Highly Selective Isolation of a Rare Metal from Sea Water by Mimicking a Biological Function

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Summary

In sea water, rare metals including vanadium, cobalt and chromium are dissolved in bulk but at very low concentrations. Total resource of the rare metals in sea water are much more rich than the terrestrial resource of them. The rare metals are necessary for new industries in the next generation as materials for semiconductors, superconducting substances and magnetic substances.

We have focused on an unusual function that some ascidians accumulate high levels of vanadium in their blood cells from sea water and the highest concentration of vanadium in ascidian blood cells, 350mM, corresponds 10^7 times the vanadium concentration in sea water.

Recently we found a clue to solve the mechanism of vanadium accumulation. Vanadium-associated proteins (VAPs) have been already extracted from the soluble extracts of blood cells by an anion exchange column chromatography. Now, we have cloned cDNAs encoding two of those proteins, 12.5-kDa and 15-kDa VAPs. These cDNAs encoded about 120 amino-acid proteins in which the content of cysteine residues are very high. A plasmid encoding a fusion protein of a maltose-binding protein (MBP) and each of the two VAPs was transformed into *E. coli* strain BL21. The fusion proteins purified by an amyrose resin column chromatography were analyzed by equilibrium dialysis experiments to have an affinity with vanadium ions. The 12.5 kDa and 15 kDa VAPs bound to roughly 10 molar equivalent of vanadium ions in the +4 or +5 oxidation state, respectively.

Experiments to clarify metal binding sites in VAPs and binding constant with vanadium ions are in progress.