

Global lithium deposits (pegmatites and brines) as indicators of plume-tectonics

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Spodumene pegmatites. Comparative analysis of geotectonic position of Li-bearing pegmatite deposits of Central Asian Folded Belt and their isotopic ages (U-Pb, Rb-Sr, Ar-Ar, Re-Os) suggests the coincidence of time intervals of the pegmatite formation with main age peaks of plume activity (LIP). The origination of deep-seated granite sources of the pegmatite melts with extremely high lithium contents was stipulated by asthenosphere uplift, and their occurrences was connected with strike-slip deformations in continental lithosphere [1-2].

Salt lakes. Comparative analysis of lithium brine deposits of South America and Central Asia allowed us to conclude that lithium contents in lake waters were determined by lithium concentrations in feeding springs and underground waters, their salinity, tectono-volcanic activity of considered regions, arid climate conditions. The formation of lithium brines of salt lakes is usually connected with leaching of acid tuffs, entering in bimodal volcanic series, which are characteristic for marginal and within-plate riftogenesis [3-4].

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Siderite Amendment for *in situ* pH Control in Hyperalkaline Environments

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Remediation of soils and sediments and restoration of sites contaminated by hyperalkaline wastes associated with legacy industrial facilities (e.g. Solvay and chlor-alkali process wastes) present unique challenges and opportunities for geochemical engineering solutions. The feasibility and success of *in situ* treatment strategies such as soil mixing and sediment capping in such settings depends on the use of reactive amendments that can maintain long-term pH neutralization and ultimately lead to establishment of plants and habitat restoration. We present results of extensive experimental and modeling studies carried out to evaluate the reactivity, kinetics, and performance of siderite (FeCO₃) for such applications. Porewater pH neutralization and buffering by natural siderite ore concentrates from Texas was investigated in a series of kinetic batch tests using a hyperalkaline (pH 12) Na-Ca-Cl brine porewater from contaminated lake sediments. In all tests, pH was neutralized and consistently buffered to circum-neutral values within timeframes of weeks to months. The reaction rate was inversely dependent on liquid/solid ratio (varied between 2:1 to 50:1) and only weakly dependent on siderite grain size (from 0.1 to 2 mm), the latter due to the aggregate nature of the siderite ore which consists of individual crystallites <<50 μm in size. Calcite and iron oxides/oxyhydroxides were identified as the main reaction products in the batch experiments. Column testing confirmed the effectiveness of siderite for pH neutralization under dynamic flow conditions representative of field situations with groundwater upwelling through contaminated sediments. A reactive transport model of a siderite-amended sediment cap, incorporating time-dependent porewater upwelling and consolidation following cap construction, siderite dissolution (pH-dependent transition-state theory rate law) and secondary product precipitation kinetics, was developed using PHREEQC with reaction rate constants calibrated to the batch experiment data. The model has been used to simulate pH neutralization under different sediment cap designs, conduct sensitivity analyses to assess potential effects of vertical segregation of amendments during subaqueous cap materials placement, and develop optimal siderite dosing estimates for long-term pH control in support of remedial design for a major sediment remediation project.