Module B. Colour from the Cosmos

Lesson 9 - Diamond Mineralogy and Gemology

Diamonds in the Rough

The external shape (i.e., habit) of any mineral is controlled by its internal arrangement of atoms (recall this from the section on mineralogy and crystallography). Because carbon atoms in diamond have cubic symmetry, the primary shapes that diamond can take must adhere to the rules dictated by this symmetry. Secondary, or modifying, shapes can change the initial shape of any mineral through processes like corrosion or abrasion. The resulting shape of natural uncut diamonds, therefore, is a mixture of primary crystallographically controlled shapes variably modified by secondary processes. Certain morphologies can indicate specific growth environments and subsequent geological history of a particular set of diamonds.

The most common habit/shape of diamond is the octahedron. Cubes are also common shapes, as well as combinations of cubes and octahedrons (octahedron modified by cube faces, or cubes modified by octahedron faces). Uncommonly, diamonds may be dodecahedral, twinned or show a flat tabular form known as macles. Diamonds sometimes form in polycrystalline (poly=many) aggregates and tend to be harder than monocrystalline (mono=one) specimens.

Diamond forms and faces, as sketched by Kraus and Slawson (1939) in their[investigation of differential hardness in diamond](https://connect.ubc.ca/bbcswebdav/pid-2559832-dt-content-rid-10494223_1/courses/SIS.UBC.EOSC.118.99C.2014WC.44220/Course_Files/moduleB/lesson09/download/Kraus%20and%20Slawson%201939%20-%20Variable%20Hardness%20in%20Diamond.pdf). The lines projecting out from the form are the crystallographic axes. The planes marked by the letter 'd' are the dodecahedral form, those marked with 'o' are the octahedral form, and those marked with 'h' are the hexahedral (ie., cube) form. All are external forms of the isometric crystal system. The arrows are indicative of the relative hardness for diamond, with longer arrows meaning a harder plane (ie, harder to erode but therefore better for polishing) - the cube (h) faces are the easiest to polish and the tables of cut diamonds are usually paralell with this plane.

Diamond octahedron, as exhibited at the [UBC Pacific Museum of the Earth](http://www.eos.ubc.ca/resources/museum/).

Diamond macle with a thin tabular shape, as exhibited at the [UBC Pacific Museum of the Earth](http://www.eos.ubc.ca/resources/museum/).

Twinned diamond octahedron. Photo courtesy of the [Gemological Institute of America](http://www.gia.edu/).

The temperature at which a diamond grows has been shown to be a strong determining factor on diamond morphology, with higher temperatures yielding octahedral shapes. The shape of diamonds is also affected by the saturation conditions diamond grows in. Under supersaturated conditions (i.e., being more highly concentrated in solution than normally possible) diamond grow too fast resulting in cloudy crystals or fibre-like overgrowths.

Secondary modifications usually occur during two distinct phases in a diamond's life. The first is after growth but during transport to the Earth's surface by kimberlite magmas (we'll talk about kimberlite rock later). Modifications here typically include corrosion of diamonds along preferential weaknesses that are prone to chemical attack (this is analogous to someone preferentially digging in soft sand instead of on a concrete sidewalk). The second phase is during transport while on the Earth's surface. This is primarily the result of abrasion during river or alluvial transport.

This Canadian diamond grew initially as a unincluded (clean) crystal but later growth periods resulted in a murky low quality outer core. Dirty diamonds, called bort, are often used to impregnate the diamond discs that faceters use.

Corrosive modifications during transport (or sometimes in an original unstable growth environment) give rise to rounded edges of primary crystal growths (which are usually octahedrons). The end product is a diamond with strongly rounded features almost approaching the shape of a beach ball. Sometimes there will be multiple growth and corrosion events in a diamond crystal's history, which can lead to highly complex and intricate shapes.

An octahedral diamond like this one would have been slightly resorbed (corroded) during magmatic transport but could not have endured mechanical abrasion during alluvial transport since it is still encased in rock. Exhibited at the [UBC Pacific Museum of the Earth](http://www.eos.ubc.ca/resources/museum/).

Modifications during transport of diamonds in alluvial settings are minor when compared to modifications during magmatic transport. The most common alterations result from processes on the Earth's surface (mainly mechanical abrasion) and are manifested as scratched surfaces on the diamond or as abraded crystal edges. Because of the good durability and high hardness of diamonds, it can take many millions of years to significantly abrade a diamond from processes on the Earth's surface. Often, a particular diamond bearing pipe or sets of similar pipes will show similar diamond morphologies - this has been used in some cases to try and track the origin of 'uknown' diamonds back to their source.

Yellow diamond (mounted on epoxy puck) showing strong resorption features. Exhibited at the [UBC Pacific Museum of the Earth](http://www.eos.ubc.ca/resources/museum/).

Yellow tinted diamond with resorption and stepped growth features. Exhibited at the[UBC Pacific Museum of the Earth](http://www.eos.ubc.ca/resources/museum/).

Secondary shapes through increasing degrees of magmatic resorption. From left to right: 1) sharp edged primary octahedron (100% mass preserved); 2) octahedron with dodecahedral faces; 3) rounded dodecahedron with residual octahedral faces; 4) rounded dodecahedron (less than 55% of original mass preserved).