mine. There is, however, movement along some of the bedding planes and contacts. Slickensides are formed in these areas. One of the claystone (No. 760) was broken and thin films of native selenium were seen on the slickensides. Fig. 1 shows the selenium film on the slickensides. The selenium film is rather corrugated because it was deposited between the polished and striated surfaces of the slickensides. Numerous minute and fresh pyrite crystals appear in the claystone.

Identification

Some physical properties of the native selenium are as follows: Luster metallic, color grayish black; some with bluish tint. Because of this bluish tint, some thin films of the native selenium may be mistaken for molybdenite. Streak grayish black. Some of the thinnist fragments are brownish red in transmitted light. The x-ray powder diffraction data are listed in Table 1.

Acknowledgment

The permission of the Uranium Division, Calumet and Hecla, Inc., to publish this geological note is gratefully acknowledged.

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THE AMERICAN MINERALOGIST, VOL. 44, NOVEMBER-DECEMBER, 1959

SIMPLE TECHNIQUE FOR THE CONSTRUCTION OF POLYHEDRAL STRUCTURE MODELS

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When complex crystal structures are studied the visualization of the structures requires good structure models. The standard ball models help this visualization, but they are often either too expensive to purchase or too time-consuming to construct. Most structures, however,

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can be illustrated by polyhedral models, where the polyhedra represent the coordination polyhedra of the cations. Such models not only illustrate the linkage of the polyhedra and the whole structure, in many cases better than a ball model, but also offer possibilities for simple and inexpensive model construction techniques.

The use of polyhedral models is not unknown among crystallographers. Most of the published models are made of cardboard paper and some are made of wooden blocks or plaster of paris. The first technique is simple and time-saving, but the models are primitive and temporary only. In studying tetrahedral structures the author sought a simple and fast technique for making over 40 structure models. An efficient and inexpensive technique was found which permits making well-constructed and sturdy models in a matter of a few hours.

(1) The tetrahedra of the model are made of acetate sheets. Acetate sheets of 15 mils thickness were found to be the most satisfactory for the construction of models on a scale of 1 inch to 2 Angströms. The acetate sheets are first dulled with steel-wool. This fogging renders the tetrahedra opaque and helps to hide the minor imperfections. Equilateral triangles are then cut out. This cutting can be achieved by a simple paper cutter, but if a large number of models is anticipated, it pays to have a die made for mechanical cutting. The acetate triangles are glued into tetrahedral form with acetone, which is a solvent of the acetate and dries very quickly. This process can be accelerated if a mold, such as shown in Fig. 1 is used for the assemblage of the tetrahedron.

(2) The tetrahedra are attached to each other by means of narrow acetate strips (1 mm. by 8 mm.). These are set at the approximate linkage angle and fastened to the corresponding corners of the tetrahedra with acetone. The two softened acetate surfaces stick immediately and the joint hardens in a matter of a few seconds. This approximate angle is later changed to the correct angle by softening the acetate strips with a drop of acetone. The model is assembled by following a good drawing of the structure, or by constructing the motif of tetrahedra of the structure and repeating it according to the symmetry of the space group.

(3) Before attaching the last few tetrahedra to the model, the model is placed in a $\frac{1}{8}$ inch brass wire frame. The frame might represent a unit cell or any multiple or fraction of the unit cell. The last tetrahedra are then added to the model to complete it. In some cases the brass wire has to be embedded in a tetrahedron. This can be done easily by cutting and partially opening the tetrahedron, and removing a circular area of acetate where the wire is to penetrate the face. The tetrahedron is then glued together again after it is placed on the frame. In order to fix the position of the model in the wire frame a few narrow strips of acetate can

be glued to peripherally-located tetrahedra and the frame. Transparent strips of acetate can be used for this purpose in order to prevent their interference in the appearance of the model. When the model is ready and all the linkage angles are set correctly, an extra acetate strip can be added to each connected corner to assure firm connections. The model with the frame can then be fixed to a base, if desired.

A model of high-quartz constructed by this technique is shown in Fig. 2. In this model the structure is extended beyond a unit cell in order

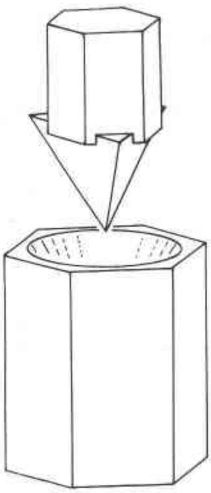

FIG. 1. Mold for assembling tetrahedra.

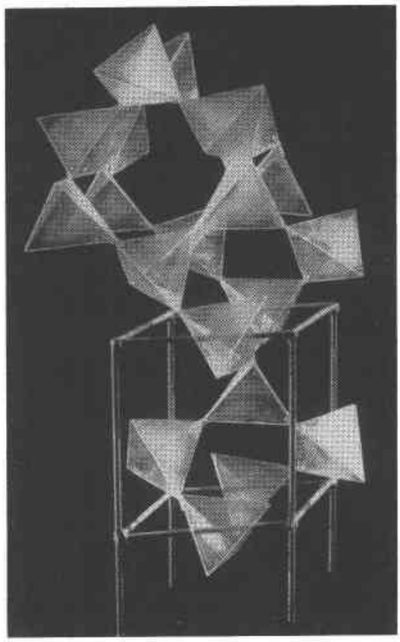

FIG. 2. Model of high-quartz.

to illustrate the 6- and 8-membered loops of tetrahedra. All the silica and silicate models can be constructed similarly and plastic balls can be added to illustrate the location of the non-tetrahedrally coordinated cations in silicates. Mica and clay models can be constructed by the combination of tetrahedral and octahedral sheets. If so desired the polyhedra of the different cations in a complex structure model can be painted in different colors.

The models constructed by this technique are fairly permanent. Unfortunately, the acetate becomes brittle after a few years and the model may fall apart if handled constantly. It is, therefore, advisable to keep the models in closed display cases as much as possible.