Crystal faces and crystal forms

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CRYSTAL FACES AND CRYSTAL FORMS

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One of the most alluring aspects of crystals is their flat surfaces (crystal faces), which naturally develop during crystal growth. Pliny the Elder (AD 23/24 – 79) noted "the polish on the faces of crystals is so exquisite that no art can possibly equal it!". Even the seasoned mineral collector takes great pleasure in viewing the natural "polish" and geometric perfection every time they hold a pyrite cube from Navajun, Spain.

Crystals were first recognized by their flat faces and symmetric or geometric morphology. The word crystal derives from the ancient Greek word κρύσταλλος (krustallos), meaning "cold drawn together", or ice. It was later applied to rock crystal, also by Pliny the Elder, because he postulated that quartz was ice that had frozen so cold that it would not melt. With the advent of X-ray diffraction in the early 20th century scientists learned that a regular repeating arrangement of atoms comprised all crystals. One of the quantifiable properties of the repeating arrangement of atoms in a crystal structure is symmetry.

Equally alluring and particularly intriguing are the symmetric shapes of crystals, which result from the combination of faces that develop during their formation. The external symmetry observed in crystal shapes (Fig. 1 & 2) is ultimately the result of the internal symmetry of the crystal structure. In the English language a common synonym for shape is form. However, in crystallography and mineralogy form has a much more specific meaning that is not equivalent to shape or morphology. In these contexts a form is defined as a set of crystal faces that are related to one another by the symmetry of the crystal structure. Such faces are said to be symmetrically equivalent. Accordingly, we can simply define a form as a set of symmetrically equivalent crystal faces. There are 47 possible form types found among crystals (excluding those found on quasicrystals).

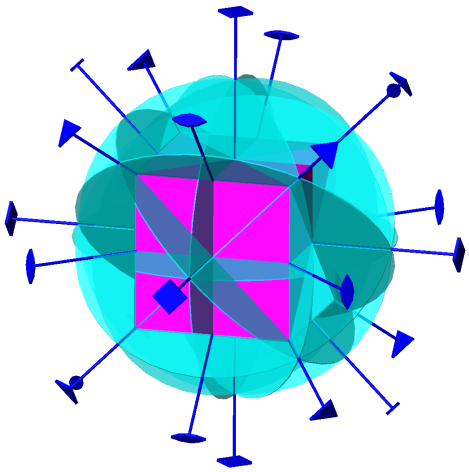

Figure 1. SHAPE® rendering of a cube with graphical symbols of all of the symmetry elements (e.g. axes of rotation (dark blue) and mirror planes (light blue)) superimposed.

These include pedion, pinacoid, prism, cube, etc. The morphology or habit of a crystal is governed by the forms present and by the relative development or size of the faces among those forms.

Though related to the symmetry of the crystal structure, apparent external symmetry can be influenced by extrinsic factors during crystal growth; for example, unequal development of the faces of a cube can result in a crystal with the shape of a square prism, leading to an apparent symmetry or pseudosymmetry that is different than that of a cube (Fig. 2B). Understanding the basics of crystallography, with concepts like symmetry, face indices (e.g. Miller indices), and forms, can lead to a much deeper appreciation of the beautiful crystals that adorn mineral collections, and lays the foundation for recognizing unexpected crystal characteristics; i.e. specimens that violate the laws of classical crystallography (the topic of John Jaszczak's abstract and presentation at the 42nd Annual New Mexico Mineral Symposium).

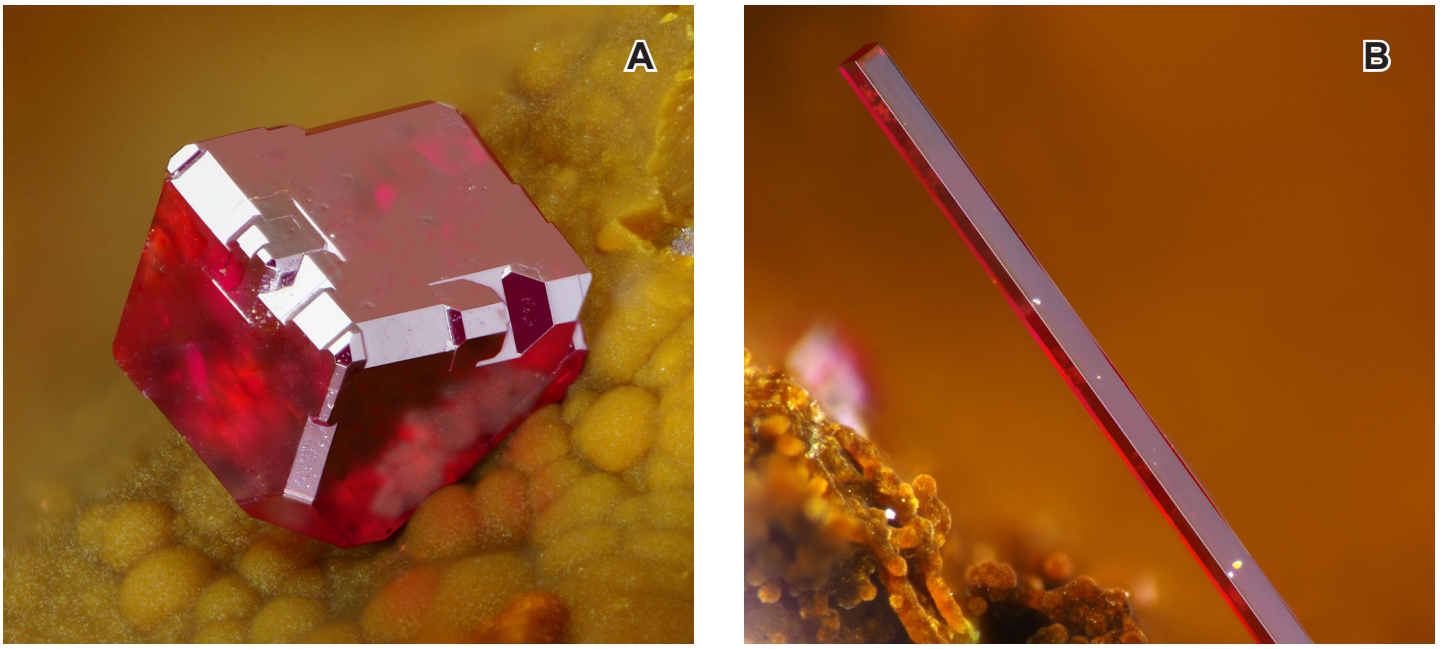

Figure 2. A) Cuprite crystal showing equal development of the faces in the cube form, modified by dodecahedral and octahedral faces along the cube edges and corners. B) Cuprite crystal showing unequal development of the faces in the cube form resulting in a pseudo tetragonal symmetry. Laszlo Toth photos.