Journal of Advances in Science and Technology

Vol. IV, No. VIII, February-2013, ISSN 2230-9659

SIGNIFICANCE OF FLUID INCLUSION STUDIES OF BARYTES DEPOSITS OF RAJGARH AREA, DISTRICT ALWAR (RAJASTHAN) INDIA

www.ignited.in

Journal of Advances in Science and Technology
Vol. IV, No. VIII, February-2013, ISSN 2230-9659

Significance of Fluid Inclusion Studies of Barytes Deposits of Rajgarh Area, District Alwar (Rajasthan) India

Dr. L. N. Sharma

Associate professor, Department of Geology, Govt. College, Narnaul (Haryana)

Abstract* – Fluid inclusion study in barytes of Rajgarh deposits was carried out to determine the role of temperature, pressure and composition of the fluid medium from which minerals were formed – depends upon the correct identification of fluids trapped from the original medium during growth of crystals, as distinct from those introduced at some later stage in the history of the mineral. It has been proved that the results of fluid inclusion studies are so consistent and reasonable that most of the scientists accepted them as such. The density, salinity rate of movement and composition of the solution can be determined by the fluid inclusion study to understand the origin of deposits. More elaborated studies can yield data on isotopic and chemical nature of hydrothermal solutions. Under certain circumstances (when mineral precipitates from boiling solution), the true temperature of precipitation and depth below the pale horizon can be calculated. The fluid inclusion studies have been used in fields of economic Geology, Mineral Exploration, Sedimentology, Stratigraphy, Geothermometry, Geochemistry, etc. Fluid inclusions are probably best known as a Geothermometry specially in the study of ore deposits, indicating the chemical composition of hydrothermal solutions.

***Key words:* deposits, minerals, crystals, hydrothermal solutions.**

---------------------------♦-----------------------------

INTRODUCTION

Fluid inclusions are little droplets of fluids that were present when the enclosing minerals grew or recrystallised from the same fluids. These droplets may be of aqueous solution, carbon dioxide, oil or any other fluids (**Sorby, 1958**,; Kennedy,1950; **Roedder, 1962**, 1984). Gas bubbles that occasionally are trapped in minerals, growing from gas saturated or boiling liquids and the globules of immiscible fluids, such as oil, that are trapped along with water phase(**Roedder, 1963**). The gas bubbles present in fluid inclusions were result of differential shrinkage of the liquid and the enclosing mineral during cooling from the higher temperature of trapping to the temperature of observation (Sorby,1958). The temperature of trapping can be estimated by heating the sample to the temperature when the bubble disappears.

The fluid inclusions are used as evidence of characteristics of ore forming fluid and environment of deposition of Barytes at the Rajgarh belt. The applications of fluid inclusion are based on certain major assumptions as pointed by Sorby (1858), Roedder (1967, 1976) and Edington and Wilkins (1980) are summarized as:

1. Trapping of some fluid medium takes place within the crystal during the process of growing and development of some irregularities in it.

2. The Trapped fluid is a sample of the mineralising fluid at the time of trapping.

3. The inclusions after trapping do not loose or gain any quantity of material.

4. The inclusions once formed remains always in the same position.

5. Due to the thermal expansion or precipitation on the walls during cooling, the inclusions may change in volume (1 to 2%) .

REVIEW OF LITERATURE:

The observations and conclusions based on studies by **Sorby (1958)** and Zirkel (1870) regarding the significance of fluid inclusions are still valid and useful (**Roedder 1972**). The distinction was not made by various workers of nineteenth century on fluid inclusions (Humphrey, Davy, Brewater, Sorby, Zirkel etc.) (Smith, 1953). Consequently the range of homogenization temperatures commonly observed in single crystal eventually gave rise to the feeling that leaking must have been common place and that any fluid inclusion data was untrustworthy. However, validity of fluid inclusion studies have been challenged by some workers. Philips (1875) pointed out that a single sample may have inclusions of different nature and chemical composition.

In the first half of the century the fluid inclusion study is largely attributed to the lack of understanding of origin of inclusions. By 1923, it was clear that fluid could be trapped in minerals after their formation (Dale, 1923). This problem was solved by Laemmlein (1929) on the healing of fracture surfaces. Yermakov (1949) identified the important class of pseudosecondry inclusions, the only tools for satisfactory interpretation of fluid inclusion origins have been available. Perrin and Roubault (1952) thought of inclusions of secondary origin. Some other believed that data from fluid inclusions are unreliable as leakage of inclusions is invariably there. Later on, Roedder and Skinner (1968) has experimentally shown that leakage in fluid inclusions usually does not occur.

Fluid inclusion studies of Barytes deposits of Rajgarh area:

In the present course of the fluid inclusion study, the barytes samples from various deposits of Rajgarh area were selected. For the study , many polished plates as well as polished thin sections were prepared . The inclusions were studied by nondestructive methods. The identification and various petrographic characters were observed under the Jenapole C-Z microscope and Leitz Labour Lux microscope of COHU with video camera and Sony Videographic Printer. Microthermometry apparatuses and freezer were not used as the heating and freezing of the samples was not possible because most of the inclusions observed from the samples of Rajgarh barytes are of secondary monophase type having an aqueous phase (Plate 3,4). in rare cases a few small vapour bubbles are also visible (plate 6).

Choice of Samples and Preparation of Polished Plates:

Transparent to translucent barytes samples were selected from five major deposits of Rajgarh area i. e. Khora-Makhrora, Bhagat ka Bas, Jamrauli, Guarah Gujar and Ramsinghpura. Only transparent barytes were found suitable for fluid inclusion study. Barytes which is not transparent is unsuitable for the study as it imparts opacity for microscopic work. In non transparent barytes, fluid inclusion occur as a network of interconnected cavities, some of which partially filled with fluid. From a few translucent barytes which have some transparent zones where fluid inclusions could be noticed, were also selected for the study. After the selection of suitable samples the polished plates of barytes were prepared by adopting the traditional method. The thick plates were found suitable for the study of large number of inclusions.

Petrography:

About 25 selected polished plates of barytes samples from Khora- Makhrora, Bhagat ka Bas, Jamrauli, Guarah Gujar and Ramsinghpura deposits have been used for petrography study of the fluid inclusions. In the barytes of the area only primary and secondary type fluids inclusions could be traced. Most of the samples show secondary fluid inclusions except one or two samples from Bhagat ka Bas mine. Pseudo secondary inclusions have not been found in any of the samples.

Primary Fluid Inclusion:

Primary fluid inclusions are observed in one or two samples from Bhagat ka Bas mine which are of biphasic nature confined to growth planes of barytes crystal. The inclusions are roughly of triangular, oval or rounded shape (Plate 5) having rounded vapour inclusions at places. Some independent vapour bubbles are also observed out of which some occupy more than 90% space in fluid inclusions. No presence of carbon dioxide and methane is located in inclusions.

Secondary Fluid Inclusion:

The detailed petrographic study of fluid inclusions of barytes deposits of Rajgarh area reveals that most of the inclusions are of secondary type and monophase (Liquid) where as some of them consisting of two phases (liquid+ vapour). Cryometric study shows that the cavities contain low density gas owing to their small size. They are possibly occupied by low density aqueous phase. Trails of isolated gaseous inclusions are also observed. Some mineral inclusions such as quartz and amphiboles of irregular surface have also been observed (Plate 1).

Fluid inclusion in the studied samples are variable in size & shape and some of them are typically related to healed fracture, crossing the cleavage plane and grain boundaries (Plate 2,4,6). Their morphology vary from tubular to subspherical with regular to irregular shapes. Most inclusions are monophase occure in trails of very small size (Plate 4). In a few samples more than two or three trails are running parallel which transgress the cleavage and mineral boundary. Furthermore, some isolated inclusions are distributed along cleavage planes. The monophase inclusions are quite irregular in shape (plate 3, 4) showing subspherical to subellipsoidal (Plate 6) shapes. Occasionally some flat, negative crystal shaped inclusions are also found.

Heating and Freezing study:

As mentioned above the barytes samples from the area contained mostly the secondary monophase inclusions and display irregular to oval shape. Occasionally small vapour bubbles (plate 5) are also visible. Freezing study was not performed on these inclusions because they indicate false temperature , because of metastability (Roedder, 1984). Being monophase, heating study is not required as they are already homogenized. Vapour bubbles in fluid inclusions would form if the original fluid at the time of trapping has a temperature of more than 70^0 C (Roedder , 1984). No carbon dioxide phase was identified in any of the inclusions. Thus the fluid inclusion study of the area reveals that they must have been trapped at a temperature of around 70^0 C.

CONCLUSION:

The fluid inclusion study of barytes of Rajgarh area reveals that most of the inclusions are of secondary type and monophase (Liquid) where as some of them consisting of two phases (liquid+ vapour). These inclusions are possibly occupied by low density aqueous phase. Fluid inclusion study of the area reveals that the fluid inclusions are variable in size & shape and typically related to healed fracture, crossing the cleavage plane and grain boundaries. Most of the secondary inclusions are monophase, occurs in trails of very small size and quite irregular in shape.

The fluid inclusion study further reveals that they have been trapped at a temperature of around 70^0 C, which indicates that the barytes of the area was not formed at temp. more than 70^0 C and also under the low pressure conditions. These results can also be compared with the results described by Boni (1986) for Iqlesiente-sulcis mining district (Italy) barytes vein deposits (Cortecci et.al. 1989).

It may therefore be concluded that Rajgarh barytes deposits of magmatic affiliation form at a great distance from the magmatic source under low temperature, pressure conditions where cavity filling dominates (Bateman, 1959), termed as telethermal deposits. Thus the contribution of meteoric water is also easily supported under these conditions.

Plate 1

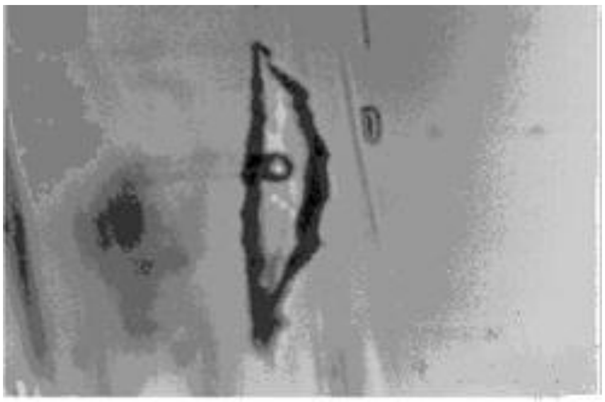


Plate 2

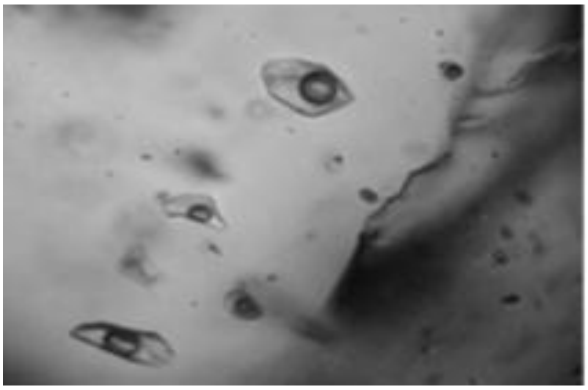


Plate 3

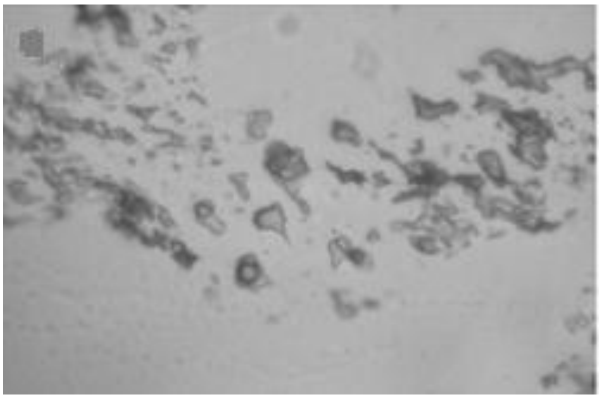


Plate 4

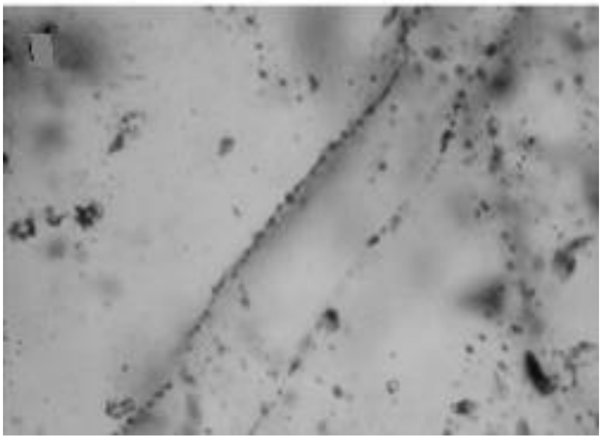


Plate 5

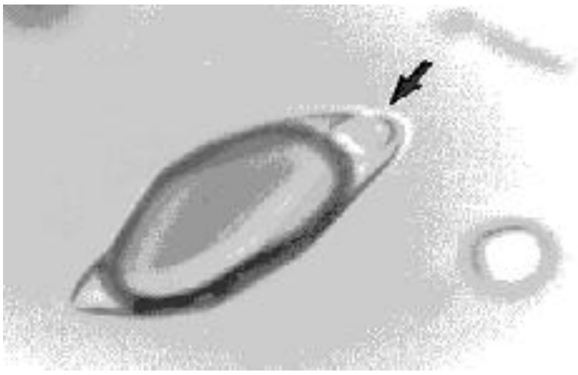
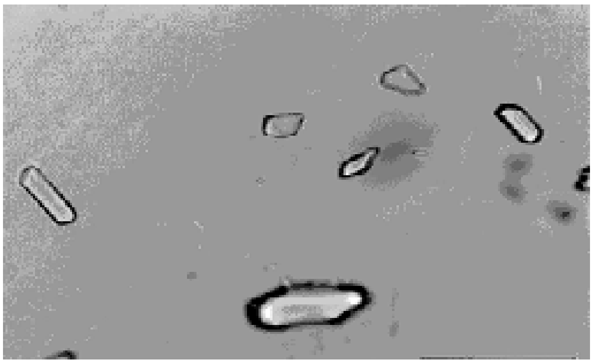


Plate 6



REFERENCES:

1. Anderson, C.A.1969; Massive sulphide deposits and volcanism E. Con. Geol. V.64(2)pp. 129-146

2. Anon 1975 : Asbesto and barites, mineral resources series, MR-I, Indian Bureau of Mines, Nagpur.

3. Bali,V. 1881: Barytess: Rajasthan. Manual of Economic Geology of India, G.S.I.P.474.

4. Banerjee, A.K. , Datta A.K. and Ravindra, R 1980: Geology and Mineral resources of Alwar district Rajasthan, Mem.G.S.I.Vol.110.

5. Blount, C.W., 1977: Barite solutions and thermodynamic quantities up to 300^0 C and 1400 bars, Am. Miner, pp.1942-1957

6. Brian Meson, 1966: Principles og geochemistry, Third edition, John Wilky & sons, Inc. New York.

7. Brobst, D.A., 1958; Barite resources of the United States. U.S. Goel. Surv. Bull. 1072-B.

8. Buchana, L.J.et.al., 1981; Fluid inclusion study of the Fiumarella Barite deposits (Catan zaro- S. Italy) Mineral Deposita (1981) 16, pp. 215-226.

9. Cortecci, G. et.al., 1989: Oxygen, sulphur and strontium isotopes and fluid inclusion study of barite deposites from the Iglesien- sulcis mining district, South- West Sardamia, Italy. Minalium dposita No. 24, pp.34-42.

10. Dunham, A.C. and Hanor, J.S. 1967: Controls on Barite mineralization in the Western United States, Eco Geol. 62, pp. 82-94.

11. Eddington, P. J. and Wilkins, R.W.T., 1980: The origin and interpretation and chemical analysis of fluid inclusions in minerals. Technical communication of the CSIRO Institute of Earth Sc., Division of mineralogy.

12. Hall W.E. and Friedman, I., 1963 composition of fluid inclusions cave in-Rocks fluerite district, Illinois and upper Mississippi valley Zinc-Lead district. Eco. Geol. Vol. 58, pp. 886-911.

13. Heron, A.M.,1917: Geology of North Estern Rajputana and adjescent district . Memo. Geol. Survey India Vol. xlv pt 1

14. Hollister, L.S. and Crawford, M.L. 1981(ed.): Short course in fluid inclusions: Applications to , petrology, mineralogical Association of Canada, Second Printing, 1983.

15. Krauskof, B. Konard, 1967: Introduction to Geochemistry Mc. Graw- Hill Book co., New York etc.

16. Keneddy, G.C.1950: “Pneumatolysis and the liquid inclusion method of geologic thermometry”, Eco., Geol. 45, pp. 533-547.

17. Laurance, R.A. 1939: Origin of the sweet water, Tennessee Barite deposits, eco. Geol. 34 pp. 190-200.

18. Leech D.L. 1980: Nature of mineralizing fluids in the barites deposits of central and south Massouri Eco. Geol. 75, pp,. 1168-1180

19. Mathur, A.K. 1977: Report on the reconnaissance for the mineral barites in Rajgarh and other areas of Alwar distt. (Unpublished) Deptt. of Mines and Geology, Govt. of Rjasthan, Udaipur.

20. Nagar A.K., Rawat , R.S. , and Patil, R.R. , 1984: Geological and fluid inclusion petrographic observations on barites mineralization in the Tons valley, lesserHimmalya. National Seminar on Scientific and Industrial Applications on fluid inclusion in minerals- Walia Institute of Himalyan Geology, Dehradun (Abst. P 30).

21. Poty,B.Leroy, J.and Jachimowicz, L.,1976: Anew device for measuring temperature under the microscope. The chaixmeca micro thermometry apparatus. Bull. Soc. France, Min. Cristallog, 99 pp. 182-186 (In French; Translared in fluid inclusions res. Proc. of COFFI, 9 pp.173-178)

22. Plumer L.N. 1971: Barite deposits in central Kentucky. Eco. Geol. Vol. 66, pp.252-258.

23. Ranakama, K. and Sahama, T.G., 1950: Geochemistry Chicago press pp. 4, pp. 457-484.

24. Roedder, E. ,1962: Ancient fluids in crystals. Scientific American Vol. 207, no. 4, pp. 38-47.

25. Roedder, E.,1963: Studies on fluid inclusions II: Freezing data and their interpretation. Eco.Geol. 58. pp.167-211.

26. Roedder, E.,1972-i: Composition of fluid inclusions U.S.Geol. Surv. Prof. Paper 440 J.J., 164P.

27. Roedder, E.,1972- ii- Barite fluid inclusion geothermometry Cartersville mining dist. North-west, Georgia (USA) Eco. Geol. 67 pp.821-822.

28. Roedder, E.,1984Fluid inclusions. Mineralogical Society of America, Review in Mineralogy, Vol.12, 644p.

29. Wegner, R.J., 1973: Stratigraphic and structural control and genesis of barites deposites in Washington County, Missouri (Ref. in Leach, 1980).

30. White, D.E. 1974: Diverse origins of hydrothermal ore fluids Eco. Geol. Vol.69, pp.954-973.