Exploration of Lithium Minerals in Lead-Zinc-Barites Mineralization at Ubaru Area, Ebonyi State, Southeastern Nigeria

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This study assesses the lithium potential of structurally controlled lead-zinc-barites vein systems at Ubaru, located in the Lower Benue Trough, southeastern Nigeria. The area is underlain by Albian-aged shales of the Asu River Group and hosts NW–SE and NE–SW trending quartz-barite veins enriched in galena, sphalerite, and fluorite. While traditionally exploited for base metals, the site remains unexplored for critical metals such as lithium. Thirty-two samples were collected from hydrothermal veins, altered wall rocks, and pegmatitic zones. Petrographic analysis revealed the presence of sericitized feldspar, muscovite, tourmaline, and quartz within veins and veinlets, with minor accessory fluorite and chlorite. X-ray fluorescence (XRF) analysis confirmed significant concentrations of Pb (up to 2.13 wt.%), Zn (up to 3.42 wt.%), Ba (4.87–6.54 wt.%), and Mn (0.84 wt.%). Though lithium-specific ICP-MS data is pending, pathfinder elements such as Rb (210-430 ppm), Cs (58–144 ppm), and F (530–1,100 ppm) indicate evolved, volatile-rich hydrothermal systems—typical of lithium-cesium-tantalum (LCT)-type mineralization. Environmental water samples from nearby streams and mine pits revealed lead concentrations between 0.016–0.048 mg/L and zinc between 1.23–3.52 mg/L—below WHO permissible limits but indicative of metal mobility. Total dissolved solids ranged from 321 to 528 mg/L, while calcium hardness exceeded 260 mg/L in some locations, suggesting active water-rock interaction. Soils from vein-adjacent sites showed depletion in potassium (0.81 wt.%) and sodium (0.58 wt.%) relative to farmlands, consistent with base-metal leaching and cation exchange processes. This study proposes that the Ubaru vein systems may host cryptic lithium enrichment associated with pegmatite-altered hydrothermal zones. Follow-up studies using ICP-MS, XRD, and fluid inclusion geothermometry are underway to establish lithium occurrence, temperature of formation (estimated 152–240°C), and ore genesis. The results contribute novel data to Nigeria's orebody knowledge and align with global strategies for critical mineral exploration in polymetallic terrains.