

# Trepça Ore Belt and Stan Terg mine – Geological overview and interpretation, Kosovo (SE Europe)

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## Abstract

The Trepça Belt of Pb-Zn-Ag mineralization is located within the NNW-SSE trending Vardar zone. The Belt extends for over 80 km, and supported five mines during the period 1930–2008. It contains a number of the other Pb-Zn occurrences too. The replacement and vein type mineralization is hosted primarily by Mesozoic carbonates, but also occasionally by amphibolites, and displays a clear structural control. Mineralization is spatially and genetically related to Neogene andesite-dacite extrusives and sub-volcanic intrusives. Only Stan Terg mine is presented in this paper.

## Introduction

The history of silver, lead and zinc mining in Kosovo is woven into with the history of Kosovo itself. In the modern era, the production of silver, lead and zinc has been synonymous with Trepça. This briefing note describes the current situation at Trepça and examines its future outlook.

Mining activities and smelting of the silver-bearing lead-zinc ore in Kosovo has a long history and can be dated back to even pre-Roman times as the relics of tools and diggings show. From the Roman period to the Middle Ages, the area between Serbia and Greece especially the southern part of Kosovo was intensively exploited for its lead-zinc and silver ores and at that time was one of most important sources of its kind. The Roman and Ottoman Empires fought to take control of the silver mines in Kosovo and at a later stage the Serbian Middle Kingdom produced much of its coinage from silver mined at Artana/Novo Berdo.

The British company Seltrust, founded at one stage, operated nine mines in Trepça as shown on the map (Fig. 1). Currently, only five of these have significant remaining resources, although all have the potential for extensions to the known mineralization. The mining and processing infrastructure following the conflict was in a very poor condition. However, after major effort and significant investment, four of the mines have recommenced limited production.

The successful industry of the 1960s and the historic mines were founded on the quality of the lead-zinc deposits that occur in the Trepça Mineral Belt running in a NW-SE direction from

Kapaonik (Beloberdo) in the north to Kizhnica in the south. Whilst the 80s and 90s were characterized, at least partly, by a lack of exploration, the known deposits are not exhausted and mineable reserves and measured resources (Adam Wheeler

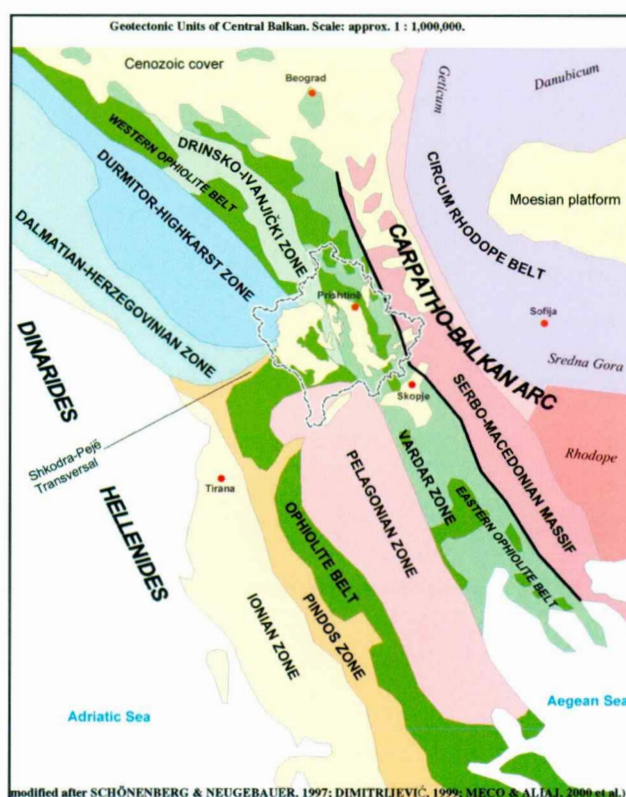


Fig. 1. Map of Kosovo in geotectonic units



study) at the five key mines total 7,068,000 tonnes of 5.46 wt% lead, 5.64 wt% zinc and 116 g/tonne silver. All deposits are open at depth or extend on strike. Recent geological work strongly indicates that the deposits within the Trepça Mineral Belt are considered highly prospective with regard to additional reserves and resources as the mineralization is structurally and/or fault controlled. Consequently, the Trepça Mineral Belts (HYSENI & LARGE, 2003) hold great potential, not only for lead, zinc and silver, but also for copper and gold.

### Trepça Mineral Belt regional geology

The linear Trepça "Belt" of lead-zinc mineralization extends for over 80 km in northern Kosovo, and includes numerous mines and occurrences (Figs. 1, 2). Although evidence of mining dates back to the Romans, who were primarily interested in small gold occurrences, modern mining began in 1930 at the Stan Terg lead-zinc mine, which is located on the Trepça stream.

The Trepça Belt, which comprises part of what has been previously described as the Kapaonik District (FORGAN, 1948; JANKOVIC et al., 1997), includes numerous lead-zinc deposits. On a regional scale, the Trepça Belt belongs to the Kosovo sector of the Serbo-Kosovo-Macedonian-Rhodope metallogenic belt of Oligocene-Miocene age. This includes the base and precious-metal districts in Kosovo, southern and western Serbia, Macedonia, northern Greece and southern Bulgaria (HEINRICH & NEUBAUER, 2002). The Trepça Belt lies within the NNW-SSE trending Vardar tectonic zone (Fig. 2).

The regional structure marks the fundamental suture between the Serbo-Kosovaro-Macedonian Massif, which is underlain by late Proterozoic metamorphic successions, and the Dinarides, which are comprised of Mesozoic ones with typical Al-

pine deformation. The Vardar Zone contains fragments of Paleozoic crystalline schist and phyllite, with unconformable overlying Triassic clastics, phyllites, volcanoclastic rocks and Upper Triassic carbonates. Serpentinized ultrabazik rocks, gabbros, diabases and sediments of the ophiolite association characterize the Jurassic. The Cretaceous sequence consists of a complex series (sometimes described as *mélange*) of clastics, serpentinite, mafic volcanics and volcanoclastic rocks, and carbonates. The Tertiary (Oligocene-Miocene) andesite, trachyte and latite sub-volcanic intrusives, volcanics and pyroclastic rocks occur at several centres within the Trepça Belt, covering large areas (MILETIC, 1997). They are particularly well developed in the eastern sector (the so-called Inner Vardar sub-zone) of the Vardar zone. Miocene and Pliocene shallow water sediments fill the Kosovo Basin, which borders the central and southern sectors of the Trepça Belt to the west.

The structure of the Trepça Belt is dominated by NNW-SSE trending structures. Overthrusts with SE vergence are dominant, some of which are demonstrably post-Oligo-Miocene in age while others are clearly older. Congruent WSW-ENE structures link the dominant NNW-SSE trending structures. It is considered that many of the Vardar structures may be reactivated Variscan structures marginal to the Serbo-Kosovaro-Macedonian Massif. The possible influence of the NW-SE structures in the Drina-Ivanjica (Drenica) structural block, which is an external unit of the Dinarides and forms the western margin of the Vardar zone, are overprinted on the dominant NNW-SSE trend.

Trepça geologists recognized three regional (NNW-SSE) trending zones of mineralization within the Belt (Fig. 3).

**Zone I** includes Artana-(Novoberdo)-Batllavë. Zone I follows the boundary between the Kosovo sector of the Serbo-Kosovaro-Macedonian Massif, which is marked here by extensive Neogene calc-alkaline volcanics and intrusives, with the Vardar Zone.

**Zone II** extends from the Hajvalia-Kizhnica district in the south to Belo Berdo in the north, and includes the Stan Terg mine and numerous other occurrences. Zone II follows the major fault that marks the eastern margin of the Miocene Prishtina basin, and its extension to the NNW and the intrusive and volcanic complexes (Fig. 3) in northern Kosovo.

**Zone III** includes the Crnac mine, and extends along a number of lead-zinc occurrences on the western border of the Vardar Zone, where it is in contact with the Dinaride-Drina-Ivanjica (Drenica) structural block.

### Stan Terg mine

#### *Exploration and mining history*

The Stan Terg mine, which has been considered one of the best lead, zinc and silver mines in

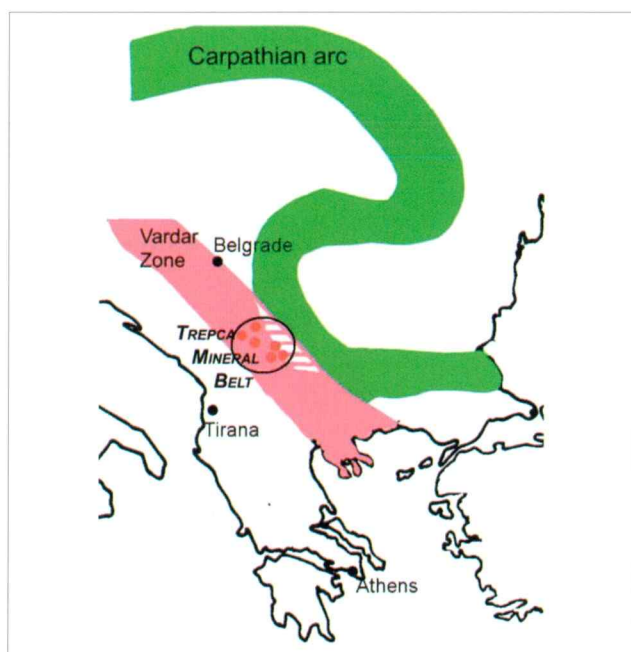


Fig. 2. Vardar zone and position of Pb-Zn-Ag mineralization in Kosovo



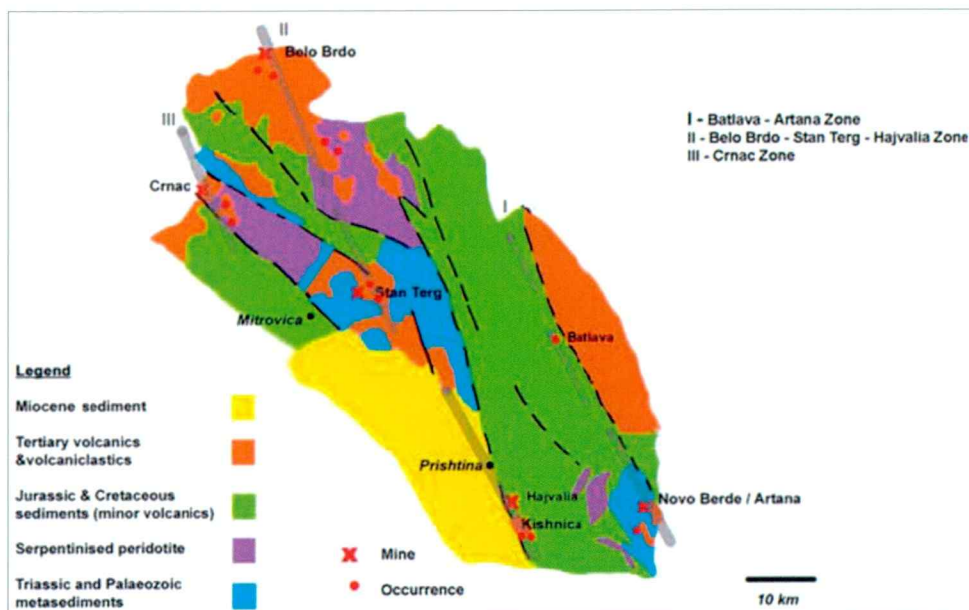


Fig. 3. Trepça mineral belt

Europe, was initially explored by Selection Trust Ltd in 1925. The deposit was discovered after exploration in the vicinity of mediaeval workings. Development commenced in 1927, and production in 1930. Production was maintained during the German-Italian occupation (1941-1945), and then continued until 1999 under state ownership. Mining has been performed from the surface down to Level 9 at a depth of 600 m below the surface. Average annual production from 1945 to 1990 was 580,000 tonnes, and it is estimated that total production has been approx. 32 million tonnes. The highest annual production was 704,000 tonnes in 1984.

In the vicinity of the Stan Terg deposit there are several occurrences of Pb-Zn ore bodies, such as Didoma, Meljenca, Rasane, Terstnea and Zijača with all of the Stan Terg style of mineralization, holding economic potential and further resources.

#### Stan Terg regional geology

The Stan Terg Pb-Zn-Ag deposit is located within the Vardar zone of the Dinaride Alpine Belt, consisting of Paleozoic basement rocks, Jurassic-Cretaceous sediments and rocks of ophiolitic affinities. These rock units have been foliated during the early Tertiary (Fig. 4). During the late Tertiary, the Balkan Area was heavily affected by plutonic, sub-volcanic and volcanic processes with the deposition of mainly granodioritic magmas at depth, andesites, dacites and quartz latite flows and dykes as well as pyroclastic rocks, mostly tuffs, lapilli tuffs and ignimbrites. Structurally, the Stan Terg deposit is situated in the centre of the so-called Trepça Mineral Belt (Kapaonik Zone). This tectonic zone, within which the Balkan Pb-Zn-Ag deposits are located, is marked by very strong lineaments and a fracture zone striking NW-SE. It can be followed from Bosnia, through Kosovo and Macedonia to the Gulf of Selanik in Greece and varies in width from 40 to 60 kilometres.

#### Mine Geology

The overall geological structure at Stan Terg is complex, consisting of an anticline plunging at about 40° NW, with a prominent volcanic breccia pipe along the hinge of the asymmetric anticline. The core of the anticline consists of Triassic carbonates surrounded by sericite schist (Fig. 5).

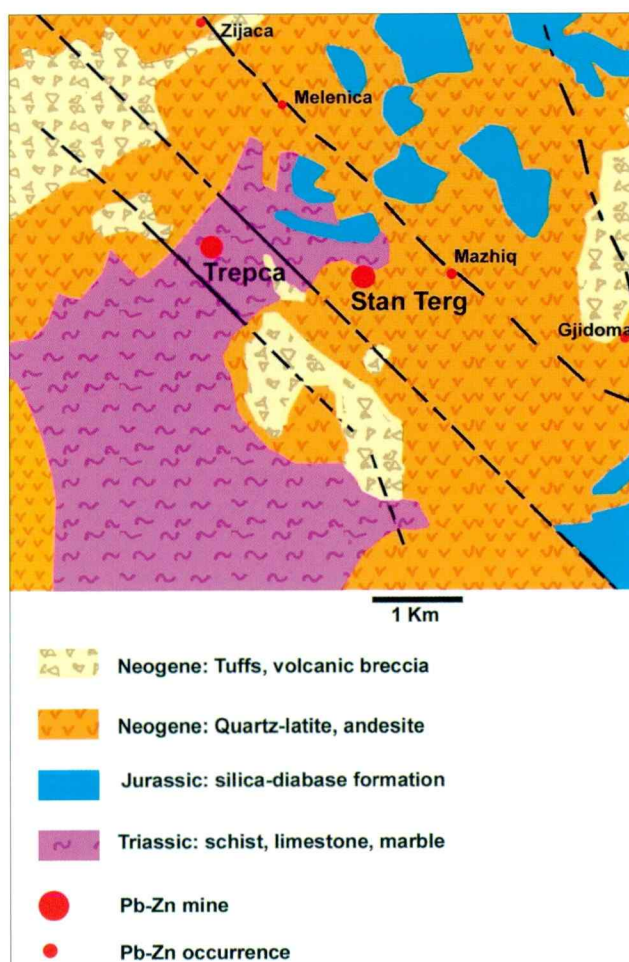


Fig. 4. Stan Terg regional Geology

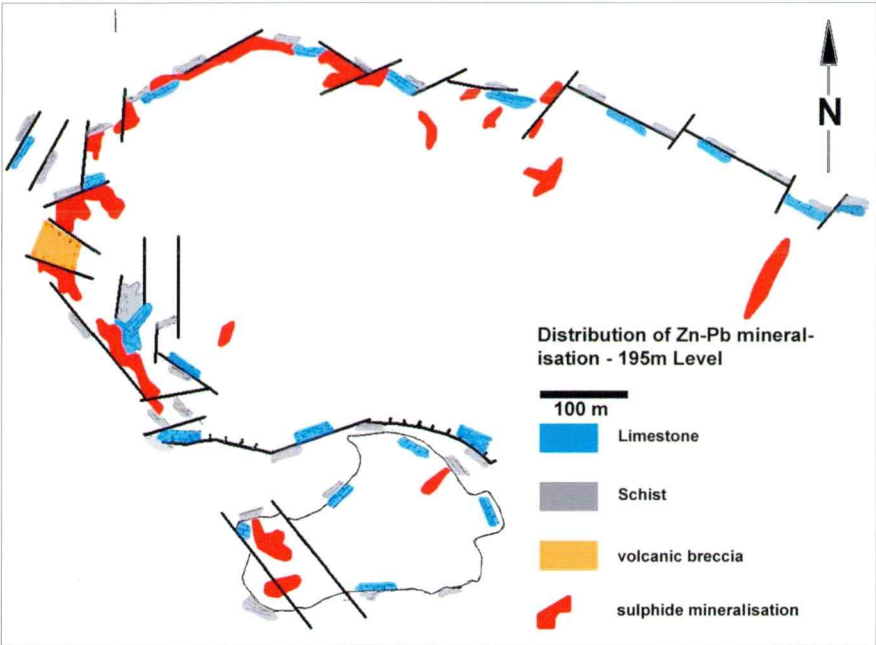


Fig. 5.  
Plan of 195 m level outline of anticline

Low-grade mineralization occurs along elongated paleo-karst features and cavities, commonly associated with skarn-type alterations.

Massive sulphide ore of economic importance forms continuous, columnar shaped ore bodies of the carbonate replacement type. These are located along the carbonate-schist contact and dip parallel to the plunge of the anticline and structural fabric and the dip of the flanks. The ore bodies along this contact extend along a strike length of 1,200 m, and have been explored to a depth of 925 m below the surface (11 levels – Fig. 6).

The ore mineralogy of the deposit is dominated by pyrite, pyrrhotite, sphalerite and galena, with typical carbonate gangue minerals and minor quartz.

In detail, the ore mineralogy is very varied and includes a number of primary Pb-Zn- as well as secondary sulphides in cavities and vugs, including rare minerals such as boulangerite.

The large ore bodies along the footwall are in contact with the volcanic breccia pipe and consist of massive Pb-Zn sulphides of lower grade, including ilvaite and hedenbergite garnet as well as -magnetite, - pyrite and- chalcopyrite skarn together with Fe-rhodochrosite, siderite, ankerite and dolomite. This skarn-type mineralization also occurs together with smaller ore bodies and sub-economic pockets associated paleo-karst cavities.

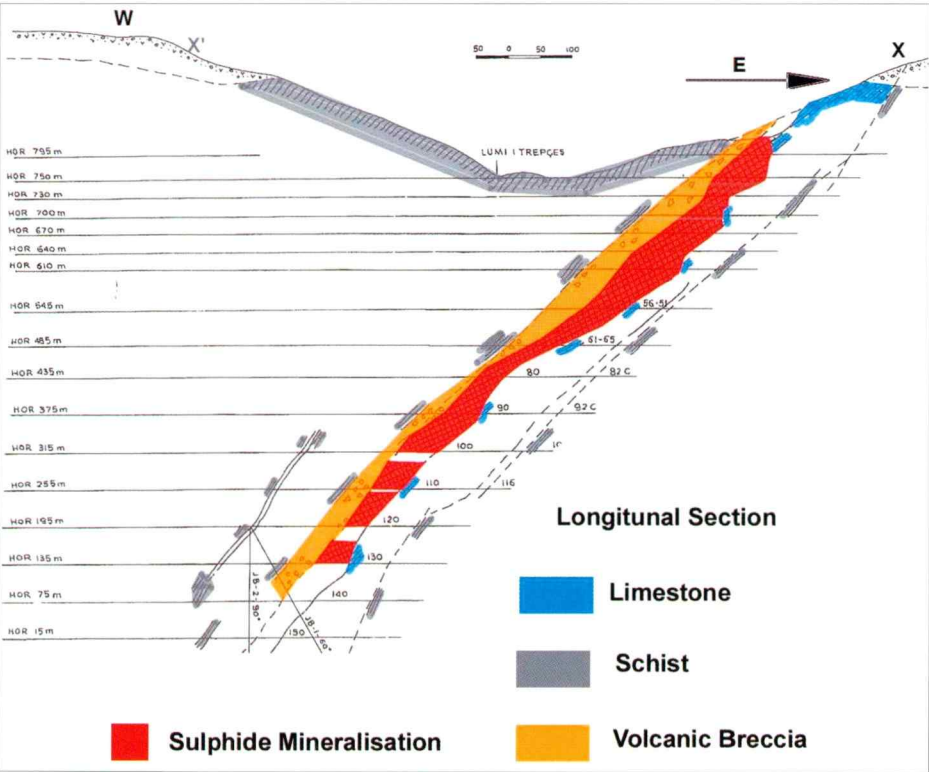


Fig. 6. Section through main mineralised zone in Stan Terg



Reserve estimation

These figures are derived from detailed reviews of previous estimates, 3D modelling using Data Mine software (WHEELER 2003), re-evaluation and re-assaying of production stops (Table 1). The resource figures pertain to 22 stopes within the bottom three levels (8-9) and have had economic cut-off calculations and mining factors applied. The figures given as probable and proven refer mainly to production stopes on Level 10 and minor to Level 9 and 11 stopes. Fig.7 does not strictly comply with CIM reporting standards due to a lack of reconciliation data.

Table 1. Stan Terg mine reserves and resources:

	Tonnes	% Pb	% Zn	g/t Ag
Proven reserves:	120,340	5.14	5.13	88.0
Probable reserves:	311,660	5.10	3.17	80.5
Total mine able reserves:	432,000	5.10	3.17	80.5
Total resources:	12,488,000	3.21	2.21	56.4

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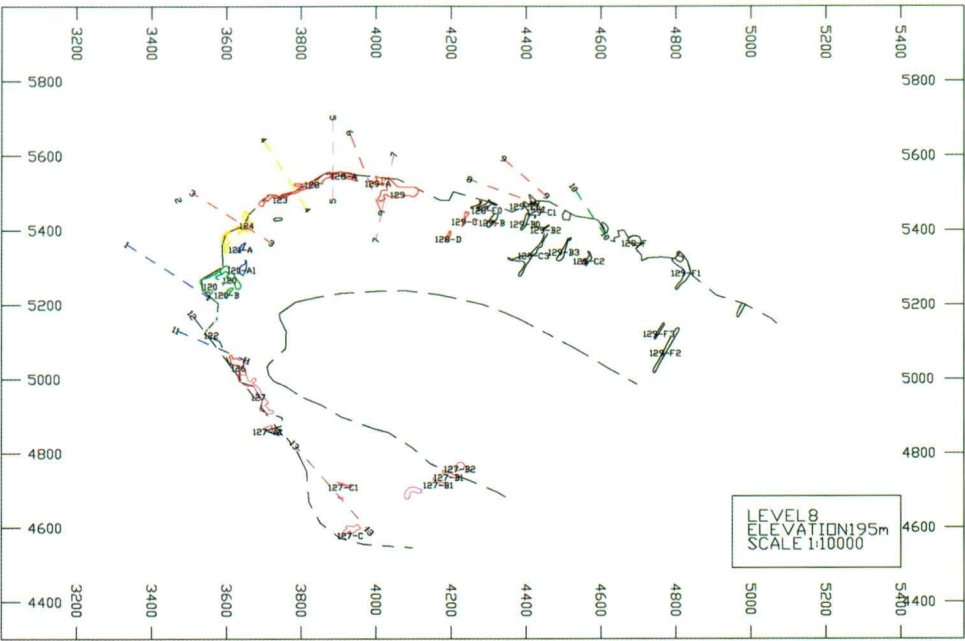


Fig. 7. The geological plane, level 8 (195m) Stan Terg mine.

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