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# Sodium Silicate Treatment for Uranium (VI) Bearing Groundwater Systems at F/H Area at Savannah River Site

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## Background

- The Savannah River Site (SRS) was one of the most significant manufacturing facilities during the Cold War era for producing nuclear materials.
- At the end of the Cold War, the Site's mission changed to support the environmental restoration of the Site due to over six decades of research, development, and production of nuclear weapons.
- Currently SRS is a major hazardous waste management facility responsible for nuclear materials storage, and remediation of contaminated soil and groundwater from radionuclides.
- This research focuses on controlling the mobilization of the contaminants, specifically uranium (VI) located in groundwater plumes at the Site's F/H Area Seepage Basin, where approximately 1.8 billion gallons of hazardous waste were deposited.

## Objective

- To evaluate the potential use of sodium silicate for uranium removal from the aqueous phase, as well as to restore the pH of the treatment zone.
- Adding sodium silicate increases the pH of the treatment zone and uranium precipitation is achieved, therefore immobilizing the contaminant.
- Through a series of experiments the optimal concentration of sodium silicate was investigated.

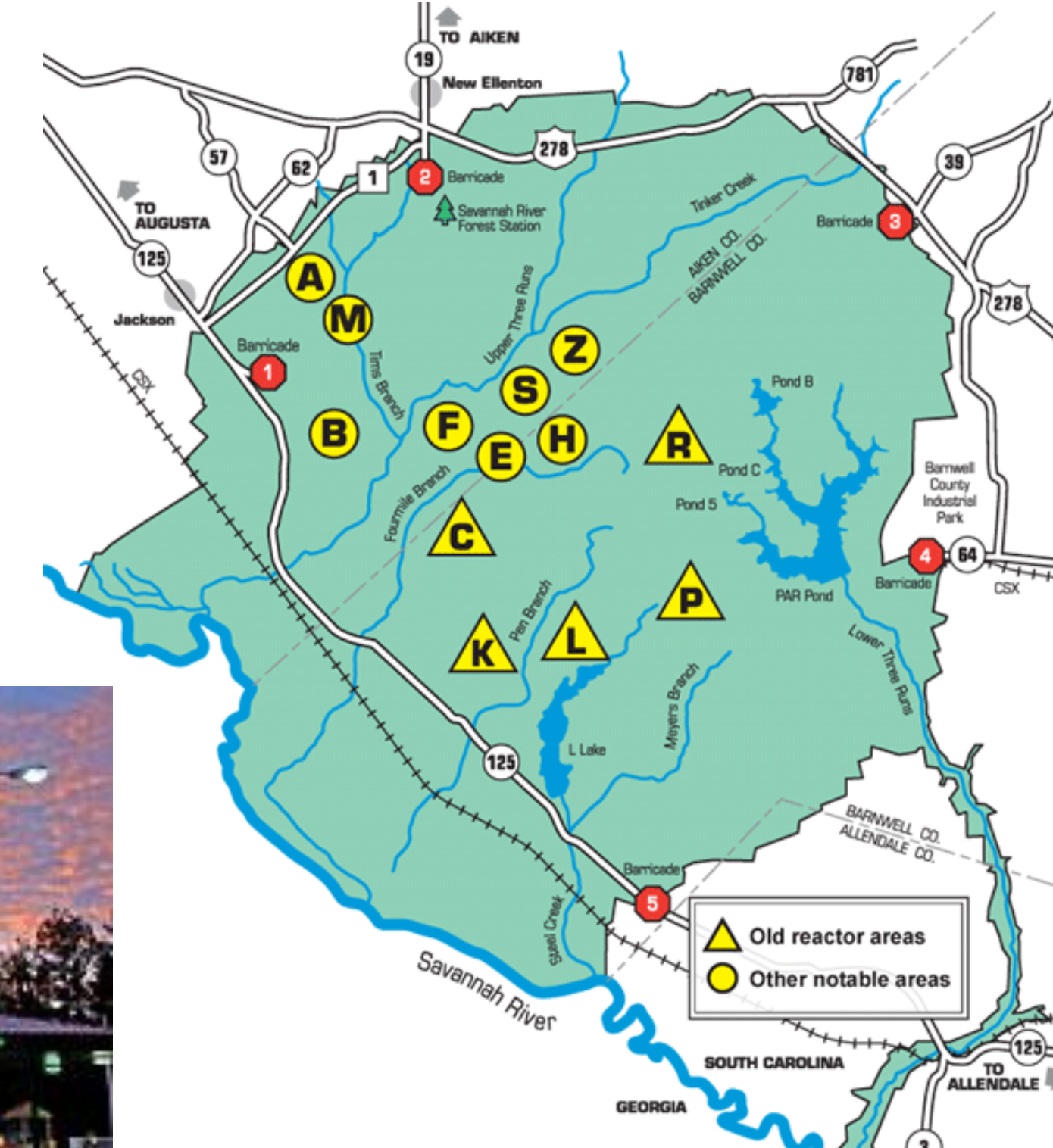


Figure 1. Savannah River Site

## Materials and Methodology

### Part 1

- An experiment was conducted in order to determine the effect of sodium silicate on the pH of a solution containing Savannah River Site soil and synthetic groundwater replicated after the Site's natural groundwater composition.
- Each sample was spiked with the appropriate volume from the sodium silicate stock solution in order to achieve final desired sodium silicate concentrations of 10, 20, 40, 50, 60, 70, and 80 parts per million.
- The samples were placed on a platform shaker for three days during which pH readings were collected in regular intervals to determine which silicate concentration produced a pH in the neutral range ( $6 > \text{pH} < 8$ ).



Figure 2. Experimental sample, KPA Instrument, platform shaker used throughout the experiment

### Part 2

- A sequential experiment was conducted specifically using 40 and 50 ppm of sodium silicate with Savannah River Site soil, synthetic groundwater, and 0.5 ppm of uranium (VI), in order to investigate the removal of uranium in the aqueous phase via precipitation.
- Samples were extracted and categorized into a filtered and non-filtered control group.
- Each sample was diluted 1:20 with 1% nitric acid and analyzed using the Kinetic Phosphorescence Analyzer (KPA) in order to measure uranium concentrations in the supernatant.
- By measuring the concentration of uranium in the supernatant the percent removal is obtained for the comparison between the filtered and non-filtered samples, revealing the amount of uranium precipitation that occurred for each silicate concentration.

## Results and Conclusions

- A sodium silicate concentration of between 40-50 ppm proved ideal for achieving uranium precipitation and creating a circumneutral pH environment in the aqueous phase.
- 50 ppm achieved the larger percent of uranium precipitation with a range of 30-50% removal for the filtered samples and between 60-95% removal for the non-filtered samples.
- A large difference between the removal of filtered and non-filtered samples from the same day was observed for both sodium silicate concentrations tested, indicating that there is a considerable amount of uranium species retained in the filter.
- The addition of sodium silicate proved effective in the removal of uranium precipitation from the aqueous phase.

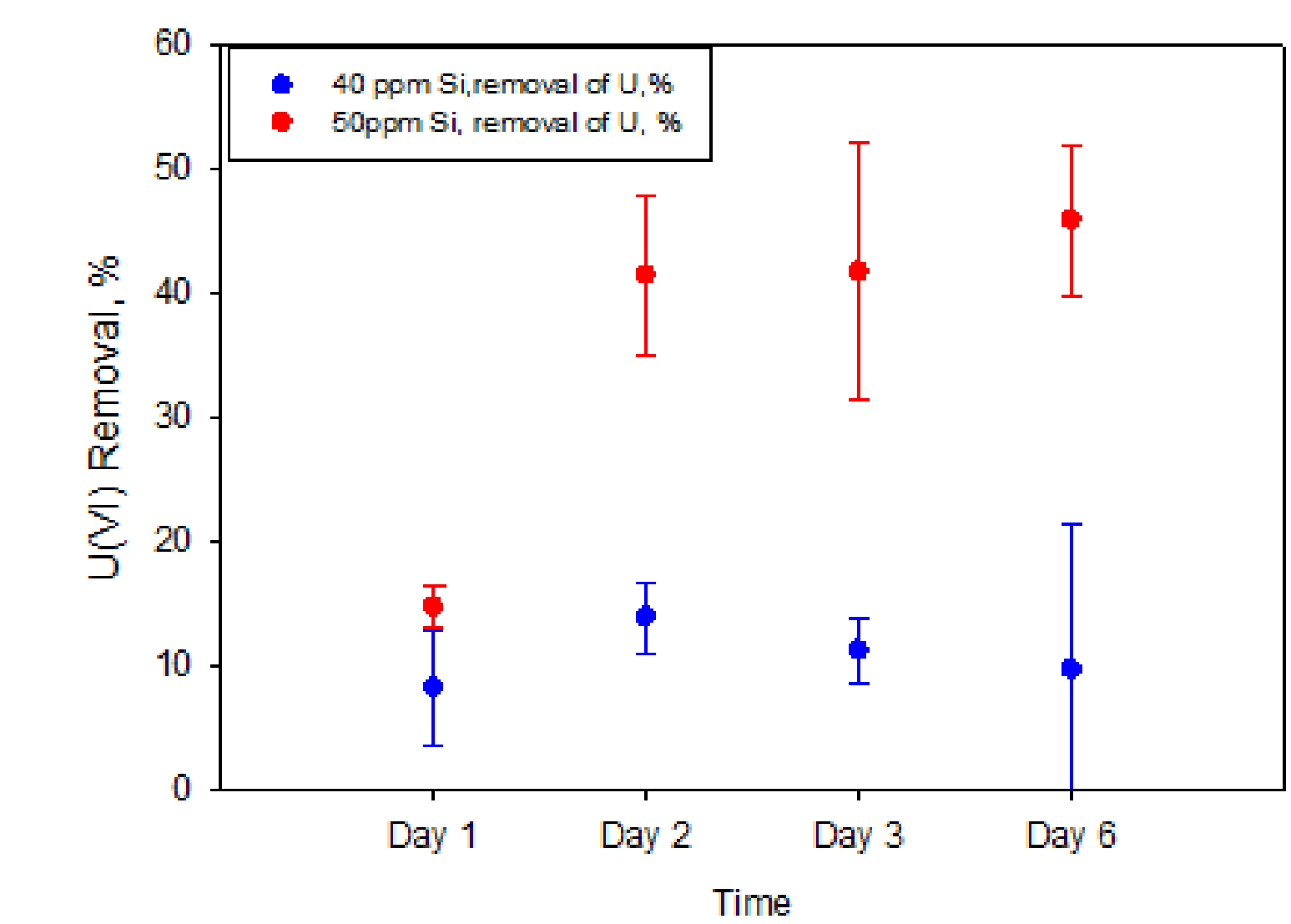


Figure 3. U(VI) % removal as a function of time for non-filtered samples for 40 and 50 ppm of sodium silicate.

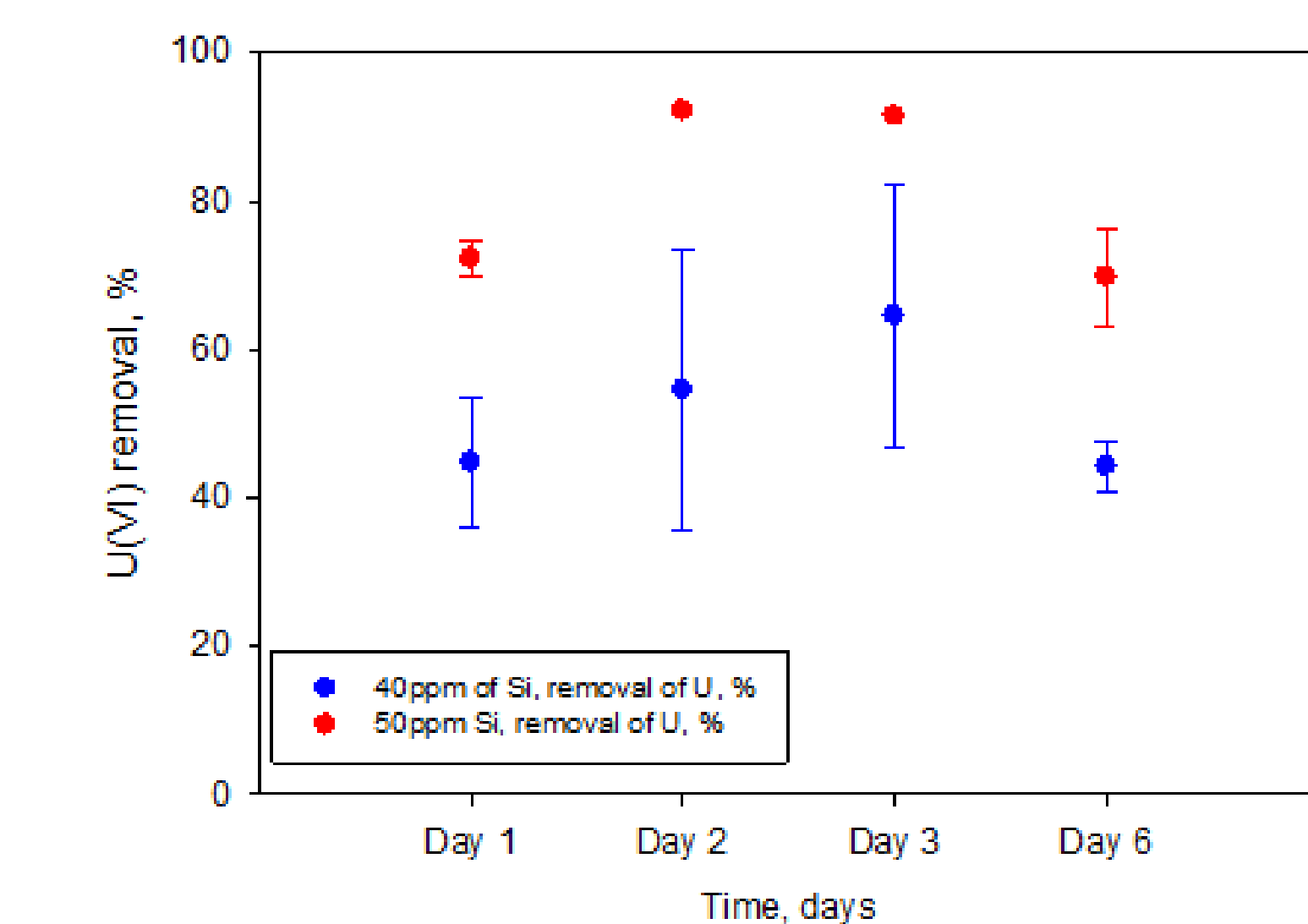


Figure 4. U(VI) % removal as a function of time for filtered samples for 40 and 50 ppm of sodium silicate.

## Future Work

- Determine potential resolubilization of uranium concentrations
- Examine mineralogy and surface morphology of dried precipitate using XRD and SEM/EDS