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# Durable Materials for GNEP Waste Streams

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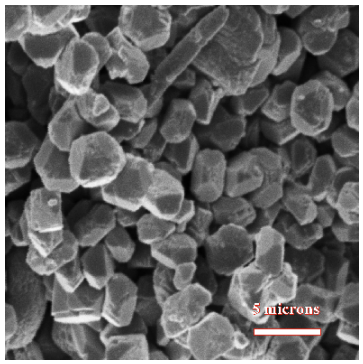
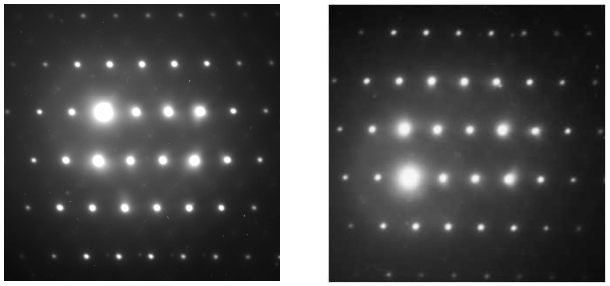
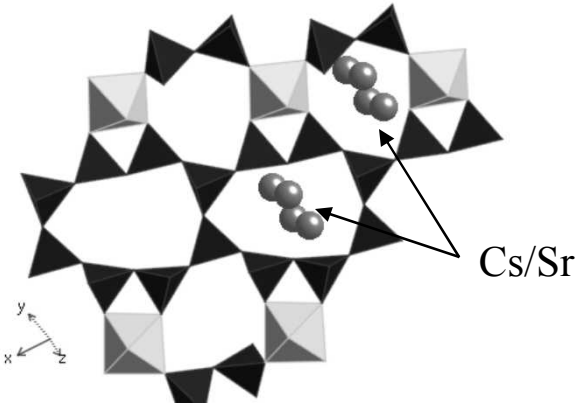
# CST for Cs/Sr Wastes




Increasing Radiation Dose






**SNL CST method**

-low Cs/Sr leach rate (0.0001 g/m$^2$•day)
-small volume waste form (SA=30m$^2$/g)
-thermally stable to 1000 °C
-removes 1 part Cs per 100,000 parts Na
-stable over entire pH range
-commercially available as UOP IE-911
-geologically stable

CST oxide components: $Na_2O$, $Cs_2O$, $SiO_2$, $TiO_2$, $Nb_2O_5$, $ZrO_2$

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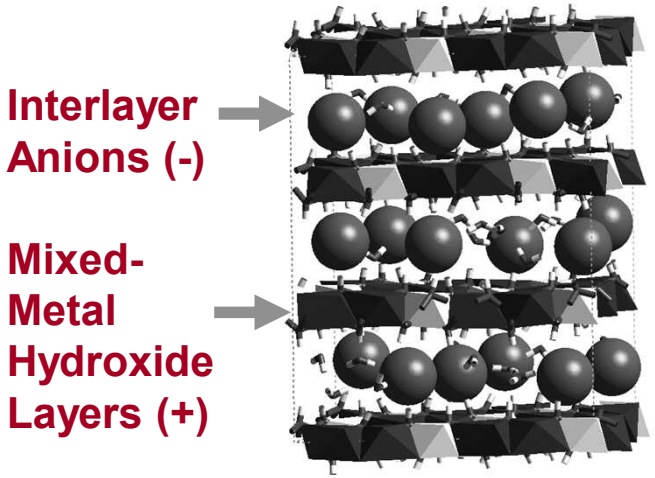
# Clay Materials for Tc/I Wastes

- affinity for actinides
- most promising for anions $TcO_4^-$, $I^-$ and $IO_3^-$; work as scavengers
- geologically stable

*Other options for I

If Hg already in waste stream, then HgS




Hydrotalcite Lattice

*Consider CuI instead of KI

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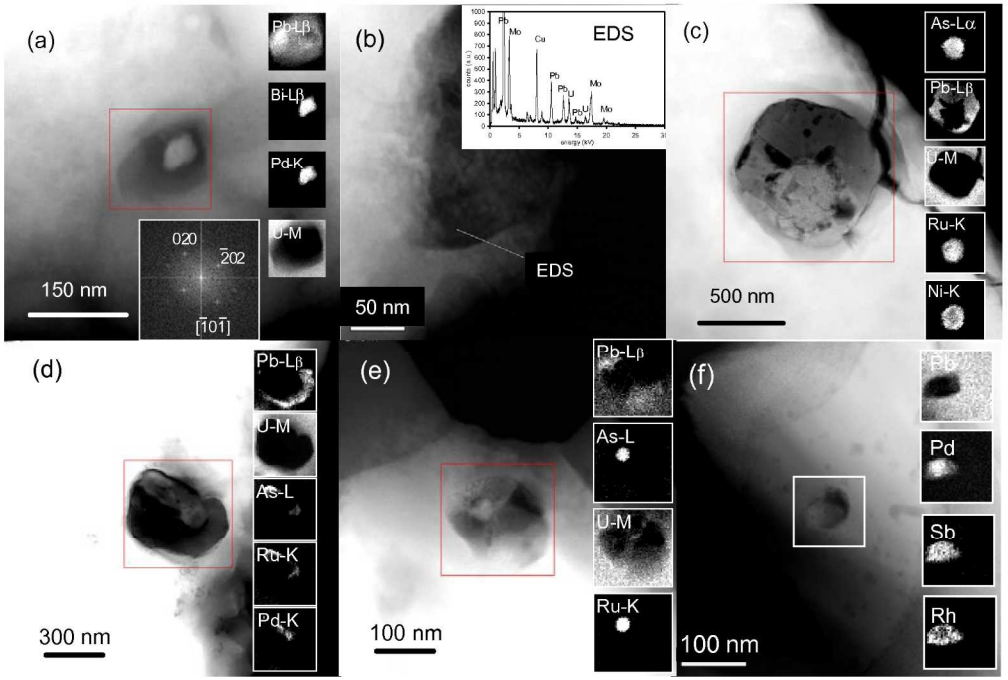
# Metallic Tc Waste Form

- OKLO natural reactor went critical approximately 2Gy
- Fate of epsilon particles subject of recent study at University of Michigan
- Tc migrated less than 2 microns in 2 billion years




Utsunomiya et al., Radiochemica Acta (2006) submitted

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# Mineral Waste Form for Act, REE, etc.

- **Synroc: titanate mineral assemblage that can incorporate ALL of the radionuclides in HLW streams**

- **A.E. Ringwood et al., Nature, 1979; Dosch et al., SAND82-2980, 1982.**

| Synroc-C phase assemblage | wt.% | radionuclides |
|---|---|---|
| Hollandite $Ba(Al,Ti)_2Ti_6O_{16}$ | 30 | Cs, Rb |
| Zirconolite $CaZrTi_2O_7$ -*pyrochlore* $A_2B_2O_7$ | 30 | RE, Act |
| Perovskite $CaTiO_3$ | 20 | Sr, RE, Act |
| Titanium oxides $Ti_xO_{2x-1}$ | 10 | |
| E-phase (alloy) | 5 | Tc, Pd, Rh, Ru, Mo |

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