Phosphorus and sulfur cycles

Phosphorus compounds

Unlike the carbon and nitrogen cycles, the phosphorus cycle does not involve the atmosphere. Phosphorus is a primary nutrient. Large quantities are needed for healthy plant growth. Organic phosphorus compounds include nucleotides, nucleic acids and phospholipids. Phosphates react with and bind tightly to soil particles. They not readily lost by leaching.

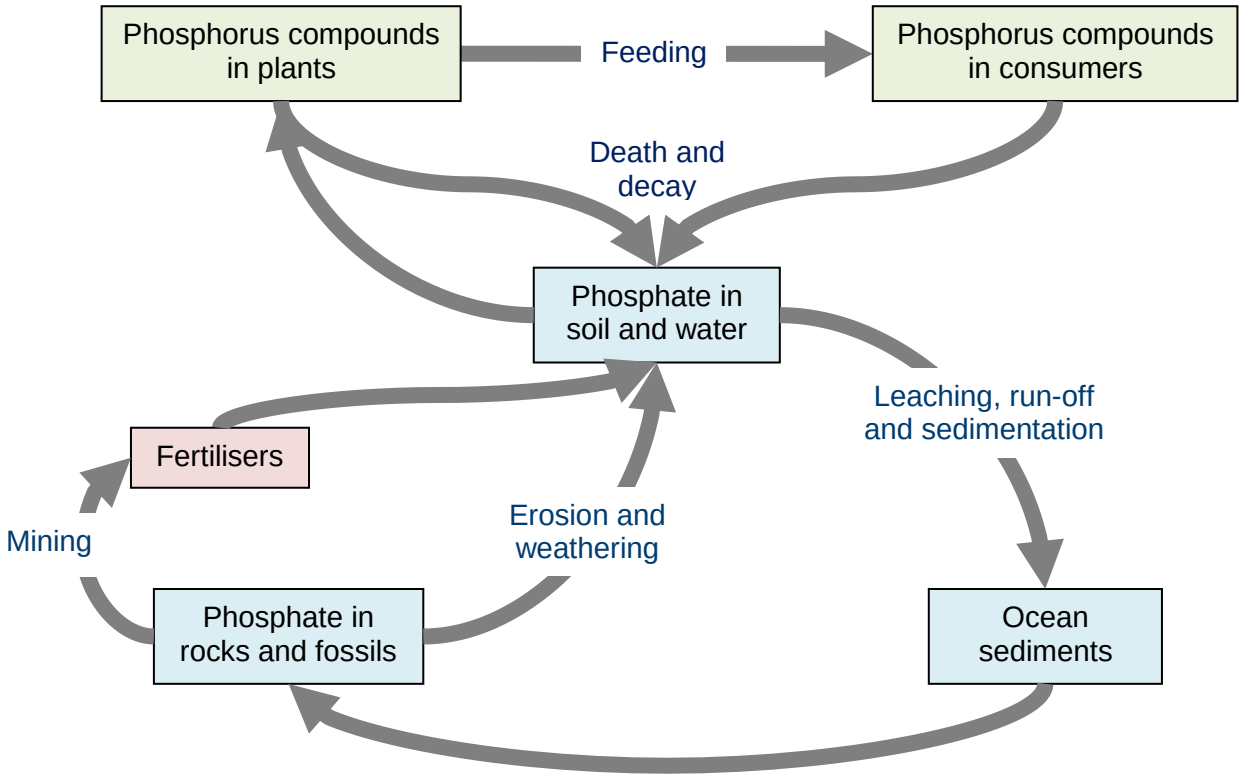

Figure 1 The phosphorus cycle.

Metal ions usually form insoluble compounds with phosphate ions. So addition of phosphate to soil can reduce the bioavailability of these metal ions.

Sulfur compounds

Organic sulfur compounds such as proteins in living organisms cycle with inorganic sulfate ions in soil or water. Most sulfur is bound up in rocks and salts or buried in deep ocean sediments.

Decomposers break down organic sulfur compounds to gases such as hydrogen sulfide which enter the atmosphere and are oxidised to sulfur dioxide.

Sulfur dioxide dissolves in water droplets in the atmosphere to give solutions of sulfurous acid, H_2SO_3.

$$SO_2(g) + H_2O(l) \rightleftharpoons H_2SO_3(aq)$$

Sulfurous acid is a weak acid and only partially ionises in water

$$H_2SO_3(aq) \rightleftharpoons H^+(aq) + HSO_3^-(aq)$$

This is oxidised in water droplets in clouds to form sulfuric acid, H_2SO_4.

Sulfuric acid is washed into the soil by rain. Sulfate ions form which can be absorbed and utilised by plants.

Sulfuric acid can also be formed from DMSP (dimethyl sulfoniopropionate) which is formed by plankton species and gives the seaside it characteristic smell.

Photosynthetic sulfur bacteria are able to form free sulfur from hydrogen sulfide gas. Industrial processes, including burning fossil fuels and volcanoes liberate hydrogen sulfide and sulfur dioxide gases.

Sulfate ions are easily leached out of the soil.

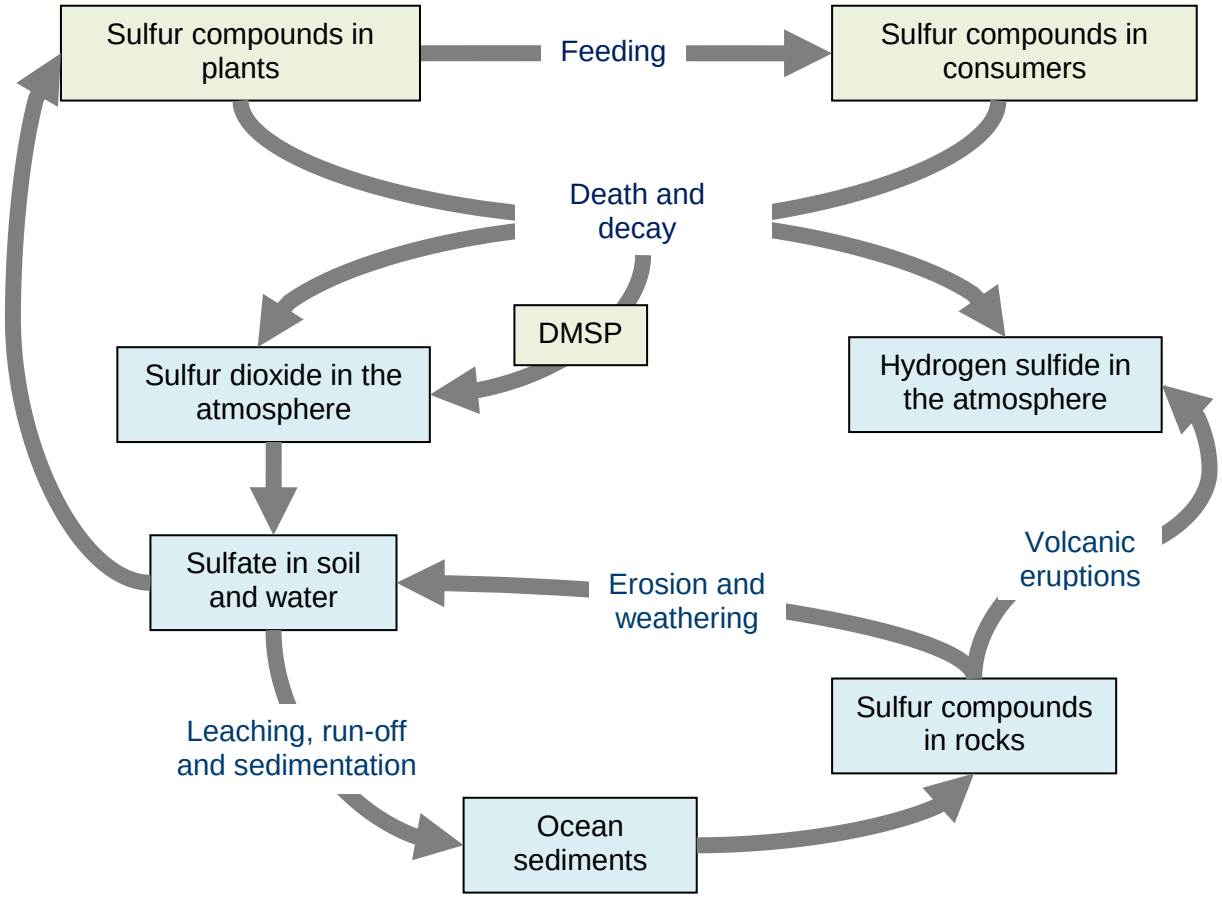

Figure 2 The sulfur cycle.

Finding out

Which phosphorus compounds occur naturally in rocks?

Which sulfur compounds occur naturally in rocks?

Sulfuric acid is a strong acid while sulfurous acid is a weak acid. What is the difference and how might this be explained?