HYGROSCOPY and DEHYDRATION

HYGROSCOPY

Many minerals easily dissolve in water. Less well known is that some minerals are *self-dissolving* in air. They absorb moisture from the air and, in time, transform themselves from a solid mineral specimen to a large puddle. Such minerals are ***hygroscopic***. They are difficult to keep in mineral collections.

The best known of the hygroscopic minerals is halite, NaCl. In our homes we know this as *table salt*. During humid summer days, it absorbs water to become a granular mush that refuses to pour. The common practice of adding rice grains with the salt, so the rice will absorb the water and prevent the salt from clumping, is an effective remedy.

Hygroscopy of salt can be demonstrated in the classroom. You will need:

- Several fragments of halite. If unavailable, substitute 5 - 10 cc of table salt.
- A wide-mouth jar with screw-cap lid
- A watch glass, plastic lid, or other small, shallow container that will fit in the jar with at least 5 mm clearance all around
- A handful of pebbles or several small wooden blocks
- About 50 ml of water

Procedure

1. Place the pebbles or wooden blocks in the bottom of the jar. These act as supports to hold the watch glass above the water level during the experiment.
2. Pour water into the jar, making sure that the water level is below the top of the pebbles.
3. Place the watch glass on top of the pebbles so it rests horizontally..
4. Put the fragments of halite in the center of the watch glass.
5. Close the jar.
6. Observe the halite during the next few days to see how long it takes to become visibly moist, and how long it takes to dissolve completely.

If you wish to make this experiment quantitative, have students determine the mass of the halite fragments before placing them in the jar, and the mass of the container those fragments will be placed in. They can then do a separate experiment to determine how many grams of halite can be dissolved in 100 ml of water at room temperature. Once this is known, students can calculate the amount of water that should be absorbed by the fragments in the jar, and compare this to the amount of water actually absorbed (= total mass of watch glass plus brine, minus the combined mass of the watch glass and the halite).

DEHYDRATION

Many minerals are *hydrous*—they contain water as a part of their chemical composition. In some, the water is a firmly-bound component of the crystal structure and can be driven off only at high heat. In others, the water is loosely bound, and only mild heating in a glass tube is

required to release it. In others, even this is unnecessary—the mineral will lose water by itself, at room temperature, simply by placing it in dry air. Displaying such minerals is possible only by storing them in oil or in a jar containing air at close to 100% humidity.

Depending on the mineral species, the effects of dehydration reactions can be reversible or permanent, and visually obvious or subtle. Borax (sodium borate), when fresh, is pale-colored and transparent, but on exposure it gradually dehydrates to a white powder, and falls apart if touched. Other minerals may change color when they dry and revert to the original color when the air is humid. A mineral found in northern Finland, ilmakiur, is a "natural barometer": it has white spots in fair weather and turns gray or black when rain approaches.

In the classroom:
Lumps of borax are cheap, fairly easy to obtain, and dramatically alter their appearance upon loss of water. These qualities make the mineral good for a classroom demonstration of dehydration, but the reaction is a slow one. Place a fresh piece of borax early in the school year in an open jar on a shelf where it can be seen but not disturbed. Observe during the following weeks how the original vitreous luster dulls. Definable patches of white powder (the mineral *tincalconite*) will appear, and eventually the entire surface will become white and chalky, visually quite unlike the original material. Finally, as the dehydration is complete, the original solid mass will fall apart into a pile of powdery white fragments. It might prove useful to show students a sample of unaltered borax to remind them of the original appearance.

Adapted from: "Hygroscopy and Dehydration" by Earl R. Verbeck, Sterling Hill Mining Museum, Ogdensburg, NJ, USA