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Full Length Research Paper

Testing of Silver Sulphide in Antimony Mineralization Hydrothermal Karst Formations Ain-Kerma

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ABSTRACT

Antimony mineralization of Ain-Kerma are located about 15 km northwest of the city of Constantine, the cottage is located in limestone belonging to the "series Cretaceous neritic Constantine" appearing in the window under post-webs miopliocènes Basin Constantine. Mineralization occupies solution cavities and by extension its origin was held related to karst phenomena. Samples collected from the ore body show, through studies by reflection optical microscopy and SEM, the presence of a silver sulfide: argentite (Ag_2S). This mineral is a good temperature indicator which forms more than 179 °C. His presence and abundance of silica in the matrix of ore provide arguments for classifying this cottage as a hydrothermal karst.

Keywords: Ain-Kerma, lodging, antimony, argentite, hydrothermal karst

INTRODUCTION

The deposit of Ain-Kerma is located some 15 km to the North- West of the city of Constantine (Fig.1), on the South-East flanc of Djebel Kheneg; it was discovered in 1906 and was actively mined from 1913 to 1951, with an overall production of 50 000 tons of cervantite with a mean gade of antinomy of 40%.

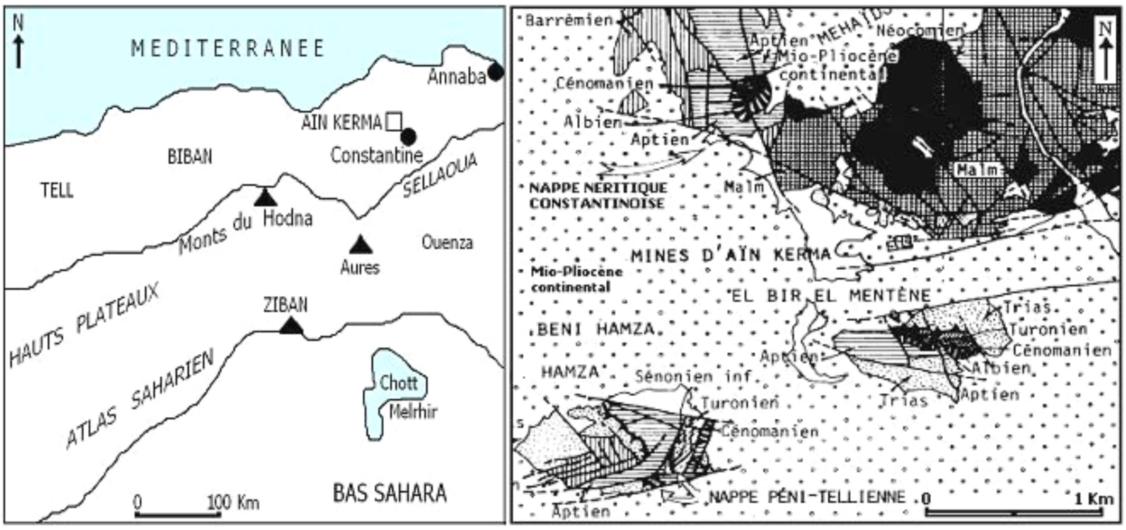

Figure 1 Location map and geology of the area under study

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GEOLOGY OF THE DEPOSIT

Djebel Kheneg forms a tectonic window outcropping as blocks amid the post-tablecloth series of the basin of Constantine (Vila, 1980). It consists of three major regional structural units, from bottom to top: the neritic series, the tellian series and the post-tablecloth series (Fig. 2), the neritic series being affected by polyphase karsistification as described by many authors (Joleaud, 1918; Vila, 1980).

According to morphology and composition, the mineralization can be classified into three types: fracture deposits, contact deposits and piocket deposits.

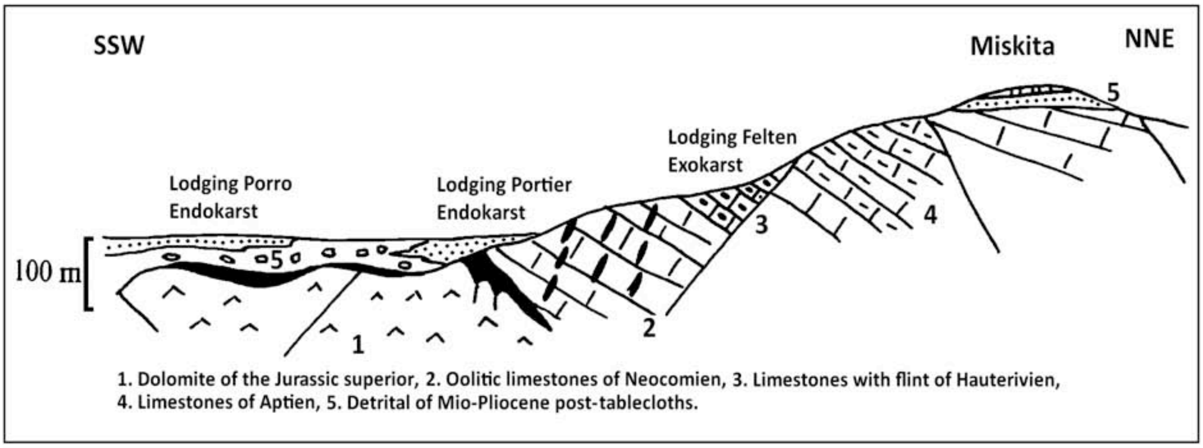

Figure 2 Geological cross-section through the main deposits of Ain- Kerma.

The morphology of the ore bodies is that of a paleokarst ; the fracture deposits are located at the top in the shape of a string of vertical cavities extending to one hundred meter depth, the exokarst , while the contact deposits and the pockets deposits with a horizontal extent, underneath, are associated with the endokarst (Coquette and James,1987). The bottom of the latter is irregular in shape, scratched with many openings in the form of shafts. The roof of the deposit shows collapsed structures in the shape of a dome which was revealed by mining.

MATERIALS AND METHODS

Samples of ore body were collected in the so-called Portier contact deposit; polished sections were made in order to be studied using reflexive metallogenic microscope and SEM at ISTEEM-Montpellier (France).

RESULTS AND DISCUSSION

The ore composition is that of the usual filling of karstic cavities with some detrital elements of the country rocks (elements of limestone and dolomite), carbonate concretions, nodules of stibine partially oxidized and some crystals of quartz (Fig. 3).

Stibine (Sb_2S_3) and its oxide can also have the aspect of small flat slabs few cm in length along the bedding what makes the ore texture look stripped or with a « nougat » aspect. Some nodules of stibine show collapsing structures (Fig. 3 and Fig. 4) which corroborate the nonconsolidated state of the sediments when the mineralization took place (Toubal, 1984) moreover, the occurrence of neoformation quartz in the matrix should be mentioned.

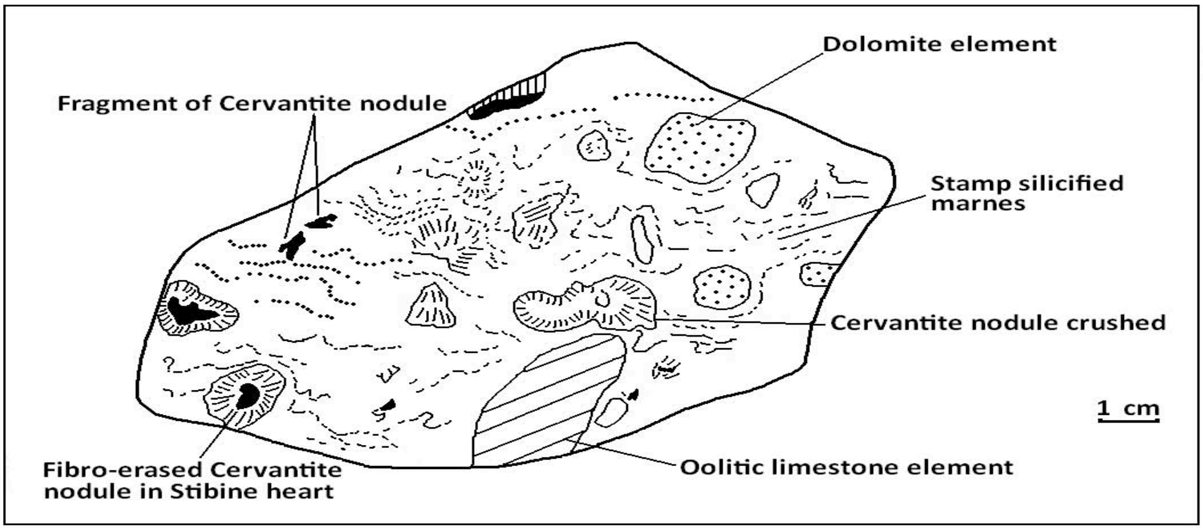

Figure 3 Sample detail of the ore in the main layer of Portier deposit.

Figure 4 Sample from the so- called Portier deposit: intra- karstic filling a- Element of dolomite b- stripped cervantite.

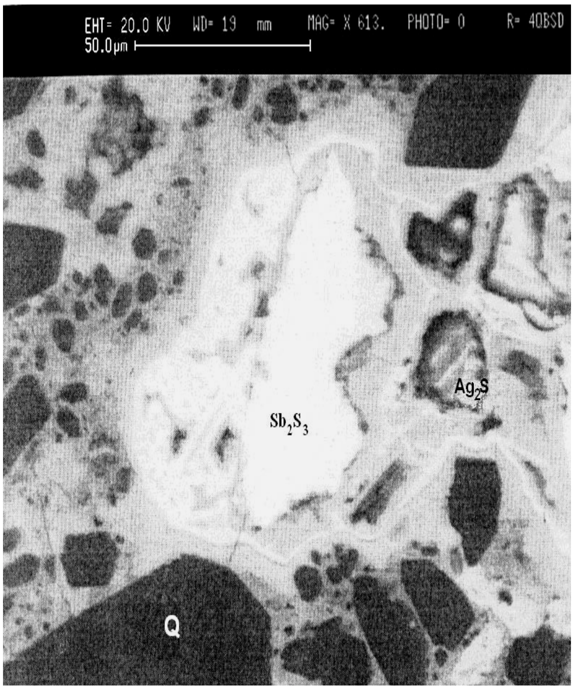

Figure 5 Photos of retrodiffused electron SEM: stibine (Sb2S3), quartz (Q), argentite (Ag_2S).

The other minerals revealed are barytine and silver; in some polished sections, argentite has been recognized by SEM analyses: this mineral occurs as twined lamellous micrigeodes in a siliceous clayey matrix (Fig. 6 and Fig. 7).

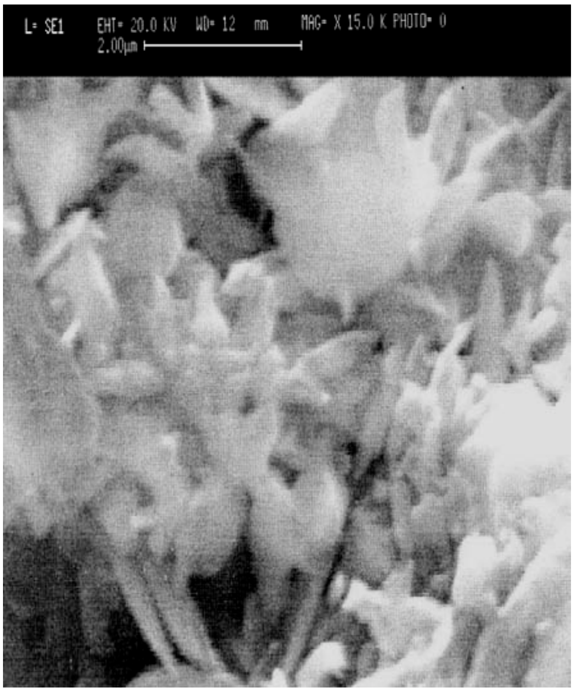

Figure 6 (SEM). Retro diffused electron image: aspect of twined argentite.

Polysynthetic twins are evidence, according to Pico P. 1982, of the reversal of cubic $Ag_2\alpha$ to argentite and then to acanthite. The argentite corresponds to cubic form at temperature above 179°C (Hence, the notion of by hydrothermal karst).

The occurrence of argentite is recognized for the first time, the following observations can thus be made: the paragenesis of antimony deposits of the North-West Algeria is not as simple as previous descriptions suggest. Ain Kerma was thought to be a monomineral deposit (Deleau and Therry, 1953; Toubal, 1984); on the other hand, the occurrence of silver sulfide associated to that of antimony is probably an indication of telescoping phenomena and high temperature conditions. Argentite corresponds to the cubic form at temperature above 179°C, the occurrence of wish may be considered as a good geological thermometer (Picot and Johan 1982).

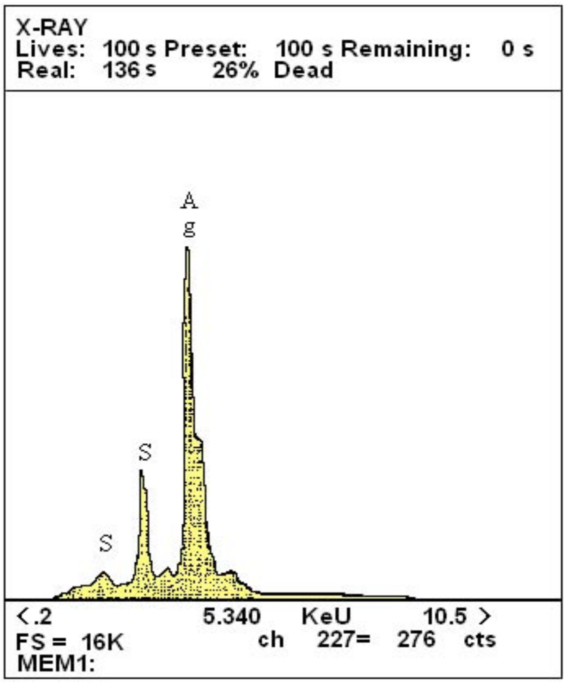

Figure 7 Argentite Spectrum.

5. CONCLUSION

The deposits of Ain-Kerma are related to a karst that developed in a carbonate series of Cretaceous age underneath a Miopliocene unconformity, the karstifications affect a set of cracks, diaclases and reverse faults putting side by side materials of different physicochemical composition (dolomite and limestone).

The ore deposits composition is that of a karst. In the lower parts, the mineralization contains detrital elements from the bottom layer and the roof (limestone, dolomite); precipitations of in situ collomorphe chemical deposits are observed. The ore deposits developing vertically in the upper parts belong to the exokarst while those extending horizontally in the lower parts belong to the endokarst (Fig. 8).

In Ain-Kerma, there exists also an early mineralization which occurs as nodules of stibine, impregnating still unconsolidated sediment of the karstic felling in a silica-rich matrix. These features are that of a particular karstic environment which is the siege of hydrothermal circulations.

Figure 8. Aspect of karstic felling: collapsing breccias with elements of limestone and dolomite from the roof of the cavity.

The transgressive post-tablecloth formation acted as a screen to the hydrothermal solutions, the mineralization being trapped in the karstic receptacle. The hydrothermalism of the area is related to the Neogene magmatic activity of the North of Algeria (Raoult and Velde, 1971). The deposited silica by thermal solutions lead to the antimony as sulfides (Sb_2S_3); this is the case in most of the indices of the neritic series were siliceous travertine contain thin capillary inclusions of stibine (Toubal 2005). In the English literature, these mineralizations are known as sinters, in Turkey (Bernasconi et al., 1980), New Zealand and USA Nevada (Roberts et al., 1971).

For the first time, the occurrence of silver sulfides (argentite) indicating temperature equal or above 179°C is revealed. The antimony – silver – silica association was pointed out many times in the world, especially in New-Zealand (Krupp and Sewward, 1990). In Tunisia, the occurrence of silver was reported in the karstic cavities (Steinberg and all., 1985). This mineral association is the result of hydrothermalism related to the Neogene magmatism of the North-East of Algeria (Marignac, 1984).

The North-East of Algeria is characterized by a relatively high geothermal gradient (5°/100m on average) due to the thinning of the lithosphere (Kazi-Tani, 1986).

Drilling at depth of 100 to 290m, less than 10km away from Zitouna at the Algerian-Tunisian border, show temperatures above average (1°/30m), exceeding sometimes 1°/10m. On the surface, this geothermal anomaly is revealed by serial hot springs, hammam (Mexa, Sidi Trad, Beni Salah, and Meskoutine), water temperature ranging from 95° to 30°. Data from Geotravers program in Tunisia corroborate the crustal thinning following the rise of the Moho (25 km).

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