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Cobalt in the Aquatic Environment (February 2006)

For the purposes of this short article, we have taken the aquatic environment to include freshwater systems such as lakes, streams and rivers and salt water or marine systems including estuaries and oceans.

What level of Cobalt is found in Natural Waters?

As Cobalt (Co) is naturally occurring and widely dispersed element, all natural waters contain a trace level of this element; sometimes called “background”, i.e. the level that is present without any anthropogenic influence. This “background” level varies widely around the world and can even vary within the same water body. This can be due to water quality characteristics such as acidity or alkalinity (pH), temperature, and salinity, as well as, the plants and animals present and the composition of the sediments. For example, if Manganese is present in the sediment, then it will attract and adsorb almost all of the Co out of the water column and onto the mineral grains within the sediment. As a result, “nodules” form naturally in some areas of the ocean. One day Co may be recovered or extracted from these sediments as an alternative to terrestrial mining (i.e. mining on land).

The levels of Co found in surface waters of the Pacific and Atlantic Oceans are very low, averaging below 30 micrograms of Co per litre of sea water (i.e. 0.00003 g per litre). It should also be remembered that Co in the form of vitamin B12 is regarded as essential to the microbial ecology of the ocean.

In European freshwaters, the amount of dissolved Co is typically between 0.18 – 0.21 micrograms. Total concentrations vary between 0.22 – 0.5 micrograms, with the difference between total and dissolved being the proportion associated with organic matter in the water, e.g. humic acids. At these concentrations no toxicity to local aquatic organisms is expected to occur.

How does Co enter the aquatic environment?

Co can enter the aquatic environment from a number of sources, both natural and anthropogenic. The natural sources include volcanic emissions, the weathering of rocks by the action of water and decomposition of plant waste. One of the main human related releases into the aquatic environment is from sewage which, due to advances in modern sewage treatment, may only release around one part per billion (i.e. one unit Co for every billion units of sewage released) into the environment.

Where does Co go after the aquatic environment?

Natural and anthropogenic Co have the same transport pathways within the aquatic environment. The principle pathway involves binding to sediment at the bottom of the water body. Depending on the depositional environment, Co may remain on the sea/lake floor, become buried under further deposition or be transported into ocean where it will be deposited as sediment. The Co can be bound to sediments permanently unless there is a major change in the chemistry of the overlying waters. This is a natural geological process which, millions of years ago, created some of the ore bodies that are mined today.

Some Co, however, will remain in the water column (i.e. the water above the sediment). Co, if it is in the form of vitamin B12, is utilised by fauna in the environment. If this low level of Co in water was unavailable, a number of the aquatic organisms in these waters would show signs of vitamin B12 deficiency such as not achieving optimal growth or development.

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