HERCYNIAN ACID MAGMATISM AND RELATED MINERALIZATIONS IN WESTERN ALGERIA FLUID INCLUSION CHARACTERISTICS OF QUARTZ VEINS

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Abstract

The Beni Snouss granite is a member of the late-hercynian Granites of NW Algeria. The Beni snouss Complex comprises an assemblage of two nested intrusions Tairet and Bouabdous. The studied intrusion, represented by a composite association of granites with dark microgranular enclaves, has a typical high-K calc-alkaline evolution, with peraluminous trend. U-Pb zircon geochronology yielded the minimum emplacement age of 297 ± 1 Ma.

Mineralized quartz (±sulfide) veins are hosted by granitoids in close spatial association with granitoids having quartz veins representing hydrothermal activities associated with them. Invisible gold occurs in a very small arsenopyrite minerals.

Fluid inclusions were studied in vein quartz. They have salinities of 21 eq. wt.% NaCl. These fluids may represent late magmatic fluids associated with greisenisation and mineralisation.

Key words: Hercynian granites, Au, Vein quartz, Algeria, Ghar Roubane.

Introduction

Unlike European deposits whose mineralogy, fluid chemistry and age of emplacement are well established, North African deposits, and more specifically those of Algeria, remain poorly understood owing to the lack of geochronologic, fluid inclusion, and isotopic data

The Beni-Snouss monzogranitic intrusion is a part of the Oranian Magmatic Province, which is mainly characterized by several Late-Hercynian post-collisional granitic intrusions.

In the Beni Snouss massif (Ghar rouban, West Algeria), gold –quartz vein are linked with Hercynian granites and pegmatites. Here, free native gold is preponderant, while invisible gold occurs in a very small arsenopyrite minerals, veinlets and echelon tension gash fillings.

The mineralized structures which consist mostly of quartz and barite occur principally as N110° to N140, and E-W-trending transtensional steeply dipping veins.

Geological Setting

The study region (Fig. 1) is located in the oriental part of the Ghar Roubane Massif. According to Lucas, (1942, 1952) the main geologic units are: (i) Hercynian granites (late to post-tectonic 297 ± 1 Ma) and (ii) Silurian metasediments (mostly schists with subordinate quartzite and carbonaceous slates). The Tairet and Bouabdouss granites have been classified as alkaline granites. The most important formations are Jurassic sedimentary rocks that show their maximum thickness along the oriental part of Ghar Roubane.

The granite plutons selected for this study are formed during thelate Hercynian phase and intrudes the Lower Silurian metasediments which were affected by the major Hercynian folding phases (Lucas, 1942, Elmi, 1979) . An important Quartz vein field cross-cutting metasedimentary and granitic rocks.

Granitic rocks are mainly represented by two small bodies, about 1 km^2 each, called from west to east: Tairet granite and Bouabdouss granite (Fig. 1).

Contact metamorphism is marked by the transformation of pelitic sediments to spotted hornfels showing a quartz, biotite, muscovite, andalusite and cordierite association.

Dikes of aplites, pegmatites and andesites have been reported in the Beni Snouss area . These dikes postdate the calc-alkaline granite. The structural evolution of the district has been deciphered by Elmi (1973)

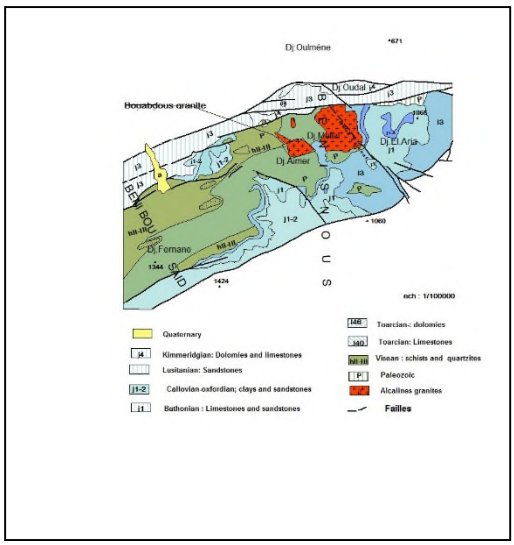

Fig. 1 Schematic geological map of the studied area with major Variscan structures

Petrography and Geochemistry

The petrography and geochemistry of the Beni Snouss batholith have been well described through multiple investigations (Lucas, 1942; Harbibi., 2000; Bouraoui, 2003; Remaci et al., 2005).

The Beni-Snouss monzogranitic intrusion is part of the Oranian Magmatic Province, which is mainly characterized by several late-Hercynian post-collisional granitic intrusions. The composite massif consists of two different units of biotite-rich porphyritic granite: the coarse-grained monzogranite of Tairet (fig 2.a) and the medium

grained monzogranite of Bouabdous with abundant microgranular enclaves, which are rare in Tairet.

They exhibit aporphyritic hypidiomorphic granular texture and contain typically interstitial quartz showing undulatory extinction, perthitic K feldspar (orthoclase and microcline), plagioclase (oligoclase-andesine) biotite and some muscovite, tourmaline. Apatite, zircon and topaze are found as accessory minerals. Tourmaline is abundant in Tairet granite.

The studied intrusion, represented by a composite association of granites with dark microgranular enclaves, has a typical high-K calc-alkaline evolution, with peraluminous trend. This association consists of crustal granitic magma and a dark, but felsic magma that had preserved previous isotopic mantle source signature. The mingling process occurred during the advanced crystallization of the biotite granite magma. Similar mineralogical and geochemical features of the enclaves and their host rocks, as well as the observation of important mechanical transfers of crystals, enable us to estimate a significant hybridization mechanism during the mixing/mingling of the two magmas. Nevertheless, the chemical variations of biotite, as well as the difference of initial Sr and Nd isotopic signatures prove that equilibrium was not completely attained between the enclaves and their host rocks. Furthermore, this intrusion was affected by post-magmatic hydrothermal alterations, which developed greisenization effects and produced dilution of the initial LREE and MREE. (Remaci et al, 2003).

Fig 2.a. Pink granite of Tairet

Fig 2.b. Grey granite of Bouabdous

Mineral deposits

The Beni Snouss district displays two types of mineral deposits:

(i) Quartz veins with Au occurrences, located at the edge of the district (Figs. 1 and 2), striking N50E to N80E and dipping N to NW (average 65) ,

(ii) (ii) Widely distributed and exploited Ba (Pb- Zn) veins (Bouabdouss.). These veins are hosted by Paleozoic sediments, and cut across the granitic stocks.

Quartz veins

The quartz-tourmaline veins and veinlets (fig 3.a) are typically either N110 -150 or E-W trending, with thicknesses ranging from 1 to 3 m and lengths of a few hundred meters. The

veins are milky white to light grey. Several quartz occurrences are observed: grey and microcrystalline; white macrocrystalline and translucent with palissadic textures; or locally pyramidal .The ore minerals are mainly arsenopyrite and rare gold.
The hematite-bearing quartz veins (fig 3.b) are mainly composed of massive and euhedral quartz and hematite with minor amounts of pyrite and pyrrhotite. Locally, some mineralized veins occur as conjugate vein pairs and en echelon tension gash. Texturally, the veins display comb, laminated, breccia and crack and seal textures, suggesting that episodic, multiple mechanisms were important for trans-tensional vein formation. Small vug-filling disseminations of sulphides also occur within the quartz.

In the Beni Snouss massif (Ghar rouban,West Algeria), gold –quartz vein are linked with hercynian granites and pegmatites . Here, free native gold is preponderant, while invisible gold occurs in a very small arsenopyrite minerals. In both cases, the precipitation of invisible gold in arsenopyrite and pyrite by a possible $(Fe, Au)^{3+}= (As-S)^{3-}$ substitution mechanism may have been facilitated by rapid, non-equilibrium conditions involving pressure decreases and wall rock reaction (sulphidation, carbonatisation) (Aissa , 2003).

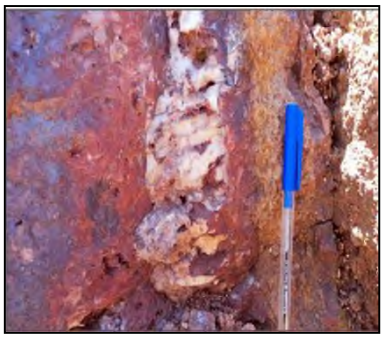

Fig3.a Quartz veins **Fig3.b Hematite - Quartz veins**

Barite veins and stockworks

Barite veins and stockworks are developed in the granites, and are observed at Mallal and Bouabdous. A few veins contain sulfide mineralization. The vein varies in thickness from a few centimeters up to 2 meters, and their length varies from 10 up to 100 m. Most of veins are N50 - N75 and 60 to 90 dip. They show massive, brecciated and drusy textures.
The important minerals of the veins in the order of their abundance are barite, galena, chalcopyrite pyrite, and fluorite secondary malachite and azurite appear locally.
Most of the barite is of a white color but some is pink or even transparent. The pink variety occurs only in Tairet granite .The ore minerals are generally disseminated among barite and quartz in the veins.

Fluid inclusions in vein quartz

Microthermometric measurements of fluid inclusions in quartz were performed using a Linkam heating-freezing. The fluid inclusions present in quartz samples are all two-phase (L+V) liquid rich aqueous inclusions. (Fig 5.a) They occur along growth zones) and along annealed fractures in the vein quartz indicating primary and secondary trapping(Fig. 5b). Salinities are about 21 eq. wt.% NaCl. Homogenisation to liquid took place between 140 and 225°C.

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