

# Quartz

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## Quartz

Quartz is the commonest mineral found on earth. It occurs in an amazing variety of forms. In the world of gem stones, quartz also supplies more different varieties than any other mineral. Chemically, it is simply the oxide of the element silicon, and its chemical formula is  $SiO_2$ . Gem quartzes can roughly be divided into three main groups: (1) crystallized quartz, (2) compact quartz, and (3) cryptocrystalline quartz'.

The first group comprises transparent crystals that show definite crystal forms. Perhaps the best known of these is the clear and transparent rock crystal, which consists of pure crystalline silica. Incidentally, the word "crystal" originates from the Greek word *krystallos*, meaning ice, for the ancient Greeks thought that these transparent rock crystals were in fact frozen water turned into stone. Today, the main sources of rock crystal are Brazil and Madagascar, but there are also many minor sources widely distributed all over the world. Crystals of brownish color known as cairngorm are also found in the Scottish mountains.

Amethyst, another of the crystallized quartzes, ranges from a lilac shade to a dark, rich purple, and, for many centuries, it has been held in high esteem as a gem of considerable beauty. Its name comes from the Greek and means "not drunk," since in ancient times it was thought that amethysts were a preventive against the effects of alcohol. It has been established to many people's satisfaction that the violet color comes from the combination of iron and irradiation. Amethysts are chiefly found in Brazil, Uruguay, Madagascar, and the Ural Mountains, although stones of inferior color are found in many parts of the world. Aggregates of small impure crystals are sometimes used as paper weights.

Citrine, the yellow form of quartz, may range in color from a pale yellow to a brownish red. It is valued as a gem stone, but is often confused with the much more valuable topaz and is even mistakenly called by that name.

Rose quartz, in delicate shades of pink, may also be classed as a crystal-line quartz although it rarely occurs in crystal shapes. It is normally found in massive lumps. The material is translucent and will allow light to pass through it, but it is usually not clear enough to be transparent. Rose quartz has become particularly popular as a medium for carved ornaments and can also be most attractive as beads worn as necklaces and other forms of jewelry. It is found in Brazil, Madagascar, and the United States.

One fine form of quartz, known as tiger eye, is much valued as a gem stone. It is particularly attractive as a ring stone of a brown, silky appearance. If cut cabochon, a single bright line of light will appear on its surface. This is caused by straight fibrous inclusions that run through the stone and can be likened to the ruby and sapphire star stones, in which the effect is produced by similar causes.

The second group, compact quartz, does not consist of large, individual crystals. The best-known form, jasper, consists essentially of an aggregate of tiny quartz grains packed together into massive lumps containing as much as 20 per cent of foreign matter in the form of clay and iron oxide. Even in thin sections this form of quartz is opaque, yet it occurs in many attractive shades such as brown, yellow, red, and green. Jasper is found in many parts of the world and is mostly an ornamental stone that, in ancient times, was much used in the art of engraving.

Aventurine is another of the compact quartzes. Usually green in shade, but on occasions brown and yellow, it contains a mass of tiny mica flakes that give the stone a speckled sheen. Richest sources lie in the Ural Mountains and eastern India. This form of quartz is sometimes most effectively imitated by forms of colored glass containing tiny copper flakes.

Finally come the large group of cryptocrystalline quartzes. Cryptocrystal-line means made up of hidden crystals, and this is indeed what they are. Cryptocrystalline quartzes consist of a mass of tiny quartz crystals that have formed together into large lumps and show no external crystal form, yet each of the component crystals that makes up the mass is a genuine crystal. These quartzes have been grouped under the general title of chalcedony. The most valuable of the group is one called chrysoprase. It has an apple-green color due to the presence of the metal nickel. Chrysoprase free from faults is rare and highly valued. Like most cryptocrystalline quartzes, it has always been much used for ornamental carved objects and also is an attractive stone for jewelry. Other varieties of chalcedony are: green spotted with red, called bloodstone; orange-red translucent, called carnelian; and deep brown translucent, known as sard.

Among the best-known forms of cryptocrystalline quartzes are the agates. Technically, they are really the same as chalcedony, already referred to, but formed in a special way that makes them attractive. They consist of chalcedony arranged in curved or circular bands. These are made up of various colors of different degrees of transparency. In ancient lava rocks, where the chalcedony was deposited, they were formed in almond-shaped holes. Sometimes, these cavities are not completely filled, and may be lined on the inside with some purple amethyst crystals.

Agates are mostly used for ornamental objects such as ash trays or umbrella handles, and much of this material now is artificially colored with some special dyes. The center of the agate-cutting industry is in Idar-Oberstein in Germany, but most of the agates used there have to be imported from Brazil since German sources have become exhausted.

There are a number of other banded varieties of quartz, one of them being onyx. Here, the bands run in straight lines and usually there is one layer of white adjacent to one layer of black. Such stones have been much used for cameo brooches, where the stones are so cut that a white picture is carved against a black background. Another form is the so-called sardonyx, where red and white bands alternate.

Finally, there is yet another strange, but exciting, form known as moss agate. It is white or gray in color with internal black or greenish markings resembling strange plants or little trees. An important source for it is India.

The industrial uses of quartz are numerous and important. As material for lenses, quartz can replace glass when superior hardness is called for to resist scratching and undue wear. Quartz is also more transparent to ultra-violet radiation than ordinary glass and can be used in specialized photographic equipment where lenses with such transparency are of importance.

When crystalline quartz is fused in an intensely hot oxyhydrogen flame, silica glass is formed. This differs in its physical properties from the crystalline variety in that it has a lower specific gravity and refractive index, and its hardness is reduced to 5 on Mohs' scale. It is singly refractive and thus unable to split light rays like the crystalline form. Its importance to science and industry lies in the fact that, unlike most other glasses, it can withstand sudden large temperature changes without risk of fracture. This allows it to be used extensively in the construction of crucibles and other laboratory apparatus.

Another important use of crystalline quartz lies in the field of radio broadcasting. It was discovered that physical pressure on a crystal slab induces opposite electrical charges on the opposite faces; the charges are reversed when the crystals are stretched. This phenomenon is known as piezoelectricity. Conversely, a thin crystal slab placed into an alternating electric field can be made to oscillate. During the last war these properties were developed extensively for use in radio apparatus to control the frequency of radio circuits. Thin plates are cut from untwinned pure quartz crystals and used as oscillator plates in the radio equipment. Supplies of suitable quartz for this purpose are derived mainly from Brazil, but much of this material is today produced synthetically.

Quartz sand is used extensively as an abrasive on sandpapers, in glass-making, and in scouring powder. It also forms an essential constituent of many materials used in the building industry.