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NATIVE GOLD – Ni-ARSENIDES ASSEMBLAGE IN SERPENTINITES FROM CZARNA GÓRA, ŚLĘŻA OPHIOLITE COMPLEX

Abstract: A native gold grain was found adjacent to the orcelite ($Ni_{5-x}S_2$) grain in the serpentinite of the Czarna Góra area, Ślęża ophiolite. Native gold occurrence together with Ni-arsenides in altered ultramafic rocks is connected to migration of CO_2-rich fluids during post-collisional evolution of the ophiolite complex. According to the autor's knowledge this is the first native gold inclusion in serpentinite rocks reported from this area.

Keywords: native gold, nickel arsenides, nickel sulphides, serpentinite, Ślęża ophiolite

INTRODUCTION

Gold is very rare element in the Earth's mantle and it does not form mineral phases in the mantle rocks. It is usually an admixture in primary mantle sulphides (e.g. pentlandite, pyrrhotite). The average Au content in mantle tectonites does not exceed 1.5 ppb (Leblanc 1990). Au can be mobilised from primary sulphides and next aggregated together with Ni- and Ni-Fe-arsenides during the serpentinization and especially listwaenitization (CO_2-metasomatizm) of primary rocks. The latter process is concomitant to tectonic emplacement of the ophiolite and/or to later events. The term listwaenite (also spelled "listwanite" or "listvenite") has not been formally defined, and it is loosely characterized as "a carbonatized ultramafic rock" (Buisson, Leblanc 1986). The secondary processes can concentrate Au as aggregate together with sulphides and arsenides in sulphide-rich serpentinites and listwaenites (average Au content is 9 ppb and 20 ppb respectively; Leblanc, 1990) or result in forming individual Au mineral phases (e.g. native gold and auricupride – Cu_3Au).

Au content in the Ślęża ophiolite rocks has been reported by several authors (e.g. Sachanbiński, Łazarienkow 1994, Michalik et al. 1997, Niczyporuk 1997). It does not exceed 4.6 ppb in unaltered serpentinite, however it can reach 17 ppb in chromite ore (Michalik 2001). Native gold was found in talc- and vermiculite rocks by Dubińska et al. (1995). Native gold grains from weathered serpentinite residua and chromite-rich alluvia from Uliczno contain Cu admixture (Fedak, Magdziarz 1972, Michalik 2001). Moreover, Speczik and Piestrzyński (1995) reported native Au inclusions in arsenopyrite from Nasławice serpentinite quarry.

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Described association was lacking in Ni-minerals. Native gold phases associated with Ni-arsenides and Ni-sulphides from serpentinites and listwaenites, however, up to the present was not reported from Ślęża ophiolite.

The purpose of this study is to present the native gold occurrence in serpentinized ultramafic rocks at the Gogołów-Jordanów massif and to briefly discuss the native gold origin.

SAMPLES AND METHODS

The samples for this study were collected at the slopes of Czarna Góra, Gogołów -Jordanów massif, close to the abandoned chromite mine (Fig. 1). Investigated rocks are mantle tectonites (Dubińska, Gunia, 1997). They are serpentinites formed at the expense of harzburgites, often intergrown by carbonate minerals.

Identification of mineral phases was performed using reflected light microscopy. Chemical analyses and BSE images of minerals were obtained using electron microprobe Cameca sx 100 at the Faculty of Geology, Warsaw University.

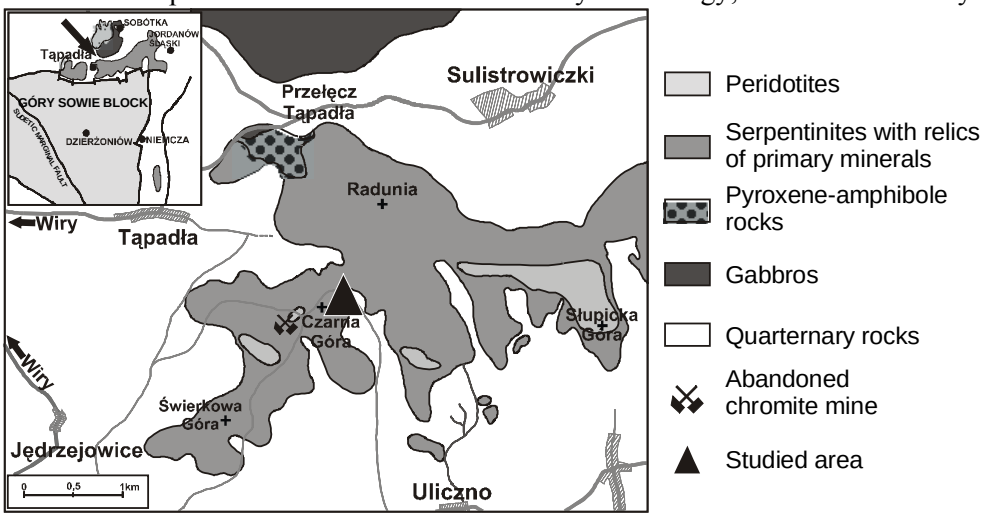

Fig 1. Geologic sketch-map of the central part of the Ślęża ophiolite (compiled after 1:25000 geological maps by Gaździk, Szałamacha and Walczak-Augustyniak).

RESULTS

Serpentinites from Czarna Góra usually represent antigorite variety with minor relicts of olivine, pyroxene and scarce carbonate minerals. Ore minerals are represented by oxides (i.e. chromian spinel and magnetite), Ni-sulphides, Ni-arsenides and native metals (Au and Ni). Chromian spinel is the only primary phase among the ore minerals. Magnetite either forms minute grains (<100 μm) or laths. The laths of magnetite occur in aggregates together with sulphides (heazlewoodite), arsenides (orcelite) and serpentines. Ni-sulphides (e.g. heazlewoodite, millerite and pentlandite: Fig. 2) occur as separate

xenomorphic crystals (<300 μm) as well as aggregates with magnetite. The Ni-sulphides do not contain any Au admixtures.

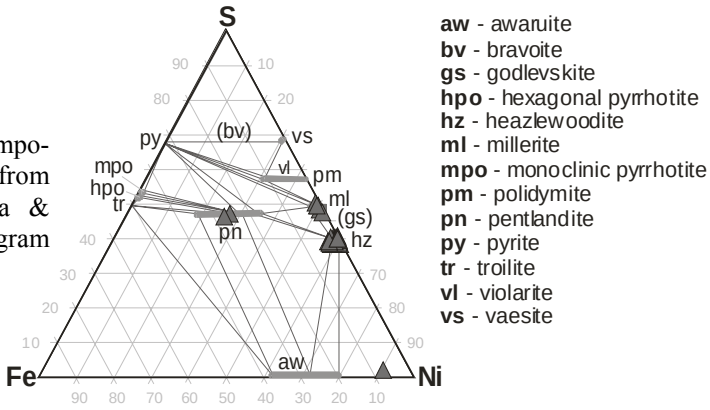

Fig. 2. The chemical composition of Ni-sulphides from Czarna Góra on Misra & Fleet (1973) phase diagram for the Fe-Ni-S system.

Arsenic minerals ranging from maucherite ($Ni_{11}As_8$) to orcelite ($Ni_{4,77}As_2$). The "maucheritic" phases occur usually as small individual grains (<100 μm), whereas "orcelitic" occur as aggregates together with heazlewoodite and/or magnetite and they seem to replace sulphides. They do not contain any Au either.

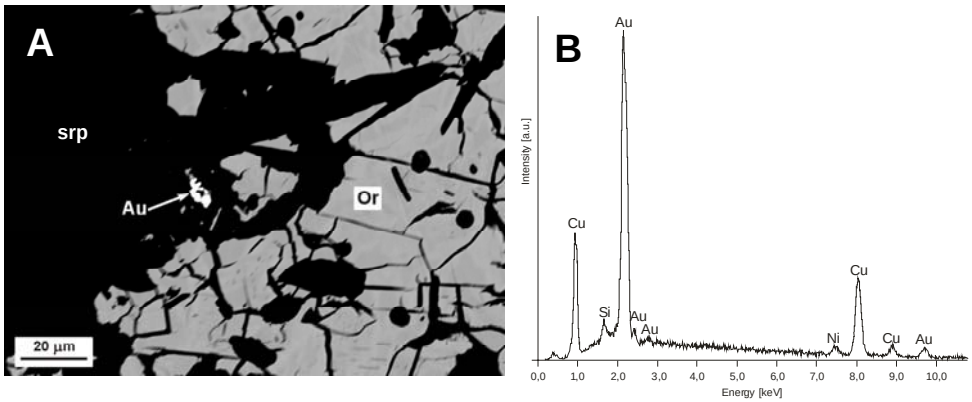

Fig. 3. A) BSE image of native gold (Au - white) associated with orcelite (or - grey) and serpentines (srp - black). B) EDS spectrum of native gold from serpentinites.

Native metals are very rare in the studied serpentinites. Only one single, xenomorphic grain of native Ni was observed close to olivine (Fig. 2). Single native gold grain was found in association with orcelite and serpentine minerals (Fig. 3A). It is xenomorphic and forms aggregate close to orcelite. EDS spectrum revealed the admixture of Cu (Fig. 3B) analogously to grains described by Michalik (2001).

CONCLUSIONS AND DISCUSSION

The investigations revealed at least three stages of ore minerals formation. First stage comprises crystallisation of primary phases such as chromian spinel

and probably mantle Ni-Fe-sulphides. The second stage is related to serpentinization and it resulted in magnetite and Ni-sulphides formation. The native gold was not precipitated during serpentinization or the content of the mantle Au-bearing sulphides was very low, as it is suggested by lack of native Au-bearing Ni-sulphides in serpentinites. Third stage of mineralization took place during liswaenitization of serpentinites, however, the process was not extensive. Maucherite-orcelite phases and carbonate minerals were formed together with native gold at this stage. Moreover, increased Au content in nearby carbonatized chromitites (17 ppb; Michalik 2001) suggests Au migration with CO_2-saturated fluid. Lack of native Au inclusions in Ni-arsenides together with occurence of native gold grain at orcelite grain margin suggest that Au precipitation took place at the final phase of listwaenitization.

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