Conserve O Gram

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Health And Safety Issues With Geological Specimens

This is an expansion of the section entitled Health Hazards in Geological Storage Areas in *COG* 11/2. See also *COG* 2/11 Health and Safety Risks of Asbestos and NPS *Museum Handbook*, Part 1, Chapter 11 and Appendix H, Curatorial Health and Safety.

Many parks have historical or abandoned mines and park collections may include representative minerals or ores. The general impression that "rocks" are inert, strong, and durable is not applicable to all minerals. There are approximately 3600 different mineral species (types) that have been described. Only a small subset pose a potential health hazard. It is important to know which minerals are present in the collection and their chemical composition. This allows you to identify those that may pose a potential health hazard, and that require special precautions for storage and handling. Proper identification is therefore the first step. Indications that a specimen is chemically active may include deterioration or changes in the specimen itself, specimen labels, storage materials or changes in the interior of the storage cabinet. The examples used in this *COG* are not an exhaustive list but are meant to be illustrative of potentially hazardous specimens. This *COG* does not address radioactive minerals which are discussed in *COG* 11/10.

The environment in which minerals are stored will determine their level of reactivity, potential off-gassing and other potential health hazards. As in all museum collections, this is partially controlled by temperature and relative humidity but other storage conditions may affect the process also. While it is NPS policy that collections are stored in metal cabinets, it is known that some materials such as wood, different coatings, adhesives and sealants used in the construction of storage cabinets and display cases will emit acetic and other carboxylic acids that can react with different minerals. In some cases only the mineral will be damaged but in other cases there may be associated health hazards with the by-products of the chemical reaction.

Toxic Gases

Some minerals may release toxic gases or vapors. Since specimen cabinets are designed to be fully sealed from the outside, these gases cannot escape. If the cabinet is left closed for extended periods of time the concentration of these gases can become high. An individual will become exposed to these high concentrations when a cabinet is first opened. The types of gases that may be produced by a mineral specimen will depend on the chemical composition of the mineral.

A **sulfide** is a combination of sulfur with another element. Common sulfide minerals include chalcopyrite (copper iron sulfide, $CuFeS_2$), galena (lead sulfide, PbS) and iron pyrite (FeS_2). Under some environmental conditions these minerals can react with water vapor and produce gases or vapors. Iron pyrite

(FeS_2) in a high humidity environment (greater then 60%) can release sulfur dioxide (SO_2) which in turn can combine with water to produce sulfuric acid.

The element sulfur which can occur as a mineral and in crystal form will, in an environment of high humidity, produce small amounts of hydrogen sulfide (H_2S) gas. Although only small amounts of H_2S will form from the specimen reacting with the moisture in the air, it is a powerful odor producer and is the dominating contributor to the odor of rotten eggs. Most specimens of sulfur, when kept dry, do not emit a strong odor. H_2S is a colorless, transparent gas that is extremely toxic and irritating with a characteristic rotten-egg odor at low concentrations but which is not detectable at high concentrations. When present in the blood it reduces the blood's oxygen-carrying capacity, thereby depressing the nervous system. It is oxidized quite rapidly to sulfates in the body therefore no permanent aftereffects occur, except in those cases of acute exposure in which oxygen deprivation of the nervous system is prolonged. There is no evidence that repeated exposures to hydrogen sulfide will result in accumulative or systemic poisoning. Effects such as eye irritation, respiratory tract irritation, slow pulse rate, lassitude, digestive disturbances, and cold sweats may occur but these symptoms disappear in a relatively short time after removal from the exposure.

Mercury vapor is readily liberated from the mineral cinnabar (mercury sulfide, HgS). The mineral may have elemental (liquid) mercury associated with it and thus be dangerous to handle. Body temperature is often enough to vaporize the mercury out of the rock and this gas can be absorbed through the skin.

Mineral Dust

In addition to gases the physical breakdown of some minerals can release particles that may be inhaled. Inhaling mineral dust may be more of a hazard than handling the specimen. The amount of dust depends on how friable the specimen is and how it is handled. For example, handling of an asbestos mineral may release individual fibers that can become airborne and inhaled. Although mineral dust may not be a primary problem in museum collections, at times it may be important to use a good quality respirator when handling specimens, especially if they are being cut or trimmed.

The best known examples of mineral fibers that should not be inhaled are the asbestos-containing minerals. "Asbestos" refers to a small number of minerals that are formed of flexible fibers. Asbestos can be subdivided into two major classifications of minerals: amphiboles and serpentines. All but one form, chrysotile, are amphiboles. Chrysotile asbestos is the fibrous variety of the mineral serpentine and is the most commercially important type of asbestos. Other asbestos minerals include crocidolite, a dark blue variety of the mineral riebeckite, amosite, anthophyllite asbestos, tremolite asbestos, and actinolite asbestos. Asbestos fibers have no detectible odor or taste. They are all solids that do not move through soil and are insoluble in water.

Color will vary according to type, and metallic composition. Crocidolite has iron and sodium as its metallic elements and is the most colorful with a range of colors including shades of lavender, blue and green. In general, asbestos minerals that contain iron may display a green color ranging from a hint of green to solid green depending upon the amount of iron present. Tremolite contains no iron, but is part of a continuous mineral series with actinolite, in which iron and magnesium can freely substitute with each other. As a result, some specimens of tremolite may show a hint of pale green. Chrysotile and tremolite, which in pure form contain no iron, tend to be white. Together with actinolite and anthophyllite they are grouped together as "white asbestos" and classified as UN2590 (under the United Nations chemical ID numbering system). Amosite and crocidolite are classified as UN2212. **Amosite** and **crocidolite are considered to be extremely hazardous.** Chrysotile is more flexible and has been considered to be less hazardous than either amosite or crocidolite. Anthophyllite, actinolite and tremolite have been lumped with the "lesser evil" chrysotile under the UN Identification numbering system. All three of these amphiboles also have non-asbestos forms associated with them in nature that are not harmful. See also *COG* 2/11.

Health Hazards of Asbestos

Laboratory experiments have identified three principal diseases resulting from exposure to one or more of the asbestos minerals. These are:

- Lung cancer, which includes cancer of the trachea, bronchus, and lung proper.
- Mesothelioma, a cancer of the pleural and peritoneal membranes which line the lung and abdominal cavities, respectively.
- "Asbestosis", a diffuse interstitial fibrosis of the lung tissue, often resulting after long exposure, which can lead to severe loss of lung function and ultimately respiratory failure.

If your collection contains asbestos minerals, they can be secondarily stored in a sealable bag in order to prevent individual particles from becoming airborne. The contents should be clearly marked on the bag.

Handling Mineral Specimens

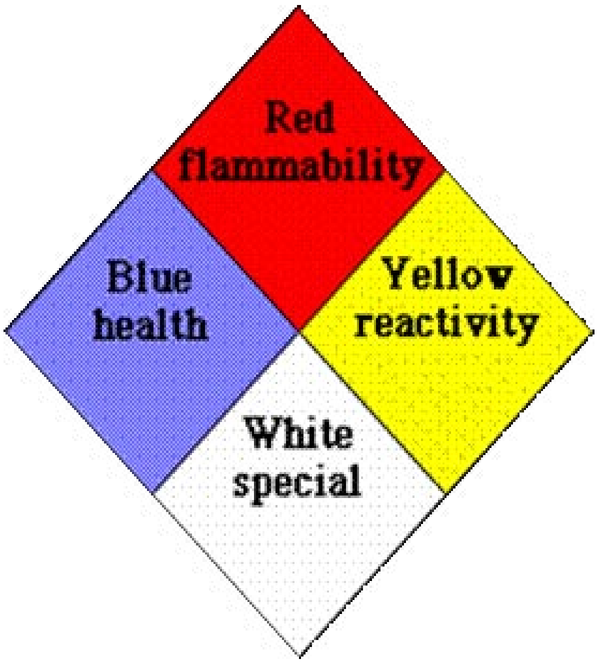
Some minerals may contain elements that are toxic. The most common ones are Aluminum, Antimony, Arsenic, Beryllium, Bismuth, Bromine, Cadmium, Lead, Mercury, Selenium, Thallium and Uranium.

Toxic metals that enter the body are not easily removed. They are persistent and cumulative in their effect, often replacing nutrient minerals at enzyme binding sites. Handle all minerals containing these elements with care. Always wear neoprene gloves when handling minerals that contain potentially toxic elements and always be sure to wash your hands when you are finished as an added precaution.

Collection Management Suggestions

As with any safety issues all potential health issues should be brought to the attention of the Park Safety Officer or the Regional Public Health Officer, and the Regional Curator. All procedures and mitigation should be cleared through them.

Label all cabinets housing such minerals with the appropriate National Fire Protection Association (NFPA) Hazard Warning Symbol. This will ensure that anyone opening the cabinet; staff, visitors, and emergency personnel are aware of these potential hazards.



Be sure to note the presence of these minerals in relevant emergency planning documents (such as your Museum Emergency Operations Plan [MEOP]) and brief all first responders on their presence.

If you are not able to identify the minerals yourself based on available references, contact the geology department at the local university and see if a member of the faculty can aid with the identification. Check the chemical composition of the mineral to determine if any special storage or handling is required.

The Mineralogical Society of America promotes scientific research, teaching, and educating the public concerning mineralogy. The Society publishes *American Mineralogist*, *Reviews in Mineralogy and Geochemistry*, monographs, a newsletter, and books. It holds courses, lectureships, symposia, and meetings. For further information, contact the Society at:

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Also to learn more about managing mineral collections see:
The Society of Museum Mineral Professionals
http://www.smmp.net/

References

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Waller, R. K. Andrew, and J. Tétreault. 2000. "Survey of gaseous pollutant concentration distributions in mineral collections." *Collection Forum* 14(1-2):1-32.

The chemical formulas and brief descriptions of the different types of minerals (referred to as species) are given in the following references:

Fleischer, M. 1986. *Glossary of Mineral Species*. 5th edition. Mineralogical Record, Tucson, 202 pp.

Nickel, E.H. and M.C. Nichols. 1991. *Mineral Reference Manual*. Van Nostrand, Reinhold, New York, 250 pp.

Roberts, W.L., T.J. Campbell, and G.R. Rapp, Jr. 1990. *Encyclopedia of Minerals*. Second edition. Van Nostrand, Reinhold, New York, 979 pp.

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