**Introduction**

Reservoirs on the Savannah River Site (SRS) have been contaminated with $^{137}$Cs resulting from nuclear weapons production. As an alkaline metal that displays similar chemical properties to that of potassium (K), $^{137}$Cs has a strong affinity for illitic clay minerals. This is important because $^{137}$Cs can bind within the physical structure of the clay, in essence, trapping $^{137}$Cs and reducing its bioavailability. SRS soils are somewhat deficient in illitic clays. In an effort to test whether illitic clay addition to SRS reservoir sediments can improve $^{137}$Cs binding, we used three different test soils/sediments with different properties: Ottawa sand, Fe-rich subsoil, and a surface soil rich in organic matter. Two different forms of illitic clay were added to the surface of the test soils to see if they enhance Cs fixation. Stable Cs was incrementally added to the sediments to simulate Cs release and the Cs and K concentrations were monitored in the water column above the sediments.

**Materials and Methods**

1. Nine total columns with 100 g total material added to each column
2. 300 mL of 0.5 mM CaCl$_2$ solution added to each column
3. Two forms of illite clay added: powdered illite [columns 4-6] and pelletized illite [columns 7-9]
4. Cesium spike solution: 0.5 mM CaCl$_2$ with 100 ppb stable Cs
5. 5mL of Cs-Spike solution injected into Subsurface Port
6. Columns allowed to equilibrate for several hours before water samples extracted (two locations: extraction port and water surface)
7. Continue to inject 5mL of Cs-Spike solution and extract water samples of 2.5mL from lower water column and water surface at set intervals
8. Analyze water samples using ICP-Mass Spectrometry

**Soil Characteristics**

<table>
<thead>
<tr>
<th></th>
<th>Ottawa Sand</th>
<th>SRS Clay</th>
<th>SRS Organic</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Sand</td>
<td>100</td>
<td>90.0</td>
<td>69.7</td>
</tr>
<tr>
<td>% Silt</td>
<td>1.9</td>
<td></td>
<td>2.5</td>
</tr>
<tr>
<td>% Clay</td>
<td>8.1</td>
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<td>27.8</td>
</tr>
<tr>
<td>Sand</td>
<td>Loamy Sand</td>
<td>Sandy Clay Loam</td>
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</tr>
</tbody>
</table>

**References**


**Results**

- Pelletized illite settled quickly when added to the water column, making it more effective in targeted placement compared to the powdered illite.
- SRS soils are dominated by kaolinite and HIV/HIS, with limited illitic clays, providing limited potential for Cs fixation.
- In ponded mesocosm experiments, limited Cs release was observed for all treatments over the first 100 hours, regardless of illite addition, including the Ottawa sand.
- Significant K was released to the water column in the presence of 0.5 mM CaCl$_2$ for all three test sediments, even the Ottawa sand.
- Powdered illite addition released much higher K levels due to the K associated with the clay.

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