Hydrothermal Solution activity in Precambrian Granitoides in Dasarigudem Village Nalgonda District Telangana India

Mallikanti Anjaneyulu[1], Ravi Vorsu[2], K. Madhusudhan Reddy[3], Prof. I. Panduranga Reddy[4]

[1] Department of Geology, University College of Science and Informatics, Mahatma Gandhi University, Nalgonda

[2] Department of Geology, University College of Science and Informatics, Mahatma Gandhi University, Nalgonda

[3] Department of Geology, University College of Science and Informatics, Mahatma Gandhi University, Nalgonda

[4] Professor, Department of Geology, Osmania University, Hyderabad

Abstract: ***Interaction of hydrothermal circulation in fractured rocks is a common feature in crystalline sequence. In the study area the granitic rock adjacent to fractures in Dasarigudem village northern Nalgonda, has been studied with emphasis on this mineral reactions and associated element mobility occurred during the alteration. The reaction occurred with hydrothermal solutions are complete saussuritization of plagioclase accompanied by chloritization of biotite. Magnetite had been replaced by hematite whereas K- feldspar altered into sericitization and Quartz also effected by hydrothermal solutions. Under the microscope, the quartz grain edges are marked as saw. This is due to fluorine (HF) react with Quartz and amalgamated into them from their edges.***

Keywords: hydrothermal alteration, Element mobility, saussuritization, Chloritization, cericitization, amalgamation

1. Introduction

The present study area bounded between longitudes of 79°14'27.66"E and 79°14'50.01"E, latitude 17°09'20.06"N and 17°08'59.21"N. Physiography of the area covered by small hillock and plain land, the basement of the rock is biotite rich granite. The basement rock intruded by hydrothermal solution and subjected to Steatization, Chloritization, Tourmalinization, Kaolinization and Cericitization. The trend of the hillock N-S in direction, fractures developed in E-W direction and the area is covered by red soils. The surroundings of this study area at Western margin covered by pink granite hillock and Eastern side covered by grey granite. Northern part covered by granite gneiss and the trend of the gneiss is NE-SW in direction. The southern side covered by red soils and the rocks are not exposed at long distance.

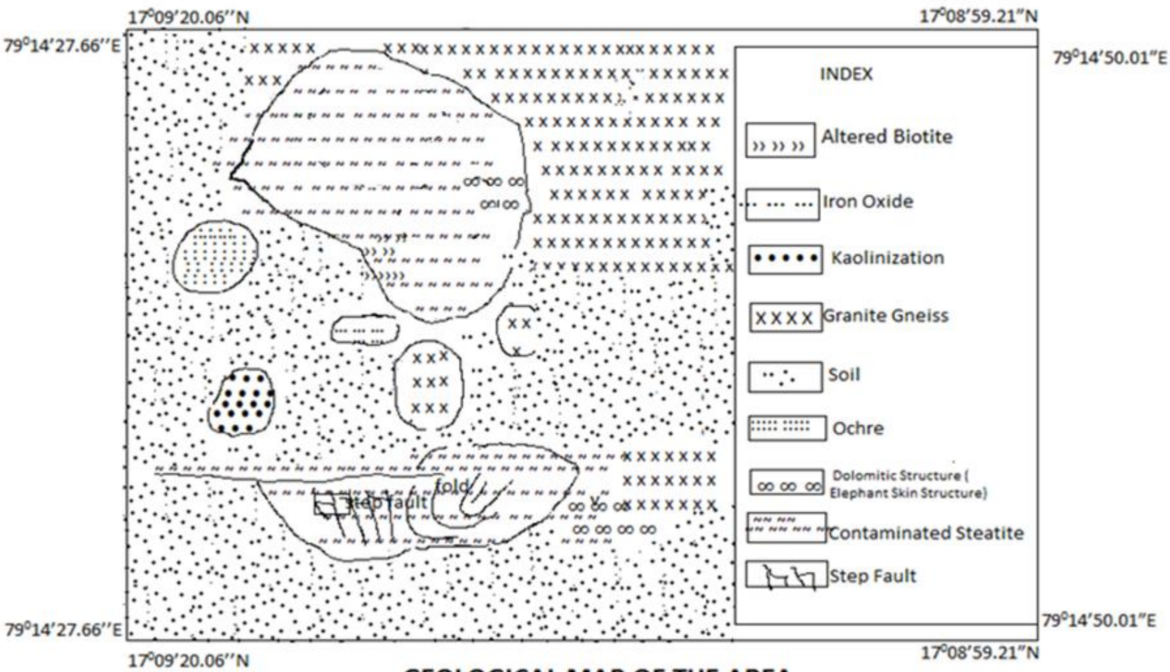
2. General Geology of the Area

The rock types of the study area are contaminated steatite, granite gneiss, chlorite with Steatite, tourmaline, complex pegmatite, Quartz, yellow Ochre, kaolinite, clay, fluorite bearing granite, Hematite, Chalcopyrite, amphibolite boulders and Quartz veins, small vug structures and comb structures are more common in this area. Both type of comb structures are common symmetrical comb structures are not developed that much than asymmetrical comb structures. The size of the comb crystals varying from place to place ranging from 5cm to .5cm. All the rock types of the study area are belongs to Precambrian period.

3. Regional geology of the Area

The trend of the area is N-S direction and the area covered by two small hillocks, one is at northern side and other one in southern side. The northern side hillock is having greater size than southern one; both are showing some similarities such as slickenslides, complex pegmatite and elephant skin structure (the special characteristic feature of the dolomite), but the southern small hillock showing step faults. The trend of the step faulting is north and south direction and they are not in straight line, they are showing curvature convex shape towards western side and concave towards eastern side. Some of the faulted blocks are parallel to each other and some are not (showing in different direction NNW- SSE). Step faults made an isoclinal folding in small hillock the limbs of the fold are similar in direction (NE-SW). At the western margin of the small hillock dug by workers for soil for road material. Within the dug pit some of the fresh rocks are exposed, and they are mostly grey granite with Xenolith patches of amphibolites. Amphibolites are undergone to spheroidal weathering, and intruded by Quartz and Pegmatite veins.

The bed rock is also showing the isoclinal folds in direction of N-S and the axial plain is horizontal with N-S direction. This hillock intruded by two contaminated Steatite dykes, one of two trending is EEN-WWS direction and other contaminated Steatite dyke is in N-S direction. This NW-SE direction dyke encountering the northern part of the bigger hillock and it is completely over turning towards NE-SW and again overturning towards NW-SE trend finally it is making an anticlinal fold in the direction of NE-SE. At the eastern margin of the small hillock steatite body showing the elephant skin structure and northern part of the hillock also showing the same feature. At the bellow of the elephant skin structure had undergone to tectonic activity and structurally showing different **maven** of slicken slides with curved cleavage. This indicates the chlorite, and it bears the curved cleavage.



GEOLOGICAL MAP OF THE AREA

4. Geological setting of the study area:

4.1 Metasomatism

Most metamorphic reactions involve movement of ions on the scale of consuming eactant and growing product grains. However, the foregoing pages have demonstrated that large-scale fluid movement occurs in metamorphic terrains. In most instances, these infiltrating fluids are likely to react to some degree with the rocks through which they flow. The term metasomatism has been placed in a thermodynamic context since the middle twentieth century by J. B. Brady, G. W. Fisher, D. S. Korzhinskii, J. B. **Thompson** [1], and others. For reviews see **Barton**[5] et al. (1991) and **winter** [4](2001).

Metasomatism can be driven by differences in chemical potential between adjacent compositionally contrasting rock volumes and accomplished by diffusion at relatively high *T* over prolonged periods of time. An example is the so-called bi-metasomatism at contacts between silicate and carbonate-bearing rock where, to a first approximation, Si has moved from the former into the latter and Ca in the opposite direction. Most metasomatism, however, is related to infiltration of fluids into highly permeable rocks. This is especially common in, but by no means restricted to, contact metamorphic aureoles (**Myron G. Best**[6])

4.1.1 Metasomatic process occurs in the area

Solubilities depend on the composition of the fluid, *P*, and *T* (**Labotka, 1991**[8]). In the studt area the greater Cl concentrations in aqueous fluids can promote greater solubilities, especially for alkalies (Na, K, Rb). Salts of Cl^-, SO_4^2, and CO^2_3, such as KCl, $CaSO_4$, and Na_2CO_3, have significantly greater solubilities in aqueous fluids than silicates and consequently greater amounts of these materials can be transported by fluid flow. As carbonates, halides, and sulfates are the materials generally found in fluid inclusions in metamorphic minerals, they are likely to have been involved in the solid–fluid reactions occurring during metamorphism. Mineral components can have a source in the rocks through which fluids percolate, dissolving or leaching out the more soluble, mobile components. Common alkali-ion-exchange reactions in metamorphic rocks involve micas and feldspars as these are the chief repositories of Na and K. High H_ concentrations relative to K_ and Na_ stabilize an aluminosilicate, whereas the opposite stabilize feldspars. Micas are stable at intermediate alkali ion/hydrogen ion ratios.

Hydrogen metasomatism is particularly common and widespread around granitic intrusions in the shallow continental crust. The high H_ activity relative to other major elements causes removal of Na, K, Ca, Mg, and Fe in feldspars and mafic silicates in felsic country rocks as well as the intrusion. In the initial **sericitic alteration** stage, white micas _ clay minerals are stabilized at the expense of feldspars. Clay minerals, such as kaolinite, are stabilized at the expense of K-feldspar according to the reaction (**Myron G. Best**[6], **Labotka TC**[8])

$$2K\,Al\,Si3\,O_8 + 2H^+ + H_2O = Al_2\,Si_2\,O_5\,(OH)_4 + 4SiO_2 + 2K^+$$

4.1.2 Chloritization*:* is defined as the process of formation of chlorite mainly due to hydrothermal alteration or metasomatic processes. It is a common product of hydrothermal alteration of primary ferromagnesian minerals like biotite, amphiboles, etc. in granitoids. Biotite readily alters to chlorite at low–moderate temperatures, and the product is often present as a complex sandwich of chlorite layers coherently disposed between relic layers of biotite. The sheet tructure of primary mica is relatively unchanged and immobile with addition of water during the ydrothermal alteration process (**Dinesh Pandit**[14]**)**. In fact, this process is more complex than understood earlier, and the behaviour of K+, Na+, Ca_2+, Mg_2+, Fe_2+ and other ions needs to be addressed in greater detail.

Chlorites are hydrous silicate minerals, primarily incorporating Mg, Al and Fe in octahedral site and Al and Si in tetrahedral site; form a continuous solid solution series between Mg and Fe species.

4.1.3 Steatization (carbon dioxide metasomatism): silica readily displaces carbon dioxide from carbonate at moderate temparater and high temperature; many silicates converted are with equal ease to carbonate by hydrothermal reaction with solutions containing carbon dioxide at lower temperature. In the field area auto-matasomatic replacement of feldspar by carbonate is an common process illustrated by igneous rocks of widely different composition. Magnesium silicates seem particularly susceptible to this type of alteration. A fine example of carbon dioxide metasomatism in connection with gold deposition is afforded by A. Knopf's account of hydrothermal alteration of rocks adjacent to the auriferous quartz veins of the mother lody system of California (A. **Knopf**[12]).

4.1.4 Kaolinization and Cericitization

Kaolin originates from the jells of SiO_2 or Al_2O_3 in neutral solutions free of alkali metals or in acid solutions containing alkali metals, at the temperature below 400°c on other hand, montmorillonite from in alkaline solutions of the alkali metals, and high concentration of potash and sericite appears. Sericite has often been formed at the expense of the feldspar at lower temperature less than 400^0 C. That depend up on the alkali solutions sericite or kaolin are formed. From the province of hydrothermal metasomatism of feldspar these pass over to the hydrolic breaking of silicate minerals in weathering. The systems are investigated by Hemley, who determined experimentally the stability field of the important minerals as a function of temperature and ratio of potassium to hydrogen ion concentration **(J. J. Hemley[13])**. He find out at a given temperature and pressure sure with increasing k+/H+ ratios the field of kaolinite, mica and potash feldspar are successively traversed.

4.1.5 Tourmalinization; boron metasomatism of intrusion of granite or granodiorite cause borosiliate or tourmaline or even a borate to appear in the metamorphic assemblage. An example provided by the rock in the contact aureoles of the granites of cornwell and devon, where tourmalinization of aluminous rocks, and local complete auto-metasomatism of granite itself, yield the same assemblage namely tourmaline-quartz-another instance of mineralogical convergence in metasomatism.(**J. S.Flett, A. A. Fitch and S.O. Agrell**[9,10,11])

6. Conclusion

The chemistry of biotite, chlorite and epidote associated with the sulphide ore minerals indicates that these minerals play an important role in the aqueous solution at the time of mineralization. However, chlorite is the most dominant secondary phase in the host granitoid, whose role during the hydrothermal alteration is important and needs to be studied in detail

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8. Field Photographs

Figure 1: weathered amphibolite showing speroidal weathring.

Figure 2: steatite bearing granite showing step faulting

Figure 3: comb structure vug

Figure 4: compex pegmatite

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