"Minerals that do things…"

Hands-on demonstrations of mineral properties

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The Mineral That Gets a Suntan

Object: Exposure to ultraviolet light causes changes in minerals. One of the lesser-known phenomena is **tenebrescence**, in which a mineral actually changes color upon exposure to ultraviolet light (this is not the same as fluorescence). Using an ultraviolet light, students can give a mineral a reversible "suntan." They'll change the color of hackmanite or tugtupite, then allow the specimens to change back to their original color.

Procedure description: After noting the specimen's original color, students hold a UV lamp close to a specimen of hackmanite or tugtupite and observe the changing color. Hackmanite, for instance, changes from white to purple-red. After a few minutes, pull the UV lamp away from the specimen. Note the purple-red color. When the specimen is subsequently exposed to white light (such as that coming from a fluorescent light), it will quickly "relax" back to its original color. This cycle can be repeated again and again. Test other photochromic materials such as an old pair of PhotoGray® glasses, some "UV beads", or photochromic fingernail polishes in a similar manner.

Specimens to test: Hackmanite (a variety of sodalite, the best material comes from Ilimaussaq, Greenland, although good Canadian material is also available); tugtupite; an old pair of PhotoGray® glasses; "UV beads"; photochromic fingernail polish.

Equipment needed: Ultraviolet lamp (short-wave UV is best for these demos); small piece of thick glass.

Scientific discussion: When some minerals such as hackmanite are exposed to ultraviolet light (short-wave UV is best) they change from white to a purple-red or raspberry color. Called tenebrescence, this effect is also known as reversible photochromism. "Tenebrae" is Latin for shadow or darkness – in this case the mineral acquires a purple shadow. The effect is reversible in hackmanite: under white light the raspberry color fades back to white. (Technically, this effect in sodalite, variety hackmanite, appears to be due to substitution of sulfur for chlorine in the structure, but there is usually not much need to go into such details during demonstrations.) The mineral tugtupite has similar abilities.

Tenebrescence is a rare phenomenon in nature – only hackmanite and tugtupite show the effect readily. Light-colored spodumene is also tenebrescent and will turn green. However, it takes X-rays or higher energy radiation to achieve the green color. This green color will fade upon exposure to light or heat.

We use synthetic materials with tenebrescent characteristics. For instance, glass PhotoGray® lenses have small silver halide crystals imbedded in them that react to ultraviolet light to darken the lenses. These PhotoGray® glasses and other similar eyeglass lenses only darken in the outdoor

sunlight because it takes ultraviolet light to set off the tenebrescent effect. Indoor lamps produce very little UV light, and sunlight shining through a window has little UV light because the window glass absorbs most of the ultraviolet, so the glasses don't darken indoors. You can also see the tenebrescence in "UV beads" and photochromic fingernail polishes.

Additional possibilities: Show students that glass will adsorb ultraviolet light by placing a piece of thick glass between the UV lamp and a specimen. Most glass will not allow UV light to pass through, thus the specimen, when protected by the glass, will not show the tenebrescent effect.

Notes for demo tables: If you are doing demonstrations for large numbers of visitors (such as at a booth at a trade show), I've found that it is best to use one of the strong high-output UV lamps manufactured by companies such as Way Too Cool, Inc., or UV Systems, Inc. (See the web page of the Fluorescent Mineral Society www.uvminerals.org for dealers that sell these and other lamps.) These lamps are available with long-wave and short-wave UV bulbs. Although they are expensive, these lamps can be used for a wide variety of demonstrations and they will give good results with tenebrescent hackmanite, or tugtupite.