Low-sulfidation, 'non-magmatic' epithermal AuAg deposits of the eastern Rhodopes mountains, Bulgaria

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ABSTRACT: The eastern part of Bulgaria's Rhodope mountains host at least 10 documented low-sulfidation epithermal AuAg occurrences and deposits, most of which were unrecognized by modern exploration until the 1990's, though many were worked in Thracian and later times. The deposits display a wide range of morphology, host rocks and variable geochemical signatures including Au:Ag ratios and relative enrichments or deficiencies in typical epithermal elements As, Sb, Hg, but show no enrichment in base metals. Many deposits occur at or immediately below the unconformity of basal Tertiary conglomerates and underlying metamorphic rocks, and are demonstrably older than most Tertiary volcanism in the region. Notably, none of the low-sulfidation systems appear to be related to magmatic rocks, and most appear to be older than the numerous adjacent Tertiary magmatic-related PbZn systems, some of which have economic AuAg grades in their upper and peripheral portions.

Bulgaria's most recently discovered Au orebody is Ada Tepe, perhaps a "classic" low-sulfidation vein/stockwork system, developed at the contact of lower Tertiary sedimentary rocks, and underlying metamorphic rocks. Ada Tepe is one of many low-sulfidation AuAg occurrences throughout the adjacent Rhodopes Mountains that have been identified and explored within the last fifteen years. However unlike most low-sulfidation AuAg epithermal deposits worldwide, which are either hosted in or clearly connected to contemporaneous volcanic/intrusive rocks, most of the Rhodopes occurrences have no such direct spatial or genetic tie to magmatic rocks. This paper summarizes basic geologic and geochemical information on several of these deposits, their spatial distribution, and their morphology. It is hoped that further study will use this basis as a stepping stone toward clarifying their genesis and spatial distribution

Fig. 1 Location of E. Rhodopes low-sulfidation AuAg province

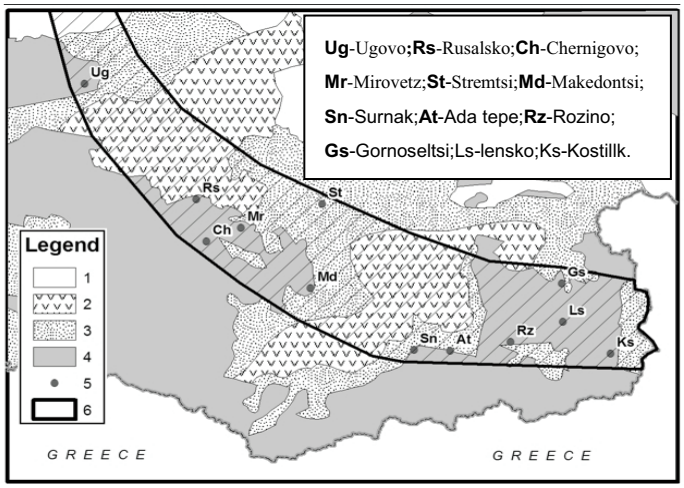

Fig. 2 Generalized map of E Rhodopes low- sulfidation Au-Ag province: **1** *Pliocene-Quaternary sediments;* **2** *Upper Eocene-Miocene volcanic areas;* **3** *Palaeocene-Eocene sediments;* **4** *Metamorphic basement;* **5** *Low-sulfidation Au-Ag deposits and occurrences;* **6** *Eocene low-sulfidation Au-Ag belt.*

The low-sulfidation AuAg deposits occur over an area of approximately 2000 km² (Figure 2). Roughly half are hosted in conglomerate-breccias, conglomerates and sandstones, presumably of Palaeocene - Eocene age. The remainder are hosted in gneiss, calc-schists, and marbles of ages ranging from Proterozoic to Palaeozoic age which forms the underlying basement rocks to the lower Tertiary sediments. Although Ada Tepe

and Makedontzi occur in sediments directly at the Tertiary/basement unconformity, at Stremtsi, the mineralization is hosted in sandstone-conglomerate at least 300m above metamorphic basement rocks. At many occurrences, Tertiary sediments are often removed by erosion or were never present. The age of mineralization has not been directly dated but at Surnak is well-constrained by the age of overlying post-ore limestones, of Priabonian age. In places, there is suggestion that early ore-related structures which controlled early Tertiary low-sulfidation Au mineralization, which is it devoid of base metals, may have been reactivated during Tertiary magmatic-related PbZnAg systems of Oligocene age. At Rozino, localized PbZn veinlets were intersected in basement rocks but do not appear to represent a continuous zoning pattern from adjacent Au mineralization. At Stremtsi, a silicified limestone unit which occurs at least 150m stratigraphically above the ore-hosting sandstone-conglomerate, and which may be younger than the Stremtsi Au mineralization itself, contains very high Ag values and is virtually devoid of Au.

The deposits have textural and alteration features typical of low-sulfidation AuAg systems, including banded veins, cavernous carbonate-replacement textures, local adularia, massive silicification, and silica-white mica-chlorite alteration. Morphologies of the mineralized zones vary from roughly stratiform bodies of disseminations and strata-confined vein stockworks in sandstone-conglomerate (Stremtsi), to slab-like low-angle veins and adjacent overlying vein stockworks in basal sandstone-conglomerate (Ada Tepe), steeply-dipping wide stockworks/breccias (Spoluka-Mirovetz), to discreet, wide banded to massive quartz veins (Spoluka-Chernigovo).

Occurrence	**Hostrock**	**Morphology**	**Ag:Au etc**	**Ancient workings?**
Ada Tepe	Tertiary congl> gneiss/schist	Stratiform replacement; steep veins	1:1	Large
Surnak-Kuklitza	Gneiss/schist; marble	Breccia-sockwork and carbonate replacement	10:1 As, Co, Ni	None
Stremtsi	Tertiary conglom.	Dissem. and stratabound veinlets	5:1 Mo, Sb	Large
Lensko-Kostilkovo	Marble; schist	Veins parallel schistosity and carbonate replacement	2:1 As,Sb	Large
Rozino	Tertiary conglom.; granite; gneiss	Disseminated and stockwork	2:1 As,Sb,Mo	Limited
Spoluka: Mirovetz	Gneiss	Breccia-stockwork	>10:1	None
Spoluka: Chernigovo	Gneiss	Large vein	1:1	None
Makedontzi	Tertiary conglom.	Breccia and disseminated, steep veins	5:1 As,Ba	None
SpolukaRusalsko	Gneiss	Brecciasstockwork; veins,	5:1, As,Sb	None
Gornoseltsi/Dolnoseltsi	Tertiary conglom>schists	Disseminated, veins parallel schistosity	5:1, Sb,As	Limited

Table 1: Summary characteristics of eastern Rhodopes low-sulfidation epithermal Au(Ag) systems

The deposits are characterized by varying Ag:Au ratios and concentrations of As, Sb, Hg, locally Co and Ni, where ofiolite blocks are presented in the underlying basement. CONCLUSIONS: The epithermal low-sulfidation hydrothermal systems of the east Rhodopes are emplaced along tectonic boundaries of Early Palaeogene post-collision grabens and are

hosted in the Precambrian metamorphic basement, and in the basal conglomerate-sandstone levels of lower Tertiary sedimentary units. These basic geologic data suggest that the early Tertiary Au(Ag) deposits and occurrences are more likely connected to the metamorphic core complexes than Eocene-Oligocene magmatic activity. The Upper Cretaceous collision-related metamorphism is a possible heat source for the widespread low-sulfidation epithermal systems, developed in post-collision extension environments together with the extension of the early Tertiary graben depressions.

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