Diversity of copper and gold deposits in the Eastern Europe Balkan, Carpathian and Rhodopean belts: tectonic, magmatic and geochronological investigations

SCOPES Project - Conference & Field Trip: Macedonia & Serbia

Organizers: A. von Quadt, T. Serafimovski, I. Peytcheva & V. Cvetkovic

May 29 - June 02, 2012 - Izgrev Hotel, Stip, Macedonia

Program, abstracts and field guide, edited by A. von Quadt & T. Serafimovski
(vonquadt@erdw.ethz.ch- todor.serafimovski@ugd.edu.mk)

ETH
Eidgenössische Technische Hochschule Züric
Swiss Federal Institute of Technology Zurich

Geological Institute
BAS - Sofia

University "Goce Delcev"-Stip

University of Belgrade

FNSNF
Fonds national suisse
Schweizerischer Nationalfonds
Fondo nazionale svizzero
Swiss National Science Foundation

SE Europe
SE Europe
Geoscience Foundation

DIREKTION FÜR ENTWICKLUNG UND ZUSAMMENARBEIT DEZA
DIRECTION DU DEVELOPPEMENT ET DE LA COOPERATION DDC
DIREZIONE DELLO SVILUPPO E DELLA COOPERAZIONE DSC
SWISS AGENCY FOR DEVELOPMENT AND COOPERATION SDC
AGENCIA SUIZA PARA EL DESARROLLO Y LA COOPERACION COSUDE

Content

Participant list of the workshop in Stip, May – June 2012

	First name	Name	Institution
1	Todor	Serafimovski	University Goce Delcev, Stip
2	Goran	Tasev	University Goce Delcev, Stip
3	Dobriela	Rogozareva	University Goce Delcev, Stip
4	Aneta	Donkova-Petrushova	University Goce Delcev, Stip
5	Lazar	Georgiev	University Goce Delcev, Stip
6	Violeta	Stefanova	University Goce Delcev, Stip
7	Albrecht	von Quadt	ETH Zurich
8	Stephan	Lehmann	ETH Zurich
9	Joshua	Barcikowski	ETH Zurich
10	Daniela	Gallhofer	ETH Zurich
11	Milorad	Antic	Uni Basel
12	Stefan	Schmid	ETH Zurich
13	Nino	Seghedi	Romanian Academy-Institute of Geodynamics
14	Irena	Peytcheva	BAS - Geological Institute
15	Peter	Marchev	BAS - Geological Institute
16	Valentin	Grozdev	BAS - Geological Institute
17	Stoyan	Georgiev	BAS - Geological Institute
18	Elitsa	Stefanova	BAS - Geological Institute
19	Petyo	Filipov	BAS - Geological Institute
20	Rossitsa	Vassileva	BAS - Geological Institute
21	Zlatko	Peltekovski	University Goce Delcev, Stip
22	Atanas	Hikov	BAS - Geological Institute
23	Valdica	Cvetkovic	University Belgrade, Faculty of Mining and Geology
24	Aleksandar	Pacevski	University Belgrade, Faculty of Mining and Geology
25	Kristina	Saric	University Belgrade, Faculty of Mining and Geology
26	Suzanna	Eric	University Belgrade, Faculty of Mining and Geology
27	Miodrag	Banjesevic	
28	Masa	Radivojevic	University Belgrade, Faculty of Mining and Geology
29	Aleksandar	Miskovic	University of British Columbia, Vancover
30	Craig	Hart	Department of Earth & Ocean Sciences
31	Bojan	Djordjevic	Avala Resources DOO
32	Sinisa	Glisic	Avala Resources DOO
33	Sibila	Borojevic Sostaric	University Zagreb
34	Dejan	Kozelj	South Danube Metals DOO Beograd
35	Stela	Anatasova	BAS
36	Bayram	Artun	Teck Cominco Limited
37	Daniela	Bombol	EurOmax Macedonia DOOEL Skopje
38	Mihaela-Elena	Cioaca	Geological Institute of Romania
39	Saygun	Keles	Teck Cominco Limited

40	Yassen	Khrischev	Empire Mining Corporation
41	Kemal	Kurcan	Teck Cominco Limited
42	Georgi	Magaranov	Mundoro Capital Inc
43	John	Menzies	Cmi Capital Limited
44	Marian	Munteanu	Geological Institute of Romania
45	Gligor	Saveski	Atlas Copco AB
46	Dechev	Teo	Mundoro Capital Inc
47	Vasil	Andreev	
48	Dorin	Dordea	PROSPECTIUNI SA
49	Veselin	Kovachev	University Sofia
50	Osman	Kurtulus	
51	Dimitar	Tsotsorkov	Asarel
52	Ahmet	Tukac	
53	Bahri	Yildiz	Stratex Madencilik San. Tic. Ltd. Şti
54	Trajca	Toncic	Mining and Metallurgical Company
55	Aleksandar	Pacevski	University Belgrade, Faculty of Mining and Geology
56	Nadka Bozhkova	Vasileva	Ellatzite Mine
57	Zheyazko Hristo	Yalamov	Ellatzite Mine
58	Aurelien	Rombaut	
59		Driver	

SCOPES Project - Conference & Field Trip: Macedonia & Serbia

May 29 - June 02, 2012

"Diversity of copper and gold deposits in the Eastern Europe Balkan, Carpathian and Rhodopean belts: tectonic, magmatic and geochronological investigations".

	Name	Title	Affiliation	
0	Albrecht von Quadt	Opening	ETH Zurich	8.15 - 8.30
	Regional Geology			
1	Stefan Schmid	Correlation of tectonic units from the Alps to Western Turkey	ETH Zurich	8.30 - 9.00
2	Ioan Seghedi	Miocene-Quaternary basalts from East Carpathian volcanic chain, Romania: a mineral chemistry and melt inclusion study	Institute of Geodynamics of Romanian Academy, Bucharest	9.00 - 9.30
3	Sibila Borojevic Sostaric	Oligocene shoshonitic rocks of the Rogozna Mts. (Central Balkan Peninsula): evidence of petrogenetic links to the formation of Pb-Zn-Ag ore deposits	Faculty of Mining Geology, Zagreb	9.30 - 9.45
4	Kristina Saric	New LA-ICP-MS U/Pb zircon data on various granitoids from the European side of the Tethyan Mesozoic suture	Faculty of Mining and Geology, Belgrade	9.45 - 10.00
	Regional Metallogeny			
5	Todor Serafimovski	Major Alpine ore districts at the territory of the Republic of Macedonia	University "Goce Delcev"-Stip	10.00 - 10.30
6	Daniela Gallhofer	Geodynamics, geochronology and Cu-Au hydrothermal ore provinces in the Banat region and Apuseni mountains	ETH Zurich, IGP	10.30 - 11.00
	Coffee break			**11.00 - 11.30**
7	Alexsandar Pacevski	Skarn mineralizations in the Bor ore district: new evidence from study of bornite-chalcopyrite-hematite paragenesis	Faculty of Mining and Geology, Belgrade	11.30 - 11.45
	Environmental Geology			
8	Lazar Gjorgiev	Technogenous deposits and their environmental impact around the Buchim Mine	University "Goce Delcev"-Stip	11.45 - 12.00
9	Aneta Donkova-Petrushova	Au-Ag tellurides and other mineral associations in the Ilovitza Cu-Au deposit	University "Goce Delcev"-Stip	12.00 - 12.15
10	Dobriela Rogožareva	Some typical hydrothermal alterations in the Ilovitza Cu-deposit	University "Goce Delcev"-Stip	12.15 - 12.30
	Lunch			**12.30 - 14.00**
	Deposit Studies			
11	Elitsa Stefanova	Ilovitsa porphyry Cu-Au deposit: sequence of vein formation and sulfide deposition	BAS, Geological Institute, Sofia	14.00 -14.15
12	Zlatko Peltekovski	Principle metallogenic features of the Sasa Pb-Zn deposit, Republic of Macedonia	University "Goce Delcev"-Stip	14.15 - 14.30
13	Goran Tasev	New data of fluid inclusions study of the Kadiica deposit, Republic of Macedonia	University "Goce Delcev"-Stip	14.30 - 14.45
14	Violeta Stefanova	Placer gold prospecting around the Tertiary occurrences in the Republic of Macedonia	University "Goce Delcev"-Stip	14.45 - 15.00
15	Rossitza Vassileva	Compositional characteristics of sulphide mineralization from the hydrothermal Madan Pb-Zn deposits: a LA-ICP-MS study	BAS, Geological Institute, Sofia	15.00 - 15.15

16	Atanas Hikov	Rare earth element mobility during advanced argillic alteration in Assarel porphyry copper deposit, Central Srednogorie, Bulgaria	Elatsite Mine	15.15 - 15.30
Magmatism				
16	Joshua Barcikowski	Magmatic evolution of the Buchim-Damjan-Borov Dol ore district - Petrology-geochemistry	ETH Zurich	15.30 - 15.45
17	Stephan Lehmann	Magmatic evolution of the Buchim-Damjan-Borov Dol ore district- Geochronology-source material	ETH Zurich	15.45 -16.00
	Coffee break			**16.00 - 16.30**
18	Milorad Antic	More than 500 Ma of magmatic and tectonic evolution of the Serbo-Macedonian Massif (south Serbia, southwest Bulgaria and east Macedonia)	University of Basel	16.30 - 16.45
19	Stela Atanasova	Magma Interaction Recorded in Amphiboles from Vitosha pluton, Western Srednogorie, Bulgaria"	BAS, Geological Institute, Sofia	16.45 - 17.00
20	Petyo Filipov	Preliminary Data on the Age and Geochemistry of Mesta Volcanic Complex and Central Pirin Pluton	BAS, Geological Institute, Sofia	17.00 - 17.15
21	Stoyan Georgiev	Transect trough the Cenozoic magmatism in WSW Bulgaria and Macedonia from Pirin Mountain to Kozhuf: temporal and isotope-geochemistry constraints	BAS, Geological Institute, Sofia	17.15 - 17.30
22	Valentin Grozdev	U-Pb zircon dating and zircon population analyses of the Paleogene magmatic rocks in Kyustendil and Kratovo area.	BAS, Geological Institute, Sofia	17.30 - 17.45

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

Barcikowski Joshua[1], Lehmann Stephan[1,] von Quadt, Albrecht[1], Heinrich, Christoph A.[1] and Serafimowski, T.[2]

[1]IGP, ETH-Zurich, Switzerland, joshuaba@student.ethz.ch, lehmanst@student.ethz.ch
[2] *Faculty of Natural and Technical Sciences, Dept.Mineral Deposits, University "Goce Delcev"-Stip, R. Macedonia*

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 km^2 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, Bunarzik), 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 km^2 (Čifligance 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 (Čifligance 1993). All four ore bodies lay in different Precambrian Gneisses (Čifligance 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 Bunarzik 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 shoshoitic 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.

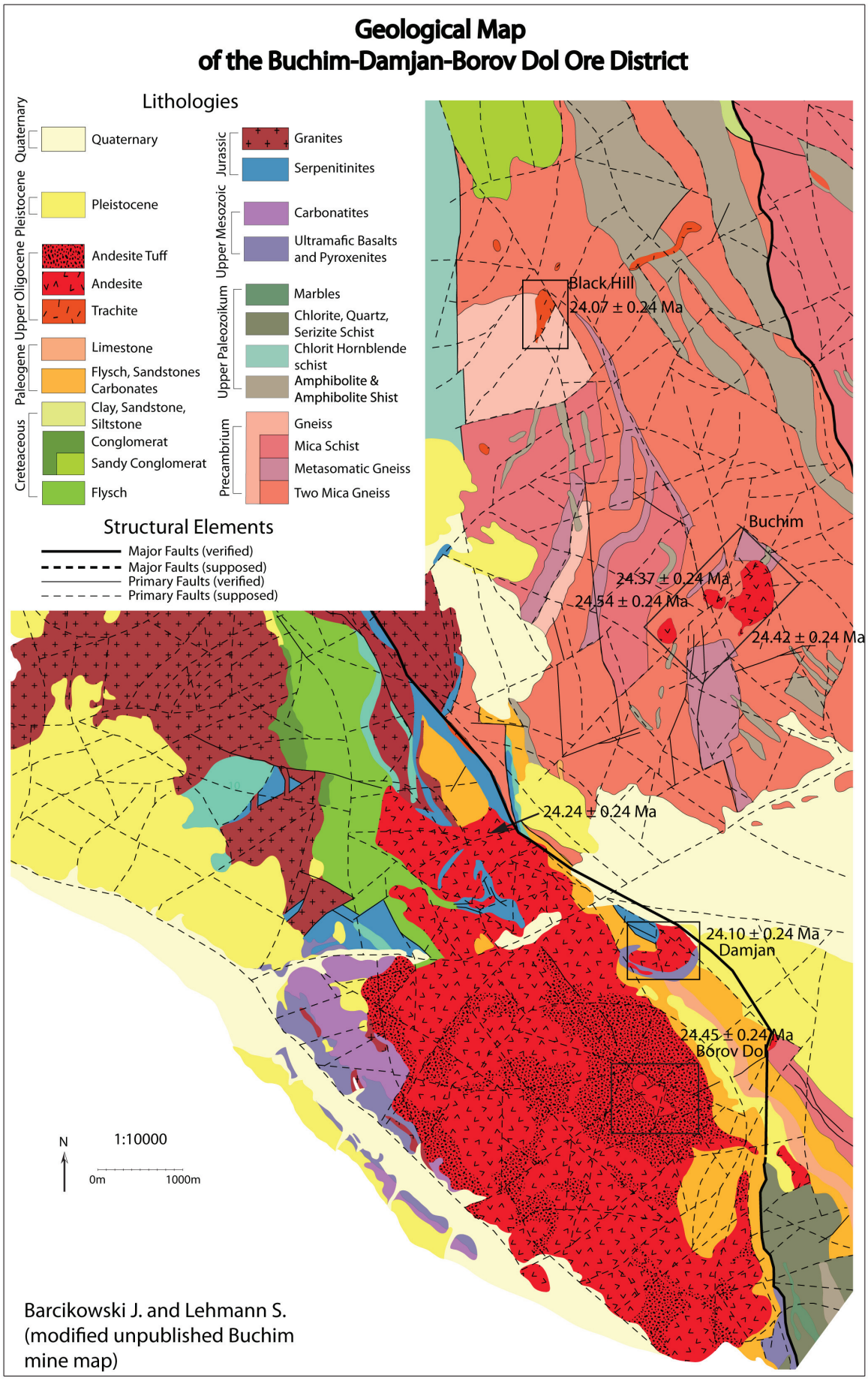

Fig. 1: Geological map of the Buchim-Damjan-Borov Dol ore district

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 curst, 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