

THE ROLE OF MAFIC AND ULTRAMAFIC ROCKS IN THE CONTAMINATION OF WATERS AND SOILS: A CASE STUDY IN THE KOHISTAN REGION OF NORTHERN PAKISTAN

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Mafic and ultramafic rocks are enriched in minerals such as olivine and pyroxene and are, therefore, having high concentrations of Ca, Mg, Fe, Cr, Ni, Mn, Co, Cd. The weathering of these rocks gives a variety of soils known as ultramafic or serpentine soil. Uptake by the plants, growing on these soils and leaching of metals into the percolating water could be of great environmental concern. Macro and trace metal contamination represents one of the most burning threats to soil ecosystem, as well as human health due to their sever effects and toxicity. In Pakistan mafic and ultramafic rocks are well exposed in the Kohistan region where the Indus Suture Zone (ISZ) represents the thrusting of the Indian plate underneath the Kohistan island arc. In order to investigate the effects of mafic and ultramafic rocks on the ecosystem of Kohistan region, the geochemical investigations of the waters, soils and plants of the region were carried out during this study. The macro (Na, K, Ca, Mg, Fe and Mn) and trace (Cu, Pb, Zn, Cd, Cr, Ni and Co) element concentrations were analyzed in water, soil and wild plant samples collected from mafic and ultramafic horizons in the Jijal, Dubair and Alpuri areas of Kohistan region. In the water samples collected from Kohistan region, all the physical parameters, anions and majority of heavy metal concentrations were found within the permissible limits set by world health organization (WHO). However, Pb, Zn, Cd, Ni and As showed higher concentrations than their respective permissible limits in 29%, 6%, 7%, 2% and 2% water samples, respectively. Heavy metal concentrations were evaluated for non-carcinogenic risk such as chronic daily intake (CDI), hazard quotient (HQ) and cancer risk (CR). The noncarcinogenic risk HQ were <1 for all the HMs except As. This level of contamination revealed a low chronic risk and medium cancer risk when compared with US-EPA guidelines. The soil samples of the study area showed significant ($P < 0.05$) contamination level of various heavy metals, while plants had greater variability in the metal uptakes from the serpentine soil. The multifold enrichment factor of Cr, Ni, Co and Cu in *B. lyceum*, *S. jacquimonthi* and *R. hastatus* of the plant species suggested that these plants have the ability to uptake and accumulate high concentrations of metals. This high accumulation of these toxic metals such as Cr and Ni, may pose potential threats to local community of Kohistan region after entering into human food chains.

Keywords: mafic and ultramafic rocks, contamination of waters, Pakistan