

Foundational Study on Selective Extraction of Rare Metal from Seawater, Based on the Mechanism of Accumulation of High Levels of Vanadium by Ascidians

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Ascidians are marine animals that live under water, either free in the sand or attached to stones, rocks and solid surfaces. High levels of vanadium were found by mere chance in the blood cells of an ascidian by the German chemist M. Henze in 1911. Subsequently, many investigators revealed that ascidians are the only organisms in the animal kingdom able to accumulate vanadium at high concentrations. We reexamined the vanadium content of several tissues from 20 ascidian species, employing the extremely sensitive method of neutron-activation analysis for the quantification of this metal. The highest concentration of 350 mM vanadium was found in the blood cells of *Ascidia gemmata*, which concentration corresponds to 10,000,000 times the concentration in sea water. Furthermore, ESR measurements of the oxidation state in the blood cells revealed that the vanadocytes contained vanadium, about 98% of which was in the +3 oxidation state. We attempted to extract a vanadium-binding and/or -reducing substance from the blood cells. In the present experiment, it became clear that this substance is extractable and has the ability to reduce exogenous vanadate(V) to vanadyl(IV), employing HPLC and ESR spectrometry. Ascidians with these unusual physiological characteristics may help us to develop a technique for selective extraction of rare metals from sea water.