THE AMUR OKHOTSK PROJECT

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Obvious as it may seem, phytoplankton, one of the building blocks on which marine ecosystems are based, is a living organism that consumes nutrients. In spite of high concentrations of nutrients, however, there are a number of areas of sea around the world where phytoplankton struggles to grow. One such area is the northern part of the Pacific Ocean, bordered by far eastern Eurasia and North America. Because of a lack of iron, this is an area in which phytoplankton doesn't grow fully, even if the required nutrients are present. Iron is one of the elements that activates chlorophyll (plant pigment) and is essential to its growth.

Despite being the most common element on land, the concentration of iron in seawater is exceedingly low. Iron found in seawater comes from one of two sources; either iron particles that have traveled through the air from land or iron that has been carried into the sea by rivers. As it is far removed from any land and has no major rivers flowing into it, the northern part of the Pacific has a remarkably low concentration of iron.

Elsewhere, the Sea of Okhotsk off the coast of northern Japan is rich in nutrients and vital supply area for aquatic resources. Observations carried out to date have revealed that the Sea of Okhotsk differs from the adjointing northern part of the Pacific in that all of its rich layers of nutrients are used up by the production of phytoplankton. Whereas there are nutrients left unused in the northern Pacific due to the lack of iron, they are all used up in the Sea of Okhotsk. So what is the reason for this difference ?

We believe that the difference stems from a rich supply of dissolved iron brought in by the Amur river. Originating in the high lands of Mongolia, the great Amur covers a total of 4,350 kilometers, flowing across the Russian and Chinese borders in to the Sea of Okhotsk. It has a river basin nearly five times the size of Japan, the majority of which is taken up by forests and wetlands. Large quantities of iron from the surrounding land are carried away by the river. In a oxygen-rich environment, however, iron soon oxidizes and turns into particles, forming precipitate. Once in particle form like this, iron is of no use to living organisms. Dissolved iron on the other hand can be used. Therein lies the cleaver mechanism by which dissolved iron is carried from the river to the sea.

In wooded area, leaves fall from the trees and pile up on the ground gradually turning into humus. Similarly, vegetation in wetlands also turns to humus. The organic matter produced as part of this process contains fulvic acid, which once produced, flows out to the sea in the river. Iron that has dissolved into water in areas with relatively little oxygen, such as wetlands, combines with fulvic acid to form a substance called fulvic-Fe (III) complex. In this form, iron does not oxidize easily and is carried long distance by the river. The reason why the iron carried to the Sea of Okhotsk is so important to the production of organisms is that large quantities of fulvic-Fe (III) complex are brought in by the Amur river. This fulvic-Fe (III) complex is essentially the product of the expansive forests and wetlands that line the basin of the Amur.

Land uses in the Amur river basin have continued to undergo rapid change since the twentieth century. There has been a spate of major forest fires recently, resulting in a dramatic decline in forest resources. Expanding areas of farmland have also eaten into the region's wetlands. But will changes in the surface of the land stemming from natural and human causes such as these affect the volume of fulvic-Fe (III) complex being carried out to sea by the Amur river ? And if so, what changes will this bring about in primary production in the Sea of Okhotsk ?

It was with issues such as these in mind that we initiated the five-year Amur-Okhotsk Project in April 2005. The aim of this project is to investigate the way in which matter circulates between the Amur river and the Sea of Okhotsk and explore what impact changes in the surface of the land in the Amur river basin have had and will have on the marine ecology of the Sea of Okhotsk. Based on our findings, we hope to produce proposals regarding the development of the Amur river basin to enable the sustained use of the marine ecology of the Sea of Okhotsk.

The team responsible for this project is made up of forty-five researchers from Japan, China, and Russia. The team members' specialist areas include physical oceanography, chemical oceanography, biogeochemistry, hydrology, glaciology, geography, climatology, economics, political science, and forestry, reflecting the interdisciplinary nature of the project. In 2009, we plan to bring together the results of observation and surveys of the Amur river and its basin carried out in 2005 and 2008 and the results of observation of the Sea of Okhotsk in 2006 and 2007 to produce proposals in collaboration with Chinese and Russian researchers detailing how development of the Amur river basin should proceed. This is an issue that has not been tackled to date due to a range of problems, including the vast scale of the area, the fact that it spans different countries' borders, and the fact that it covers areas of both land and the sea. As researchers, we consider these trilateral efforts to solve such a major issue both a challenge and a great pleasure.

(Original text was first printed in The Japan Journal, Vol. 2, No. 2, 30, June 2005)