 1977) and Th vs. Co (Hastie et al. 2007) are all indicating the rock composition as andesitic. The only exception is Black Hill. It has a trachytic composition. Based on the Th vs. Co data the rocks further belong to the high K and shoshitic series. Chondrite-normalized (after Hofmann 1988) rare earth element patterns of the samples are showing enrichment in light REE and depletion in middle REE elements leading to hockeystick geometry. This indicates an early amphibole fractionation. The result is supported by high Sr/Y ratio, which indicates high-pressure magma and/or hydrous magma, in which plagioclase crystallization is suppressed and hornblende saturated (Rohlach and Loucks 2005). Microscopical features are supporting this interpretation of an early amphibole phase and amphibole fractionation. Further N-MORB normalized (after Hofmann 1988) values showing a clear continental arc setting pattern.

Geological Map of the Buchim-Damjan-Borov Dol Ore District

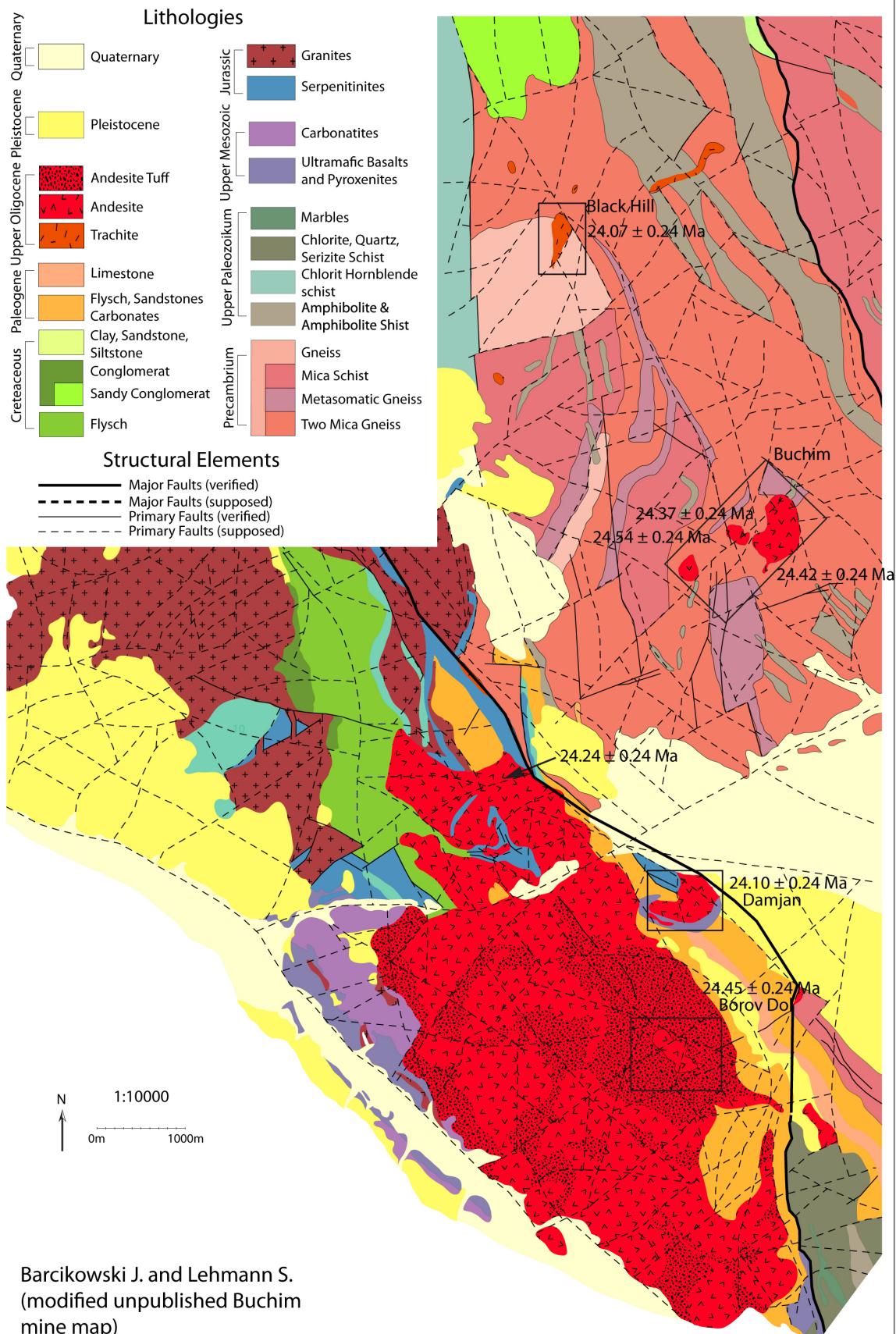


Fig. 1: Geological map of the Buchim-Damjan-Borov Dol ore district

References

- Čifliganec, V., 1993, Copper Mineralization in the Republic of Macedonia: Types and Distribution Patterns: With Special Reference to the Porphyry Copper Deposit Bučim, Faculty of Mining and Geology, Štip/Mining and Metallurgy of Copper “Bučim”, Radoviš, 303 pp.
- Hastie, A.R., Kerr, A.C., Pearce, J.A., Mitchell, S.F., 2007, Classification of altered volcanic island arc rocks using immobile trace elements: Development of the Th-Co discrimination diagram, Journal of petrology, v. 48, pp. 2341-2357
- Hofmann, A.W., 1988, Chemical differentiation of the Earth: the relationship between mantle, continental crust, and oceanic crust, Earth Planet, Sci. Lett. 90, pp. 297-314
- Pierce J.A., 1996, A users guide to basalt discrimination diagrams. In: Wyman, D.A. (eds.) Trace Element Geochemistry of Volcanic Rocks: Applications for Massive Sulphide Exploration. Geological Association of Canada, Short Course Notes 12, 79-113
- Rohrlach, B.D., Loucks, R.R., 2005, Multi-million-year cyclic ramp-up of volatiles in a lower crustal magma reservoir trapped below the Tampakan copper-gold deposit by Mio-Pliocene crustal compression in the Southern Philippines, in Porter, T.M. (Ed), Super Porphyry Copper & Gold Deposits: A Global Perspective; PGC Publishing, Adelaide, v. 2, pp. 369-407
- Serafimovski, T., Stefanova, V., Volkov, A.V., 2010, Dwarf Copper-Gold Porphyry Deposits of the Buchim-Damjan-Borov Dol Ore District, Republic of Macedonia (FYROM), Geology of Ore Deposits, v. 52, pp. 179-195
- Serafimovski, T., Cifliganec, V., Jankovic, S., Boev, B., 1996, Genetic Model of the Buchim Porphyry copper deposits, republic of Macedonia: Plate Tectonic Aspects of the Alpine Metallogeny in the Carpatho-Balkan Region," in Proceedings of the Annual Meeting, v. 1, pp. 63–73
- Volkov, A.V., Serafimovski T., Stefanova, V.,Sidorov, A.A., 2010, Formation Mechanism of Dwarfish Cu-Au Porphyry Deposits of Macedonia, Doklady Earth Sciences, v. 431, pp.649-655
- Winchester, J.A., Floyd, P.A., 1977, Geochemical magma type discrimination: application to altered and metamorphosed basic igneous rocks, Earth and Planetary Science Letters 28, 459-469