Camiro 1.0 – The Romanian cave minerals database program

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ABSTRACT. The present article introduces the Cave Minerals of Romania database (CAMIRO 1.0), a computer-based program that allows cataloging of all known cave mineral species including their main characteristics. CAMIRO 1.0 is a mineralogical database created using Borland® Delphi™ 4 Professional, an object-oriented, visual-programming environment that allows rapid application development. CAMIRO 1.0 is a collection of geologic, mineralogic, crystallographic, and protection information about cave minerals. It holds and organizes large amounts of information, including photos. Related information (e.g., mineralogical or crystallographic) are grouped together to form *records*. These records are gathered into several related *fields*. In order to logically group all necessary fields we have created the following three pages: *General data, Mineralogical data,* and *Crystallographic data.* Such a cave minerals database would have many various scientific purposes or it could simply be a quick and easy to surf electronic handbook. With the help of its easy–to-excess content, the database could provide cavers with basic information on identifying and describing the mineralogy of most of the strange-looking speleothems.

Motivation

Over the last 30 years, several papers and three major books dealing with various aspects of cave minerals worldwide have been published (MOORE, 1970; HILL, 1973; HILL & FORTI, 1986, 1997; MOORE & SULLIVAN, 1997; ONAC, 1999).

In 1973, Hill published the first book describing the entire cave minerals found in United States up to that period. Later, Hill and Forti published two editions (1986 and 1997) of *Cave Minerals of the World,* providing both cavers and professional mineralogists with an incredible amount of information on cave minerals and the resulting speleothems they form.

Advancements in technology (new high-tech X-ray Diffraction, SEM and TEM devices, powerful models of ICP-MS) have resulted in an explosion of new mineralogical data included in the last edition of *Cave Minerals of the World.* However, the last two editions were published 11 years apart, showing that in order to keep up-to-date information on this exponential-like curve of the cave mineralogy knowledge a computer-aided database is needed.

At least three reasons for creating such a mineralogical electronic database are as follows: (1) the data (various information and illustrations) can easily be archived, (2) to update a previous version takes a shorter time and less money than printing a new book edition, and (3) the database can be distributed worldwide so that more cavers and scientists can access it.

About CAMIRO 1.0

CAMIRO 1.0 is a mineralogical database created using Borland® Delphi™ 4 Professional, an object-oriented, visual-programming environment that allows rapid application development

CAMIRO 1.0 has the following minimum system requirements:

- IBM PC/PS2 or compatible with 486 based CPU or higher.
- At least 4MB free on its hard disk.
- Windows 95 or later.
- At least 2MB RAM.

Those interested in purchasing this program are welcome to place their request with one of the authors at the above-mentioned address.

Application description

CAMIRO 1.0 is a collection of geologic, mineralogic, crystallographic, and protection information about cave minerals. It holds and organizes large amounts of information (including photos), and makes any item immediately accessible. Related information (e.g., mineralogical or crystallographic) are grouped together to form *records*. These records are gathered into several related *fields*. In order to logically group all necessary fields we have created the following three pages: *General data, Mineralogical data,* and *Crystallographic data.*

General data

This page contains fields such as: *Mineral name*, *Cave name, Other locations, Geographic settings, Geologic settings, Cave climate, Occurrence, First description, References, and Speleothem image* (Fig. 1). A few of these fields include several records and therefore need further explanation.

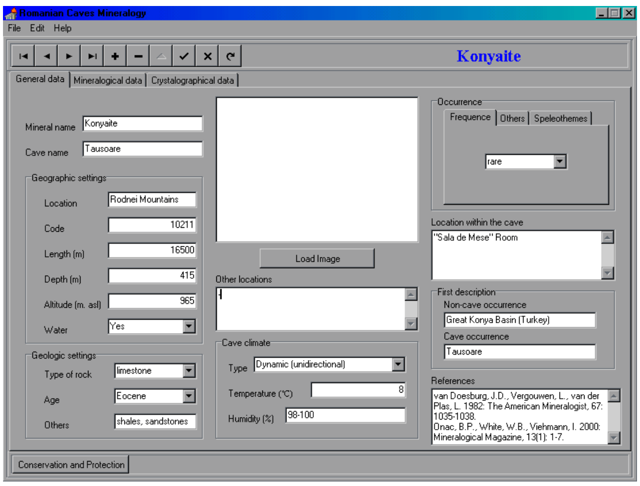

Fig. 1. General data page with its fields and records.

Within the *Geographic setting* field, information such as cave location and cave numerical code (extracted from the Romanian Cave Index; GORAN, 1982) to allow users interested in a certain cave to perform a rapid mineral search. In addition, information such as length and depth of the cave, altitude of the cave entrance, and presence or lack of underground stream was included

The type and age of rock that host the cave are the main records grouped under the *Geologic settings* field. If more than one type of rock is present this is mentioned within *Others* record.

Cave climate through its main parameters of ventilation type, temperature, and humidity is often responsible for the genesis of some mineral species in the cave environment. Knowing such information, one can better understand the deposition and stability of minerals.

Under the *Occurrence* field the three dialogue windows are *Speleothems*, *Frequency*, and *Others*. These windows allow a user to find out what types and subtypes of *Speleothems* were identified (according to the classification proposed by HILL & FORTI, 1997) and what is their *Frequency* (i.e., very common, common, rare, and uncommon). If additional remarks can be made under this main field, these comments should be placed in the window called *Others*.

The *First description* field contains two records: *Non-cave occurrence* and *Cave occurrence*. The *Non-cave occurrence* record cites the location of those minerals that were first described outside the cave. The *Cave occurrence* field cites the first cave in which that mineral was found. When the *Non-cave occurrence* record remains empty, the user should understand that the mineral was first discovered in a cave.

Whenever a common mineral (e.g., calcite, aragonite, gypsum, brushite, etc.) was found in several caves, only that cave where the mineral is best displayed is presented in detail. Other caves were the mineral occurs are listed within the *Other location* field.

Location of certain speleothems within the cave (i.e., well-ventilated passages, aerosols-rich environment, etc.) is sometimes essential when discussing the mineral genesis. For this reason, we believe both cavers and scientists should always record this information in their field book.

Mineralogical data

The page called *Mineralogical data* provides information that is obtained after a number of observations and laboratory analyses (Fig. 2). Foremost, the *Mineral status* (approved, discredited, or revised by IMA) is presented. The mineral is then placed within the chemical *group* where it belongs. The *Chemical formula* is given according to STRUNZ (1982). If the speleothem of a variety of a well-known mineral (e.g., selenite, which is a coarsely crystalline, transparent variety of gypsum) this information is in the *Varieties* field. Cave minerals often do not appear alone but with other minerals formed under the same set of circumstances. The *Mineral assemblage* field emphasizes what other mineral(s) was/were identified in the composition of the same speleothem. The external shape of crystals is described under the *Habit*. *Color, Luster, Hardness* and *Cleavage* represent the major *Physical properties* of a mineral and are each recorded in a different dialogue window. For those minerals with *Diagnostic features* (e.g., calcite fizzes vigorously in dilute HCl, nitrates have a very bitter, pungent taste, mirabilite forms glassy-clear crystals etc.) a special window was created.

The *Analytical data* field contains an *Identification* by record, listing the main methods used to describe the mineral (X-ray, thermal, IR etc.). In addition, a dialogue window was added in order to specify any other laboratory diagnostic methods.

The *Chemistry* field displays quantitative chemical data provided by various analytic methods (XRF, EDS, ICP-MS, etc.).

The last dialogue window of the *Mineralogical data* page relates to the *Deposition and stability* of the cave minerals. At this location, cavers and scientists will find information on the cave settings under which a particular mineral formed.

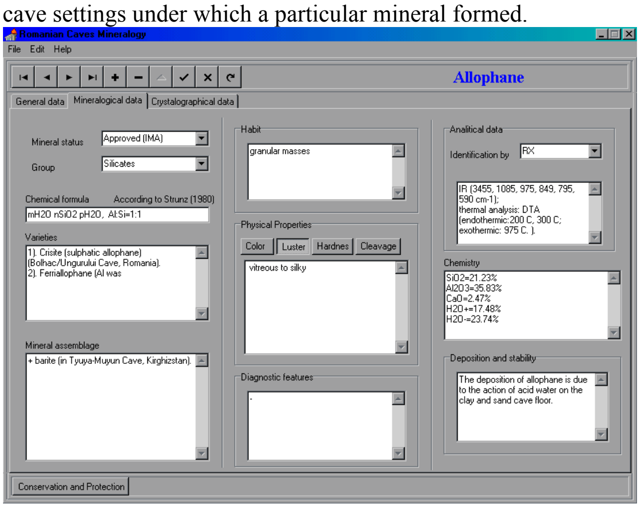

Fig. 2. Mineralogical data page.

Crystallographic data (Fig. 3)

In the first field of the *Crystallographic data* page users will learn to which of the seven *Crystallographic system* the mineral belongs.

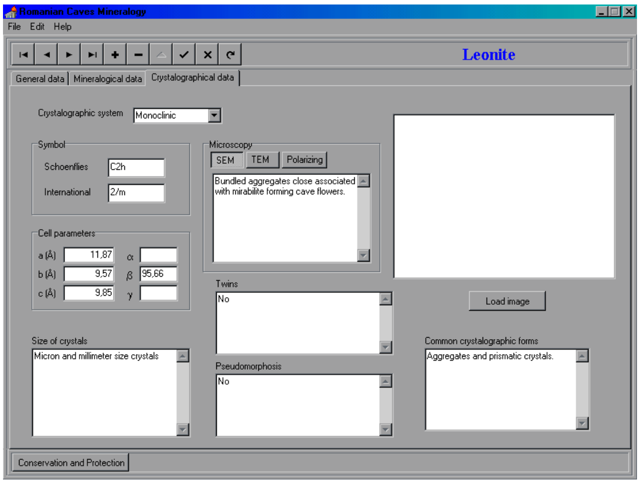

Fig. 3. Crystallographic data page.

Both *Schoenflies* and *International* notations devised for crystal classes are presented under the *Symbol* field.

Two types of data used to describe the axial elements are gathered under the *Cell parameters* field. These include (1) the cell size parameters (a, b, c) and (2) the angles between the crystal's crystallographic axes (α, β and γ) (interaxial angles).

The following four fields bring specific data on the mineral under question: *Size of crystals,* the presence of *Twins* or *Pseudomorphs,* and the most *Common crystallographic forms* (i.e., prisms, rhombohedron etc.). The Load image button can display images of the crystal. This option is normally deactivated in order to increase the application speed.

All results acquired through different optical techniques are grouped under the *Microscopy* field. Observations made with an ordinary polarizing microscope (e.g., refractive indices, twins, cleavage etc.) and with more high-powered scanning (SEM) and transmission electron microscopes (TEM) (crystal fabric and structure, inclusions etc.) are recorded.

Conservation and Protection

Within each of the three pages a button located in the lower left corner opens the *Conservation and Protection* dialogue window. The purpose of this memo field is to provide a warning signal for cavers on how they should behave when entering a cave that is decorated with speleothems of different mineralogy. To preserve speleothems (minerals) in both wild and show caves, many factors must be considered. For example, when a cave hosts mirabilite speleothems it is absolutely prohibited to camp in their close vicinity. Mirabilite crystals are highly sensitive to temperature and humidity variations and will quickly dehydrate and disintegrate into a white powder.

Conclusions

The CAMIRO 1.0 application, developed using Borland Delphi 4 Professional, is a mineralogical database designed to store a variety of information on all cave minerals discovered in Romania.

Presently, this application represents the first attempt in creating a computer-aided mineralogical database that can be distributed among the speleological community. The intent is to expand it and generate a worldwide electronic catalogue of cave minerals. Such a cave minerals database would have many various scientific purposes or it could simply be a quick and easy to surf electronic handbook. With the help of its easy–to-excess content, the database could provide cavers with basic information on identifying and describing the mineralogy of most of the strange-looking speleothems.

In order to improve the present version of CAMIRO we would appreciate any comments, ideas, and observations. Major input is expected from members of the *Cave Mineralogy Commission* within the International Union of Speleology.

Acknowledgements: The authors are grateful to Joe Kearns for his comments on an earlier stage of the paper. Funding for purchasing of specific computer programs and part of the fieldwork necessary to develop this database was provided by the Romanian Council for Scientific Research (CNCSIS) through grant 69/382 to Bogdan P. Onac.

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