Acid Rain

Effects on Forests

Effects on Buildings

Acid Rain Solutions

Elmhurst College

Chemistry Department

Virtual ChemBook

## Acid Lakes

**Natural Causes of Acidity:**

Soils and surface waters such as streams and lakes receive acid from a variety of natural sources.

Natural sources of acids include:
sulfur oxides/sulfuric acid from volcanoes, forest fires, decomposition of plants and animals, carbon dioxide in air forms carbonic acid, lightning bolts convert nitrogen molecules in air to nitrogen oxides to nitric acid.

A research project, called the Integrated Lake Watershed Acidification
Study conducted by the Electric Power Research Institute, studied three Adirondack lakes located so close to each other that they received the same rain and snow.

One of the lakes was healthy (basic), another was acidic, and the third cycled back and forth from basic to acidic. It was found that the acid rain and snow probably played only a very small part in the whether the lakes are acidic or basic.

**Vegetation:**

Types of soil, trees, and decaying leaves which surround a lake have the strongest influence on the whether a lake is acidic or basic. Water drains from the surrounding land into a lake. Water from rain and snow comes into contact with materials surrounding the lake before it drains into the lake.

The layers of decaying leaves, called humus, are rich in organic matter and produce acids similar to vinegar. The pH of water in contact with humus is generally very acidic.

**Acid Neutralizing Capabilities:**
**Natural Bases:**

What happens when rain, rain runoff, snow melt runoff, or ground water reaches a lake or a stream?

A lake may contain bicarbonate and other basic ions derived from rock weathering. Rocks which contain limestone contain bases. Rocks which contain granite contain very little bases. These natural bases can neutralize acids present from the rain, snow, or soil. If the acids are neutralized by the natural bases, the pH of the lake will remain about the same.

Rocks which contain limestone contain bases. Rocks which contain granite contain very little bases.

In the graphic on the left, the location is given for lakes which are sensitive to acid rain. **Red area = lakes** sensitive to acid because the rocks are mostly granite.

It is now clear that acid rain has already caused widespread acidification of lakes in the Northeastern U.S., Eastern Canada, Norway, Sweden, and the United Kingdom (Britain). In Norway and Sweden fish have died in 6500 lakes and 7 Atlantic Salmon rivers.

In Ontario, Canada, approximately. 1200 lakes are dead. In the Adirondack Mountain region of N. Y., more than 200 lakes are too acidic to support fish.

**Natural Alkalinity:**

The **amount of bases** present in the water is known as the **alkalinity**. The value of the alkalinity provides one measure of whether a lake will become acidified.

A lake with a high value of alkalinity is protected against acid rain.
A lake with a low or zero value of alkalinity will most likely be effected by acid rain.

To predict whether a lake will become acidic is based on a number of factors which may not be known.

1. What is the level of alkalinity?
2. How fast are the bases replenished by weathering?
3. How long can the bases be replenished?
4. How much acid is reaching the lake, both from the acid rain, snow, or natural decay of organic matter?

The evidence is that alkalinity has been replaced by sulfate ions in many lakes. Average lakes have lost 40 % of their alkalinity. Some sensitive waters have lost all alkalinity. New inputs of acid rain cause large decreases in pH.