IDENTIFICATION OF MINERALS

We have now reached the last month of this series of presentations. Despite the heading in red, this Topic will not be concerned with providing detailed information about how minerals are identified, but it will concern some basic ideas about how it can be done.

For you to develop the capability to identify a range of mineral specimens, such as in our ID exercises, is simple but time consuming. There are no short cuts. Make it your business to look at mineral specimens as often as you can manage. Look at a mineral and the name, commit both to memory. You might not remember it the first time but after a while, you will. Where to look. Club showcases, the Show - Open Days – and dealers, our ID exercises, books, various collections and so on - it's up to you. This is what Ann did, it's what I did, it's what dealers and experts do. There is no alternative. The harder you work on it the better your ID skills will become.

X-ray Analysis

So, how are new minerals identified for the first time? These days, it is done in high–tech X-ray laboratories in research institutions or universities.

The specimen is a very small piece of the mineral ground to a fine powder and so consisting of a very large number of tiny crystal fragments. These are cemented together and mounted in **an x-ray diffractometer**. A narrow beam of monochromatic x-rays is directed into the specimen where constructive interference occurs and x-rays are scattered in various directions. The scattered x-rays are detected by a Geiger or other counter rotating around the specimen. The output of the counter is printed as a function of the rotation angle and shows the angles at which the scattered rays occurred and the intensity of each scattered ray. This is called the **x-ray diffraction powder pattern** of that mineral.

Many modern x-ray machines have a data bank of the powder patterns for all known minerals and can identify an unknown mineral by comparison with that data bank. If there is no match then the unknown is a new mineral. The crystallography of the new mineral can be found from analysis of the powder pattern.

Without going into detail, the angles at which scattering occurs are determined by the geometry of the unit cell of the structure of the specimen crystal. And, the intensity of each scattered ray is determined by the identity of the atoms and the array of those atoms in the cell. By measuring the angle for each scattered ray the size and shape of the unit cell can be reconstructed and by measuring the intensity of each scattered ray, the identity and location of atoms in the unit cell can also be reconstructed. This then is the crystal structure and identity of that new mineral.

This kind of work is obviously not for hobbyists but it is useful for hobbyists to have some appreciation of the kind of equipment and procedures are necessary to obtain crystallographic data.

Property Analysis

Some hobbyists take up the challenge of mineral identification by a route different from x-ray diffraction. There are more than 7000 minerals known to exist with another 100 or so new ones added each year. Some 200 of those are fairly common. Professional mineralogists can recognise maybe 400 minerals on sight and keen amateurs can name anything up to a couple of 100. How many for Mineral Group members? If you had a specimen than you couldn't recognise and really wanted to ID, how would you tackle your problem? **Property Analysis** Is one answer.

The most obvious property of a mineral is colour. For idiochromatic minerals colour is characteristic but not for allochromatic minerals. What we do know is this. If an unknown is orange, only 5% of the 7000 known minerals (only about 350) are possibilities. Or if it is black, there are only about 1330 possibilities and similarly for other colours. This would be a good place to start but what to look at next?

There are several physical properties that are relatively simple to assess depending the availability of appropriate specimens. Presuming that this presents no problems, lustre as either metallic or non-metallic should be a helpful second step in reducing the number of possibilities. Next, cleavage then streak should help to reduce the possibilities further. This procedure of measuring or assessing properties one at a time, then applying the result to only those minerals remaining as possibilities should ultimately point to that mineral that satisfies all tests.

Tests for Mohs hardness and relative density will require a set of hardness points and a good set of scales but should provide measurements of sufficient accuracy to help greatly in elimination of incorrect possibilities.

Even so, with over 7000 known minerals to start with, these tests may not be sufficient for an identification. One further piece of information could be very helpful in this situation. Where did the specimen come from? If that information is known, MINDAT might list all minerals known to occur at that locality and so aid in the identification.

This brings to a close our final Topic in the series aimed at improving your understanding of minerals. How well has it helped you?

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