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Preliminary Hydrogeochemical Characterization of Crystalline Rocks in Taiwan

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Deep geological disposal is the predominant approach for isolating high-level nuclear waste (HLW) worldwide. By integrating natural and engineered barriers, the multiple barrier system mitigates the ecological impact of HLW. Crystalline rocks, characterized by their high strength, low-heat sensitivity, permeability, and dissolution properties are suitable for the host formation for deep geological disposal. Understanding the composition of groundwater in crystalline rocks is essential for assessing the long-term safety of deep geological disposal, as it informs reference evaluations of solute and radionuclide transport, as well as potential rock-water reactions.

This study examined geochemical parameters in both water and rock compositions. Water analysis included basic parameters (temperature, pH, conductivity, total dissolved solids, oxidation-reduction potential, and dissolved oxygen), chemical composition, and isotopic data from groundwater and surface water at various depths and locations. Rock analysis focused on thin section and major mineral element analysis. Among 140 datasets of water analysis, groundwater pH ranged from 7.0 to 8.7; and total dissolved solids ranged from 100 to 380 ppm. Piper diagrams suggested a Ca-HCO_3 water type, with groundwater resembling regional surface water. Isotopic data revealed a meteoric water origin. Rock composition results indicated schistose structures predominated by fractured minerals like feldspar, quartz, and biotite. This research explored spatiotemporal hydrogeochemical distribution using seasonal sampling data. Furthermore, stable isotope results were utilized to interpret the regional groundwater recharge pattern, providing confirmation for regional groundwater flow direction. Subsequent studies would integrate rock mineral composition to assess potential rock-water interactions, deducing deep geochemical evolution.