

Name COPPER Native Element Chemical Composition Cu 2.5-3 Shiny, copper, red Metallic Cleavage None Fracture Hackly Density 8.94-8.95 g/cm<sup>3</sup> Mineral Habit Arborescent Crystal System Isometric Environment of Formation Most common in volcanic basalt rocks Economic Importance Copper alloys, electricity, U.S. pennies Other Properties Oxidizes to a green coloration Name DIAMOND Native Element Chemical Composition C 10 White Adamantine Cleavage Octahedral cleavage Fracture Conchoidal, Uneven Density 3.52 g/cm<sup>3</sup> Mineral Habit Octahedron Crystal System Cubic Environment of Formation About 90 to 120 miles underground, under conditions of extreme heat and pressure Economic Importance National revenue, jewelry Other Properties High thermal conductivity, high electrical resistance Name GOLD Native Element Chemical Composition Au 2.5-3 Golden-yellow Metallic Cleavage No Fracture Hackly Density 19.32 g/cm<sup>3</sup> Mineral Habit Varies, if it's gold it's probably gold or Pyrite. Crystal System Isometric Environment of Formation Hydrothermal deposits Economic Importance Safe-haven asset for economy, hedge against inflation, valuable Other Properties Resistant to tarnishing, high conductivity, high ductility Name GRAPHITE Native Element Chemical Composition C 1-2 Gray Metallic or Earthy Cleavage Perfect Basal Fracture Uneven Density 2.26 g/cm<sup>3</sup> Mineral Habit Flake, massive, vein forms Crystal System Hexagonal Environment of Formation Metamorphic and igneous settings Economic Importance Batteries, pencils Other Properties High electrical and thermal conductivity, lubricant Name SILVER Native element Chemical Composition Ag 2.5-3 Silver-white Metallic Cleavage No Fracture Hackly (jagged) Density 10.49 g/cm<sup>3</sup> Mineral Habit Massive, wire-like, and dendritic Crystal System Cubic (isometric) Environment of Formation Hydrothermal, magmatic, and sedimentary processes Economic Importance Used in renewable energy, technology, jewelry, hedge against inflation Other Properties Exceptional electrical and thermal conductivity, high reflectivity, malleability, and ductility Name SULFUR Native Element Chemical Composition S 1.5-2.5 Yellow Resinous to greasy Cleavage None Fracture Conchoidal Density 2.07 g/cm<sup>3</sup> Mineral Habit Massive, granular, crystallic Crystal System Orthorhombic Environment of Formation Near volcanoes and hot springs largely Economic Importance Production of sulfuric acid Other Properties Distinct smell 2.2 Sulfides: Name BORNITE Sulfide Chemical Composition Cu<sub>5</sub>FeS<sub>4</sub> 3-3.5 Brownish-black Metallic Cleavage None Fracture Subconchoidal Density 5.3 g/cm<sup>3</sup> Mineral Habit Massive to granular, sometimes crystalline Crystal System Orthorhombic Environment of Formation High- and low-temperature hydrothermal veins Economic Importance Important copper ore in some deposits, a source of copper in porphyry and hydrothermal systems Other Properties Often shows vivid iridescent tarnish Name CHALCOPYRITE Sulfide Chemical Composition CuFeS<sub>2</sub> 3.5-4 Greenish-black Metallic Cleavage None Fracture Uneven to Hackly Density 4.2 g/cm<sup>3</sup> Mineral Habit Massive, granular, disseminated Crystal System Tetragonal Environment of Formation Massive, granular, disseminated Economic Importance The primary ore of copper worldwide Other Properties Softer than gold Name GALENA Sulfide Chemical Composition PbS 2.5 Lead-gray Metallic Cleavage Cubic Fracture Subconchoidal to even Density 7.5 g/cm<sup>3</sup> Mineral Habit Cubic crystals, octahedral and combinations Crystal System Isometric Environment of Formation Hydrothermal veins, carbonate replacement deposits, Mississippi Valley-type (MVT) sulfide deposits, contact metamorphism Economic Importance Primary ore of lead Other Properties Soft and heavy Name PYRITE Sulfide Chemical Composition FeS<sub>2</sub> 6-6.5 Greenish/brownish black Metallic Cleavage None Fracture Conchoidal to uneven Density 5.1 g/cm<sup>3</sup> Mineral Habit Cubic crystals Crystal System Isometric

Environment of Formation Hydrothermal veins, sedimentary (rivers), quartz veins Economic Importance Commonly mistaken for gold. Other Properties Strikes produce sparks, commonly called Fool's Gold Name SPHALERITE Sulfide Chemical Composition  $(\text{Zn}, \text{Fe})\text{S}$  3.5-4 Yellow-brown to brown Resinous Cleavage Dodecahedral Fracture Conchoidal to uneven Density 4.0 g/cm<sup>3</sup> Mineral Habit Massive, granular, tetrahedral crystals Crystal System Isometric Environment of Formation Hydrothermal vein deposits, Mississippi Valley-type (MVT), Economic Importance Primary zinc ore, source of cadmium as well, important for industrial alloys Other Properties Color and vary with iron percentage, fluoresces SOMETIMES. Name STIBNITE Sulfide Chemical Composition  $\text{Sb}_2\text{S}_3$  2-2.5 Grayish-black Metallic Cleavage 1 direction Fracture Uneven to brittle Density g/cm<sup>3</sup> Mineral Habit Elongated prismatic, acicular, bladed, or fibrous crystals Crystal System Orthorhombic Environment of Formation Low-temperature hydrothermal veins, hot springs, and epithermal systems Economic Importance Used in flame retardants, alloys, good source of antimony. Other Properties Forms silky aggregates. 2.3 Oxides/Hydroxides: Name CORUNDUM Oxide/Hydroxide Chemical Composition  $\text{Al}_2\text{O}_3$  9 Colorless/white Vitreous to adamantine Cleavage None Fracture Conchoidal to uneven Density 4.0 g/cm<sup>3</sup> Mineral Habit Barrel-shaped, tabular, prismatic Crystal System Hexagonal Environment of Formation Metamorphic, igneous, placer deposits Economic Importance Abrasive, valuable in gemstones Other Properties Extremely hard, often red (ruby) or blue (sapphire) Name GEOTHITE/LIMONITE Oxide/Hydroxide Chemical Composition Goethite =  $\text{FeO(OH)}$  Limonite =  $\text{FeO(OH)} \cdot n\text{H}_2\text{O}$  (mix) 5-5.5 Yellowish-brown Dull to submetallic Cleavage None Fracture Earthy to uneven Density 4.0 g/cm<sup>3</sup> Mineral Habit Massive, botryoidal, stalactitic, fibrous Crystal System Orthorhombic Environment of Formation Weathering of iron-bearing minerals, bog iron deposits, gossans, low-temperature hydrothermal Economic Importance Iron ore Other Properties Forms earthy brown coatings Name HEMATITE Oxide/Hydroxide Chemical Composition  $\text{Fe}_2\text{O}_3$  6.0 Red to reddish-brown Metallic, submetallic, earthy Cleavage None Fracture Uneven to sub-conchoidal Density 4.0 g/cm<sup>3</sup> Mineral Habit Massive, botryoidal, micaceous, earthy, tabular Crystal System Trigonal Environment of Formation Banded iron formations, hydrothermal veins Economic Importance Iron ore Other Properties Always gives a red-brown Name MAGNETITE Oxide/Hydroxide Chemical Composition  $\text{Fe}_3\text{O}_4$  6.0 Black Metallic Cleavage None Fracture Subconchoidal to uneven Density 4.0 g/cm<sup>3</sup> Mineral Habit Granular, massive, octahedral crystals Crystal System Isometric Environment of Formation Banded iron formations, hydrothermal Economic Importance Iron ore, used in magnets and electronics Other Properties Highly magnetic Name PYROLUSITE Oxide/Hydroxide Chemical Composition  $\text{MnO}_2$  2-2.5 Black to bluish-black Submetallic to metallic Cleavage One direction Fracture Uneven Density 4.7 g/cm<sup>3</sup> Mineral Habit Fibrous, radiating, massive, granular Crystal System Tetragonal Environment of Formation Supergene manganese deposits, sedimentary manganese nodules, and hydrothermal veins Economic Importance Main ore of manganese Other Properties Very soft Name RUTILE Oxide/Hydroxide Chemical Composition  $\text{TiO}_2$  6-6.5 Pale brown Adamantine to metallic Cleavage Distinct in two directions Fracture Uneven to subconchoidal Density 4.2 g/cm<sup>3</sup> Mineral Habit Prismatic, acicular, needle-like, granular Crystal System Tetragonal Environment of Formation Metamorphic, igneous, and detrital in sediments Economic Importance Major ore of titanium Other Properties Often forms needle inclusions in quartz Name ZINCITE Oxide/Hydroxide Chemical Composition  $\text{ZnO}$  4-4.5 Yellow-orange Submetallic to resinous Cleavage Perfect in one direction Fracture Uneven to conchoidal

Density 5.65 g/cm<sup>3</sup> Mineral Habit Massive, granular Crystal System Hexagonal Environment of Formation Oxidized zinc deposits Economic Importance Minor zinc ore, fluorescent materials, pigments Other Properties Often bright red-orange, fluoresces strongly 2.4 Halides: Name FLUORITE Halides Chemical Composition CaF<sub>2</sub> 4 White Vitreous Cleavage Octahedral Fracture Subconchoidal to uneven Density 3.1 g/cm<sup>3</sup> Mineral Habit Cubic crystals, octahedra, massive, granular Crystal System Isometric Environment of Formation Hydrothermal veins, pegmatites, sedimentary replacement deposits, hot-spring veins Economic Importance Source of fluorine and fluorite Other Properties Occurs in many colors (purple, green, yellow, blue) Name HALITE Halides Chemical Composition NaCl 2-2.5 White Vitreous Cleavage Cubic Fracture Conchoidal when cleavage isn't visible Density 2.1 g/cm<sup>3</sup> Mineral Habit Cubic crystals, massive, granular, fibrous Crystal System Isometric Environment of Formation Evaporite deposits from saline lakes, seas, and evaporating basins Economic Importance SALTTTTTTT Other Properties Soluble in water 2.5 Carbonates: Name ARAGONITE Carbonate Chemical Composition CaCO<sub>3</sub> 3.5-4 White Vitreous to resinous Cleavage One direction (slightly) Fracture Subconchoidal to uneven Density 3.0 g/cm<sup>3</sup> Mineral Habit Acicular, fibrous, columnar, radiating, earthy Crystal System Orthorhombic Environment of Formation Marine shells, hot springs, caves, hydrothermal deposits Economic Importance Minor industrial use Other Properties Less stable than calcite Name AZURITE Carbonate Chemical Composition Cu<sub>3</sub>(CO<sub>3</sub>)<sub>2</sub>(OH)<sub>2</sub> 3.5-4 Light blue Vitreous Cleavage One direction (slightly) Fracture Conchoidal to uneven Density 3.8 g/cm<sup>3</sup> Mineral Habit Prismatic crystals Crystal System Monoclinic Environment of Formation Secondary copper deposits Economic Importance Minor copper ore Other Properties Deep blue color Name CALCITE Carbonate Chemical Composition CaCO<sub>3</sub> 3 White Vitreous Cleavage Rhombohedral Fracture Conchoidal Density 2.7 g/cm<sup>3</sup> Mineral Habit Rhombohedral crystals, scalenohedra, massive, fibrous, stalctitic Crystal System Hexagonal Environment of Formation Varies wildly Economic Importance Cement, lime, building stone Other Properties Reacts strongly with HCl Name DOLOMITE Carbonate Chemical Composition CaMg(CO<sub>3</sub>)<sub>2</sub> 3.5-4 White Vitreous to pearly Cleavage Rhombohedral Fracture Subconchoidal Density 2.8 g/cm<sup>3</sup> Mineral Habit Rhombohedral crystals, saddle-shaped crystals, massive Crystal System Trigonal Environment of Formation Diagenetic alteration of limestones ("dolomitization") Economic Importance Used in refractories, building stone, magnesium source Other Properties Slow reaction with HCl Name MALACHITE Carbonate Chemical Composition Cu<sub>2</sub>CO<sub>3</sub>(OH)<sub>2</sub> 3.5-4 Light green Vitreous to silky Cleavage One direction Fracture Splintery, uneven Density 3.9 g/cm<sup>3</sup> Mineral Habit Botryoidal, fibrous, banded, massive Crystal System Monoclinic Environment of Formation Oxidation zones of copper deposits Economic Importance Ornamental Other Properties Bright green, forms with azurite Name MAGNESITE Carbonate Chemical Composition MgCO<sub>3</sub> 3.5-4.5 White Vitreous to dull Cleavage One direction Fracture Conchoidal to uneven Density 3.1 g/cm<sup>3</sup> Mineral Habit Massive, granular, nodular Crystal System Trigonal Environment of Formation Alteration of ultramafic rocks (serpentinization), hydrothermal veins, sedimentary deposits Economic Importance Magnesium source, refractory bricks Other Properties Reacts slowly with HCl Name RHODOCHROSITE Carbonate Chemical Composition MnCO<sub>3</sub> 3.5-4 White Vitreous Cleavage Rhombohedral Fracture Conchoidal Density 3.6 g/cm<sup>3</sup> Mineral Habit Massive, banded, rhombohedral crystals, stalactitic Crystal System Trigonal Environment of Formation Hydrothermal veins, manganese-rich deposits, sedimentary Mn layers Economic Importance Ore of manganese, pretty Other Properties Pink

to rose-red, often banded, alters to brown Mn oxides Name SIDERITE Carbonate Chemical Composition FeCO<sub>3</sub> 3.5-4.5 White Vitreous to pearly Cleavage Rhombohedral Fracture Uneven Density 3.9 g/cm<sup>3</sup> Mineral Habit Rhombohedral crystals, massive, granular Crystal System Trigonal Environment of Formation Sedimentary iron formations, hydrothermal veins, diagenetic concretions Economic Importance Iron ore (minor) Other Properties Brown, tan, or yellowish. May alter to limonite 2.6 Sulfates: Name BARITE Sulfate Chemical Composition BaSO<sub>4</sub> 3-3.5 White Vitreous to resinous Cleavage 1 direction Fracture Uneven to subconchoidal Density 4.5 g/cm<sup>3</sup> Mineral Habit Tabular crystals, rosettes ("desert roses"), fibrous, granular, massive Crystal System Orthorhombic Environment of Formation Hydrothermal veins, sedimentary layers, residual deposits, with lead-zinc ores Economic Importance Primary ore of barium; used in drilling muds, paints, medical imaging Other Properties Heavy Name CELESTITE Sulfate Chemical Composition SrSO<sub>4</sub> 3-3.5 White Vitreous to pearly Cleavage 1 direction Fracture Uneven Density 4.0 g/cm<sup>3</sup> Mineral Habit Tabular, prismatic, fibrous, granular, massive Crystal System Orthorhombic Environment of Formation Sedimentary deposits (limestones, dolostones), evaporites, hydrothermal settings Economic Importance Source of strontium Other Properties Found in geodes, sky-blue, fluoresces under UV Part of: Gypsum Varieties Name GYPSUM (GENERAL) Sulfate Chemical Composition CaSO<sub>4</sub>·2H<sub>2</sub>O 2 White Vitreous to silky or pearly Cleavage Perfect in 1 direction Fracture Uneven to splintery Density 2.3 g/cm<sup>3</sup> Mineral Habit Massive, fibrous, bladed, tabular Crystal System Monoclinic Environment of Formation Evaporites, sedimentary basins, volcanic fumaroles, weathering of sulfides Economic Importance Plaster, drywall, cement retarder, soil conditioner Other Properties Very soft, easily scratched by fingernail Part of: Gypsum Varieties Name ALABASTER Sulfate Chemical Composition CaSO<sub>4</sub>·2H<sub>2</sub>O 2 White Dull to waxy Cleavage Obscured by fine grain Fracture Conchoidal to Density 2.3 g/cm<sup>3</sup> Mineral Habit Fine-grained massive gypsum Crystal System None Environment of Formation Evaporites, sedimentary basins, volcanic fumaroles, weathering of sulfides Economic Importance Extensively used for carving, sculpture, decorative objects, architectural inlay Other Properties Translucent in thin sections Part of: Gypsum Varieties Name SATIN SPAR Sulfate Chemical Composition CaSO<sub>4</sub>·2H<sub>2</sub>O 2 White Silky Cleavage Distinct, fibers easily split Fracture Splintery or fibrous Density 2.3 g/cm<sup>3</sup> Mineral Habit Fibrous bundles, parallel fibers, sometimes curved Crystal System Monoclinic Environment of Formation Low-temperature evaporite settings, forms from hydration of anhydrite, sedimentary Economic Importance Used decoratively for carvings, lamps, display pieces Other Properties Strong chatoyancy Part of: Gypsum Varieties Name SELENITE Sulfate Chemical Composition CaSO<sub>4</sub>·2H<sub>2</sub>O 2 White Vitreous to pearly Cleavage 1 direction Fracture Uneven Density 2.3 g/cm<sup>3</sup> Mineral Habit Transparent tabular crystals, blades, swallowtail twins, massive cleavable sheets Crystal System Monoclinic Environment of Formation Evaporite deposits, cave systems, sedimentary sulfate Economic Importance Used for decorative crystals, lamp materials, optical demonstrations, and educational geology samples Other Properties Very clear, easily scratched with a fingernail 2.7 Phosphates: Name TURQUOISE Phosphate Chemical Composition CuAl<sub>6</sub>(PO<sub>4</sub>)<sub>4</sub>(OH)<sub>8</sub>·4H<sub>2</sub>O 5-6 Bluish-white to greenish-white Waxy to subvitreous Cleavage None Fracture Conchoidal to uneven Density 2.7 g/cm<sup>3</sup> Mineral Habit Cryptocrystalline masses, nodules, vein fillings Crystal System Triclinic Environment of Formation Secondary mineral in arid, oxidized zones of copper Economic Importance Ornamental gemstone Other Properties Porous, can darken from skin oils, commonly in jewelry

Name APATITE GROUP Phosphate Chemical Composition  $\text{Ca}_5(\text{PO}_4)_3(\text{F},\text{Cl},\text{OH})$  5 White  
Vitreous to subresinous Cleavage None Fracture Uneven to conchoidal Density 3.2 g/cm<sup>3</sup>  
Mineral Habit Hexagonal prisms, massive, granular Crystal System Hexagonal Environment of Formation Igneous rocks, metamorphic rocks, hydrothermal veins, sedimentary phosphorites Economic Importance Major source of phosphate for fertilizers Other Properties Often green, blue, or brown Name FLUORAPATITE Phosphate Chemical Composition  $\text{Ca}_5(\text{PO}_4)_3\text{F}$  5 White  
Vitreous Cleavage None Fracture Conchoidal to uneven Density 3.2 g/cm<sup>3</sup> Mineral Habit Hexagonal prisms, granular, massive Crystal System Hexagonal Environment of Formation Igneous rocks (especially pegmatites), metamorphic rocks, sedimentary deposits Economic Importance Fertilizer production, constituent of tooth enamel Other Properties Commonly green or blue, may fluoresce Name PYROMORPHITE Phosphate Chemical Composition  $\text{Pb}_5(\text{PO}_4)_3\text{Cl}$  3.5-4 White to yellowish Resinous to subadamantine Cleavage None Fracture Brittle, uneven Density 6.8 g/cm<sup>3</sup> Mineral Habit Barrel-shaped hexagonal prisms, botryoidal masses Crystal System Hexagonal Environment of Formation Secondary mineral in oxidized zones of lead deposits Economic Importance Minor ore of lead, collector material Other Properties Bright green, yellow, orange, or brown, forms well defined crystals Name FLUORAPATITE Phosphate Chemical Composition  $\text{Ca}_5(\text{PO}_4)_3\text{F}$  5 White  
Vitreous Cleavage None Fracture Conchoidal to uneven Density 3.2 g/cm<sup>3</sup> Mineral Habit Hexagonal prisms, granular, massive Crystal System Hexagonal Environment of Formation Igneous rocks (especially pegmatites), metamorphic rocks, sedimentary deposits Economic Importance Fertilizer production, constituent of tooth enamel Other Properties Commonly green or blue, may fluoresce Name VANADINITE Phosphate Chemical Composition  $\text{Pb}_5(\text{VO}_4)_3\text{Cl}$  3 Yellow to light brown Resinous to subadamantine Cleavage None Fracture Brittle, uneven Density 6.8 g/cm<sup>3</sup> Mineral Habit Hexagonal prisms, short barrel-like crystals, crusts Crystal System Hexagonal Environment of Formation Oxidized zones of lead ores in arid environments Economic Importance Ore of vanadium Other Properties Typically bright red or orange, sharp crystals 2.8 Silicates: Part of: Amphibole Group Name ACTINOLITE Silicate Chemical Composition  $\text{Ca}_2(\text{Mg},\text{Fe})_5\text{Si}_8\text{O}_{22}(\text{OH})_2$  5-6 White to gray Vitreous to silky Cleavage Amphibole (2 directions) Fracture Uneven to splintery Density 3.2 g/cm<sup>3</sup> Mineral Habit Prismatic, fibrous, columnar Crystal System Monoclinic Environment of Formation Metamorphism of mafic rocks (regional), skarns, contact metamorphism Economic Importance Minor, asbestos was used Other Properties Green to dark green, may be fibrous Part of: Amphibole Group Name HORNBLENDE Silicate Chemical Composition  $(\text{Ca},\text{Na})_2\text{-}3(\text{Mg},\text{Fe},\text{Al})_5(\text{Si},\text{Al})_8\text{O}_{22}$  5-6 Gray to white Vitreous to dull Cleavage Amphibole (2 directions) Fracture Uneven to splintery Density 3.1 g/cm<sup>3</sup> Mineral Habit Prismatic crystals, elongated Crystal System Monoclinic Environment of Formation Igneous (intermediate to mafic), metamorphic (amphibolites) Economic Importance Igneous (intermediate to mafic), metamorphic (amphibolites) Other Properties Dark green to black Part of: Amphibole Group Name TREMOLITE Silicate Chemical Composition  $\text{Ca}_2\text{Mg}_5\text{Si}_8\text{O}_{22}(\text{OH})_2$  5-6 White Vitreous to silky Cleavage 2 direction Fracture Uneven to splintery Density 3.0 g/cm<sup>3</sup> Mineral Habit Prismatic, fibrous, or massive Crystal System Monoclinic Environment of Formation Metamorphism of ultramafic rocks, skarns Economic Importance ASBESTOS Other Properties Usually white to gray-green Part of: Other Silicates Name APOPHYLLITE Silicate Chemical Composition  $\text{KCa}_4\text{Si}_8\text{O}_{20}(\text{F},\text{OH}) \cdot 8\text{H}_2\text{O}$  4.5-5 White  
Vitreous to pearly Cleavage One direction Fracture Uneven to conchoidal Density 2.3 g/cm<sup>3</sup>

Mineral Habit Tabular to prismatic crystals Crystal System Tetragonal Environment of Formation Cavities in basalts, zeolite-bearing hydrothermal cavities, pegmatitic vugs Economic Importance Collector specimen Other Properties Often transparent Part of: Other Silicates Name BERYL Silicate Chemical Composition  $\text{Be}_3\text{Al}_2\text{Si}_6\text{O}_{18}$  7.5-8 White Vitreous Cleavage 1 direction Fracture Conchoidal to uneven Density 2.7 g/cm<sup>3</sup> Mineral Habit Hexagonal prismatic crystals, often elongated and well-formed Crystal System Hexagonal Environment of Formation Pegmatites, hydrothermal veins, mica schists Economic Importance Gemstones Other Properties Large hexagonal prisms Part of: Other Silicates Name CHRYSOCOLLA Silicate Chemical Composition  $(\text{Cu},\text{Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4 \cdot n\text{H}_2\text{O}$  2-4 Light blue-green to white Vitreous to dull, waxy Cleavage None Fracture Conchoidal to uneven Density 2.0 g/cm<sup>3</sup> Mineral Habit Botryoidal, massive, crusts Crystal System Amorphous to microcrystalline Environment of Formation Secondary copper oxidation zones, near-surface weathering of copper deposits Economic Importance Minor copper ore, ornamental and gem material Other Properties Blue-green color Part of: Other Silicates Name DIOPTASE Silicate Chemical Composition  $\text{CuSiO}_3 \cdot \text{H}_2\text{O}$  5 Green Adamantine to vitreous Cleavage 1 direction Fracture Conchoidal to uneven Density 3.4 g/cm<sup>3</sup> Mineral Habit Prismatic to short prismatic crystals Crystal System Trigonal Environment of Formation Oxidized zones of Cu deposits, silica-rich zones of oxidized copper sulfides Economic Importance Collector gem specimen Other Properties Intense emerald-green color, fragile crystals Part of: Other Silicates Name EPIDOTE Silicate Chemical Composition  $\text{Ca}_2(\text{Al},\text{Fe})_3(\text{SiO}_4)_3(\text{OH})$  6-7 White to gray Vitreous to resinous Cleavage None Fracture Vitreous to resinous Density 3.4 g/cm<sup>3</sup> Mineral Habit Prismatic, elongate crystals Crystal System Monoclinic Environment of Formation Metamorphic (regional, contact), hydrothermal veins, altered igneous rocks Economic Importance Minor value in collections Other Properties Pistachio-green common Part of: Feldspar Group Name ALBITE Silicate Chemical Composition  $\text{NaAlSi}_3\text{O}_8$  6-6.5 White Vitreous to pearly on cleavage surfaces Cleavage Two directions at 90° Fracture Uneven to conchoidal Density 2.61 g/cm<sup>3</sup> Mineral Habit Tabular, blocky crystals, cleavable masses Crystal System Triclinic Environment of Formation Igneous (granites, syenites, pegmatites), metamorphic, hydrothermal Economic Importance Major rock-forming mineral, ceramics, glass Other Properties Commonly displays albite twinning Part of: Feldspar Group Name LABRADORITE Silicate Chemical Composition  $(\text{Ca},\text{Na})(\text{Al},\text{Si})_4\text{O}_8$  6-6.5 White Vitreous, displays labradorescence Cleavage Two directions at 90° Fracture Uneven to conchoidal Density 2.70 g/cm<sup>3</sup> Mineral Habit Tabular crystals, often labradorescent surfaces in polished slabs Crystal System Triclinic Environment of Formation Igneous (gabbro, basalt, anorthosite), metamorphic Economic Importance Decorative stone Other Properties Spectacular iridescent schiller from lamellar twinning Part of: Feldspar Group Name AMAZONITE Silicate Chemical Composition  $\text{KAlSi}_3\text{O}_8$  6-6.5 White Vitreous to pearly Cleavage Two directions at 90° Fracture Uneven to conchoidal Density 2.58 g/cm<sup>3</sup> Mineral Habit Blocky crystals, masses Crystal System Triclinic, Monoclinic Environment of Formation Pegmatites, granites, alkali igneous rocks Economic Importance Gem/ornamental stone Other Properties Blue-green color due to lead and water in structure Part of: Feldspar Group Name ORTHOCLASE Silicate Chemical Composition  $\text{KAlSi}_3\text{O}_8$  6-6.5 White Vitreous to pearly Cleavage Two directions at 90° Fracture Uneven to conchoidal Density 2.56 g/cm<sup>3</sup> Mineral Habit Tabular crystals, perthitic intergrowths Crystal System Orthoclase (monoclinic), microcline (triclinic) Environment of Formation Igneous (granite, syenite), pegmatites, metamorphic

Economic Importance Ceramics, glass, gemstone Other Properties Microcline shows grid twinning Part of: Garnet Group Name ALMANDINE Silicate Chemical Composition  $\text{Fe}_3\text{Al}_2\text{Si}_3\text{O}_{12}$  7-7.5 White Vitreous to resinous Cleavage None Fracture Conchoidal to uneven Density 4.1 g/cm<sup>3</sup> Mineral Habit Dodecahedral to trapezohedral crystals; granular masses Crystal System Isometric Environment of Formation Metamorphic (schists, gneisses), some igneous rocks, metamorphosed sediments Economic Importance Gemstone (garnet), abrasive material Other Properties Deep red to brown-red color common Part of: Garnet Group Name GROSSULAR Silicate Chemical Composition  $\text{Ca}_3\text{Al}_2\text{Si}_3\text{O}_{12}$  6.5-7.5 White Vitreous to resinous Cleavage None Fracture Conchoidal to uneven Density 3.7 g/cm<sup>3</sup> Mineral Habit Dodecahedral crystals, granular Crystal System Isometric Environment of Formation Contact metamorphism of limestones (skarn), metamorphosed carbonate rocks Economic Importance Gemstone (hessonite, tsavorite), collector mineral Other Properties Colors range from green to orange Part of: Mica Group Name BIOTITE Silicate Chemical Composition  $\text{K}(\text{Mg},\text{Fe})_3\text{AlSi}_3\text{O}_{10}(\text{OH})_2$  2.5-3 White to gray Pearly to vitreous Cleavage Perfect basal cleavage Fracture Flexible, elastic flakes Density 2.8 g/cm<sup>3</sup> Mineral Habit Micaceous flakes, books, scaly masses Crystal System Monoclinic Environment of Formation Igneous (granites, pegmatites), metamorphic (schists) Economic Importance sometimes in insulating materials historically Other Properties Commonly forms sheets Part of: Mica Group Name LEPIDOLITE Silicate Chemical Composition  $\text{K}(\text{Li},\text{Al})_3(\text{Al},\text{Si})_4\text{O}_{10}(\text{F},\text{OH})_2$  2.5-3 White Vitreous to pearly Cleavage Perfect basal cleavage Fracture Uneven Density 2.9 g/cm<sup>3</sup> Mineral Habit Micaceous plates, scaly aggregates Crystal System Monoclinic Environment of Formation Lithium-bearing pegmatites, granitic pegmatites Economic Importance Source of lithium Other Properties Often associated with spodumene Part of: Other Silicates Name KAO LINITE Silicate Chemical Composition  $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$  2-2.5 White Earthy to dull Cleavage One direction Fracture Earthy Density 2.6 g/cm<sup>3</sup> Mineral Habit Clayey, fine-grained masses, earthy coatings Crystal System Triclinic Environment of Formation Weathering of aluminosilicate minerals, hydrothermal alteration, soils, kaolin deposits Economic Importance Ceramics, paper coatings, pharmaceuticals, cosmetics, refractory uses Other Properties Soft, white, plastic when wet Part of: Other Silicates Name KYANITE Silicate Chemical Composition  $\text{Al}_2\text{SiO}_5$  4.5-7 White Vitreous to pearly Cleavage 1 direction Fracture Splintery to uneven Density 3.60 g/cm<sup>3</sup> Mineral Habit Bladed, columnar crystals, fibrous aggregates Crystal System Triclinic Environment of Formation High-pressure regional metamorphism of pelitic rocks; in metamorphic schists and gneisses Economic Importance Refractory, porcelain, foundry, high-temperature ceramics Other Properties Strongly anisotropic Part of: Other Silicates Name OLIVINE Silicate Chemical Composition  $(\text{Mg},\text{Fe})_2\text{SiO}_4$  6.5-7 Colorless Vitreous to greasy Cleavage None Fracture Conchoidal to uneven Density 3.8 g/cm<sup>3</sup> Mineral Habit Granular, stubby prismatic crystals, massive in peridotite Crystal System Orthorhombic Environment of Formation Mantle-derived rocks (peridotite), mafic/ultramafic igneous rocks, basaltic lavas, xenoliths Economic Importance Gem-quality olivine = peridot Other Properties Olive-green color, weathers to iddingsite Part of: Mica Group Name MUSCOVITE Silicate Chemical Composition  $\text{KAl}_2(\text{AlSi}_3\text{O}_{10})(\text{OH})_2$  2-2.5 White Pearly to vitreous Cleavage 1 direction Fracture Flexible, elastic thin plates Density 2.80 g/cm<sup>3</sup> Mineral Habit Flaky sheets, books, scaly aggregates Crystal System Monoclinic Environment of Formation Igneous (pegmatites, granites), metamorphic rocks, hydrothermal veins Economic Importance Heat-resistant insulating materials, electrical insulators (historically), lubricant in

some forms Other Properties Colorless to silvery, splits into very thin transparent sheets Part of: Other Silicates Name PREHNITE Silicate Chemical Composition  $\text{Ca}_2\text{Al}_2\text{Si}_3\text{O}_{10}(\text{OH})_2$  6-6.5 White Vitreous to pearly Cleavage Uneven to poor Fracture Uneven to conchoidal Density 2.9 g/cm<sup>3</sup> Mineral Habit Botryoidal, globular, stalactitic crusts, radiating aggregates Crystal System Orthorhombic Environment of Formation Low-grade metamorphism, hydrothermal veins, basalt cavities (amygdales) Economic Importance Collectors Other Properties Pale green to yellow-green Part of: Pyroxene Group Name AUGITE Silicate Chemical Composition  $(\text{Ca},\text{Na})(\text{Mg},\text{Fe},\text{Al})(\text{Si},\text{Al})_2\text{O}_6$  5-6 White to gray Vitreous to dull Cleavage Two directions at ~87° and 93° Fracture Uneven to conchoidal Density 3.4 g/cm<sup>3</sup> Mineral Habit Short prismatic crystals, stubby prisms, granular Crystal System Monoclinic Environment of Formation Igneous (gabbro, basalt), metamorphic (high-temperature) Economic Importance Major rock-forming mineral Other Properties Dark green to black Part of: Pyroxene Group Name RHODONITE Silicate Chemical Composition  $(\text{Mn},\text{Fe},\text{Mg},\text{Ca})\text{SiO}_3$  5.5-6.5 White to pale pink Vitreous to pearly Cleavage Distinct in two directions Fracture Uneven to conchoidal Density 3.6 g/cm<sup>3</sup> Mineral Habit Massive, granular, tabular crystals Crystal System Triclinic Environment of Formation Contact metamorphism of Mn-rich sediments, hydrothermal deposits Economic Importance Ornamental/gemstone (cabochons), minor ore of manganese Other Properties Pink to rose-red color Part of: Pyroxene Group Name SPODUMENE Silicate Chemical Composition  $\text{LiAlSi}_2\text{O}_6$  6.5-7 White Vitreous to pearly Cleavage Two good cleavages Fracture Uneven to conchoidal Density 3.1 g/cm<sup>3</sup> Mineral Habit Prismatic, elongated crystals in pegmatites Crystal System Monoclinic Environment of Formation Lithium-rich pegmatites, greisens Economic Importance Major source of lithium Other Properties Color varies by impurity Part of: Quartz Varieties Name AVENTURINE Silicate Chemical Composition  $\text{SiO}_2$  w/ mica impurities 7 White Vitreous, sparkly Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Massive, cryptocrystalline to macrocrystalline quartz with inclusions Crystal System Trigonal Environment of Formation Veins, metamorphic and igneous rocks where quartz forms with inclusions Economic Importance Ornamental/gemstone Other Properties Sparkly effect due to plate-like inclusions (typically mica or hematite) Part of: Quartz Varieties Name AGATE Silicate Chemical Composition  $\text{SiO}_2$  (microcrystalline) 6.5-7 White Waxy to vitreous Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Botryoidal, banded, nodular, stalactitic; fills cavities as agate bands Crystal System Trigonal Environment of Formation Volcanic cavities (geodes), silica-rich hydrothermal veins Economic Importance Gem/ornamental Other Properties Banded patterns diagnostic Part of: Quartz Varieties Name AMETHYST Silicate Chemical Composition  $\text{SiO}_2$  ( $\text{Fe}^{3+}$  impurities and irradiation cause purple color) 7 White Vitreous Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Prismatic crystals, druses, geodes Crystal System Trigonal Environment of Formation Hydrothermal veins, cavities in volcanic rocks, geodes Economic Importance Gemstone Other Properties Purple color varies with iron content and irradiation Part of: Quartz Varieties Name CITRINE Silicate Chemical Composition  $\text{SiO}_2$  (Fe impurities, heat-treated amethyst often) 7 White Vitreous Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Prismatic crystals, druses Crystal System Trigonal Environment of Formation Hydrothermal, volcanic cavities; many commercial citrines are heat-treated amethyst Economic Importance Gemstone Other Properties Part of: Quartz Varieties Name JASPER Silicate Chemical Composition  $\text{SiO}_2$  (with impurities) 6.5-7 White Dull to vitreous Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Massive, opaque, often

brecciated or banded Crystal System Trigonal Environment of Formation Sedimentary/volcanic silica deposition, hydrothermal silicification Economic Importance Ornamental, carving stone Other Properties Opaque and often richly colored/patterned Part of: Quartz Varieties Name MILKY QUARTZ Silicate Chemical Composition SiO<sub>2</sub> (w/ microscopic fluid inclusions causing milky appearance) 7 White Vitreous to waxy Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Massive, crystalline Crystal System Trigonal Environment of Formation Common Economic Importance Industrial quartz, ornamental uses Other Properties White and translucent due to microscopic inclusions Part of: Quartz Varieties Name OPAL Silicate Chemical Composition SiO<sub>2</sub>·nH<sub>2</sub>O 5.5-6.5 White Vitreous to waxy Cleavage None Fracture Conchoidal Density 2.2 g/cm<sup>3</sup> Mineral Habit Massive, botryoidal, nodular, hydrous fillings in host Crystal System Amorphous Environment of Formation Low-temperature silica deposition in sediments, weathering zones, geothermal areas Economic Importance Gemstone Other Properties Precious opal shows play-of-color, fragile and sensitive to heat/dehydration Part of: Quartz Varieties Name ROCK CRYSTAL Silicate Chemical Composition SiO<sub>2</sub> 7 White Vitreous Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Transparent prismatic crystals, druses, massive Crystal System Trigonal Environment of Formation Hydrothermal veins, igneous rocks, metamorphic rocks Economic Importance Gem, optical uses, electronics (pure quartz) Other Properties Used in precision instruments when high purity Part of: Quartz Varieties Name ROSE QUARTZ Silicate Chemical Composition SiO<sub>2</sub> (trace Ti, Mn, or microscopic inclusions cause pink color) 7 White Vitreous to greasy Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Massive, rarely well-formed crystals Crystal System Trigonal Environment of Formation Pegmatites, hydrothermal Economic Importance Ornamental/gemstone Other Properties Pink color Part of: Quartz Varieties Name SMOKY QUARTZ Silicate Chemical Composition SiO<sub>2</sub> (Al + radiation cause smoky color) 7 White Vitreous Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Prismatic crystals, druses, masses Crystal System Trigonal Environment of Formation Hydrothermal, pegmatites, high-temperature quartz vein, often irradiated natural radiation exposure Economic Importance Gem/ornamental Other Properties Brown to black in color Part of: Quartz Varieties Name TIGER'S EYE Silicate Chemical Composition SiO<sub>2</sub> with fine fibrous asbestos/amphibole 6.5-7 White Silky chatoyant Cleavage None Fracture Conchoidal to uneven Density 2.65 g/cm<sup>3</sup> Mineral Habit Fibrous, chatoyant bands in massive quartz Crystal System Trigonal Environment of Formation Metamorphic replacement of amphibole by silica under low-grade metamorphism Economic Importance Ornamental/gemstone Other Properties Golden-brown chatoyancy Part of: Other Silicates Name SODALITE Silicate Chemical Composition Na<sub>8</sub>(Al<sub>6</sub>Si<sub>6</sub>O<sub>24</sub>)Cl<sub>2</sub> 5.5-6 White Vitreous to greasy Cleavage None Fracture Conchoidal to uneven Density 2.3 g/cm<sup>3</sup> Mineral Habit Massive, dodecahedral crystals rare, compact granular masses Crystal System Isometric Environment of Formation Undersaturated igneous rocks (nepheline syenites), pegmatites, contact metamorphics Economic Importance Ornamental stone Other Properties Often blue; may fluoresce orange under UV Part of: Other Silicates Name STAUROLITE Silicate Chemical Composition Fe<sub>2+</sub>2Al<sub>9</sub>Si<sub>4</sub>O<sub>23</sub>(OH) 7-7.5 White to gray Adamantine to resinous Cleavage Poor to indistinct Fracture Uneven Density 3.7 g/cm<sup>3</sup> Mineral Habit Prismatic to tabular crystals Crystal System Monoclinic Environment of Formation Regional metamorphism of pelitic rocks Economic Importance None really Other Properties Brown to reddish-brown, common as twinned crosses Part of: Other Silicates Name STILBITE Silicate Chemical

Composition  $\text{NaCa}_4(\text{Si}_{27}\text{Al}_9)\text{O}_{72}\cdot28\text{H}_2\text{O}$  3.5-4 White Vitreous to pearly Cleavage Perfect in one direction Fracture Uneven to conchoidal Density 2.1 g/cm<sup>3</sup> Mineral Habit Sheaf-like, radiating blades, tabular crystals, crusts in cavities Crystal System Monoclinic Environment of Formation Low-temperature hydrothermal veins, cavities in basalts Economic Importance None really Other Properties Often pinkish to colorless, forms attractive radiating aggregates Part of: Other Silicates Name TALC Silicate Chemical Composition  $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$  1 White Pearly to greasy Cleavage 1 direction Fracture Uneven to sectile Density 2.7 g/cm<sup>3</sup> Mineral Habit Massive, foliated, platy Crystal System Monoclinic Environment of Formation Metamorphism of ultramafic rocks (talc schist), hydrothermal alteration of Mg-rich rocks Economic Importance Major industrial mineral Other Properties Soapy feel, softest mineral Part of: Other Silicates Name TOPAZ Silicate Chemical Composition  $\text{Al}_2\text{SiO}_4(\text{F},\text{OH})_2$  8 White Vitreous to adamantine Cleavage 1 direction Fracture Subconchoidal to uneven Density 3.5 g/cm<sup>3</sup> Mineral Habit Prismatic, tabular crystals, well-formed terminated prisms common Crystal System Orthorhombic Environment of Formation Rhyolitic cavities, hydrothermal veins Economic Importance Gemstone Other Properties Color range from colorless to blue, yellow, pink Part of: Other Silicates Name TOURMALINE Silicate Chemical Composition Uhhhhhhhhh, many kinds 7-7.5 White Vitreous to resinous Cleavage None Fracture Uneven to conchoidal Density 3.1 g/cm<sup>3</sup> Mineral Habit Long prismatic, striated crystals, often vertically striated Crystal System Hexagonal Environment of Formation Pegmatites, metamorphic schists, hydrothermal veins Economic Importance Gemstone, piezoelectric Other Properties Wide color range Part of: Other Silicates Name WILLEMITE Silicate Chemical Composition  $\text{Zn}_2\text{SiO}_4$  5.5-6 White Vitreous to adamantine Cleavage Poor/indistinct Fracture Conchoidal to uneven Density 4.0 g/cm<sup>3</sup> Mineral Habit Granular, massive, prismatic crystals Crystal System Hexagonal Environment of Formation Oxidized zones of zinc deposits Economic Importance Minor zinc ore Other Properties Usually green, famous fluorescent specimens Part of: Other Silicates Name WOLLASTONITE Silicate Chemical Composition  $\text{CaSiO}_3$  4.5-5 White Vitreous to pearly Cleavage Good in two directions Fracture Uneven to splintery Density 2.9 g/cm<sup>3</sup> Mineral Habit Bladed, acicular, fibrous, radiating aggregates Crystal System Triclinic or monoclinic Environment of Formation Contact metamorphism of limestones (skarns), metamorphosed siliceous limestones Economic Importance Industrial mineral Other Properties White to gray Part of: Other Silicates Name ZIRCON Silicate Chemical Composition  $\text{ZrSiO}_4$  (often with Hf and U substitutions) 7.5 White Adamantine to vitreous Cleavage Poor/indistinct Fracture Conchoidal to uneven Density 4.6 g/cm<sup>3</sup> Mineral Habit Prismatic tetragonal crystals, bipyramidal terminations, detrital grains in sands Crystal System Tetragonal Environment of Formation Zircon in igneous (granites, syenites) and metamorphic rocks Economic Importance Source of zirconium and hafnium Other Properties Often strongly resistant to weathering 3. Rock Identification 3.1 Igneous: Name ANDESITE Igneous, Intermediate, Extrusive Mineral Composition Plagioclase feldspar, amphibole, pyroxene 6 White to gray Dull to vitreous on mineral grains Cleavage None Fracture Irregular, uneven Density 2.6 g/cm<sup>3</sup> Mineral Habit Fine-grained, sometimes porphyritic Texture Aphanitic or porphyritic Environment of Formation Convergent margins, volcanic arcs Economic Importance Source rock for construction aggregate Other Properties Common lava of stratovolcanoes Name BASALT Igneous, Mafic, Extrusive Mineral Composition Pyroxene, plagioclase, olivine 6 Gray Dull to slightly vitreous on crystals Cleavage None visible Fracture Conchoidal to uneven Density 2.9 g/cm<sup>3</sup> Mineral Habit

Fine-grained, massive Texture Aphanitic Environment of Formation Mid-ocean ridges, hotspots, flood basalts Economic Importance Crushed stone, road base, mineral wool Other Properties Often vesicular Name DIORITE Igneous, Intermediate, Intrusive Mineral Composition Plagioclase, amphibole, biotite 6 White Sub-vitreous on crystals Cleavage Cleavage present in amphibole Fracture Irregular Density 2.8 g/cm<sup>3</sup> Mineral Habit Coarse-grained, speckled black-and-white Texture Phaneritic Environment of Formation Underground hardened igneous flows Economic Importance Decorative stone, crushed rock Other Properties Intermediate between gabbro and granite Name GABBRO Igneous, Mafic, Intrusive Mineral Composition Pyroxene, plagioclase, sometimes olivine 6 White to gray Dull to sub-vitreous Cleavage Present within pyroxenes Fracture Blocky, uneven Density 3.0 g/cm<sup>3</sup> Mineral Habit Coarse-grained Texture Phaneritic Environment of Formation Oceanic crust, mafic intrusions Economic Importance Dimension stone, crushed aggregate Other Properties Dark-colored, heavy Name GRANITE Igneous, Felsic, Intrusive Mineral Composition Quartz, feldspar, mica 6-[REDACTED] (fine, 7) White Mostly vitreous Cleavage None Fracture Irregular Density 2.6 g/cm<sup>3</sup> Mineral Habit Coarse-grained, interlocking Texture Phaneritic Environment of Formation Continental underground hardened igneous flows Economic Importance Countertops, monuments, building Other Properties Highly resistant to weathering Name OBSIDIAN Igneous, Felsic, Extrusive Mineral Composition Amorphous silica-rich glass 5-5.5 Light gray Vitreous, glassy Cleavage None Fracture Conchoidal Density 2.4 g/cm<sup>3</sup> Mineral Habit Glassy, compact Texture Glassy Environment of Formation Rapid cooling of lava Economic Importance Historically a cutting tool, modern uses have it for decoration Other Properties Razor sharp edges Name PEGMATITE Igneous, Ultramafic, Intrusive Mineral Composition Olivine dominant, pyroxenes 6 White Vitreous Cleavage None Fracture Irregular Density 2.7 g/cm<sup>3</sup> Mineral Habit Coarse, granular Texture Pematitic Environment of Formation Late-stage magma crystallizing Economic Importance Source of gemstones, lithium, and rare metals Other Properties Huge crystals common Name PERIDOTITE Igneous, Felsic, Extrusive Mineral Composition Igneous, Ultramafic, Intrusive 6 Colorless/white Dull to slightly vitreous Cleavage None Fracture Uneven Density 3.3 g/cm<sup>3</sup> Mineral Habit Coarse, granular Texture Phaneritic Environment of Formation Upper mantle intrusions Economic Importance Source of diamonds and magnesium Other Properties Very dense and green toned Name PUMICE Igneous, Felsic, Extrusive Mineral Composition Silica-rich glass and microcrystals 6 White Dull Cleavage None Fracture Irregular Density 0.5 g/cm<sup>3</sup> Mineral Habit Frothy, vesicular Texture Highly vesicular Environment of Formation Explosive volcanic eruptions Economic Importance Abrasives, lightweight concrete Other Properties Very porous, extremely light, floats Name RHYOLITE Igneous, Felsic, Extrusive Mineral Composition Quartz, feldspar, mica 6 White Dull to slightly vitreous Cleavage None Fracture Conchoidal to uneven Density 2.4 g/cm<sup>3</sup> Mineral Habit Fine-grained, often banded Texture Aphantic or porphyritic Environment of Formation Contenental volcanic settings Economic Importance Minor aggregate use Other Properties Light colored volcanic equivalent of granite Name SCORIA Igneous, Mafic, Extrusive Mineral Composition Basaltic minerals 5-6 Gray Dull Cleavage None Fracture Irregular Density 1.5 g/cm<sup>3</sup> Mineral Habit Vesicular, cindery Texture Vesicular Environment of Formation Eruptions Economic Importance Landscaping stone Other Properties Dark, heavy vesicular lava Name SYENITE Igneous, Intermediate, Intrusive Mineral Composition Alkali feldspar, hornblende, biotite, a little quartz 6 White Vitreous Cleavage Feldspar cleavage Fracture Irregular Density 2.8 g/cm<sup>3</sup> Mineral Habit Coarse-grained

Texture Phaneritic Environment of Formation Alkaline intrusios Economic Importance  
Decorative stone Other Properties Quartz-poor granite analog Name TUFF Igneous,  
Pyroclastic, Extrusive Mineral Composition Volcanic ash fragments, pumice, crystals 3-6 White  
to gray Dull Cleavage None Fracture Crumbly to uneven Density 1.6 g/cm<sup>3</sup> Mineral Habit  
Fragmental Texture Pyroclastic Environment of Formation Explosive eruptions, ash fall or ash  
flow Economic Importance Building stone, lightweight materials Other Properties Often soft and  
porous Name TUFF BRECCIA Igneous, Pyroclastic, Extrusive Mineral Composition Angular  
volcanic fragments, ash matrix 3-6 Gray Dull Cleavage None Fracture Blocky, irregular Density  
2.0 g/cm<sup>3</sup> Mineral Habit Coarse pyroclastic Texture Brecciated Environment of Formation  
Violent eruptions producing large fragmented blocks Economic Importance Limited Other  
Properties Contains large angular clasts 3.2 Metamorphic: Name AMPHIBOLITE Metamorphic  
(Foliated) Mineral Composition Hornblende, plagioclase, with garnet and biotite 5-6 White to  
gray Subvitreous to dull Cleavage Not really, but kinda 56°/124° Fracture Splintery, uneven  
Density 3.1 g/cm<sup>3</sup> Mineral Habit Bladed amphibole crystals, massive Texture Medium to  
coarse-grained, schistose or banded Environment of Formation Regional metamorphism of  
basaltic Economic Importance Crushed stone Other Properties Dark-colored, high amphibole  
content gives green-black appearance Name GNEISS Metamorphic (Foliated, banded) Mineral  
Composition Feldspar, quartz, mica, may include hornblende or garnet 6 White Vitreous to  
pearly Cleavage Poor Fracture Irregular, uneven Density 2.7 g/cm<sup>3</sup> Mineral Habit Layered,  
banded Texture Coarse-grained Environment of Formation High-grade regional metamorphism  
Economic Importance Building stone Other Properties Alternating light/dark mineral bands  
Name MARBLE Metamorphic Mineral Composition Calcite or dolomite 3-4 White Vitreous to  
pearly Cleavage Perfect rhombohedral Fracture Subconchoidal Density 2.7 g/cm<sup>3</sup> Mineral Habit  
Interlocking carbonate grains Texture Medium to coarse crystalline Environment of Formation  
Contact or regional metamorphism of limestone Economic Importance Dimension stone,  
sculptures, building materials Other Properties Effervesces in acid, softer than quartz rich rocks  
Name PHYLITE Metamorphic Mineral Composition Fine mica, quartz, feldspar 1-3 White  
Satin-like sheen Cleavage Excellent slaty cleavage Fracture Uneven Density 2.7 g/cm<sup>3</sup> Mineral  
Habit Thin sheets Texture Fine-grained, glossy sheen Environment of Formation Low to medium  
grade regional metamorphism Economic Importance Limited, sometimes decorative stone Other  
Properties Shiny surface but finer than schist Name QUARTZITE Metamorphic Mineral  
Composition Quartz 7 White Vitreous Cleavage None, quartz grains Fracture Conchoidal  
Density 2.7 g/cm<sup>3</sup> Mineral Habit Massive, granular Texture Interlocking quartz grains, sugary  
Environment of Formation Metamorphism of quartz sandstone Economic Importance  
Construction aggregate, decorative stone Other Properties Very hard, breaks across grains Part  
of Schist Series Name SCHIST (GENERAL) Metamorphic Mineral Composition Micas  
dominate, quart, feldspar, garnet, and amphibole possible 3-5 White Sparkly Cleavage  
Schistosity Fracture Uneven Density 2.7 g/cm<sup>3</sup> Mineral Habit Platy, flaky Texture Medium to  
coarse grained Environment of Formation Medium to high-grade regional metamorphism of  
shale Economic Importance Decorative stone Other Properties Flaky layers Part of Schist  
Series Name GARNET SCHIST Metamorphic (foliated) Mineral Composition Mica + quartz +  
feldspar + garnet porphyroblasts 5-7 White Sparkly Cleavage Schistosity Fracture Uneven  
Density 2.7 g/cm<sup>3</sup> Mineral Habit Platy, flaky Texture Medium to coarse grained Environment of  
Formation Medium to high-grade regional metamorphism of shale Economic Importance

Decorative stone Other Properties Flaky layers Part of Schist Series Name MICA SCHIST Metamorphic (foliated) Mineral Composition Biotite or muscovite dominant 2.5-4 White Sparkly Cleavage Schistosity Fracture Uneven Density 2.7 g/cm<sup>3</sup> Mineral Habit Platy, flaky Texture Medium to coarse grained Environment of Formation Medium to high-grade regional metamorphism of shale Economic Importance Decorative stone Other Properties Flaky layers Part of Schist Series Name TALC SCHIST Metamorphic (foliated) Mineral Composition Serpentine group minerals 1 White Sparkly Cleavage Schistosity Fracture Uneven Density 2.7 g/cm<sup>3</sup> Mineral Habit Platy, flaky Texture Medium to coarse grained Environment of Formation Medium to high-grade regional metamorphism of shale Economic Importance Decorative stone Other Properties Flaky layers Name SERPENTINITE Metamorphic (nonfoliated) Mineral Composition Serpentine group minerals 2.5-4 White Greasy to waxy Cleavage Poor Fracture Splintery to conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Massive, fibrous Texture Smooth, scaly, or veined Environment of Formation Hydration of ultramafic rocks Economic Importance Asbestos source (chrysotile), decorative stone Other Properties Often green, slick feel Name SLATE Metamorphic (foliated) Mineral Composition Clay minerals 2.5-4 Gray Dull to slightly silky Cleavage Excellent slaty cleavage Fracture Flat, planar Density 2.7 g/cm<sup>3</sup> Mineral Habit Thin plates Texture Very fine-grained Environment of Formation Low-grade metamorphism of shale Economic Importance Roofing, chalkboards, tiles Other Properties Higher sound "ring" when struck compared to shale 3.3 Sedimentary: Name BANDED IRON FORMATION Sedimentary Mineral Composition Hematite, magnetite, chert, quartz 5-7 Red-brown (hematite bands), black (magnetite bands) Metallic to dull Cleavage None Fracture Uneven Density 4.2 g/cm<sup>3</sup> Mineral Habit Layered bands of iron oxides and chert Texture Laminated, banded Environment of Formation Marine, Precambrian oceans Economic Importance Iron ore source Other Properties Often very dense, alternating dark/light layers, resistant to weathering Name BAUXITE Sedimentary Mineral Composition Gibbsite, boehmite, diasporite, clay minerals 1-3 White to pale brown Earthy to dull Cleavage None Fracture Conchoidal to uneven Density 2.25 g/cm<sup>3</sup> Mineral Habit Massive, pisolithic, nodular Texture Porous, pisolithic Environment of Formation Lateritic soils in tropical climates, residual weathering of aluminum-rich rocks Economic Importance Primary ore of aluminum Other Properties Soft, powdery, often used as abrasive in industrial applications Name BRECCIA Sedimentary Mineral Composition Varies 3-7 Variable Dull to vitreous Cleavage None Fracture Irregular Density 2.4 g/cm<sup>3</sup> Mineral Habit Angular clasts in matrix Texture Clastic, coarse, poorly sorted Environment of Formation Alluvial fans, debris flows, fault zones, landslides Economic Importance Construction aggregate, decorative stone Other Properties Angular clasts distinguish it from conglomerate Name CHERT/FLINT Sedimentary Mineral Composition SiO<sub>2</sub> 7 White Waxy to dull Cleavage Very fine-grained, smooth Fracture Conchoidal Density 2.65 g/cm<sup>3</sup> Mineral Habit Massive, nodular, layered Texture Massive, nodular, layered Environment of Formation Deep marine chemical precipitation Economic Importance Flint tools, aggregate Other Properties Hard and brittle Name CONGLOMERATE Sedimentary Mineral Composition Rounded gravel-sized clasts of quartz, chert, or other rocks in sand 3-7 Variable Dull to sub-vitreous Cleavage None Fracture Irregular Density 2.6 g/cm<sup>3</sup> Mineral Habit Rounded clasts in matrix Texture Clastic, poorly to moderately Environment of Formation Riverbeds, alluvial fans, glacial outwash, beaches Economic Importance Construction aggregate, decorative stone Other Properties Rounded clasts distinguish from breccia Name DIATOMITE Sedimentary Mineral Composition Silica

( $\text{SiO}_2$ ) from diatom frustules 1-2 White Earthy, dull Cleavage None Fracture Brittle, uneven Density 1.0 g/cm<sup>3</sup> Mineral Habit Massive, soft, powdery Texture Very fine-grained, porous, siliceous Environment of Formation Freshwater/marine deposits, accumulation of diatom skeletons Economic Importance Filtration, abrasives, lightweight aggregates, insulation Other Properties Very light, high porosity, floats in water if dry Name DOLOSTONE Sedimentary Mineral Composition  $\text{CaMg}(\text{CO}_3)_2$  3.5-4.5 White Vitreous to dull Cleavage None Fracture Conchoidal to uneven Density 2.9 g/cm<sup>3</sup> Mineral Habit Massive, crystalline Texture Fine to Coarse Grained Environment of Formation Replacement of limestone (dolomitization), shallow marine Economic Importance Source of magnesium Other Properties Reacts with HCl, can form reservoirs for oil and gas Name ROCK SALT Sedimentary Mineral Composition NaCl 2-2.5 White Vitreous Cleavage Cubic Fracture Conchoidal Density 2.2 g/cm<sup>3</sup> Mineral Habit Massive, granular, cubic crystals Texture Coarse to fine crystalline Environment of Formation vaporite deposits from saline lakes or seas Economic Importance Salt production, chemical industry, de-icing Other Properties Soluble in water Name ROCK GYPSUM Sedimentary Mineral Composition  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  2 White Vitreous to silky Cleavage 1 direction Fracture Uneven Density 2.3 g/cm<sup>3</sup> Mineral Habit Massive, tabular crystals, fibrous Texture Fine to medium grain Environment of Formation Evaporite deposits in lakes, seas Economic Importance Plaster, drywall, fertilizer Other Properties Plaster, drywall, fertilizer Name SHALE Sedimentary Mineral Composition Clay minerals, quartz, feldspar, minor organics 3 Gray, brown, red Dull Cleavage Excellent fissility (splits into thin layers) Fracture Conchoidal to uneven Density 2.3 g/cm<sup>3</sup> Mineral Habit Laminated, fine-grained Texture Very fine-grained, laminated Environment of Formation Quiet water deposits (lakes, deep ocean, floodplains) Economic Importance Source rock for oil/gas Other Properties Splits easily along bedding planes, can contain fossils Name SILTSTONE Sedimentary Mineral Composition Quartz, feldspar, minor clay 3-4 Gray Dull to earthy Cleavage None Fracture Conchoidal to uneven Density 2.4 g/cm<sup>3</sup> Mineral Habit Massive, blocky, fine-grained Texture Finer than sandstone, coarser than shale Environment of Formation Rivers, deltas Economic Importance Aggregate Other Properties May split along bedding Part of: Coal Varieties Name ANTHRACITE Sedimentary Mineral Composition C 2.5-3 Black Submetallic, glossy Cleavage None Fracture Conchoidal Density 1.35 g/cm<sup>3</sup> Mineral Habit Massive, compact Texture Hard, dense, shiny Environment of Formation Metamorphosed peat in high-pressure settings Economic Importance Fuel, energy Other Properties Burns cleanly Part of: Coal Varieties Name BITUMINOUS Sedimentary Mineral Composition C 2-2.5 Black Dull to slightly shiny Cleavage None Fracture Conchoidal Density 1.25 g/cm<sup>3</sup> Mineral Habit Massive, layered Texture Soft, layered Environment of Formation Compacted peat under moderate pressure Economic Importance Fuel, energy Other Properties Produces soot and smoke Part of: Coal Varieties Name LIGNITE Sedimentary Mineral Composition C 1-2 Brownish-black Earthy, dull Cleavage None Fracture Uneven Density 1.2 g/cm<sup>3</sup> Mineral Habit Massive, soft Texture Woody or layered appearance Environment of Formation Compacted peat, shallow burial Economic Importance Fuel for power plants Other Properties High moisture content Part of: Limestone Varieties Name CHALK Sedimentary Mineral Composition CaCO<sub>3</sub> 1-2 White Earthy Cleavage None Fracture Conchoidal Density 2.3 g/cm<sup>3</sup> Mineral Habit Massive, fine-grained, porous Texture Soft, powdery Environment of Formation Deep marine, planktonic microfossils Economic Importance Cement, lime, agricultural soil conditioner Other Properties Reacts with HCl, very soft Part of: Limestone Varieties Name COQUINA Sedimentary

Mineral Composition CaCO<sub>3</sub> 3 White Dull to vitreous Cleavage None Fracture Uneven Density 2.3 g/cm<sup>3</sup> Mineral Habit Massive, shell-fragment cemented Texture Fossil-rich, coarse-grained Environment of Formation Shallow marine, high-energy beaches Economic Importance Construction stone Other Properties Easily crumbles, composed almost entirely of shells Part of: Limestone Varieties Name FOSSIL LIMESTONE Sedimentary Mineral Composition Calcite, fossil fragments 3 White Dull to vitreous Cleavage None Fracture Uneven Density 2.3 g/cm<sup>3</sup> Mineral Habit Massive, fossil-rich Texture Fossil fragments visible, coarse Environment of Formation Shallow marine environments Economic Importance Building stone, aggregate Other Properties Fossils preserved in rock Part of: Limestone Varieties Name OOLITIC LIMESTONE Sedimentary Mineral Composition Calcite oolites 3 White Dull to vitreous Cleavage None Fracture Uneven Density 2.3 g/cm<sup>3</sup> Mineral Habit Spherical ooids in cement Texture Oolitic (small orbs) Environment of Formation Warm, shallow, agitated marine water Economic Importance Building stone Other Properties Often used decoratively Part of: Limestone Varieties Name TRAVERTINE Sedimentary Mineral Composition Calcite, sometimes aragonite 3 White Dull to silky Cleavage None Fracture Uneven to conchoidal Density 2.5 g/cm<sup>3</sup> Mineral Habit Massive, banded, stalactitic Texture Porous, fibrous Environment of Formation Hot springs, caves Economic Importance Building and decorative stone Other Properties Often banded, may be fossiliferous Part of: Sandstone Varieties Name ARKOSE Sedimentary Mineral Composition Quartz, feldspar, minor mica 6 White Dull to vitreous Cleavage None Fracture Uneven Density 2.4 g/cm<sup>3</sup> Mineral Habit Clastic, coarse grained Texture Angular feldspar grains Environment of Formation Alluvial fans, rivers; rapid deposition Economic Importance Building stone Other Properties Pinkish color common due to feldspar Part of: Sandstone Varieties Name GREYWACKE Sedimentary Mineral Composition Quartz, feldspar, rock fragments, clay matrix 6 Gray Dull Cleavage None Fracture Conchoidal Density 2.5 g/cm<sup>3</sup> Mineral Habit Clastic, poorly sorted Texture Angular grains in clay matrix Environment of Formation Turbidites, submarine fans Economic Importance Aggregate, construction Other Properties Often dark, hard, and compact Part of: Sandstone Varieties Name QUARTZ SANDSTONE Sedimentary Mineral Composition >90% quartz 7 White Vitreous Cleavage None Fracture Conchoidal Density 2.65 g/cm<sup>3</sup> Mineral Habit Clastic, well sorted Texture Medium to coarsely grained Environment of Formation Beaches, dunes, rivers Economic Importance Construction, glass making Other Properties Very durable, resistant to weathering Native Element Chemical Composition Cu 2.5-3 Shiny, copper, red Metallic Cleavage None Fracture Hackly Density 8.94-8.95 g/cm<sup>3</sup> Mineral Habit Arborescent Crystal System Isometric Environment of Formation Most common in volcanic basalt rocks Economic Importance Copper alloys, electricity, U.S. pennies Other Properties Oxidizes to a green coloration Name DIAMOND Native Element Chemical Composition C 10 White Adamantine Cleavage Octahedral cleavage Fracture Conchoidal, Uneven Density 3.52 g/cm<sup>3</sup> Mineral Habit Octahedron Crystal System Cubic Environment of Formation About 90 to 120 miles underground, under conditions of extreme heat and pressure Economic Importance National revenue, jewelry Other Properties High thermal conductivity, high electrical resistance Name GOLD Native Element Chemical Composition Au 2.5-3 Golden-yellow Metallic Cleavage No Fracture Hackly Density 19.32 g/cm<sup>3</sup> Mineral Habit Varies, if it's gold it's probably gold or Pyrite. Crystal System Isometric Environment of Formation Hydrothermal deposits Economic Importance Safe-haven asset for economy, hedge against inflation, valuable Other Properties Resistant to tarnishing, high conductivity, high ductility Name

GRAPHITE Native Element Chemical Composition C 1-2 Gray Metallic or Earthy Cleavage Perfect Basal Fracture Uneven Density 2.26 g/cm<sup>3</sup> Mineral Habit Flake, massive, vein forms Crystal System Hexagonal Environment of Formation Metamorphic and igneous settings Economic Importance Batteries, pencils Other Properties High electrical and thermal conductivity, lubricant Name SILVER Native element Chemical Composition Ag 2.5-3 Silver-white Metallic Cleavage No Fracture Hackly (jagged) Density 10.49 g/cm<sup>3</sup> Mineral Habit Massive, wire-like, and dendritic Crystal System Cubic (isometric) Environment of Formation Hydrothermal, magmatic, and sedimentary processes Economic Importance Used in renewable energy, technology, jewelry, hedge against inflation Other Properties Exceptional electrical and thermal conductivity, high reflectivity, malleability, and ductility Name SULFUR Native Element Chemical Composition S 1.5-2.5 Yellow Resinous to greasy Cleavage None Fracture Conchoidal Density 2.07 g/cm<sup>3</sup> Mineral Habit Massive, granular, crystallic Crystal System Orthorhombic Environment of Formation Near volcanoes and hot springs largely Economic Importance Production of sulfuric acid Other Properties Distinct smell 2.2 Sulfides: Name BORNITE Sulfide Chemical Composition Cu<sub>5</sub>FeS<sub>4</sub> 3-3.5 Brownish-black Metallic Cleavage None Fracture Subconchoidal Density 5.3 g/cm<sup>3</sup> Mineral Habit Massive to granular, sometimes crystalline Crystal System Orthorhombic Environment of Formation High- and low-temperature hydrothermal veins Economic Importance Important copper ore in some deposits, a source of copper in porphyry and hydrothermal systems Other Properties Often shows vivid iridescent tarnish Name CHALCOPYRITE Sulfide Chemical Composition CuFeS<sub>2</sub> 3.5-4 Greenish-black Metallic Cleavage None Fracture Uneven to Hackly Density 4.2 g/cm<sup>3</sup> Mineral Habit Massive, granular, disseminated Crystal System Tetragonal Environment of Formation Massive, granular, disseminated Economic Importance The primary ore of copper worldwide Other Properties Softer than gold Name GALENA Sulfide Chemical Composition PbS 2.5 Lead-gray Metallic Cleavage Cubic Fracture Subconchoidal to even Density 7.5 g/cm<sup>3</sup> Mineral Habit Cubic crystals, octahedral and combinations Crystal System Isometric Environment of Formation Hydrothermal veins, carbonate replacement deposits, Mississippi Valley-type (MVT) sulfide deposits, contact metamorphism Economic Importance Primary ore of lead Other Properties Soft and heavy Name PYRITE Sulfide Chemical Composition FeS<sub>2</sub> 6-6.5 Greenish/brownish black Metallic Cleavage None Fracture Conchoidal to uneven Density 5.1 g/cm<sup>3</sup> Mineral Habit Cubic crystals Crystal System Isometric Environment of Formation Hydrothermal veins, sedimentary (rivers), quartz veins Economic Importance Commonly mistaken for gold. Other Properties Strikes produce sparks, commonly called Fool's Gold Name SPHALERITE Sulfide Chemical Composition (Zn,Fe)S 3.5-4 Yellow-brown to brown Resinous Cleavage Dodecahedral Fracture Conchoidal to uneven Density 4.0 g/cm<sup>3</sup> Mineral Habit Massive, granular, tetrahedral crystals Crystal System Isometric Environment of Formation Hydrothermal vein deposits, Mississippi Valley-type (MVT), Economic Importance Primary zinc ore, source of cadmium as well, important for industrial alloys Other Properties Color and vary with iron percentage, fluoresces SOMETIMES. Name STIBNITE Sulfide Chemical Composition Sb<sub>2</sub>S<sub>3</sub> 2-2.5 Grayish-black Metallic Cleavage 1 direction Fracture Uneven to brittle Density g/cm<sup>3</sup> Mineral Habit Elongated prismatic, acicular, bladed, or fibrous crystals Crystal System Orthorhombic Environment of Formation Low-temperature hydrothermal veins, hot springs, and epithermal systems Economic Importance Used in flame retardants, alloys, good source of antimony. Other Properties Forms silky aggregates. 2.3 Oxides/Hydroxides: Name CORUNDUM Oxide/Hydroxide Chemical

Composition Al<sub>2</sub>O<sub>3</sub> 9 Colorless/white Vitreous to adamantine Cleavage None Fracture Conchoidal to uneven Density 4.0 g/cm<sup>3</sup> Mineral Habit Barrel-shaped, tabular, prismatic Crystal System Hexagonal Environment of Formation Metamorphic, igneous, placer deposits Economic Importance Abrasive, valuable in gemstones Other Properties Extremely hard, often red (ruby) or blue (sapphire) Name GEOTHITE/LIMONITE Oxide/Hydroxide Chemical Composition Goethite = FeO(OH) Limonite = FeO(OH)·nH<sub>2</sub>O (mix) 5-5.5 Yellowish-brown Dull to submetallic Cleavage None Fracture Earthy to uneven Density 4.0 g/cm<sup>3</sup> Mineral Habit Massive, botryoidal, stalactitic, fibrous Crystal System Orthorhombic Environment of Formation Weathering of iron-bearing minerals, bog iron deposits, gossans, low-temperature hydrothermal Economic Importance Iron ore Other Properties Forms earthy brown coatings Name HEMATITE Oxide/Hydroxide Chemical Composition Fe<sub>2</sub>O<sub>3</sub> 6.0 Red to reddish-brown Metallic, submetallic, earthy Cleavage None Fracture Uneven to sub-conchoidal Density 4.0 g/cm<sup>3</sup> Mineral Habit Massive, botryoidal, micaceous, earthy, tabular Crystal System Trigonal Environment of Formation Banded iron formations, hydrothermal veins Economic Importance Iron ore Other Properties Always gives a red-brown Name MAGNETITE Oxide/Hydroxide Chemical Composition Fe<sub>3</sub>O<sub>4</sub> 6.0 Black Metallic Cleavage None Fracture Subconchoidal to uneven Density 4.0 g/cm<sup>3</sup> Mineral Habit Granular, massive, octahedral crystals Crystal System Isometric Environment of Formation Banded iron formations, hydrothermal Economic Importance Iron ore, used in magnets and electronics Other Properties Highly magnetic Name PYROLUSITE Oxide/Hydroxide Chemical Composition MnO<sub>2</sub> 2-2.5 Black to bluish-black Submetallic to metallic Cleavage One direction Fracture Uneven Density 4.7 g/cm<sup>3</sup> Mineral Habit Fibrous, radiating, massive, granular Crystal System Tetragonal Environment of Formation Supergene manganese deposits, sedimentary manganese nodules, and hydrothermal veins Economic Importance Main ore of manganese Other Properties Very soft Name RUTILE Oxide/Hydroxide Chemical Composition TiO<sub>2</sub> 6-6.5 Pale brown Adamantine to metallic Cleavage Distinct in two directions Fracture Uneven to subconchoidal Density 4.2 g/cm<sup>3</sup> Mineral Habit Prismatic, acicular, needle-like, granular Crystal System Tetragonal Environment of Formation Metamorphic, igneous, and detrital in sediments Economic Importance Major ore of titanium Other Properties Often forms needle inclusions in quartz Name ZINCITE Oxide/Hydroxide Chemical Composition ZnO 4-4.5 Yellow-orange Submetallic to resinous Cleavage Perfect in one direction Fracture Uneven to conchoidal Density 5.65 g/cm<sup>3</sup> Mineral Habit Massive, granular Crystal System Hexagonal Environment of Formation Oxidized zinc deposits Economic Importance Minor zinc ore, fluorescent materials, pigments Other Properties Often bright red-orange, fluoresces strongly 2.4 Halides: Name FLUORITE Halides Chemical Composition CaF<sub>2</sub> 4 White Vitreous Cleavage Octahedral Fracture Subconchoidal to uneven Density 3.1 g/cm<sup>3</sup> Mineral Habit Cubic crystals, octahedra, massive, granular Crystal System Isometric Environment of Formation Hydrothermal veins, pegmatites, sedimentary replacement deposits, hot-spring veins Economic Importance Source of fluorine and fluorite Other Properties Occurs in many colors (purple, green, yellow, blue) Name HALITE Halides Chemical Composition NaCl 2-2.5 White Vitreous Cleavage Cubic Fracture Conchoidal when cleavage isn't visible Density 2.1 g/cm<sup>3</sup> Mineral Habit Cubic crystals, massive, granular, fibrous Crystal System Isometric Environment of Formation Evaporite deposits from saline lakes, seas, and evaporating basins Economic Importance SALTTTTTTT Other Properties Soluble in water 2.5 Carbonates: Name ARAGONITE Carbonate Chemical Composition CaCO<sub>3</sub> 3.5-4 White Vitreous to resinous

Cleavage One direction (slightly) Fracture Subconchoidal to uneven Density 3.0 g/cm<sup>3</sup> Mineral Habit Acicular, fibrous, columnar, radiating, earthy Crystal System Orthorhombic Environment of Formation Marine shells, hot springs, caves, hydrothermal deposits Economic Importance Minor industrial use Other Properties Less stable than calcite Name AZURITE Carbonate Chemical Composition Cu<sub>3</sub>(CO<sub>3</sub>)<sub>2</sub>(OH)<sub>2</sub> 3.5-4 Light blue Vitreous Cleavage One direction (slightly) Fracture Conchoidal to uneven Density 3.8 g/cm<sup>3</sup> Mineral Habit Prismatic crystals Crystal System Monoclinic Environment of Formation Secondary copper deposits Economic Importance Minor copper ore Other Properties Deep blue color Name CALCITE Carbonate Chemical Composition CaCO<sub>3</sub> 3 White Vitreous Cleavage Rhombohedral Fracture Conchoidal Density 2.7 g/cm<sup>3</sup> Mineral Habit Rhombohedral crystals, scalenohedra, massive, fibrous, stalctitic Crystal System Hexagonal Environment of Formation Varies wildly Economic Importance Cement, lime, building stone Other Properties Reacts strongly with HCl Name DOLOMITE Carbonate Chemical Composition CaMg(CO<sub>3</sub>)<sub>2</sub> 3.5-4 White Vitreous to pearly Cleavage Rhombohedral Fracture Subchonchoidal Density 2.8 g/cm<sup>3</sup> Mineral Habit Rhombohedral crystals, saddle-shaped crystals, massive Crystal System Trigonal Environment of Formation Diagenetic alteration of limestones ("dolomitization") Economic Importance Used in refractories, building stone, magnesium source Other Properties Slow reaction with HCl Name MALACHITE Carbonate Chemical Composition Cu<sub>2</sub>CO<sub>3</sub>(OH)<sub>2</sub> 3.5-4 Light green Vitreous to silky Cleavage One direction Fracture Splintery, uneven Density 3.9 g/cm<sup>3</sup> Mineral Habit Botryoidal, fibrous, banded, massive Crystal System Monoclinic Environment of Formation Oxidation zones of copper deposits Economic Importance Ornamental Other Properties Bright green, forms with azurite Name MAGNESITE Carbonate Chemical Composition MgCO<sub>3</sub> 3.5-4.5 White Vitreous to dull Cleavage One direction Fracture Conchoidal to uneven Density 3.1 g/cm<sup>3</sup> Mineral Habit Massive, granular, nodular Crystal System Trigonal Environment of Formation Alteration of ultramafic rocks (serpentinization), hydrothermal veins, sedimentary deposits Economic Importance Magnesium source, refractory bricks Other Properties Reacts slowly with HCl Name RHODOCHROSITE Carbonate Chemical Composition MnCO<sub>3</sub> 3.5-4 White Vitreous Cleavage Rhombohedral Fracture Conchoidal Density 3.6 g/cm<sup>3</sup> Mineral Habit Massive, banded, rhombohedral crystals, stalactitic Crystal System Trigonal Environment of Formation Hydrothermal veins, manganese-rich deposits, sedimentary Mn layers Economic Importance Ore of manganese, pretty Other Properties Pink to rose-red, often banded, alters to brown Mn oxides Name SIDERITE Carbonate Chemical Composition FeCO<sub>3</sub> 3.5-4.5 White Vitreous to pearly Cleavage Rhombohedral Fracture Uneven Density 3.9 g/cm<sup>3</sup> Mineral Habit Rhombohedral crystals, massive, granular Crystal System Trigonal Environment of Formation Sedimentary iron formations, hydrothermal veins, diagenetic concretions Economic Importance Iron ore (minor) Other Properties Brown, tan, or yellowish. May alter to limonite 2.6 Sulfates: Name BARITE Sulfate Chemical Composition BaSO<sub>4</sub> 3-3.5 White Vitreous to resinous Cleavage 1 direction Fracture Uneven to subconchoidal Density 4.5 g/cm<sup>3</sup> Mineral Habit Tabular crystals, rosettes ("desert roses"), fibrous, granular, massive Crystal System Orthorhombic Environment of Formation Hydrothermal veins, sedimentary layers, residual deposits, with lead-zinc ores Economic Importance Primary ore of barium; used in drilling muds, paints, medical imaging Other Properties Heavy Name CELESTITE Sulfate Chemical Composition SrSO<sub>4</sub> 3-3.5 White Vitreous to pearly Cleavage 1 direction Fracture Uneven Density 4.0 g/cm<sup>3</sup> Mineral Habit Tabular, prismatic, fibrous, granular, massive Crystal System

Orthorhombic Environment of Formation Sedimentary deposits (limestones, dolostones), evaporites, hydrothermal settings Economic Importance Source of strontium Other Properties Found in geodes, sky-blue, fluoresces under UV Part of: Gypsum Varieties Name GYPSUM (GENERAL) Sulfate Chemical Composition  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  2 White Vitreous to silky or pearly Cleavage Perfect in 1 direction Fracture Uneven to splintery Density 2.3 g/cm<sup>3</sup> Mineral Habit Massive, fibrous, bladed, tabular Crystal System Monoclinic Environment of Formation Evaporites, sedimentary basins, volcanic fumaroles, weathering of sulfides Economic Importance Plaster, drywall, cement retarder, soil conditioner Other Properties Very soft, easily scratched by fingernail Part of: Gypsum Varieties Name ALABASTER Sulfate Chemical Composition  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  2 White Dull to waxy Cleavage Obscured by fine grain Fracture Conchoidal to Density 2.3 g/cm<sup>3</sup> Mineral Habit Fine-grained massive gypsum Crystal System None Environment of Formation Evaporites, sedimentary basins, volcanic fumaroles, weathering of sulfides Economic Importance Extensively used for carving, sculpture, decorative objects, architectural inlay Other Properties Translucent in thin sections Part of: Gypsum Varieties Name SATIN SPAR Sulfate Chemical Composition  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  2 White Silky Cleavage Distinct, fibers easily split Fracture Splintery or fibrous Density 2.3 g/cm<sup>3</sup> Mineral Habit Fibrous bundles, parallel fibers, sometimes curved Crystal System Monoclinic Environment of Formation Low-temperature evaporite settings, forms from hydration of anhydrite, sedimentary Economic Importance Used decoratively for carvings, lamps, display pieces Other Properties Strong chatoyancy Part of: Gypsum Varieties Name SELENITE Sulfate Chemical Composition  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  2 White Vitreous to pearly Cleavage 1 direction Fracture Uneven Density 2.3 g/cm<sup>3</sup> Mineral Habit Transparent tabular crystals, blades, swallowtail twins, massive cleavable sheets Crystal System Monoclinic Environment of Formation Evaporite deposits, cave systems, sedimentary sulfate Economic Importance Used for decorative crystals, lamp materials, optical demonstrations, and educational geology samples Other Properties Very clear, easily scratched with a fingernail 2.7 Phosphates: Name TURQUOISE Phosphate Chemical Composition  $\text{CuAl}_6(\text{PO}_4)_4(\text{OH})_8 \cdot 4\text{H}_2\text{O}$  5-6 Bluish-white to greenish-white Waxy to subvitreous Cleavage None Fracture Conchoidal to uneven Density 2.7 g/cm<sup>3</sup> Mineral Habit Cryptocrystalline masses, nodules, vein fillings Crystal System Triclinic Environment of Formation Secondary mineral in arid, oxidized zones of copper Economic Importance Ornamental gemstone Other Properties Porous, can darken from skin oils, commonly in jewelry Name APATITE GROUP Phosphate Chemical Composition  $\text{Ca}_5(\text{PO}_4)_3(\text{F},\text{Cl},\text{OH})$  5 White Vitreous to subresinous Cleavage None Fracture Uneven to conchoidal Density 3.2 g/cm<sup>3</sup> Mineral Habit Hexagonal prisms, massive, granular Crystal System Hexagonal Environment of Formation Igneous rocks, metamorphic rocks, hydrothermal veins, sedimentary phosphorites Economic Importance Major source of phosphate for fertilizers Other Properties Often green, blue, or brown Name FLUORAPATITE Phosphate Chemical Composition  $\text{Ca}_5(\text{PO}_4)_3\text{F}$  5 White Vitreous Cleavage None Fracture Conchoidal to uneven Density 3.2 g/cm<sup>3</sup> Mineral Habit Hexagonal prisms, granular, massive Crystal System Hexagonal Environment of Formation Igneous rocks (especially pegmatites), metamorphic rocks, sedimentary deposits Economic Importance Fertilizer production, constituent of tooth enamel Other Properties Commonly green or blue, may fluoresce Name PYROMORPHITE Phosphate Chemical Composition  $\text{Pb}_5(\text{PO}_4)_3\text{Cl}$  3.5-4 White to yellowish Resinous to subadamantine Cleavage None Fracture Brittle, uneven Density 6.8 g/cm<sup>3</sup> Mineral Habit Barrel-shaped hexagonal prisms, botryoidal

masses Crystal System Hexagonal Environment of Formation Secondary mineral in oxidized zones of lead deposits Economic Importance Minor ore of lead, collector material Other Properties Bright green, yellow, orange, or brown, forms well defined crystals Name FLUORAPATITE Phosphate Chemical Composition  $\text{Ca}_5(\text{PO}_4)_3\text{F}$  5 White Vitreous Cleavage None Fracture Conchoidal to uneven Density 3.2 g/cm<sup>3</sup> Mineral Habit Hexagonal prisms, granular, massive Crystal System Hexagonal Environment of Formation Igneous rocks (especially pegmatites), metamorphic rocks, sedimentary deposits Economic Importance Fertilizer production, constituent of tooth enamel Other Properties Commonly green or blue, may fluoresce Name VANADINITE Phosphate Chemical Composition  $\text{Pb}_5(\text{VO}_4)_3\text{Cl}$  3 Yellow to light brown Resinous to subadamantine Cleavage None Fracture Brittle, uneven Density 6.8 g/cm<sup>3</sup> Mineral Habit Hexagonal prisms, short barrel-like crystals, crusts Crystal System Hexagonal Environment of Formation Oxidized zones of lead ores in arid environments Economic Importance Ore of vanadium Other Properties Typically bright red or orange, sharp crystals 2.8 Silicates: Part of: Amphibole Group Name ACTINOLITE Silicate Chemical Composition  $\text{Ca}_2(\text{Mg},\text{Fe})_5\text{Si}_8\text{O}_{22}(\text{OH})_2$  5-6 White to gray Vitreous to silky Cleavage Amphibole (2 directions) Fracture Uneven to splintery Density 3.2 g/cm<sup>3</sup> Mineral Habit Prismatic, fibrous, columnar Crystal System Monoclinic Environment of Formation Metamorphism of mafic rocks (regional), skarns, contact metamorphism Economic Importance Minor, asbestos was used Other Properties Green to dark green, may be fibrous Part of: Amphibole Group Name HORNBLENDE Silicate Chemical Composition  $(\text{Ca},\text{Na})_2\text{-}3(\text{Mg},\text{Fe},\text{Al})_5(\text{Si},\text{Al})_8\text{O}_{22}$  5-6 Gray to white Vitreous to dull Cleavage Amphibole (2 directions) Fracture Uneven to splintery Density 3.1 g/cm<sup>3</sup> Mineral Habit Prismatic crystals, elongated Crystal System Monoclinic Environment of Formation Igneous (intermediate to mafic), metamorphic (amphibolites) Economic Importance Igneous (intermediate to mafic), metamorphic (amphibolites) Other Properties Dark green to black Part of: Amphibole Group Name TREMOLITE Silicate Chemical Composition  $\text{Ca}_2\text{Mg}_5\text{Si}_8\text{O}_{22}(\text{OH})_2$  5-6 White Vitreous to silky Cleavage 2 direction Fracture Uneven to splintery Density 3.0 g/cm<sup>3</sup> Mineral Habit Prismatic, fibrous, or massive Crystal System Monoclinic Environment of Formation Metamorphism of ultramafic rocks, skarns Economic Importance ASBESTOS Other Properties Usually white to gray-green Part of: Other Silicates Name APOPHYLLITE Silicate Chemical Composition  $\text{KCa}_4\text{Si}_8\text{O}_{20}(\text{F},\text{OH})\cdot 8\text{H}_2\text{O}$  4.5-5 White Vitreous to pearly Cleavage One direction Fracture Uneven to conchoidal Density 2.3 g/cm<sup>3</sup> Mineral Habit Tabular to prismatic crystals Crystal System Tetragonal Environment of Formation Cavities in basalts, zeolite-bearing hydrothermal cavities, pegmatitic vugs Economic Importance Collector specimen Other Properties Often transparent Part of: Other Silicates Name BERYL Silicate Chemical Composition  $\text{Be}_3\text{Al}_2\text{Si}_6\text{O}_{18}$  7.5-8 White Vitreous Cleavage 1 direction Fracture Conchoidal to uneven Density 2.7 g/cm<sup>3</sup> Mineral Habit Hexagonal prismatic crystals, often elongated and well-formed Crystal System Hexagonal Environment of Formation Pegmatites, hydrothermal veins, mica schists Economic Importance Gemstones Other Properties Large hexagonal prisms Part of: Other Silicates Name CHRYSOCOLLA Silicate Chemical Composition  $(\text{Cu},\text{Al})_2\text{H}_2\text{Si}_2\text{O}_5(\text{OH})_4\cdot n\text{H}_2\text{O}$  2-4 Light blue-green to white Vitreous to dull, waxy Cleavage None Fracture Conchoidal to uneven Density 2.0 g/cm<sup>3</sup> Mineral Habit Botryoidal, massive, crusts Crystal System Amorphous to microcrystalline Environment of Formation Secondary copper oxidation zones, near-surface weathering of copper deposits Economic Importance Minor copper ore, ornamental and gem material Other Properties

Blue-green color Part of: Other Silicates Name DIOPTASE Silicate Chemical Composition CuSiO<sub>3</sub>·H<sub>2</sub>O 5 Green Adamantine to vitreous Cleavage 1 direction Fracture Conchoidal to uneven Density 3.4 g/cm<sup>3</sup> Mineral Habit Prismatic to short prismatic crystals Crystal System Trigonal Environment of Formation Oxidized zones of Cu deposits, silica-rich zones of oxidized copper sulfides Economic Importance Collector gem specimen Other Properties Intense emerald-green color, fragile crystals Part of: Other Silicates Name EPIDOTE Silicate Chemical Composition Ca<sub>2</sub>(Al,Fe)<sub>3</sub>(SiO<sub>4</sub>)<sub>3</sub>(OH) 6-7 White to gray Vitreous to resinous Cleavage None Fracture Vitreous to resinous Density 3.4 g/cm<sup>3</sup> Mineral Habit Prismatic, elongate crystals Crystal System Monoclinic Environment of Formation Metamorphic (regional, contact), hydrothermal veins, altered igneous rocks Economic Importance Minor value in collections Other Properties Pistachio-green common Part of: Feldspar Group Name ALBITE Silicate Chemical Composition NaAlSi<sub>3</sub>O<sub>8</sub> 6-6.5 White Vitreous to pearly on cleavage surfaces Cleavage Two directions at 90° Fracture Uneven to conchoidal Density 2.61 g/cm<sup>3</sup> Mineral Habit Tabular, blocky crystals, cleavable masses Crystal System Triclinic Environment of Formation Igneous (granites, syenites, pegmatites), metamorphic, hydrothermal Economic Importance Major rock-forming mineral, ceramics, glass Other Properties Commonly displays albite twinning Part of: Feldspar Group Name LABRADORITE Silicate Chemical Composition (Ca,Na)(Al,Si)AlO<sub>8</sub> 6-6.5 White Vitreous, displays labradorescence Cleavage Two directions at 90° Fracture Uneven to conchoidal Density 2.70 g/cm<sup>3</sup> Mineral Habit Tabular crystals, often labradorescent surfaces in polished slabs Crystal System Triclinic Environment of Formation Igneous (gabbro, basalt, anorthosite), metamorphic Economic Importance Decorative stone Other Properties Spectacular iridescent schiller from lamellar twinning Part of: Feldspar Group Name AMAZONITE Silicate Chemical Composition KAISi<sub>3</sub>O<sub>8</sub> 6-6.5 White Vitreous to pearly Cleavage Two directions at 90° Fracture Uneven to conchoidal Density 2.58 g/cm<sup>3</sup> Mineral Habit Blocky crystals, masses Crystal System Triclinic, Monoclinic Environment of Formation Pegmatites, granites, alkali igneous rocks Economic Importance Gem/ornamental stone Other Properties Blue-green color due to lead and water in structure Part of: Feldspar Group Name ORTHOCLASE Silicate Chemical Composition KAISi<sub>3</sub>O<sub>8</sub> 6-6.5 White Vitreous to pearly Cleavage Two directions at 90° Fracture Uneven to conchoidal Density 2.56 g/cm<sup>3</sup> Mineral Habit Tabular crystals, perthitic intergrowths Crystal System Orthoclase (monoclinic), microcline (triclinic) Environment of Formation Igneous (granite, syenite), pegmatites, metamorphic Economic Importance Ceramics, glass, gemstone Other Properties Microcline shows grid twinning Part of: Garnet Group Name ALMANDINE Silicate Chemical Composition Fe<sub>3</sub>Al<sub>2</sub>Si<sub>3</sub>O<sub>12</sub> 7-7.5 White Vitreous to resinous Cleavage None Fracture Conchoidal to uneven Density 4.1 g/cm<sup>3</sup> Mineral Habit Dodecahedral to trapezohedral crystals; granular masses Crystal System Isometric Environment of Formation Metamorphic (schists, gneisses), some igneous rocks, metamorphosed sediments Economic Importance Gemstone (garnet), abrasive material Other Properties Deep red to brown-red color common Part of: Garnet Group Name GROSSULAR Silicate Chemical Composition Ca<sub>3</sub>Al<sub>2</sub>Si<sub>3</sub>O<sub>12</sub> 6.5-7.5 White Vitreous to resinous Cleavage None Fracture Conchoidal to uneven Density 3.7 g/cm<sup>3</sup> Mineral Habit Dodecahedral crystals, granular Crystal System Isometric Environment of Formation Contact metamorphism of limestones (skarn), metamorphosed carbonate rocks Economic Importance Gemstone (hessonite, tsavorite), collector mineral Other Properties Colors range from green to orange Part of: Mica Group Name BIOTITE Silicate Chemical Composition K(Mg,Fe)AlSi<sub>3</sub>O<sub>10</sub>(OH)2 2.5-3

White to gray Pearly to vitreous Cleavage Perfect basal cleavage Fracture Flexible, elastic flakes Density 2.8 g/cm<sup>3</sup> Mineral Habit Micaceous flakes, books, scaly masses Crystal System Monoclinic Environment of Formation Igneous (granites, pegmatites), metamorphic (schists) Economic Importance sometimes in insulating materials historically Other Properties Commonly forms sheets Part of: Mica Group Name LEPIDOLITE Silicate Chemical Composition K(Li,Al)<sub>3</sub>(Al,Si)4O<sub>10</sub>(F,OH)<sub>2</sub> 2.5-3 White Vitreous to pearly Cleavage Perfect basal cleavage Fracture Uneven Density 2.9 g/cm<sup>3</sup> Mineral Habit Micaceous plates, scaly aggregates Crystal System Monoclinic Environment of Formation Lithium-bearing pegmatites, granitic pegmatites Economic Importance Source of lithium Other Properties Often associated with spodumene Part of: Other Silicates Name KAO LINITE Silicate Chemical Composition Al<sub>2</sub>Si<sub>2</sub>O<sub>5</sub>(OH)<sub>4</sub> 2-2.5 White Earthy to dull Cleavage One direction Fracture Earthy Density 2.6 g/cm<sup>3</sup> Mineral Habit Clayey, fine-grained masses, earthy coatings Crystal System Triclinic Environment of Formation Weathering of aluminosilicate minerals, hydrothermal alteration, soils, kaolin deposits Economic Importance Ceramics, paper coatings, pharmaceuticals, cosmetics, refractory uses Other Properties Soft, white, plastic when wet Part of: Other Silicates Name KYANITE Silicate Chemical Composition Al<sub>2</sub>SiO<sub>5</sub> 4.5-7 White Vitreous to pearly Cleavage 1 direction Fracture Splintery to uneven Density 3.60 g/cm<sup>3</sup> Mineral Habit Bladed, columnar crystals, fibrous aggregates Crystal System Triclinic Environment of Formation High-pressure regional metamorphism of pelitic rocks; in metamorphic schists and gneisses Economic Importance Refractory, porcelain, foundry, high-temperature ceramics Other Properties Strongly anisotropic Part of: Other Silicates Name OLIVINE Silicate Chemical Composition (Mg,Fe)<sub>2</sub>SiO<sub>4</sub> 6.5-7 Colorless Vitreous to greasy Cleavage None Fracture Conchoidal to uneven Density 3.8 g/cm<sup>3</sup> Mineral Habit Granular, stubby prismatic crystals, massive in peridotite Crystal System Orthorhombic Environment of Formation Mantle-derived rocks (peridotite), mafic/ultramafic igneous rocks, basaltic lavas, xenoliths Economic Importance Gem-quality olivine = peridot Other Properties Olive-green color, weathers to iddingsite Part of: Mica Group Name MUSCOVITE Silicate Chemical Composition KAl<sub>2</sub>(AlSi<sub>3</sub>O<sub>10</sub>)(OH)<sub>2</sub> 2-2.5 White Pearly to vitreous Cleavage 1 direction Fracture Flexible, elastic thin plates Density 2.80 g/cm<sup>3</sup> Mineral Habit Flaky sheets, books, scaly aggregates Crystal System Monoclinic Environment of Formation Igneous (pegmatites, granites), metamorphic rocks, hydrothermal veins Economic Importance Heat-resistant insulating materials, electrical insulators (historically), lubricant in some forms Other Properties Colorless to silvery, splits into very thin transparent sheets Part of: Other Silicates Name PREHNITE Silicate Chemical Composition Ca<sub>2</sub>Al<sub>2</sub>Si<sub>3</sub>O<sub>10</sub>(OH)<sub>2</sub> 6-6.5 White Vitreous to pearly Cleavage Uneven to poor Fracture Uneven to conchoidal Density 2.9 g/cm<sup>3</sup> Mineral Habit Botyroidal, globular, stalactitic crusts, radiating aggregates Crystal System Orthorhombic Environment of Formation Low-grade metamorphism, hydrothermal veins, basalt cavities (amygdales) Economic Importance Collectors Other Properties Pale green to yellow-green Part of: Pyroxene Group Name AUGITE Silicate Chemical Composition (Ca,Na)(Mg,Fe,Al)(Si,Al)2O<sub>6</sub> 5-6 White to gray Vitreous to dull Cleavage Two directions at ~87° and 93° Fracture Uneven to conchoidal Density 3.4 g/cm<sup>3</sup> Mineral Habit Short prismatic crystals, stubby prisms, granular Crystal System Monoclinic Environment of Formation Igneous (gabbro, basalt), metamorphic (high-temperature) Economic Importance Major rock-forming mineral Other Properties Dark green to black Part of: Pyroxene Group Name RHODONITE Silicate Chemical Composition (Mn,Fe,Mg,Ca)SiO<sub>3</sub> 5.5-6.5 White to pale pink Vitreous to pearly

Cleavage Distinct in two directions Fracture Uneven to conchoidal Density 3.6 g/cm<sup>3</sup> Mineral Habit Massive, granular, tabular crystals Crystal System Triclinic Environment of Formation Contact metamorphism of Mn-rich sediments, hydrothermal deposits Economic Importance Ornamental/gemstone (cabochons), minor ore of manganese Other Properties Pink to rose-red color Part of: Pyroxene Group Name SPODUMENE Silicate Chemical Composition LiAlSi<sub>2</sub>O<sub>6</sub> 6.5-7 White Vitreous to pearly Cleavage Two good cleavages Fracture Uneven to conchoidal Density 3.1 g/cm<sup>3</sup> Mineral Habit Prismatic, elongated crystals in pegmatites Crystal System Monoclinic Environment of Formation Lithium-rich pegmatites, greisens Economic Importance Major source of lithium Other Properties Color varies by impurity Part of: Quartz Varieties Name AVENTURINE Silicate Chemical Composition SiO<sub>2</sub> w/ mica impurities 7 White Vitreous, sparkly Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Massive, cryptocrystalline to macrocrystalline quartz with inclusions Crystal System Trigonal Environment of Formation Veins, metamorphic and igneous rocks where quartz forms with inclusions Economic Importance Ornamental/gemstone Other Properties Sparkly effect due to plate-like inclusions (typically mica or hematite) Part of: Quartz Varieties Name AGATE Silicate Chemical Composition SiO<sub>2</sub> (microcrystalline) 6.5-7 White Waxy to vitreous Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Botryoidal, banded, nodular, stalactitic; fills cavities as agate bands Crystal System Trigonal Environment of Formation Volcanic cavities (geodes), silica-rich hydrothermal veins Economic Importance Gem/ornamental Other Properties Banded patterns diagnostic Part of: Quartz Varieties Name AMETHYST Silicate Chemical Composition SiO<sub>2</sub> (Fe<sup>3+</sup> impurities and irradiation cause purple color) 7 White Vitreous Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Prismatic crystals, druses, geodes Crystal System Trigonal Environment of Formation Hydrothermal veins, cavities in volcanic rocks, geodes Economic Importance Gemstone Other Properties Purple color varies with iron content and irradiation Part of: Quartz Varieties Name CITRINE Silicate Chemical Composition SiO<sub>2</sub> (Fe impurities, heat-treated amethyst often) 7 White Vitreous Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Prismatic crystals, druses Crystal System Trigonal Environment of Formation Hydrothermal, volcanic cavities; many commercial citrines are heat-treated amethyst Economic Importance Gemstone Other Properties Part of: Quartz Varieties Name JASPER Silicate Chemical Composition SiO<sub>2</sub> (with impurities) 6.5-7 White Dull to vitreous Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Massive, opaque, often brecciated or banded Crystal System Trigonal Environment of Formation Sedimentary/volcanic silica deposition, hydrothermal silicification Economic Importance Ornamental, carving stone Other Properties Opaque and often richly colored/patterned Part of: Quartz Varieties Name MILKY QUARTZ Silicate Chemical Composition SiO<sub>2</sub> (w/ microscopic fluid inclusions causing milky appearance) 7 White Vitreous to waxy Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Massive, crystalline Crystal System Trigonal Environment of Formation Common Economic Importance Industrial quartz, ornamental uses Other Properties White and translucent due to microscopic inclusions Part of: Quartz Varieties Name OPAL Silicate Chemical Composition SiO<sub>2</sub>·nH<sub>2</sub>O 5.5-6.5 White Vitreous to waxy Cleavage None Fracture Conchoidal Density 2.2 g/cm<sup>3</sup> Mineral Habit Massive, botryoidal, nodular, hydrous fillings in host Crystal System Amorphous Environment of Formation Low-temperature silica deposition in sediments, weathering zones, geothermal areas Economic Importance Gemstone Other Properties Precious opal shows play-of-color, fragile and sensitive to heat/dehydration Part of:

Quartz Varieties Name ROCK CRYSTAL Silicate Chemical Composition SiO<sub>2</sub> 7 White Vitreous Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Transparent prismatic crystals, druses, massive Crystal System Trigonal Environment of Formation Hydrothermal veins, igneous rocks, metamorphic rocks Economic Importance Gem, optical uses, electronics (pure quartz) Other Properties Used in precision instruments when high purity Part of: Quartz Varieties Name ROSE QUARTZ Silicate Chemical Composition SiO<sub>2</sub> (trace Ti, Mn, or microscopic inclusions cause pink color) 7 White Vitreous to greasy Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Massive, rarely well-formed crystals Crystal System Trigonal Environment of Formation Pegmatites, hydrothermal Economic Importance Ornamental/gemstone Other Properties Pink color Part of: Quartz Varieties Name SMOKY QUARTZ Silicate Chemical Composition SiO<sub>2</sub> (Al + radiation cause smoky color) 7 White Vitreous Cleavage None Fracture Conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Prismatic crystals, druses, masses Crystal System Trigonal Environment of Formation Hydrothermal, pegmatites, high-temperature quartz vein, often irradiated natural radiation exposure Economic Importance Gem/ornamental Other Properties Brown to black in color Part of: Quartz Varieties Name TIGER'S EYE Silicate Chemical Composition SiO<sub>2</sub> with fine fibrous asbestos/amphibole 6.5-7 White Silky chatoyant Cleavage None Fracture Conchoidal to uneven Density 2.65 g/cm<sup>3</sup> Mineral Habit Fibrous, chatoyant bands in massive quartz Crystal System Trigonal Environment of Formation Metamorphic replacement of amphibole by silica under low-grade metamorphism Economic Importance Ornamental/gemstone Other Properties Golden-brown chatoyancy Part of: Other Silicates Name SODALITE Silicate Chemical Composition Na<sub>8</sub>(Al<sub>6</sub>Si<sub>6</sub>O<sub>24</sub>)Cl<sub>2</sub> 5.5-6 White Vitreous to greasy Cleavage None Fracture Conchoidal to uneven Density 2.3 g/cm<sup>3</sup> Mineral Habit Massive, dodecahedral crystals rare, compact granular masses Crystal System Isometric Environment of Formation Undersaturated igneous rocks (nepheline syenites), pegmatites, contact metamorphics Economic Importance Ornamental stone Other Properties Often blue; may fluoresce orange under UV Part of: Other Silicates Name STAUROLITE Silicate Chemical Composition Fe<sub>2+</sub>2Al<sub>9</sub>Si<sub>4</sub>O<sub>23</sub>(OH) 7-7.5 White to gray Adamantine to resinous Cleavage Poor to indistinct Fracture Uneven Density 3.7 g/cm<sup>3</sup> Mineral Habit Prismatic to tabular crystals Crystal System Monoclinic Environment of Formation Regional metamorphism of pelitic rocks Economic Importance None really Other Properties Brown to reddish-brown, common as twinned crosses Part of: Other Silicates Name STILBITE Silicate Chemical Composition NaCa<sub>4</sub>(Si<sub>27</sub>Al<sub>9</sub>)O<sub>72</sub>·28H<sub>2</sub>O 3.5-4 White Vitreous to pearly Cleavage Perfect in one direction Fracture Uneven to conchoidal Density 2.1 g/cm<sup>3</sup> Mineral Habit Sheaf-like, radiating blades, tabular crystals, crusts in cavities Crystal System Monoclinic Environment of Formation Low-temperature hydrothermal veins, cavities in basalts Economic Importance None really Other Properties Often pinkish to colorless, forms attractive radiating aggregates Part of: Other Silicates Name TALC Silicate Chemical Composition Mg<sub>3</sub>Si<sub>4</sub>O<sub>10</sub>(OH)<sub>2</sub> 1 White Pearly to greasy Cleavage 1 direction Fracture Uneven to sectile Density 2.7 g/cm<sup>3</sup> Mineral Habit Massive, foliated, platy Crystal System Monoclinic Environment of Formation Metamorphism of ultramafic rocks (talc schist), hydrothermal alteration of Mg-rich rocks Economic Importance Major industrial mineral Other Properties Soapy feel, softest mineral Part of: Other Silicates Name TOPAZ Silicate Chemical Composition Al<sub>2</sub>SiO<sub>4</sub>(F,OH)<sub>2</sub> 8 White Vitreous to adamantine Cleavage 1 direction Fracture Subconchoidal to uneven Density 3.5 g/cm<sup>3</sup> Mineral Habit Prismatic, tabular crystals, well-formed terminated prisms common Crystal System

Orthorhombic Environment of Formation Rhyolitic cavities, hydrothermal veins Economic Importance Gemstone Other Properties Color range from colorless to blue, yellow, pink Part of: Other Silicates Name TOURMALINE Silicate Chemical Composition Uhhhhhhhhh, many kinds 7-7.5 White Vitreous to resinous Cleavage None Fracture Uneven to conchoidal Density 3.1 g/cm<sup>3</sup> Mineral Habit Long prismatic, striated crystals, often vertically striated Crystal System Hexagonal Environment of Formation Pegmatites, metamorphic schists, hydrothermal veins Economic Importance Gemstone, piezoelectric Other Properties Wide color range Part of: Other Silicates Name WILLEMITE Silicate Chemical Composition Zn<sub>2</sub>SiO<sub>4</sub> 5.5-6 White Vitreous to adamantine Cleavage Poor/indistinct Fracture Conchoidal to uneven Density 4.0 g/cm<sup>3</sup> Mineral Habit Granular, massive, prismatic crystals Crystal System Hexagonal Environment of Formation Oxidized zones of zinc deposits Economic Importance Minor zinc ore Other Properties Usually green, famous fluorescent specimens Part of: Other Silicates Name WOLLASTONITE Silicate Chemical Composition CaSiO<sub>3</sub> 4.5-5 White Vitreous to pearly Cleavage Good in two directions Fracture Uneven to splintery Density 2.9 g/cm<sup>3</sup> Mineral Habit Bladed, acicular, fibrous, radiating aggregates Crystal System Triclinic or monoclinic Environment of Formation Contact metamorphism of limestones (skarns), metamorphosed siliceous limestones Economic Importance Industrial mineral Other Properties White to gray Part of: Other Silicates Name ZIRCON Silicate Chemical Composition ZrSiO<sub>4</sub> (often with Hf and U substitutions) 7.5 White Adamantine to vitreous Cleavage Poor/indistinct Fracture Conchoidal to uneven Density 4.6 g/cm<sup>3</sup> Mineral Habit Prismatic tetragonal crystals, bipyramidal terminations, detrital grains in sands Crystal System Tetragonal Environment of Formation Zircon in igneous (granites, syenites) and metamorphic rocks Economic Importance Source of zirconium and hafnium Other Properties Often strongly resistant to weathering 3. Rock Identification 3.1 Igneous: Name ANDESITE Igneous, Intermediate, Extrusive Mineral Composition Plagioclase feldspar, amphibole, pyroxene 6 White to gray Dull to vitreous on mineral grains Cleavage None Fracture Irregular, uneven Density 2.6 g/cm<sup>3</sup> Mineral Habit Fine-grained, sometimes porphyritic Texture Aphanitic or porphyritic Environment of Formation Convergent margins, volcanic arcs Economic Importance Source rock for construction aggregate Other Properties Common lava of stratovolcanoes Name BASALT Igneous, Mafic, Extrusive Mineral Composition Pyroxene, plagioclase, olivine 6 Gray Dull to slightly vitreous on crystals Cleavage None visible Fracture Conchoidal to uneven Density 2.9 g/cm<sup>3</sup> Mineral Habit Fine-grained, massive Texture Aphanitic Environment of Formation Mid-ocean ridges, hotspots, flood basalts Economic Importance Crushed stone, road base, mineral wool Other Properties Often vesicular Name DIORITE Igneous, Intermediate, Intrusive Mineral Composition Plagioclase, amphibole, biotite 6 White Sub-vitreous on crystals Cleavage present in amphibole Fracture Irregular Density 2.8 g/cm<sup>3</sup> Mineral Habit Coarse-grained, speckled black-and-white Texture Phaneritic Environment of Formation Underground hardened igneous flows Economic Importance Decorative stone, crushed rock Other Properties Intermediate between gabbro and granite Name GABBRO Igneous, Mafic, Intrusive Mineral Composition Pyroxene, plagioclase, sometimes olivine 6 White to gray Dull to sub-vitreous Cleavage Present within pyroxenes Fracture Blocky, uneven Density 3.0 g/cm<sup>3</sup> Mineral Habit Coarse-grained Texture Phaneritic Environment of Formation Oceanic crust, mafic intrusions Economic Importance Dimension stone, crushed aggregate Other Properties Dark-colored, heavy Name GRANITE Igneous, Felsic, Intrusive Mineral Composition Quartz, feldspar, mica 6-[REDACTED]

(fine, 7) White Mostly vitreous Cleavage None Fracture Irregular Density 2.6 g/cm<sup>3</sup> Mineral Habit Coarse-grained, interlocking Texture Phaneritic Environment of Formation Continental underground hardened igneous flows Economic Importance Countertops, monuments, building Other Properties Highly resistant to weathering Name OBSIDIAN Igneous, Felsic, Extrusive Mineral Composition Amorphous silica-rich glass 5-5.5 Light gray Vitreous, glassy Cleavage None Fracture Conchoidal Density 2.4 g/cm<sup>3</sup> Mineral Habit Glassy, compact Texture Glassy Environment of Formation Rapid cooling of lava Economic Importance Historically a cutting tool, modern uses have it for decoration Other Properties Razor sharp edges Name PEGMATITE Igneous, Ultramafic, Intrusive Mineral Composition Olivine dominant, pyroxenes 6 White Vitreous Cleavage None Fracture Irregular Density 2.7 g/cm<sup>3</sup> Mineral Habit Coarse, granular Texture Pematic Environment of Formation Late-stage magma crystallizing Economic Importance Source of gemstones, lithium, and rare metals Other Properties Huge crystals common Name PERIDOTITE Igneous, Felsic, Extrusive Mineral Composition Igneous, Ultramafic, Intrusive 6 Colorless/white Dull to slightly vitreous Cleavage None Fracture Uneven Density 3.3 g/cm<sup>3</sup> Mineral Habit Coarse, granular Texture Phaneritic Environment of Formation Upper mantle intrusions Economic Importance Source of diamonds and magnesium Other Properties Very dense and green toned Name PUMICE Igneous, Felsic, Extrusive Mineral Composition Silica-rich glass and microcrystals 6 White Dull Cleavage None Fracture Irregular Density 0.5 g/cm<sup>3</sup> Mineral Habit Frothy, vesicular Texture Highly vesicular Environment of Formation Explosive volcanic eruptions Economic Importance Abrasives, lightweight concrete Other Properties Very porous, extremely light, floats Name RHYOLITE Igneous, Felsic, Extrusive Mineral Composition Quartz, feldspar, mica 6 White Dull to slightly vitreous Cleavage None Fracture Conchoidal to uneven Density 2.4 g/cm<sup>3</sup> Mineral Habit Fine-grained, often banded Texture Aphantic or porphyritic Environment of Formation Contentinal volcanic settings Economic Importance Minor aggregate use Other Properties Light colored volcanic equivalent of granite Name SCORIA Igneous, Mafic, Extrusive Mineral Composition Basaltic minerals 5-6 Gray Dull Cleavage None Fracture Irregular Density 1.5 g/cm<sup>3</sup> Mineral Habit Vesicular, cindery Texture Vesicular Environment of Formation Eruptions Economic Importance Landscaping stone Other Properties Dark, heavy vesicular lava Name SYENITE Igneous, Intermediate, Intrusive Mineral Composition Alkali feldspar, hornblende, biotite, a little quartz 6 White Vitreous Cleavage Feldspar cleavage Fracture Irregular Density 2.8 g/cm<sup>3</sup> Mineral Habit Coarse-grained Texture Phaneritic Environment of Formation Alkaline intrusios Economic Importance Decorative stone Other Properties Quartz-poor granite analog Name TUFF Igneous, Pyroclastic, Extrusive Mineral Composition Volcanic ash fragments, pumice, crystals 3-6 White to gray Dull Cleavage None Fracture Crumbly to uneven Density 1.6 g/cm<sup>3</sup> Mineral Habit Fragmental Texture Pyroclastic Environment of Formation Explosive eruptions, ash fall or ash flow Economic Importance Building stone, lightweight materials Other Properties Often soft and porous Name TUFF BRECCIA Igneous, Pyroclastic, Extrusive Mineral Composition Angular volcanic frgments, ash matrix 3-6 Gray Dull Cleavage None Fracture Blocky, irregular Density 2.0 g/cm<sup>3</sup> Mineral Habit Coarse pyroclastic Texture Brecciated Environment of Formation Violent eruptions producing large fragmented blocks Economic Importance Limited Other Properties Contains large angular clasts 3.2 Metamorphic: Name AMPHIBOLITE Metamorphic (Foliated) Mineral Composition Hornblende, plagioclase, with garnet and biotite 5-6 White to gray Subvitreous to dull Cleavage Not really, but kinda 56°/124° Fracture Splintery, uneven

Density 3.1 g/cm<sup>3</sup> Mineral Habit Bladed amphibole crystals, massive Texture Medium to coarse-grained, schistose or banded Environment of Formation Regional metamorphism of basaltic Economic Importance Crushed stone Other Properties Dark-colored, high amphibole content gives green-black appearance Name GNEISS Metamorphic (Foliated, banded) Mineral Composition Feldspar, quartz, mica, may include hornblende or garnet 6 White Vitreous to pearly Cleavage Poor Fracture Irregular, uneven Density 2.7 g/cm<sup>3</sup> Mineral Habit Layered, banded Texture Coarse-grained Environment of Formation High-grade regional metamorphism Economic Importance Building stone Other Properties Alternating light/dark mineral bands Name MARBLE Metamorphic Mineral Composition Calcite or dolomite 3-4 White Vitreous to pearly Cleavage Perfect rhombohedral Fracture Subconchoidal Density 2.7 g/cm<sup>3</sup> Mineral Habit Interlocking carbonate grains Texture Medium to coarse crystalline Environment of Formation Contact or regional metamorphism of limestone Economic Importance Dimension stone, sculptures, building materials Other Properties Effervesces in acid, softer than quartz rich rocks Name PHYLITE Metamorphic Mineral Composition Fine mica, quartz, feldspar 1-3 White Satin-like sheen Cleavage Excellent slaty cleavage Fracture Uneven Density 2.7 g/cm<sup>3</sup> Mineral Habit Thin sheets Texture Fine-grained, glossy sheen Environment of Formation Low to medium grade regional metamorphism Economic Importance Limited, sometimes decorative stone Other Properties Shiny surface but finer than schist Name QUARTZITE Metamorphic Mineral Composition Quartz 7 White Vitreous Cleavage None, quartz grains Fracture Conchoidal Density 2.7 g/cm<sup>3</sup> Mineral Habit Massive, granular Texture Interlocking quartz grains, sugary Environment of Formation Metamorphism of quartz sandstone Economic Importance Construction aggregate, decorative stone Other Properties Very hard, breaks across grains Part of Schist Series Name SCHIST (GENERAL) Metamorphic Mineral Composition Micas dominate, quart, feldspar, garnet, and amphibole possible 3-5 White Sparkly Cleavage Schistosity Fracture Uneven Density 2.7 g/cm<sup>3</sup> Mineral Habit Platy, flaky Texture Medium to coarse grained Environment of Formation Medium to high-grade regional metamorphism of shale Economic Importance Decorative stone Other Properties Flaky layers Part of Schist Series Name GARNET SCHIST Metamorphic (foliated) Mineral Composition Mica + quartz + feldspar + garnet porphyroblasts 5-7 White Sparkly Cleavage Schistosity Fracture Uneven Density 2.7 g/cm<sup>3</sup> Mineral Habit Platy, flaky Texture Medium to coarse grained Environment of Formation Medium to high-grade regional metamorphism of shale Economic Importance Decorative stone Other Properties Flaky layers Part of Schist Series Name MICA SCHIST Metamorphic (foliated) Mineral Composition Biotite or muscovite dominant 2.5-4 White Sparkly Cleavage Schistosity Fracture Uneven Density 2.7 g/cm<sup>3</sup> Mineral Habit Platy, flaky Texture Medium to coarse grained Environment of Formation Medium to high-grade regional metamorphism of shale Economic Importance Decorative stone Other Properties Flaky layers Part of Schist Series Name TALC SCHIST Metamorphic (foliated) Mineral Composition Serpentine group minerals 1 White Sparkly Cleavage Schistosity Fracture Uneven Density 2.7 g/cm<sup>3</sup> Mineral Habit Platy, flaky Texture Medium to coarse grained Environment of Formation Medium to high-grade regional metamorphism of shale Economic Importance Decorative stone Other Properties Flaky layers Name SERPENTINITE Metamorphic (nonfoliated) Mineral Composition Serpentine group minerals 2.5-4 White Greasy to waxy Cleavage Poor Fracture Splintery to conchoidal Density 2.6 g/cm<sup>3</sup> Mineral Habit Massive, fibrous Texture Smooth, scaly, or veined Environment of Formation Hydration of ultramafic rocks Economic Importance

Asbestos source (chrysotile), decorative stone Other Properties Often green, slick feel Name SLATE Metamorphic (foliated) Mineral Composition Clay minerals 2.5-4 Gray Dull to slightly silky Cleavage Excellent slaty cleavage Fracture Flat, planar Density 2.7 g/cm<sup>3</sup> Mineral Habit Thin plates Texture Very fine-grained Environment of Formation Low-grade metamorphism of shale Economic Importance Roofing, chalkboards, tiles Other Properties Higher sound "ring" when struck compared to shale 3.3 Sedimentary: Name BANDED IRON FORMATION

Sedimentary Mineral Composition Hematite, magnetite, chert, quartz 5-7 Red-brown (hematite bands), black (magnetite bands) Metallic to dull Cleavage None Fracture Uneven Density 4.2 g/cm<sup>3</sup> Mineral Habit Layered bands of iron oxides and chert Texture Laminated, banded Environment of Formation Marine, Precambrian oceans Economic Importance Iron ore source Other Properties Often very dense, alternating dark/light layers, resistant to weathering Name BAUXITE Sedimentary Mineral Composition Gibbsite, boehmite, diasporite, clay minerals 1-3 White to pale brown Earthy to dull Cleavage None Fracture Conchoidal to uneven Density 2.25 g/cm<sup>3</sup> Mineral Habit Massive, pisolithic, nodular Texture Porous, pisolithic Environment of Formation Lateritic soils in tropical climates, residual weathering of aluminum-rich rocks Economic Importance Primary ore of aluminum Other Properties Soft, powdery, often used as abrasive in industrial applications Name BRECCIA Sedimentary Mineral Composition Varies 3-7 Variable Dull to vitreous Cleavage None Fracture Irregular Density 2.4 g/cm<sup>3</sup> Mineral Habit Angular clasts in matrix Texture Clastic, coarse, poorly sorted Environment of Formation Alluvial fans, debris flows, fault zones, landslides Economic Importance Construction aggregate, decorative stone Other Properties Angular clasts distinguish it from conglomerate Name CHERT/FLINT Sedimentary Mineral Composition SiO<sub>2</sub> 7 White Waxy to dull Cleavage Very fine-grained, smooth Fracture Conchoidal Density 2.65 g/cm<sup>3</sup> Mineral Habit Massive, nodular, layered Texture Massive, nodular, layered Environment of Formation Deep marine chemical precipitation Economic Importance Flint tools, aggregate Other Properties Hard and brittle Name CONGLOMERATE Sedimentary Mineral Composition Rounded gravel-sized clasts of quartz, chert, or other rocks in sand 3-7 Variable Dull to sub-vitreous Cleavage None Fracture Irregular Density 2.6 g/cm<sup>3</sup> Mineral Habit Rounded clasts in matrix Texture Clastic, poorly to moderately sorted Environment of Formation Riverbeds, alluvial fans, glacial outwash, beaches Economic Importance Construction aggregate, decorative stone Other Properties Rounded clasts distinguish from breccia Name DIATOMITE Sedimentary Mineral Composition Silica (SiO<sub>2</sub>) from diatom frustules 1-2 White Earthy, dull Cleavage None Fracture Brittle, uneven Density 1.0 g/cm<sup>3</sup> Mineral Habit Massive, soft, powdery Texture Very fine-grained, porous, siliceous Environment of Formation Freshwater/marine deposits, accumulation of diatom skeletons Economic Importance Filtration, abrasives, lightweight aggregates, insulation Other Properties Very light, high porosity, floats in water if dry Name DOLOSTONE Sedimentary Mineral Composition CaMg(CO<sub>3</sub>)<sub>2</sub> 3.5-4.5 White Vitreous to dull Cleavage None Fracture Conchoidal to uneven Density 2.9 g/cm<sup>3</sup> Mineral Habit Massive, crystalline Texture Fine to Coarse Grained Environment of Formation Replacement of limestone (dolomitization), shallow marine Economic Importance Source of magnesium Other Properties Reacts with HCl, can form reservoirs for oil and gas Name ROCK SALT Sedimentary Mineral Composition NaCl 2-2.5 White Vitreous Cleavage Cubic Fracture Conchoidal Density 2.2 g/cm<sup>3</sup> Mineral Habit Massive, granular, cubic crystals Texture Coarse to fine crystalline Environment of Formation vaporite deposits from saline lakes or seas Economic Importance Salt production, chemical industry,

de-icing Other Properties Soluble in water Name ROCK GYPSUM Sedimentary Mineral Composition CaSO<sub>4</sub>·2H<sub>2</sub>O 2 White Vitreous to silky Cleavage 1 direction Fracture Uneven Density 2.3 g/cm<sup>3</sup> Mineral Habit Massive, tabular crystals, fibrous Texture Fine to medium grain Environment of Formation Evaporite deposits in lakes, seas Economic Importance Plaster, drywall, fertilizer Other Properties Plaster, drywall, fertilizer Name SHALE Sedimentary Mineral Composition Clay minerals, quartz, feldspar, minor organics 3 Gray, brown, red Dull Cleavage Excellent fissility (splits into thin layers) Fracture Conchoidal to uneven Density 2.3 g/cm<sup>3</sup> Mineral Habit Laminated, fine-grained Texture Very fine-grained, laminated Environment of Formation Quiet water deposits (lakes, deep ocean, floodplains) Economic Importance Source rock for oil/gas Other Properties Splits easily along bedding planes, can contain fossils Name SILTSTONE Sedimentary Mineral Composition Quartz, feldspar, minor clay 3-4 Gray Dull to earthy Cleavage None Fracture Conchoidal to uneven Density 2.4 g/cm<sup>3</sup> Mineral Habit Massive, blocky, fine-grained Texture Finer than sandstone, coarser than shale Environment of Formation Rivers, deltas Economic Importance Aggregate Other Properties May split along bedding Part of: Coal Varieties Name ANTHRACITE Sedimentary Mineral Composition C 2.5-3 Black Submetallic, glossy Cleavage None Fracture Conchoidal Density 1.35 g/cm<sup>3</sup> Mineral Habit Massive, compact Texture Hard, dense, shiny Environment of Formation Metamorphosed peat in high-pressure settings Economic Importance Fuel, energy Other Properties Burns cleanly Part of: Coal Varieties Name BITUMINOUS Sedimentary Mineral Composition C 2-2.5 Black Dull to slightly shiny Cleavage None Fracture Conchoidal Density 1.25 g/cm<sup>3</sup> Mineral Habit Massive, layered Texture Soft, layered Environment of Formation Compacted peat under moderate pressure Economic Importance Fuel, energy Other Properties Produces soot and smoke Part of: Coal Varieties Name LIGNITE Sedimentary Mineral Composition C 1-2 Brownish-black Earthy, dull Cleavage None Fracture Uneven Density 1.2 g/cm<sup>3</sup> Mineral Habit Massive, soft Texture Woody or layered appearance Environment of Formation Compacted peat, shallow burial Economic Importance Fuel for power plants Other Properties High moisture content Part of: Limestone Varieties Name CHALK Sedimentary Mineral Composition CaCO<sub>3</sub> 1-2 White Earthy Cleavage None Fracture Conchoidal Density 2.3 g/cm<sup>3</sup> Mineral Habit Massive, fine-grained, porous Texture Soft, powdery Environment of Formation Deep marine, planktonic microfossils Economic Importance Cement, lime, agricultural soil conditioner Other Properties Reacts with HCl, very soft Part of: Limestone Varieties Name COQUINA Sedimentary Mineral Composition CaCO<sub>3</sub> 3 White Dull to vitreous Cleavage None Fracture Uneven Density 2.3 g/cm<sup>3</sup> Mineral Habit Massive, shell-fragment cemented Texture Fossil-rich, coarse-grained Environment of Formation Shallow marine, high-energy beaches Economic Importance Construction stone Other Properties Easily crumbles, composed almost entirely of shells Part of: Limestone Varieties Name FOSSIL LIMESTONE Sedimentary Mineral Composition Calcite, fossil fragments 3 White Dull to vitreous Cleavage None Fracture Uneven Density 2.3 g/cm<sup>3</sup> Mineral Habit Massive, fossil-rich Texture Fossil fragments visible, coarse Environment of Formation Shallow marine environments Economic Importance Building stone, aggregate Other Properties Fossils preserved in rock Part of: Limestone Varieties Name OOLITIC LIMESTONE Sedimentary Mineral Composition Calcite oolites 3 White Dull to vitreous Cleavage None Fracture Uneven Density 2.3 g/cm<sup>3</sup> Mineral Habit Spherical ooids in cement Texture Oolitic (small orbs) Environment of Formation Warm, shallow, agitated marine water Economic Importance Building stone Other Properties Often used decoratively Part of: Limestone Varieties

Name TRAVERTINE Sedimentary Mineral Composition Calcite, sometimes aragonite 3 White Dull to silky Cleavage None Fracture Uneven to conchoidal Density 2.5 g/cm<sup>3</sup> Mineral Habit Massive, banded, stalactitic Texture Porous, fibrous Environment of Formation Hot springs, caves Economic Importance Building and decorative stone Other Properties Often banded, may be fossiliferous Part of: Sandstone Varieties Name ARKOSE Sedimentary Mineral Composition Quartz, feldspar, minor mica 6 White Dull to vitreous Cleavage None Fracture Uneven Density 2.4 g/cm<sup>3</sup> Mineral Habit Clastic, coarse grained Texture Angular feldspar grains Environment of Formation Alluvial fans, rivers; rapid deposition Economic Importance Building stone Other Properties Pinkish color common due to feldspar Part of: Sandstone Varieties Name GREYWACKE Sedimentary Mineral Composition Quartz, feldspar, rock fragments, clay matrix 6 Gray Dull Cleavage None Fracture Conchoidal Density 2.5 g/cm<sup>3</sup> Mineral Habit Clastic, poorly sorted Texture Angular grains in clay matrix Environment of Formation Turbidites, submarine fans Economic Importance Aggregate, construction Other Properties Often dark, hard, and compact Part of: Sandstone Varieties Name QUARTZ SANDSTONE Sedimentary Mineral Composition >90% quartz 7 White Vitreous Cleavage None Fracture Conchoidal Density 2.65 g/cm<sup>3</sup> Mineral Habit Clastic, well sorted Texture Medium to coarsely grained Environment of Formation Beaches, dunes, rivers Economic Importance Construction, glass making Other Properties Very durable, resistant to weathering