FLUIDS ASSOCIATED WITH F-Ba MINERALIZATIONS OF THE STRATIFORM CARBONATE-HOSTED DEPOSIT OF HAMMAM ZRIBA (TUNISIA)

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The deposit of Hammam Zriba is situated about 8km SE of Zaghouan City and 68km from Tunis. The Hamman Zriba deposit was the most important CaF_2 mine of the "province fluorée tunisienne" Northern Tunisia. Fibrous barite and fluorite mainly compose the mineral assemblage, however we can find some galena, sphalerite, calcite and quartz (Boulhel et al.,1988).

Geology

The deposits of the F province are located near of a very important structural lineament (NE-SW) corresponding to the Zaghouan fault and consequently in the proximity of the "Jurassic Tunisian dorsal" defined by outcrops of Upper Jurassic limestones. The latter design also a geomorphological alignment (about 70km) of several mounts "djebels". The Zaghouan Djebel is a massif with about 9km length and 3km width and corresponds to the second highest summit of Tunisia (1295m).

The stratigraphy of the sector comprises a series of sedimentary rocks from the Tithonian to the upper-Eocene with a hiatus from the Berriasian to the middle-Campanian, corresponding to an emersion period (Thiebieroz, 1976). The bed corresponding to the orebody is situated between pararecifal massif limestones of Tithonian age, at the bottom, and marls alternating with limestone banklets of middle to upper-Campanian age.

The local geology corresponds to a horst striking NNW-SSE limited mainly by two normal faults: one (F1) striking N135°E to N145°E and dipping 50 to 70°NE and another (F2) striking N130°E to N150°E and dipping 50 to 70°SW (Melki, 1990).

The sector of Hammam Zriba is also characterised by actual seismicity and the existence of a thermal source.

Mineralogy

The mineral assemblage is very simple, mainly composed by barite and fluorite, however we can find some galena, sphalerite, calcite and quartz. Boulhel et al. (1988) described several types of ore, where the main one correspond to a banded ore in sub-horizontal plans essentially composed by a white and fibrous barite and well crystallized fluorite (Type F1 ore).

Fluid inclusion studies

Fluid inclusion (FI) studies were carried out in fluorite and barite from the banded ore.

In fluorite three different types of liquid fluids were found (Table I):

I- high salinity aqueous fluid (H_2O- $CaCl_2$ -NaCl), in two phase pseudosecondary FI (Lw1), with Flw from 0.90 to 0.95, Te varying between –77.7 and -55.4 °C, Tm_{ice} between -22.4 and -13.1°C and Th between 150 and 160°C;

II- low salinity aqueous fluid (H_2O-NaCl), in two phase pseudosecondary FI (Lw2), with Flw = 0.95, Te varying between -78 to –56.6 °C, Tm_{ice} between -8,1 and –2.6°C and Th between 130 and 150°C;

III- hydrocarbon-rich fluid in two phase secondary FI (Lm), defining curved alignments, with 140<Th<150°C. During the cryometric studies we observe in these FI an expansion of volatile phase between –25.5 to –23.3°C and the bubble become with its initial volume at –20 to –18°C. It was not possible to analyse the composition of these FI with a Raman spectrometer (632.817 nm-HeNe laser) due to a high fluorescence response.

In barite, due to the very small size of secondary FI (<5μm), only a few two phase fluid inclusions (n=5) were studied. They correspond to a liquid low salinity, low temperature fluid (H_2O-NaCl) with Te varying between –32 and –31°C, Tm_{ice} from –3.3 to –3.0°C and total homogenisation 130<Th<135°C. Some very small secondary inclusions with only one dark phase were observed in FIP.

Table I- Microthermetric data from fluid inclusions in fluorite

Fluid	Type	Size (μm)	Flw	Te (°C)	Tm_{ice} (°C)	Th (°C)
I	Lw	35 to 80	0.90 to 0.95	-77.2 to -55.4	-22.4 to -13.1	150 to 160
II	Lw2	33 to 65	0.95	-78.0 to -56.6	-8.1 to -2.6	130 to 150
III	Lm	45 to 100	0.70	-110 to -100		140 to 150

Actual hydrothermal fluids

Near the old mine and spatially associated with F1 fault there is a thermal source with T= 46°C of water with a chlorine-sulphate and sodium-calcium composition (Table II) characterised by values $\partial^{18}O$ of -5.9 and ∂D -33.6 and assumed to be related to Triassic lithologies (Sdki, 1998).

Table I - Chemical composition of actual thermal waters from Hamamm Zriba spar

Na	K	Ca	Mg	Cl	HCO_3	SO_4	SiO_2
mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	g/l
917.7	28	1344	244.8	1618.8	200.0	3610.5	75
Cu	Zn	Pb	Mn	Li	Fe	Co	Sr
ppb	ppm	ppm	ppm	ppm	ppm	ppb	ppm
12	0.3	0.5	0.04	0.2	12.6	18	17.1

Conclusions

The stratiform F-Ba mineralizations resulted from a hot (~150°C) multi-component brine dominated by Na-Ca-Cl-SO_4 post-Tithonian and pre-Campanian in age. The deposition occurred below an uncorformity and the mineralising fluid circulation was controlled by a pre-Campanian fault system. These faults acted as channels that allowed the fluid circulation from the Jurassic to the deep Triassic and probably also to the crystalline basement. The chemical specific characteristics of the fluids were acquired as proved by the thermal waters with a chlorine-sulphate and sodium-calcium composition.

On what concern the hydrocarbon fluid present in secondary inclusions of fluorite they can be post-Campanian in age.

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