**Gypsum Repair**

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Depending on the texture and porosity, broken sulfate speleothems can sometimes be repaired. An approved cyanoacrylate adhesive may work on very small pieces. If extremely delicate technique is employed, even gypsum flowers may be good candidates for repair.

Larger repairs on damaged gypsum crusts usually require bracing or propping while an archival epoxy cures.

**Gypsum Crusts**

In Floyd Collins Crystal Cave, Mammoth Cave National Park, Kentucky, gypsum crusts hang suspended from bedrock walls. Vandals used sledge hammers to break off chunks of gypsum weighing up to 70 pounds (32 kilograms) as well as numerous other speleothems. Mammoth Cave National Park invited us to develop techniques for rehanging large pieces of gypsum crust.

To suspend crusts from bedrock walls, mate the broken crust to intact edges and locate a position in the bedrock for a supporting rod. Set the broken piece aside. At the matching point on the bedrock wall, drill a hole and use epoxy to secure a stainless steel all-thread supporting rod. Use an archival epoxy to install the support rod approximately perpendicular to the wall. (See cave-safe epoxies, page 445–447.)

Drill through the broken piece of crust at the matching location. Lift the crust onto the rod, position the edges, and hang it somewhat like a picture on a wall. The stainless rod acts as a straight hook or pin to support the broken piece. Allow time for the epoxy to cure.

Cut off the rod even with the outer surface of the crust and cover the drill hole with a mixture of epoxy and gypsum dust. Reinforce the mating edges with a color-matched mixture gypsum powder and epoxy. Color match and texture the holes, cracks, and seams to complete the repair.

**Figure 1a** (before) and **Figure 1b** (after). These two photos show images of a vandalized gypsum crust repair in Floyd Collins Cave, Mammoth Cave National Park, Kentucky.
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Figure 2. To repair gypsum crust, use an archival epoxy and install a stainless steel pin in the wall. With the pin acting as a hook, rehang the gypsum crust.

Figure 3a. This photo shows the drill hole in the gypsum crust with the pin cut off. The pin is cut off even with the surface of the crust.

Figure 3b. Fill the drill hole with a color-matched epoxy and crushed gypsum mixture.

Figure 4. Jim Werker fills seams and gaps with a thick mixture of epoxy and gypsum dust.

Figure 5. A second gypsum crust, weighing 70 pounds (32 kilograms) is reattached using the same perpendicular pin technique.