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Climate Change Induces Variation in Groundwater Quality

Mukherjee S*

Remote Sensing Applications Laboratory, School of Environmental Sciences, Jawaharlal Nehru University, New Delhi, India

***Corresponding author:** Mukherjee S, Remote Sensing Applications Laboratory, School of Environmental Sciences, Jawaharlal Nehru University, New Delhi, India, Tel: +91-11-26704312; E-mail: saumitramukherjee3@gmail.com

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Metamorphism of Precambrian granite-pegmatite-Schist-Quartzite of Aravali formation of Delhi ridge in a part of Delhi shows improved groundwater quality in greater depth zones which shows local orographic effect of climate change. The rainfall pattern in Delhi ridge area has shown changes in space and time as well as quantity.

Unseasonal rainfall has more possibility of recharge in weathered Aravali formation. The interconnected fracture in Aravalli quartzite has been found to have potential for groundwater exploration [1]. Within Aravalli quartzite the ferruginous variety was found more fracture prone. Pegmatites, Aplite and Quartz vein [2] intercalated with schistose rocks has multiple fracture system [3]. Thin section analysis and Induced Coupled Plasma Atomic Emission Spectroscopy [4] (ICPAES) of rocks and groundwater from different depth zones of seven drilling sites shows that the grade of metamorphism [5] has relevance with groundwater quality, potentiality induced by climate change.

Thin section analysis of drill cutting samples at depth zones ranging from 50 meter below ground level to 182.92 meters below ground level shows proofs of change in grades of metamorphism of the formation. Crystal of biotite mica was found embedded within sericitised groundmass with opaque magnetite crystals were found from 50 to 60 meter below ground level. From the depth of 60 to 85 meter below ground level mineral assemblage within the rock shows that there are 25%. Biotite mica with approximately 65%, quartz crystals are present. 10% accessory minerals were found which consists of magnetite, zircon and potash feldspar. The mineral assemblage and paragenesis are suggestive of the geological history of high grade metamorphism. The crystal of biotite and quartz are showing fractures with secondary filling by opaque minerals in between 85 to 120 meter below ground level. The presence of anomalous garnet crystals from 125 meter to 155 meter are characteristics of contact metamorphic zones. Highly crushed biotite crystal and fracture filling shows that the rock at 165-180 meter depth was structurally disturbed. Hazy green colored tinge surrounding biotite and magnetite crystals are proofs of serpentinization of mafic (Fe-Mg rich) minerals. The serpentinization further proves hydrolysis of the minerals due to the presence of the groundwater in the fractured zones. Brown and pleochroic from pale brown crystal of alaanite crystal adjacent to a feldspar crystal is suggestive of an overgrowth on epidote crystal. Here alaanite was found altered to amorphous substance in other places by the breakdown of the space lattice in this granite pegmatite contact.

Reddish brown to olive green haloes in biotite is suggestive of alpha particle bombardment from small zircon crystals containing radioactive impurities. When the stage of the microscope was rotated near the extinction position peculiar crinkly appearance is noticed in biotite. All the above features are suggestive of highly crushed granite pegmatite fractured zone developed in contact metamorphic zones at greater depth in Aravalli formation.

Presence of tourmaline crystal in matrix of quartz, mica and feldspar shows strong absorption normal to the plane of the polarizer. The colour is yellowish brown the mineral identified is Mg (Magnesium) tourmaline. The variety is commonly known as Dravite. The crystals are highly distorted as shown by the curved-cleavage the extinction is practically parallel to the cleavage traces shows the metamorphism of granite pegmatite. Within dravite crystal a few fluid intrusion with secondary mineralization is suggestive of recrystallization due to high grade metamorphism.

Sercitization of Dravite mica shows the evidence of crushed zone in pegmatite mica schist boundary. Dumortierite crystal occurs within the quartzite vein at 176 to 180 meter depth. Dumortierite occurs in quartzite adjacent to granite pegmatite and schist. It typically occurs in high temperature Aluminium rich regional metamorphic rocks those resulting from contact metamorphism and also in Boron rich pegmatite. Dumortierite is a fibrous variable coloured Aluminium borosilicate mineral $Al_{6.5\text{-}7}\,BO_3\,(SiO_4)_3(OH)_3$.

Elemental composition (rock analysis) of the selected rock samples were analyzed by ICPAES. The rock sample represents potential fracture zones encountered during groundwater exploration. The analytical data reveals the following features.

1. In all the drilling sites silica content increases with depth which is suggestive of good to excellent groundwater quality at depth.

2. Concentration of Al_2O_3 decreases with depth which is also suggestive of excellent groundwater quality.

3. Concentration of Zr is found higher in upper zone (245 ppm) which reduces to bare (<20 ppm) at greater depth this suggest that emplacement of pegmatities are near the surface which is overlying on fractured quartzite at greater depth.

4. The layer resistivity of the formation when further analyzed was found out to be ranging in between 50 to 200 Ωm which is an excellent groundwater bearing zone with an indication of presence of fresh groundwater with less total dissolved solids. The ICPAES data of groundwater further confirms this observation.

References

1. Mukherjee S, Sashtri S, Gupta M, Pant MK, Singh CK, et al. (2007) Integrated water resource management using remote sensing and geophysical techniques: Aravali quartzite, Delhi, India. J Env Hydrol 15: 1-10.
2. Mukherjee S (2008) Role of Satellite Sensors in Groundwater Exploration. Sensors J 8: 2006-2017.
3. Pereira MR, Almeida C (2000) Groundwater: Past Achievements and Future challenges. [edn] Sililo O, Taylor & Francis Publisher, UK.

4. Lahi H, Lavanchy Y (2004) Hydrogeological application of trace element analysis with ICP-AES for the characterization of groundwater categories at the foot of the Swiss Jura between Geneva and Lausanne. Fresenius J Anal Chem 341: 9559-563.

5. Crawford TJ, Chapman MJ (1991) High-yielding Wells in Metamorphic Rocks: Influencing Factors. Proceedings of Georgia Water Resources Conference, Athens, Georgia 20-21.

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