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TEMPERATURE OF FORMATION OF BARITE BASED ON FLUID INCLUSION DATA

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ABSTRACT

Temperature of formation of barite has been determined by homogenization and decrepitation of the fluid inclusions. Both primary and secondary inclusions were noticed belonging to mono and two phase (liquid-gas) types. The temperature of formation estimated is 125° C which is in agreement with the approximations made on the basis of other features of barite mineralization. The investigations also revealed some interesting information regarding the physico-chemical nature of mineralizing solutions.

INTRODUCTION

THE approximate temperature of formation of minerals can be known by their petrographic characters, associations, textures and the nature of wall rock alteration (Stringham[10]; Ingerson[5]), whereas fluid inclusion studies provide more accurate results and also furnish valuable information regarding the physico-chemical nature of mineralization. It is also used as a tool in geoexploration, especially in search of blind ore deposits (Yermakov and Gromor[12]; Roedder[9]). Very little information is available on fluid inclusion studies of the ore deposits of India (Dekate[4], Ballurkar[2], Lahiry[6]). The temperature of formation of barite from Khammam District, Andhra Pradesh, has been determined by fluid inclusion studies and the results are compared with the other features of mineralization.

Principle and Method of Homogenization

During crystallization of some common hydrothermal minerals some cavities completely filled with hot solutions are formed and hermetically sealed off. On cooling this hot liquid contracts creating a vacuum which is instantly filled with vapour of the same liquid. Thus a two phase system (gas and liquid) is formed. On heating the crystal the liquid in the cavity expands and at certain temperature the gas phase disappears and the cavity is entirely filled with one homogeneous liquid phase. This process, called homogenization, approximately represents the temperation of crystallization.

A two side polished section of the mineral containing liquid inclusion is placed in the microthermochamber which is installed on the stage of the microscope. The heating is controlled by an adjustable rheostat working from a stepdown transformer. The mineral being heated is observed through the microscope with long focal length objective and when homogenization occurs the temperature is read by a thermocouple in contact with the sample. It is desirable to homogenize about 75-100 inclusions and take the temperature at which the majority of the inclusions are homogenized. The accuracy of the information is about $\pm 2°$ to $3°$ C.

Principle and Method of Decrepitation

Heating of liquid inclusions in small fragments of mineral beyond homogenization results in decrepitation (exploding) which also represents the approximate temperature of formation. This method is especially useful when the mineral lacks transparency or if the inclusions are of very small dimensions. Small grains of the mineral containing inclusions are heated in a tube in contact with a thermocouple. The explosions are measured by an automatic recorder. The temperature at which the maximum explosions occur is taken as the decrepitation temperature. The accuracy of this method which depends on several factors is slightly less than that of homogenization. It is generally around $\pm 5°$ C.

OBSERVATIONS

Barite in Khammam District occurs as cavity filling and replacement bodies in phyllitic slates and dolomites of Pakhal formations and is considered as belonging to the telethermal type, controlled mainly by the structures in the enclosing rocks (Appavadhanulu[1]; Ballurkar[3]). Samples from important occurrences have been collected and it is found that they contain plenty of fluid inclusions of varying shapes and dimensions. Most of them are minute and fall in the range of 20 to 50 microns. Both primary and secondary types are noticed in the transparent varieties. Some semi-transparent samples have shown higher population of inclusions but the size of inclusions is too small (about 2 microns), for observations. The primary inclusions are mono and two phase types showing liquid and gas phases. In most of the inclusions, gas bubble occupies about 10 to 20% of the area. The liquid is clear without any daughter minerals. The negative relief of the boundaries of the liquid indicated its refractive index lower than barite (Fig. 1). The sample also contains solid inclusions of chalcopyrite, pyrite and galena but they are not enclosed

in the inclusions. The secondary inclusions are mostly arranged along the fracture planes and some of them are seen ruptured. The criteria for distinction of primary and secondary inclusions and the methods of homogenization and decrepitation adopted as described by Yermakov *et al.*[11]. In most of the cases almost a complete homogenization is achieved around 125° C. The decrepitation has given a higher range of 130–150° C.

FIG. 1. Primary inclusion of liquid-gas phase with negative relief in the crystal of barite (× 400 approx.).

DISCUSSION

It is clear from the above observations that the lower limit of temperature of formation of barite of Khammam District may be considered as around 125° C. This is quite in accordance with the other aspects of mineralization such as nature of occurrence, petrographic characters, associated minerals and their textures and the nature of will rock alteration (Ballurkar[2]). All these features classify them as "TELETHERMAL DEPOSITS" in the modified Lindgren's classification (Ridge[8]). The extreme dilute nature of liquid and absence of multiphase and daughter minerals in the inclusions reveal the high purity of mineralizing solutions which is generally attained at the last stages of hydrothermal activity especially in the telethermal zone. This is in agreement with the paragenetic sequence of the primary minerals associated with these deposits. The presence of fine disseminations of chalcopyrite, pyrite and galena in barite and some observations of textures and paragenesis favour the genetic relationship between barite and base metal mineralization in the adjoining area which support the probable zoning of ore deposits in the Precambrians of this region as proposed by Ramana Rao and Ballurkar[7].

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1. Appavadhanulu, K., *Proc. Symp. Mineral Industry in A.P.*, Dept. Min. and Geol., A.P., 1962, p. 21.
2. Ballurkar, A., Origin and occurrence of barite deposits of Khammam Dist., A.P., Ph.D. Thesis, Osmania University, 1971, p. 153 (Unpublished).
3. —, *C.E.G. Bull.*, 1972, **2**, 123.
4. Dekate, Y. G., *Curr. Sci*, 1961, **30**, 263.
5. Ingerson, E., *Econ Geol*, **50**, 1955, 341.
6. Lahiry, A., *Ind. Jour. Earth Sci.*, 1976, **3**, 37.
7. Ramana Rao, N. and Ashok Ballurkar, *Geol. Soc. Ind.*, 1971, **12**, 187.
8. Ridge, J. D., *Geol. Soc. Am. Mem.*, 1972, p. 131.
9. Roedder, E., *Econ. Geol.*, 1977, **72**, 503.
10. Stringham, B. G., *Ibid.*, 1952, **47**, 661.
11. Yermakov, N. P. *et al.*, *Research on the Nature of Mineral Forming Solutions*, Pergamon Press, 1965, p. 743.
12. — and Gromov, A. V., *Mineralogical Thermometry and Barometry*, Nauk Press, Moscow, USSR, 1968.

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