

Geochemistry and Tectonic Framework of Malani Igneous Suite and Their Effect on Groundwater Quality of Tosham, India

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Abstract : The objective of the study was to assess the role of mineralogy and subsurface structure on water quality of Tosham, Malani Igneous Suite (MIS), Western Rajasthan, India. MIS is the largest (55,000 km²) A-type, anorogenic and high heat producing acid magmatism in the peninsular India and owes its origin to hot spot tectonics. Apart from agricultural and industrial wastes, geogenic activities cause fluctuations in quality parameters of water resources. Twenty water samples (20) selected from Tosham and surrounding areas were analyzed for As, Pb, B, Al, Zn, Fe, Ni using Inductive coupled plasma emission and F by Ion Chromatography. The concentration of As, Pb, B, Ni and F was above the stipulated level specified by BIS (Bureau of Indian Standards IS-10500, 2012). The concentration of As and Pb in surrounding areas of Tosham ranged from 1.2 to 4.1 mg/l and from 0.59 to 0.9 mg/l respectively which is higher than limits of 0.05mg/l (As) and 0.01 mg/l (Pb). Excess trace metal accumulation in water is toxic to humans and adversely affects the central nervous system, kidneys, gastrointestinal tract, skin and cause mental confusion. Groundwater quality is defined by nature of rock formation, mineral water reaction, physiography, soils, environment, recharge and discharge conditions of the area. Fluoride content in groundwater is due to the solubility of fluoride-bearing minerals like fluorite, cryolite, topaz, and mica, etc. Tosham is comprised of quartz mica schist, quartzite, schorl, tuff, quartz porphyry and associated granites, thus, fluoride is leached out and dissolved in groundwater. In the study area, Ni concentration ranged from 0.07 to 0.5 mg/l (permissible limit 0.02 mg/l). The primary source of nickel in drinking water is leached out nickel from ore-bearing rocks. Higher concentration of As is found in some igneous rocks specifically containing minerals as arsenopyrite (AsFeS), realgar (AsS) and orpiment (As₂S₃). MIS consists of granite (hypersolvus and subsolvus), rhyolite, dacite, trachyte, andesite, pyroclasts, basalt, gabbro and dolerite which increased the trace elements concentration in groundwater. Nakora, a part of MIS rocks has high concentration of trace and rare earth elements (Ni, Rb, Pb, Sr, Y, Zr, Th, U, La, Ce, Nd, Eu and Yb) which percolates the Ni and Pb to groundwater by weathering, contacts and joints/fractures in rocks. Additionally, geological setting of MIS also causes dissolution of trace elements in water resources beneath the surface. NE-SW tectonic lineament, radial pattern of dykes and volcanic vent at Nakora created a way for leaching of these elements to groundwater. Rain water quality might be altered by major minerals constituents of host Tosham rocks during its percolation through the rock fracture, joints before becoming the integral part of groundwater aquifer. The weathering process like hydration, hydrolysis and solution might be the cause of change in water chemistry of particular area. These studies suggest that geological relation of soil-water horizon with MIS rocks via mineralogical variations, structures and tectonic setting affects the water quality of the studied area.

Keywords : geochemistry, groundwater, malani igneous suite, tosham

Conference Title : ICGGS 2017 : International Conference on Geology, Geotechnology and Seismology

Conference Location : Toronto, Canada

Conference Dates : June 15-16, 2017