

## Determination of Fe(II) and Fe(III) in Seawater - for Evaluation of Ocean Wealth

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### Summary

Iron is an essential nutrient for many organisms. The concentration of iron in seawater is reported to be extremely low, ranging from 0.01 to 10 nmol/L when measured by the iron colloid coagulation method. In reality, there are still problems to be solved, such as the establishment of quantitative methods and the sensitivity of measurement. The bioavailability of iron in seawater and natural water depends on highly soluble Fe(II). Recently, it has become clear that only ferrous ion, Fe(II) is utilized for biological metabolism, oxygen transport and mitochondria, while ferric ion, Fe(III) cannot enter the mitochondria. Therefore, we believe that elucidating the existence form and bioavailability of Fe(II) in the ocean will lead to the improvement of ocean desertification, and will also be an indicator of the abundance of the ocean which has been the focus of much attention in recent years.

The concentration of iron in seawater has been reported to be 0.01-10 nmol/L, but the actual amount of Fe(II) and Fe(III) present in seawater has not been clarified. If the richness of the ocean can be evaluated by the concentration of Fe(II), the activity of Fe(II) on organisms in seawater can also be evaluated. Currently, there are three main methods used for the determination of iron in seawater.

To prevent Fe(II) oxidation, Fe(II) was complexed to form stable Fe(II)-phen (1,10 phenanthroline) complexes. Fe(II) in groundwater was measured by ESI-MS, but determination of Fe(II) in seawater is difficult due to high salt concentrations. The obtained Fe(II) concentration in brackish water was  $0.184 \pm 0.05 \mu\text{M}$ , and the total Fe concentration (total Fe) by ICP-MS was  $0.70 \pm 0.05 \mu\text{M}$ , Fe(II)/total Fe being 26 % of total Fe in brackish water. The Fe(II) concentration in groundwater was  $0.146 \pm 0.002 \mu\text{M}$ , total Fe was  $0.23 \pm 0.02 \mu\text{M}$ , and Fe(II)/total Fe was 63 %. On the other hand, in the Tama River, the Fe(II) concentration was  $0.230 \pm 0.013 \mu\text{M}$ , total Fe by ICP-MS was  $0.59 \pm 0.06 \mu\text{M}$ , and Fe(II)/total Fe was 39 %. These are consistent with the idea that exposure of Fe(II) to Fe(III) by atmospheric oxygen is a major factor in this river water and brackish water. In brackish waters with high Fe(II) concentrations, the total Fe(II) content comes from oxidation from the atmosphere and hypoxia from the seafloor.