

Miriam Galenas, Geology

University: University of Missouri-Columbia
Year in School: Sophomore
Hometown: Pilot Grove, Missouri
Faculty Mentor: Dr. Silvia Jurisson, Chemistry
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Using phosphinimines for a Tc-99 environmental contamination sensor

Miriam Galenas, Leah M. Arrigo, Raghuraman Kannan, Kattesh V. Katti, and Silvia S. Jurisson

There are many places in which there is considerable radioactive contamination in the local environment. Hanford Washington is one such place where thousands of Curies have been dumped in the Columbia River and more is leaking from aging containment facilities. One of the isotopes known to be a concern is Tc-99. Technetium exists in the environment as pertechnetate (TcO_4^-) and is extremely mobile in the environment due to its low negative charge. Locating this ion is very important in the work to clean up and contain radioactive environmental contamination at locations such as Hanford.

Phosphinimines ($\text{R}_3\text{P}=\text{N}-\text{SiMe}_3$) may prove to be very useful for this purpose. They form strong ion pairs with pertechnetate through hydrolysis and are selective for it over many other ions in the environment. The end goal for our studies is to design a sensor that uses phosphinimines to remove and concentrate the pertechnetate from a given sample and ensure detection. So far we have explored the usefulness of four phosphinimines: triphenylphosphinimine, 9-anthracenyldiphenylphosphinimine, 1-naphtyldiphenylphosphinimine, and 4-(P,P-diphenyl-N-(trimethylsilyl) phosphorimidoyl) benzoic acid. We have performed anion competition studies using excess of Cl^- , NO_3^- , H_2PO_4^- , HSO_4^- , I^- , and various organic anions. Using techniques of solvent extraction and column elution we find that the phosphinimines really are selective for pertechnetate even when other anions are in excess. We found that I^- competes with the pertechnetate at high excess. This is expected since the same competition occurs in the body when TcO_4^- uptakes in the thyroid as does I^- .

