Trace elements in seawater

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Trace elements in seawater

- □Trace Elements Those elements that do not contribute to the salinity. All elements are present.
- ☐ Many of these elements are present at very low concentrations (as low as 10-21 M).
- □1 ppm is equivalent to 1oz of salt in 32 tons of potato chips! 1 ppb is like 1 drop of gin in 100,000 liters (back yard swimming pool) of tonic water.
- ☐ This presents analytical challenges to measure and avoid contamination.

Minor elements in seawater

- ☐ The micronutrient elements N, P, Si, and Fe are essential for biological production in the ocean.
- ☐ Their abundance is controlled by horizontal and vertical circulation and by biogeochemical processes of utilization and regeneration.
- ☐ Of other elements, even dissolved gold is found in the water of all oceans. Although present in very small concentrations (0.000004 mg/litre), there is 5.6 million t of gold in all the Earth's oceans, but the dilution is such that it cannot be extracted economically.

Why study trace element distributions?

- 1. Many are nutrients and required to sustain life (e.g. P, N, Fe, Cu)
- 2. Others are toxic (e.g. Cu, Hg)
- 3. Some are tracers for redox conditions (Cr, I, Mn, Re, Mo, V, U)
- 4. Some form economic deposits such as manganese nodules (e.g. Cu, Co, Ni, Cd)
- 5. Some are tracers of pollution (e.g. Pb, Pu, Ag)

Shapes of Profiles – clues for controls

Conservative - Cesium (Cs); Molybdenum (Mo) - under oxic conditions

Nutrient Like – Biological control

Shallow (soft parts) and Deep (hard parts) Regeneration

Zinc (Zn)

Cadmium (Cd)

Nickel (Ni)

Copper (Cu)

Barium (Ba)

Surface Enrichment – Atm input, River/Coastal inputs

Lead (Pb)
Manganese (Mn)

Mid-depth Maximum – Hydrothermal inputs, Oxygen minimum

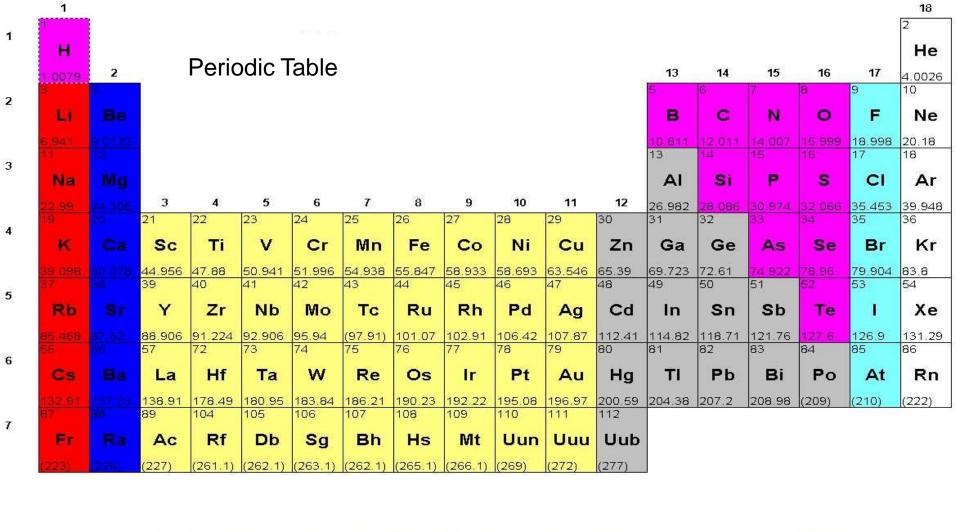
Manganese (Mn) Iron (Fe)

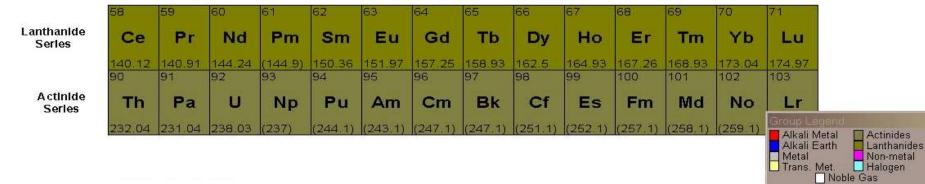
Near Bottom Enrichment – sediment source

North Sea Metals (Cd, Cu, Mn)

Deep Depletion - scavenging

Lead-210 Aluminum (AI) Manganese (Mn) Copper (Cu)





Trace Elements

- ☐ Aside from the 12 elements that are major or minor constituents and some elements that are dissolved gases, all other dissolved elements in seawater are present at concentrations less than 1 ppm and are called trace elements
- ☐ Many trace elements are essential to life.
- □ All elements are toxic at some concentration, but some are toxic at relatively low concentrations and a few are toxic at concentrations that are not far above their seawater concentration.