

An investigation into the genesis of the Zaccar iron deposit with special reference to its fluid inclusions (MILIANA, AIN DEFLA, ALGERIA)

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Summary

The Zaccar metasomatic-type iron deposit in northwestern Algeria is hosted in Jurassic carbonate sequences proximal to Neogene volcanic rocks. The deposit consists of iron carbonates and oxides. Country Jurassic limestone is partly replaced by the original epigenetic metasomatic ore of ankerite and siderite, associated with minor pyrite, chalcopyrite, galena, and barite. Abundant hematite was formed by supergene enrichment of iron carbonates controlled by ground water level at low to medium temperature. The emplacement of Miocene volcanic formation is followed by another type of iron mineralization i.e. namely specularite which crosscuts former mineralization of iron and polymetallic ore.

The microthermometry study of primary fluid inclusion trapped in quartz associate to specularite shows the existence of cavities with dominant of aqueous phase, a bubble of gas and cube of halite.

Most of the fluid inclusions homogenize into liquid phase at a temperature ranging from 270° to 290°C before dissolution of halite. The dissolution temperature of halite ranges from 300° to 320°C. Thus, salinities of mineralizing fluids range from 38 to 40 wt% NaCl eq.

Introduction

In northwestern Algeria, there are several iron deposits hosted in the Paleozoic to Mesozoic sedimentary rocks, with the majority of them located in Zaccar, Rouina and Beni Saf (e.g. Popov 1976). These deposits are classified as metasomatic carbonate replacement deposits, which were formed through the process of epigenetic replacement of limestone by siderite followed by supergene enrichment by hematite. Objective of this paper is to clarify mineralogical and geochemical characteristics of the Zaccar iron deposits.

Method

We used fluid inclusion method for studied hydrothermal quartz samples associated to specularite ore of Zaccar deposit. Fluid-inclusion microthermometry was performed on doubly polished thin-sections of samples of quartz associated to specularite hosted in rhyolite. The analysis was carried out using a Nikon microscope mounted with a LINKAM THMS-600 and TMS-190 freezing-heating stage at LMMA Laboratory, Department of Geology FSTGAT and at the Department of Earth Resources Engineering, Akita University. The accuracy of measurements of two different stage of homogenization temperature (Th) and halite dissolution temperatures (Ts) is ± 2 °C in the range of 150/400 °C.

Results and Discussion

Betier et al. (1952) suggests that temperature of formation of iron carbonate of Zaccar range from 90°C to 100°C. The emplacement of Miocene volcanic formation is followed by another type of iron mineralization i.e. namely specularite which crosscuts former mineralization of iron.

Most of the investigated quartz samples associated with specularite mainly contain primary fluid inclusions based on the definition of Roedder (1984) and Bodnar (2003). Primary fluid inclusions are observed as oval, semi-spherical to spherical in shape, and are irregularly dispersed throughout crystal lattice. Sizes predominantly range from 10 to 50µm (Fig.1). The primary fluid inclusions are dominated by three phases including halite, liquid and vapor (H + L + V) and sometimes included undetermined crystals shapes (X minerals), which were not measured. Visually estimated vapor to liquid ratios in all samples range from 5 to 20 Vol. % without large variation. Homogenization temperatures (Th) and halite dissolution (Ts) temperatures of 30 primary fluid inclusions in a quartz vein were determined. Most of the fluid inclusions homogenize into liquid phase at a temperature ranging from 270° to 290°C before dissolution of halite. The dissolution temperature of halite ranges from 300° to 320°C. It is estimated that the halite dissolution temperature decreased by about 10°C due to the pressure effect during the heating, after homogenization into the liquid phase around 270° to 290°C. Thus (300° to 320°C) + ca. 10°C was applied to calculate salinity according to experimental study of Sterner and Bodnar (1988) that reported on the estimation of the salinity from dissolution temperatures of halite crystals. In this case, salinities of mineralizing fluids range from 38.9 to 40.6 wt% NaCl eq. Possible errors range from an under estimate of the salinity by ~1.3 wt % for a halite dissolution temperature of 200°C, (Bodnar et al. 1989).

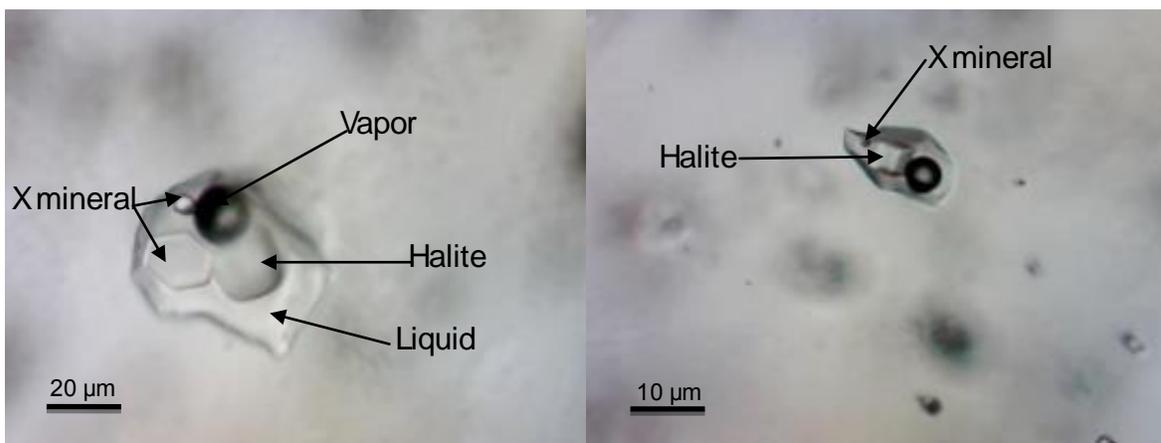


Fig.1. Fluid inclusions trapped in quartz.

The plotting of measurement into the "Magmatic-Meteoritic Mixing" fields (Beane 1983) (Fig.2) indicates the partial mixing of magmatic solutions with dilute meteoric waters. This is consistent with the agreement of several authors who consider that the presence of specular hematite could be related to high temperature formation (Gerald et Albert 1942; Panto 1952; Ducros 1974). While low to medium temperatures forming the first iron carbonate replacement were probably related to basinal brines.

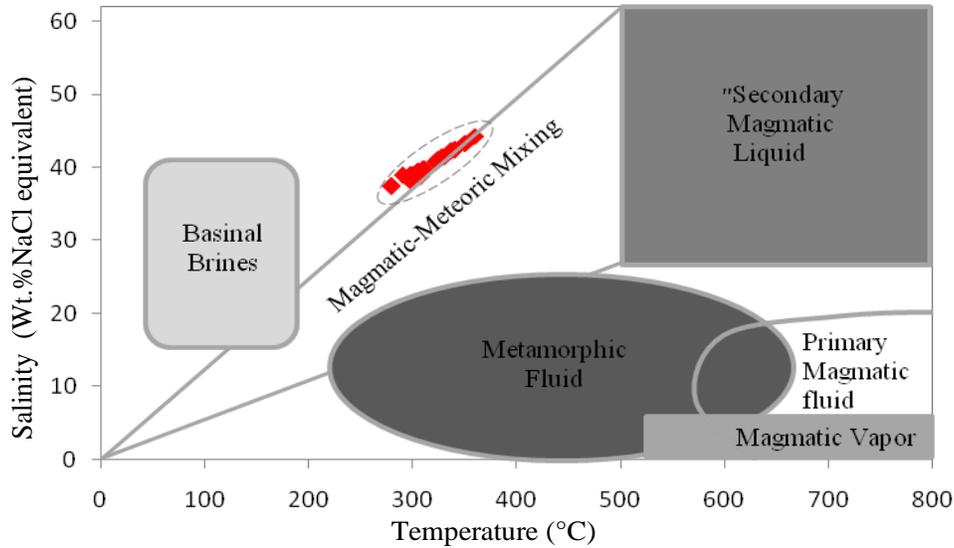


Fig.2. Plot of homogenization temperature vs. salinity values of fluid inclusions in quartz; in the diagram of Beane (1983), (red squares in the «Magmatic-Meteoric Mixing domain» belong to this study).

Conclusions

On the basis of geological and geochemical data of the Zaccar deposit, it is possible to conclude that the Zaccar iron deposit have polyphased metallogenic history, mainly represented by two events: (1) An important Fe metallogenic event that occurred by epigenesis of carbonate rocks, and (2) A minor Neogene Fe mineralization, controlled by volcanic activity.

The second type of oxide iron ore of specularite was formed at high temperature and salinity, by partial mixing of magmatic and meteoric solutions during Miocene volcanic event.

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