

Mineral and aquamarine essay



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Aquamarine: Aquamarine is an earth mineral in the beryl family. The word aquamarine is derived from latin and literally means water of the sea, or seawater. It was named by the Romans over 2000 years ago for its color which is varying shades of blue-green, like that of the ocean. Aquamarine is the birthstone of march and is said to be a good luck charm for scorpios.

Beryl Basics 1: Aquamarine is a member of the beryl family.

So I'll start by giving you some basic information on beryls. A beryl is a class of earth mineral with the basic formula $\text{Be}_3\text{Al}_2(\text{Si}_6\text{O}_{18})$. Its chemical name is beryllium aluminum silicate. A few commonly known beryls are emeralds, heliodors and of course aquamarines. Aquamarine Basics: As I said before, an aquamarine crystal is a member of the beryl family so it has the same basic chemical formula as beryl but differs from other beryls in that it also contains iron as an impurity. Specifically, this iron is in a 2+ oxidation state.

This Fe^{2+} cation causes aquamarine to have the blue-green appearance that it does. A pure beryl is clear and colorless so this proves that this impurity is the only factor determining the color. Heliodor, another beryl also contains Iron as the sole impurity but because the iron is in a different oxidation state, the 3+ oxidation state, it appears yellow. The unpaired d-electrons of the Fe^{2+} have an energy level that corresponds to this blue green color but those of Fe^{3+} have a different energy level that corresponds to the yellowish color of heliodor. This all relates back to the relationship between d-electron energy level and the absorbance wavelength that we learned about when studying coordination compounds such as those used as pigments.

The multi-colored stone seen on the slide is an example of a beryl that is a mixture of both aquamarine and heliodor and contains a mixture of iron in its 2+ and 3+ oxidation states. In order to convert the stone to aquamarine, the gem can be heated. This causes the Fe^{3+} to convert to Fe^{2+} and the color of the stone will turn totally blue. Heat treatment is done to many gems to alter the color. Most aquamarines are treated in this way to bring them to the desired shade of blue.

Aquamarine Crystallography 1: Aquamarine, is a silicate. The silicates are by far the largest group of minerals. Minerals composed of molecules containing varying amounts of silicon and oxygen and one or more metals are silicates. The construction component of all silicates is the tetrahedron, which is one oxygen atom equidimensionally placed around four silicon atoms.

These tetrahedrons, when combined with other molecules or tetrahedrons form the silicate minerals. The types of silicates are classified based on the interactive formation of the tetrahedrons. Each group of silicates has a set ratio of silicon and oxygen, although in some minerals the silicon atoms are replaced by other atoms. **Aquamarine Crystallography 2:** Aquamarine can be further classified as a cyclosilicate. A cyclosilicate is one of a group of silicate minerals that have their tetrahedrons linked into rings.

Each silicon atom is bound by two oxygen atoms that are part of another tetrahedron. Each ring consists of three, four, or six linked tetrahedrons. In the case of aquamarine, its six linked tetrahedrons. **Aquamarine**

Crystallography 3: Aquamarine has a hexagonal crystallography and has a strong tendency to be prismatic.

This slide showcases an aquamarine's crystal that exhibits both of these traits. Since the mineral is hexagonal, it has four axes, three of which are equal in length and lie at an angle of 120° from each other. The fourth is either longer or shorter but must be at a right angle toward the other corners. In the image shown on the slide, the fourth axis is longer than the others but this need not be so, it could very well have been shorter.

Aquamarine Properties 1: This slide outlines some of the basic properties of aquamarine. It is a 7.

5 - 8.0 on the Mohs hardness scale which is a scale of 1 to 10 where a 10 is the hardest, an example of which would be a diamond. Aquamarine, therefore is it is pretty hard and tough mineral but can sometimes be brittle. Aquamarine is also has a vitreous luster. The luster of a mineral is defined as the character of the light reflected by minerals which constitutes one of the means for distinguishing them. There are several different types of luster: Metallic - metals Adamantine - diamonds Vitreous - broken glass Resinous - yellow resin Eliolite - silky pearl Aquamarine Properties 2: Aquamarine has some very interesting qualities that cause it to stand out from other gems.

One such quality is its chatoyancy. Chatoyancy, coined from the French term meaning cats eye, is defined as an optical phenomenon, possessed by certain minerals in reflected light, in which a movable wavy or silky sheen is concentrated in a narrow band of light that changes its position as a mineral is turned. It results from the reflection of light from minute, parallel fibers, cavities or tubes, or needlelike inclusions within the mineral. The effect may be seen on a cabochon-cut gemstone.

Aquamarines cut into cabochons exhibit chatoyancy. A cabochon, which is discussed later, is defined as a gem without facets that is highly polished and has smooth, rounded edges. Another such reflective quality of aquamarine in the cabochon form is very similar to chatoyancy and is called asterism.

Asterism is defined as starlike rays of light observed in some minerals when viewed from certain directions, particularly if the mineral is cut as a cabochon. Yet another distinct property of aquamarine is pleochroism.

Pleochroism is the result of selective absorption of different color components of light as they pass through a crystalline gem material. If a pleochroic gemstone is observed under different light sources, it may display remarkably different colors. Although the example that I have on the slide is actually tanzanite, it is a very good example of this quality. Geological Origin: Deposits of Aquamarine occur in many different geological environments. Probably the most common are the many pegmatites throughout the world which have produced gem quality beryl crystals of all sorts.

A pegmatite is a form of igneous rock consisting of extremely coarse granite resulting from the crystallization of magma rich in rare elements. The pegmatite districts of southern California, Colorado, Brazil, Madagascar, and Pakistan are just a few of the classic areas which produce aquamarine. Aquamarine may also be found in miarolitic cavities within granite. Examples of such occurrences can be found in Mt. Antero, Colorado which is famous for aquamarine and the Ural Mountains of Siberia. Unlike pegmatites which form after the host rock has solidified, miarolitic cavities form during the same period that the host rock itself solidifies.

Miarolitic is a term applied to small irregular cavities in igneous rocks into which small crystals of the rock-forming minerals protrude. Aquamarine has also been discovered in rock formations which are of volcanic origin. These lava flows form an extrusive, igneous environment. The rhyolites of western Utah and a small area of New Mexico are the only known examples. A rhyolite is a light-colored crystalline or black glassy volcanic rock or magma, containing more than 68 percent silica.

Lastly, aquamarine may be found in certain metamorphic environments. These deposits of schist often contain emerald and aquamarines and are the product of granitic intrusions on one side and silica-poor rocks on the other. The basic elements which form the beryl come from the intruding granitic stock, but pass into the adjacent, silica-poor rock formations where they crystallize. Some of the most notable occurrences of this type of beryl deposit occur in Egypt, Africa, Austria, and the Ural Mountains.

However, most of the largest and finest aquamarines are from Brazil. The largest known aquamarine crystal was unearthed by David Mussi in the Papamel mine near Marambaia in 1910. Imagine being able to see an object distinctly through the completely transparent length of a 19 by 16 inch hexagonal gemstone prism weighing 520, 000 carats which is approximately 243 pounds! It is said that you could read a newspaper through the gem.

Aquamarine Mining: The image most people have of gem mining is of very large, mechanized, efficient operations, primarily of diamond mines. This is mostly true only for the production of diamonds.

Colored gemstone mining especially that in Africa is very different however. The vast majority of the colored gemstone production is produced by small scale miners, often using only picks, chisels, hammers and shovels. Many of these small scale miners are “ illegal” (unlicensed) and often mine until their food runs out or the mining becomes too difficult. I thought that was worth mentioning because it was definitely a misconception that I had about gem mining. Practical uses of Aquamarine: Aquamarine is basically only used cosmetically and has no real practical applications.

Although beryls in general used sometimes to harvest beryllium, this is not something specific to aquamarine. However, as a semi-precious gemstone, aquamarine is very versatile. The main reason for Aquamarine’s incredible versatility is it’s indistinct cleavage. Cleavage is defined as the property or tendency of a rock to split along secondary, aligned fractures or other closely spaced planes or textures. The fact that its cleavage is indistinct means is that it can basically be cut any way desired. Various Cuts: This slide showcases just a few of the many ways that Aquamarine can be cut.

The last cut on this slide is the aforementioned cabochon. As you can see, the cabochon has no facets and is a highly polished.