Using Basalt Powder for Remediation of Sodium Contaminated Soils: a Novel Approach to Soil Restoration

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High concentrations of sodium chloride (NaCl) persist in soil at oil and gas well sites from brine spills related to drilling and production activities, resulting in exchangeable Na+ adsorption on clay surfaces and subsequent soil dispersion. Soluble gypsum is commonly used as the calcium-based amendment to replace exchangeable Na+ on clay surfaces with Ca^{2}+ and re-establish soil structure. The gypsum is typically applied as a short-term amendment and exhausted within one to two years. Downward flushing of NaCl is effective for removal from shallow soils; however, salts migrate upward over time under arid conditions leading to persistent saline issues.

This presentation will detail a multi-year study which is examining the viability of using basalt powder as a soil amendment to provide exchangeable Ca^{2}+ to displace the Na+ from clay surfaces and provide a long-term source of exchangeable Ca^{2}+ to soils. Basalt is a globally abundant calcium- and magnesium-rich volcanic rock, with an abundance of fast-weathering minerals such as pyroxene, plagioclase feldspar, and olivine. While basalt powder has been studied extensively for carbon dioxide removal technology, little data exists regarding the adsorptive properties of basalt in complex soil solutions.

Two readily available basalts will be evaluated for weathering potential and composition to determine applicability for use as soil amendment. The study will quantify the adsorptive properties of basalt in soil solutions from multiple sodium-impacted well sites in a laboratory setting. Dose response testing with basalt powder will subsequently be carried out using soil samples impacted with multiple contaminants.

To test the viability of using basalt powder as a soil amendment for Na+ remediation under natural conditions, a field study using small plot experimentation will be implemented at a NaCl-impacted well site. This study will evaluate basalt powder for long-term supply of Ca^{2}+ to counteract upward sodium migration over time and promote soil flocculation. It will also assess secondary clay mineral formation of smectites and kaolinite.

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