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The study of fluid inclusions and genesis of mineralization in the northwest of Gonabad, the Southern Khorasan Razavi province

Sedigheh Zirjanizadeh[1]*, Mohmmad Hassan Karimpour[2&3], Somayeh Samiee[1] and Azam Entezari Hersini[4]

1) Department of Geology, Faculty of Sciences, University of Gonabad, Gonabad, Iran
2) Department of Geology, Faculty of Science, Ferdowsi University of Mashhad, Mashhad, Iran
3) Research Center for Ore Deposit of Eastern Iran, Faculty of Science, Ferdowsi University of Mashhad, Mashhad, Iran
4) Department of Geology, Payame Noor University, Tehran, Iran

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Introduction

The study area is located in the Khorasan Razavi Province, NW of Gonabad between 58° 33″- 58 ° 38″ to the east and 25° 34″ - 25° 38″ to the north. Geotectonically, the area is located in the northern part of the Lut Block. The Lut Block is the main metallogenic province in the east of Iran (Karimpour et al., 2012). There is a significant outcrop of Tertiary intermediate volcanic and pyroclastic rocks in the northwest of Gonabad. This region is rich in clay (kaolin) mineralization. The source of these kaolin deposits (argillic alteration) is related to a granitic dyke that intruded into the Shemshak Formation.

Geology

According to studies most of the rocks in this region are volcanic rocks which mainly consist of trachyte, andesite, trachyandesite, dacite, rhyodacite, pyroclastics rocks of agglomerate and tuff and some subvolcanic masses and dykes of acidic to intermediate compositions. Sedimentary rocks in the study area are slightly metamorphosed. The oldest metamorphic rock is exposed in the south- east of the study area which consists of Jurassic slates and quartzite. At this area green schist facies have led to the formation of slate and quartzite. The intrusive bodies, composition are monzogranite porphyry to diorite porphyry. The main fault zones which make specific types of structure are strike-slip.

Alteration and mineralization

The volcanic and subvolcanic rocks have been affected by hydrothermal fluids via the phenomenon which has caused alteration in the rocks. The alteration zones are propylitic, silicification, argillic, and quartz-sericite-pyrite. The silicification has occurred with higher intensity in the northern and central parts of the investigated area. Propylitic alteration has spread all over the area with higher intensity in the northwest and southern parts of the study area. The clay mineral deposits (argillic zones) have been mined. The mineralogical compositions of this clay deposits are quartz, kaolinite, dickite, montmorillonite and hematite.

Materials and Methods

Ten doubly polished wafers (0.3mm thick) of fluorite, barite and quartz crystals were prepared for fluid inclusion studies, and examined petrographically. They were studied using standard techniques (Roedder, 1984, 1992) and Linkam THM 600 heating–freezing stage (from -190 to 600 °C) mounted on an Olympus TH4–200 microscope stage at the Ferdowsi University of Mashhad, Iran.

*Corresponding author Email: s.zirjanizadeh@gonabad.ac.ir
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The accuracy is estimated to be ±0.2 °C on freezing, ±2 °C below 350 °C and about ±4 above 350 °C on heating. The salinity of the fluids trapped in fluid inclusions is calculated based on the temperature of final ice melting (Tm) and the equation of Bodnar (1993). Densities are calculated using the Flincor software according to microthermometric data (Brown and Lamb, 1989).

Discussion

Microthermometeric investigations were conducted on 126 fluid inclusions in two types of liquid-rich (L+V) fluids in silicified cap of Rokhsefid and Baghsia kaolin mines. Homogenization experiments revealed a temperature range of 186–326 °C for the studied inclusion. Salinity variations could not be determined because of the small amount of fluids. The homogenization temperature and depth of formation from the first type of inclusions are 186- 256°C and 250 meters, respectively. The second type of inclusions have Th between 275 to 326°C and are 500 meter in depth. Microthermometric study of fluid inclusions on quartz-sericite-pyrite and sulfide- silicified mineralization in Kalatehno indicates that two types of hydrothermal fluids were important in the formation of mineralization. These two types are involved. First, Th between 289- 354 °C, salinity range from 10.86 to 10.98 wt.% NaCl equivalent, and the average depth of about 600 meters. Second, Th between 266- 377°C, salinity ranges from 11.7 to 13.07 wt.% NaCl equivalent, and average depth of about 600 meters. Microthermometric study of the fluid inclusions in fluorite veins were conducted on fluorite, barite and quartz minerals. The results obtained from the fluorites indicate Th between 184- 360°C, and Salinity ranges from 0 to 3.2 wt.% NaCl equivalent. Fluid inclusion studies consisting of quartz veins and quartz- sulfide- copper carbonate in Kalatehno copper mineralization involve two types of fluids with homogenization temperatures and salinity range from 260- 300 °C and 1.5- 3.23 wt.% NaCl equivalent and 193- 240 °C and 4.1- 5.86 wt.% NaCl equivalent.

Conclusion

Fluid inclusion studies on fluorite samples have shown a temperature homogenizations (Th) between 186-326 °C. These studies indicate the average formation temperature of 280°C for argillic alteration. Fluid inclusion studies on Kalateno Cu mineralization show two types of mineralization fluids with the temperatures of 193 to 240 and 260 to 300°C with salinity between 1.5-3.23 wt. % 4.1- 5.86 wt.% NaCl equivalent, respectively. The temperature ranges obtained are similar to those of epithermal systems.

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