

Title of the SCOPES project:

**Metal transport and ore deposition: the geology, geochemistry and geodynamic setting of mineral resources in Bulgaria, Serbia-Montenegro and Romania**

Main-Applicants:

**Heinrich, C.A., von Quadt, A. and Driesner, T.**, ETH Zurich, Institute of Isotope Geology and Mineral Resources, Clausiusstr. 25, CH-8092 Zurich, [vonquadt@erdw.ethz.ch](mailto:vonquadt@erdw.ethz.ch)

Co-Applicants:

**Irena Peytcheva**, Central Lab. of Mineralogy and Crystallography, Bulgarian Academy of Science, Georgi Bonchev, bl 107, BG-1113 Sofia, [peytcheva@erdw.ethz.ch](mailto:peytcheva@erdw.ethz.ch)

**Paraskev Petrov**, Sofia University, "St. Kliment Ohridsky", Tzar Osvoboditel bd, 15, BG-1000 Sofia

**Vladica Cvetkovic**, Department of Petrology and Geochemistry, Faculty of Mining and Geology, University of Belgrade, Djusina 7, CS-11000 Belgrade

**Emilian Rosu**, Geological Institute of Romania, 1, Caransebes Str., RO-012271 Bucharest

Summary:

The research proposed here aims at understanding the geological processes controlling the origin and distribution of Europe's most important copper and gold deposits, which are located in Bulgaria, Romania and Serbia-Montenegro. On the regional scale, we want to understand the geodynamic environment and the generation of mineralising magmas, whereby radiometric age dating and igneous geochemistry will play a major role. On the scale of ore-forming magmatic-hydrothermal systems, we want to quantify the processes leading to the generation of ore-forming fluids from hydrous magmas and apply new microanalytical techniques to directly trace the dissolved metals in magmatic fluids to diverse types of mineral deposits. Three major tasks are planned in a manner that allows a clear division of responsibilities to the teams in the three collaborating countries:

- 1) Fluid processes at the magmatic to hydrothermal transition leading to the formation of epithermal and porphyry-style Cu-Au-(-PGE) deposits
- 2) Geochronology, calcalkaline magmatism and large-scale metallogeny of the Cretaceous Apuseni – Banat – Timok – Srednegorie Belt
- 3) Miocene magma generation and ore fluid evolution in the Apuseni Mountains.

This research is part of an ongoing collaboration including the core program of ETH-Zurich's Fluids and Mineral Deposits Group (supported by regular funds from SNF, ESF and a previous SCOPES-JRP to Ch. Heinrich) and is also coordinated with concurrent SCOPES projects led by R. Moritz at University of Geneva. The SCOPES funding enables a mutual transfer of scientific knowledge as well as cultural understanding within the countries of southeastern Europe. It also helps our Bulgarian, Romanian and Serbian partners to establish new contacts in research, education and industry in western Europe and worldwide. Specifically we expect:

- to offer collaborators a chance to present their existing knowledge to the international scientific community, in order to establish their own international contacts,
- to offer collaborators the chance to work with cutting-edge technologies, with an opportunity for them to demonstrate their capabilities in international collaborations,
- to actively support the best scientists in universities and research organizations in their collaboration across these traditionally separate institutions,
- to aid the interaction of scientists between traditionally rather isolated eastern countries, notably including long-isolated Serbia-Montenegro.

The specific information obtained in this research initiative will make existing as well as new geological data more easily accessible for potential investors in the primary industries sector. The contacts and the new training can give enterprising Bulgarian, Romanian and Serbian-Montenegro scientists an opportunity to provide high-quality services to the presently booming international resource markets, both within and outside their home countries.

## **Tectonic and magmatic controls on Cretaceous and Tertiary gold and copper deposits in the Rhodope Massif, the Srednogorie belt and the Caucasus, Bulgaria and Georgia**

Main-Applicants:

**Robert Moritz**, Département de minéralogie, Section des Sciences de la Terre, Université de Genève, Rue des Maraichers 13, CH-1205 Genève

Co-Applicants

**Peter G. Marchev**, Bulgarian Academy of Sciences, Geological Institute, Sec.of Petrology and Metasomatism Acad. G. Bonchev bl. 24, BG-1113 Sofia

**Nino Popkhadse**, Geological Institute, Georgian Academy of Sciences, St. M.Aleksidze 1, b.9, GE-380093 Tbilisi

**Stanislav Stoykov**, Mining and Geology Univ. 'St. Ivan Rilski', Geological and Exploration Faculty, Dept. of Economic Geology, 24, Acad. G. Bonchev Str., BG-1700 Sofia

Summary:

The project presented in this grant application is part of a European Science Foundation (ESF) program on "Geodynamics and Ore Deposit Evolution" (GEODE). The funding requested here will support field and laboratory work of our Bulgarian colleagues involved in this international research program. Previous extensive tomographic and seismic studies of the EUROPROBE program and tectonophysical modeling have yielded a very detailed knowledge of the deep structures and thermal anomalies of the crust and mantle of eastern Europe. This knowledge combined with the particular metallogenic character of the Carpatho-Balkan belt has led the ESF to include it within an international research program on the relationship between Geodynamics and Ore Deposit Evolution. This research program started in 1998 and will last until 2003. The goal of the GEODE project is to link the geological and geochemical processes related to ore deposit formation with the underlying regional scale geodynamic evolution. The aim of this SCOPES grant application is to contribute to this international research program. The research area is the Carpatho-Balkan belt which contains the most important magmatic-associated copper and gold deposits of Europe. These deposits are related to plate convergence and orogenic collapse settings, and were formed during two major periods: (1) from Early Triassic to Late Cretaceous within the Banat-Srednogorie metallogenic belt (southwestern Romania to eastern Bulgaria), and (2) during the Tertiary in the Rhodope tectonic zone (Bulgaria and Greece). The research proposed in this grant application will focus on: (1) an investigation of the magmatism and the metallogeny of the Panagyurishte ore district of the Bulgarian Srednogorie belt, with an emphasis on the world-class Chelopech gold deposit and associated gold deposits in the district; and (2) a study on the chemical and isotopic evolution of a mineralising system from the metal source reservoir to the depositional site in the Rhodope Massif on base metal and precious metal epithermal deposits. The investigation in the Panagyurishte district is a regional metallogenic and geodynamic problem where two complementary approaches are followed: (1) the regional geology and the geochemistry of the magmatic rocks will be investigated, and the genesis of the ore deposits will be interpreted with respect to the tectonic setting of the host rocks, and (2) the major ore deposits of the Panagyurishte district will be compared to identical deposits from better understood tectonic settings. The second investigation is set in a province with a better understood tectonic setting, namely the Rhodope Massif, where recently precise absolute Ar/Ar ages give us the opportunity to study processes and trace the ore components from their source to the hydrothermal ore formation site by isotope systematics. A particular emphasis is placed on the magma to hydrothermal fluid transition by studying melt inclusions. The two continental arcs provide an excellent opportunity for the evaluation of: (1) the time relationships between magmatic pulses and ore deposits, (2) the role of composition of magmas and basement rocks as sources for specific ore deposit, (3) the control of geodynamic processes on the genesis of ore-forming magmatic systems, and (4) the relative role of the different fluid types in ore-forming hydrothermal systems. This project will consist of field and laboratory (microscopy, XRF, XRD) work in Bulgaria, and labwork in Geneva (partly also in Lausanne and/or Zürich), including ion chromatography, mass spectrometry for isotope determinations, fluid inclusion microthermometry, Raman spectroscopy, Ar-Ar dating, microprobe, SEM and LA-ICP-MS.