Quartz SiO_2

Crystal Data: Hexagonal. *Point Group:* 32. As enantimorphic prismatic crystals, with $\{10\bar{1}0\}$ terminated by $\{10\bar{1}1\}$ and $\{01\bar{1}1\}$, striated $\perp$ [0001]; may be morphologically complex, with over 500 forms noted, to 6 m and 36 t. Pseudocubic or dipyramidal to tapering, needlelike, with trigonal outline; may be flattened, distorted, rarely "twisted." Parallel to divergent groups; drusy, fine-grained to microcrystalline ("chalcedony"), massive. *Twinning:* Very common, penetration twins on the Dauphiné law, about [0001], and the Brazil law, with $\{11\bar{2}0\}$ as contact plane; contact twins on the Japan law, with $\{11\bar{2}2\}$ as contact plane, may be repeated; and several other laws.

Physical Properties: *Cleavage:* Rarely observable, poor on $\{10\bar{1}1\}$, $\{01\bar{1}1\}$, $\{10\bar{1}0\}$, some others; rhombohedral parting. *Fracture:* Conchoidal. *Tenacity:* Brittle, tough when massive. Hardness = 7, variable by direction and form. D(meas.) = 2.65; 2.59–2.63 when massive. D(calc.) = 2.66 Piezoelectric and pyroelectric, may be triboluminescent.

Optical Properties: Transparent to nearly opaque. *Color:* Colorless, white; from chemical or particulate inclusions, rose-pink to rose-red, yellow to yellowish brown, green, blue, bluish violet, brown to black; zoned or mottled. *Streak:* White. *Luster:* Vitreous; waxy to dull when massive.
Optical Class: Uniaxial (+). $\omega = 1.544$ $\epsilon = 1.553$

Cell Data: *Space Group:* $P3_121$ or $P3_221$. a = 4.9135(4) c = 5.4050(2) Z = 3

X-ray Powder Pattern: Synthetic.
3.342 (100), 4.257 (22), 1.8179 (14), 1.5418 (9), 2.457 (8), 2.282 (8), 1.3718 (8)

Chemistry: SiO_2 with traces of other elements.

Polymorphism & Series: Cristobalite, tridymite, coesite, and stishovite are polymorphs; stable below 573 °C.

Occurrence: In hydrothermal veins, epithermal to alpine; characteristic of granites and granite pegmatites; in sandstones and quartzites, less abundant in other rock types; in hydrothermal metal deposits. Common in carbonate rocks; a residual mineral in soils and sediments.

Association: Calcite, fluorite, feldspars, epidote, chlorite, micas, zeolites, many other species.

Distribution: Extraordinarily common. Fine specimens from many places in the Alps of Switzerland and Austria. At Carrara, Tuscany, Italy. From Bourg d'Oisans, Isère, France. At Mursinka, Ural Mountains, in the Dodo mine, about 100 km west-northwest of Saranpaul, Subpolar Ural Mountains, and elsewhere in Russia. From Sakangyi, Katha district, Myanmar (Burma). Large twins from Yamanashi Prefecture and many other places in Japan. At Tamboholehehibe and elsewhere in Madagascar. From Brazil, in large amounts from many localities in Rio Grande do Sul, Minas Gerais, Goiás, and Bahia. Around Artigas, Uruguay. At Thunder Bay, Lake Superior, Ontario, Canada. In the USA, from Mt. Ida to Hot Springs, Ouachita Mountains, Arkansas; at Middleville, Herkimer Co., New York; in North Carolina, especially in Alexander and Lincoln Cos. From the Pala and Mesa Grande districts, San Diego Co., California; the El Capitan Mountains, Lincoln Co., New Mexico; the Crystal Park area, Beaverhead Co., and Little Pipestone Creek, Jefferson Co., Montana; and in the Pikes Peak area, El Paso Co., Colorado. From Mexico, in Veracruz and Guerrero.

Name: Of obscure origin in the Middle Ages, first applied to gangue in Saxony, Germany.

References: (1) Frondel, C. (1962) Dana's system of mineralogy, (7th edition), v. III, silica minerals, 9–250. (2) Le Page, Y. and G. Donnay (1976) Refinement of the crystal structure of low-quartz. Acta Cryst., 32, 2456–2459. (3) (1981) NBS Mono. 25, 18, 61.