3–2 How Removal of Strontium from Seawater ?

—Use of Coprecipitation Method by Barite Controlled Chemical Composition—

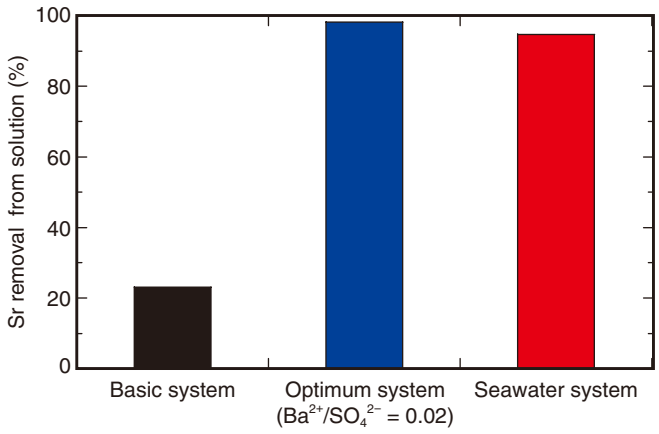

Fig.3-4 Strontium (Sr) removal by coprecipitation with barite
This figure depicts an optimal system (blue) for Sr removal from an aqueous solution by controlling a basic system (black: Sr^{2+} 0.01 mM, pH 2.0, IS 0.08 M, no coexistent ions, Ba^{2+}/SO_4^{2-} = 1). A seawater system (red) was also examined in the optimum condition and showed a high removal capacity.

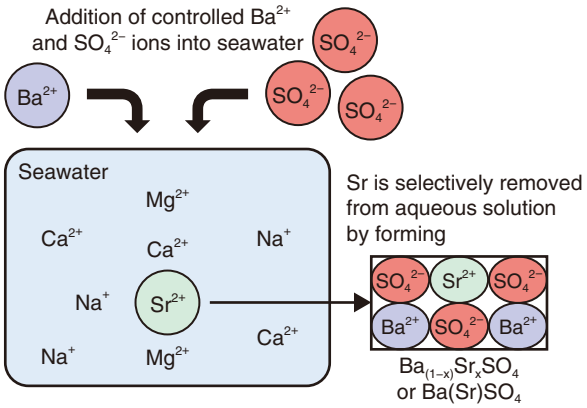

Fig.3-5 Experimental design for removing Sr from seawater by coprecipitation with barite
Sr was effectively removed from seawater by controlling the Ba^{2+}/SO_4^{2-} ratio in the initial solution.

Strontium-90, which is a fission product of uranium and can be released to the environment during nuclear plant accidents, has a low adsorption capacity on clays and a high mobility in environments. There are few effective techniques for removing Sr from seawater because of the strong inhibition of Sr uptake by the high concentration of sodium and other competitive ions in seawater. In this work, barite ($BaSO_4$) was used under various experimental conditions to develop techniques for the direct removal of Sr from seawater.

Barite is a common compound in many geological environments and easily precipitated from an aqueous mixture of Na_2SO_4 and $BaCl_2$. Several trace elements, including Sr, can be incorporated into the crystal lattice of barite during a coprecipitation process. The effects of pH, ionic strength (IS), coexistent Ca^{2+} and Mg^{2+} ion, and $[Ba^{2+}]/[SO_4^{2-}]$ ratio in the initial solution were investigated for determining the optimum condition for Sr removal by using barite. The resulting removal efficiency for three of the studied systems is shown in Fig.3-4. The main parameter found to affect the removal efficiency was the $[Ba^{2+}]/[SO_4^{2-}]$ ratio in the initial aqueous solution; Sr was completely removed from the aqueous solution when the $[Ba^{2+}]/[SO_4^{2-}]$ ratio is low. A high removal efficiency of 90% was also achieved in seawater (=1 mg/L), despite its high saline concentration, due to the negligible effect of IS and competitive ions (Na^+, Ca^{2+}, and Mg^{2+}). Thus, compared to previous techniques, barite was shown to present a reliable material for the removal of Sr from aqueous solutions, including seawater, after optimization of the $[Ba^{2+}]/[SO_4^{2-}]$ ratio and other parameters (Fig.3-5).

This method can be applied to other radioactive anions present in high-level waste at Fukushima, such as selenium-79 and iodine-129, for safety assessments of long-term geological disposal.

Reference

Tokunaga, K. et al., A New Technique for Removing Strontium from Seawater by Coprecipitation with Barite, Journal of Hazardous Materials, vol.359, 2018, p.307–315.