American Mineralogist, Volume 86, pages 380–381, 2001

# Book Review

CAVE MINERALS OF THE WORLD, 2nd Edition. By Carol Hill and Paolo Forti. National Speleological Society, Huntsville, AL, 463 p. ISBN number: 1-879961-07-5. $70.00.

Think about all of those spectacular displays of mineral crystals that grace the world's mineral museums. A great many of the large, faceted crystals grew in some sort of cavity over long periods of time. Such mineral crystals are discovered in vugs, pockets and cavities exposed in mines and quarries. The conditions under which they were found are very different from the conditions under which they grew. The fluids from which they grew are long gone, a challenge for mineralogists to deduce from the surviving clues of trace elements, isotopes, and fluid inclusions. Now, consider a cave. It also is a cavity, maintaining conditions of constant temperature, water vapor pressure, and carbon dioxide pressure for long periods of time. This is also an environment where minerals can grow. But in the case of many caves, human observers can watch the growth process in progress.

Some cave minerals appear as large faceted crystals. Some are nondescript crusts of little beauty but fascinating mineralogy. Most have formed from flowing, dripping, and seeping water and thus take on shapes dictated by the idiosyncrasies of the moving water. Such mineral deposits are known as speleothems: stalactites, stalagmites, flowstone, and a host of more intricate shapes. Hill and Forti illustrate speleothems with some spectacular color photographs. The authors have solicited contributions from cave photographers all over the world and without exception the illustrations are of outstanding quality.

The common cave minerals are carbonates and sulfates with some halides and phosphates of the expected common cations in carbonate rock environments—calcium, magnesium, and sodium. Reactions between bat guano and the carbonate wall rock produce a suite of more exotic phosphate and organic minerals. Some caves intersect ore deposits, allowing weathering products of ore minerals to form speleothems. All in all, 255 minerals have been identified in secondary cave deposits. Hill and Forti provide descriptions of all of these. As might be expected, many descriptions of cave minerals have appeared in some exceedingly obscure publications—cave club newsletters, abstracts, and minor journals. Hill and Forti seem to have tracked down all of them. By my estimate, the book contains roughly 5000 references, arranged alphabetically by author with complete titles.

Collecting the information in this volume has required the dedication of a lifetime. Although the book is titled "2nd edition," in reality it is the 3rd edition. Carol Hill published *Cave Minerals* in 1976, limited to mineral descriptions from the United States. She then teamed up with Paolo Forti who had been collecting similar information in Europe. The result was the 1st edition of *Cave Minerals of the World* in 1986. The present book is greatly enhanced and more comprehensive, the culmination of 30 years of collecting information.

The organization of the book is as follows. It opens with an introduction written by historian Trevor R. Shaw who traces accounts of cave minerals and speleothems into medieval times and earlier. Then follows a lengthy section (70 pages) on spelothems that advances a classification of the external form of cave deposits in terms of types, subtypes, and varieties and then presents these in simple alphabetical order. Given the erratic, idiosyncratic, and complicated names that have been applied to speleothems by scientists, cavers, and show cave guides, this section may be taken as a useful standard reference for what is intrinsically an arbitrary labeling. This section is profusely illustrated with photographs so as to leave little doubt concerning what the authors are actually talking about.

The core of the book (111 pages) is a systematic description of the cave minerals themselves. These are arranged in traditional fashion in groups by chemical composition, first the native elements, then oxides, sulfides, halides, arsenates, borates, carbonates, nitrates, phosphates, silicates, sulfates, vanadates, and organic minerals. The sulfates comprise the longest list; 64 sulfate minerals have been found to occur in caves. Within each group, the minerals are arranged alphabetically. The listing for each mineral describes the cave occurrences. This includes the crystalline form, the types of speleothems in which the mineral occurs, types of caves containing the mineral, and any special environments where the minerals occur. The depositional chemistry is described for those minerals for which the chemistry has been sorted out. An interesting feature of the book is the use of 16 colored icons to indicate information (e.g. "large crystals," "metastable," etc.) Photographs also document most of the mineral occurrences.

To supplement the individual mineral descriptions is a section (81 pages) of "Special Topics" These are a series of 19 short essays on topics ranging from crystallography and trace elements to preservation of speleothems and techniques for speleothem restoration. Most of the special topics are written by invited authorities. All are documented and provide a good access pathway into the literature.

To highlight the diversity of cave mineral occurrences, the authors have selected a "top ten" list of the most interesting mineralized caves. These are: Blue Cave, France with calcite and aragonite brilliantly colored by transition metal ions, mainly copper; Alum Cave, Vulcano Island, Sicily, a sea cave in volcanic ash, where fumarole activity and sea spray have created a suite of metastable minerals which can be observed in the process of reverting to stable forms; Liquid Crystal Cave, Mount Sedom, Israel, developed in salt; Cupp-Coutunn Cave, Turkmenistan with unusual minerals formed by hydrothermal solutions; Kyusen-do Cave, Kumamoto Prefecture, Japan, a limestone cave with abundant phosphate minerals; Skipton Lava Cave, Victoria, Australia, a lava tube also with an extensive suite of phosphate minerals; Mbobo Mkulu Cave, South Africa, an ore-associated cave developed in dolomite, sulfide-rich black shale and chert breccia; Caverna de Santana, Brazil, a tropical limestone cave with a variety of carbonate speleothems; Lechuguilla Cave, New Mexico, a sulfuric acid cave with some of the most spectacular speleothems ever discovered; Karchner Caverns, Arizona, with minerals from six classes in one small cave.

Hill and Forti have produced both an exceedingly detailed work of mineralogy and a book of great beauty. Serious mineralogists will find complete and well-documented descriptions of the minerals that occur in caves. Mineral collectors and other fans of mineralogy will find a marvelous collection of mineral photographs.

To close, let us return to the mineral museums mentioned at the beginning of this review. Museums and private collections provide excellent devices for the display and investigation of mineral specimens from mines and quarries. They are an exceedingly inferior device for the display and study of cave minerals. Caves are natural museums, where, with appropriate care, human observers can admire and photograph the minerals and study their deposition in situ. Cave minerals do not lend themselves to conventional collecting. Even such prosaic specimens as calcite stalactites will loose their luster in a museum display case as the fluid inclusions dry out. The place to see cave minerals is in a cave—or in Hill and Forti's book.

William B. White
*The Pennsylvania State University*
*University Park, PA 16802*