University of Minnesota

Dolomite (Carbonate Minerals)

Chemical Composition	$CaMg(CO_3)_2$ - Calcium Magnesium Carbonate. Iron may substitute for some of the magnesium.
Color	Transparent to translucent crystals are typically colorless, white, gray or pink, but if iron impurities are present can be red, brown or even black. In massive form, dolomite is typically buff, gray, or white.
Cleavage	Perfect cleavage in three directions to produce rhombohedra
Hardness	3.5 - 4 (relatively soft)
Specific Gravity	2.85 (feels relatively light) to 3 in iron-rich samples
Luster	Crystals are vitreous (glass-like) to pearly, massive form is dull
Streak	White
Misc. Properties	Effervesces (bubbles) weakly only with heated dilute acid, or with room temperature dilute acid if dolomite is first crushed into a fine powder to increase its surface area.

Often confused with...

Did you know...

Dolomite is one of our major sources for the concrete so essential to modern society's road and building infrastructure. Crystals of dolomite are common in hydrothermal vein deposits and in sedimentary rocks, where they fill pores in their host rock. By volume, however, most dolomite occurs in its massive form as dolostone or mixed dolostone/limestone sedimentary rocks. These dolostone rocks originally formed as limestone marine deposits on ancient shallow seafloors that were later altered to dolostone as magnesium-rich waters moved through them. Dolostones that formed from the alteration of limestone rock can retain much of the rock's original depositional textures, such as fossils, bedding, and other sedimentary features, although sometimes all of this original fabric was lost as the rock recrystallized.

Description and Identifying Characteristics

Most often found as a massive, white to buff or gray, carbonate rock-forming mineral, dolomite is one of the three most abundant carbonate minerals, calcite and aragonite being the other two. Dolomite differs from calcite and aragonite in its crystal structure. In dolomite crystals, layers of carbonate ions alternate with layers of magnesium and calcium ions, rather than only having layers of calcium ions alternate with carbonate ions as in calcite and aragonite. Dolomite crystals usually form transparent to translucent rhombs that are colorless to light-colored, although crystals may be red

to brown if iron impurities are present. Some dolomite crystals also exhibit crystal faces that form slightly curved surfaces, rather than flat planes.

Pure samples of dolomite and calcite may have a similar appearance and share many properties, so the easiest way to distinguish them is by their reaction with room temperature dilute acid. Calcite (and aragonite) will readily react with acid to form small bubbles (effervescence). Dolomite will only effervesce if the mineral is ground up into powder (or if the acid is heated). Unfortunately, natural massive samples often consist of a mixture of the two minerals, so it is sometimes difficult to distinguish whether dolomite is present in a mixed massive sample. Iron may also substitute for some of the magnesium in dolomite, so dolomite may grade into siderite, an iron carbonate ($FeCO_3$), although dolomite is far more abundant than siderite.

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In Our Earth: The Geologic Importance of Dolomite

Dolomite forms in hydrothermal veins or as a pore-filling mineral in carbonate rocks, and more rarely as an accessory component in igneous pegmatites or altered mafic igneous rocks. By far though, most dolomite occurs in altered sedimentary marine rocks called dolostones or in marbles formed from the metamorphism of dolostone. Because dolostones are composed primarily of the mineral dolomite, geologists once used the term ‘dolomite’ for both the mineral and the rock. The term is now only used for the mineral, since a dolostone may include other minerals besides dolomite.

Few dolostones are primary in origin. In other words, they did not originally form as dolostone, but instead formed from the alteration of limestone rock as magnesium-rich water moved through the limestone, altering its calcite and aragonite into dolomite. The main exception to this is primary dolomite that forms in evaporitic settings as a relatively late product of seawater evaporation. These primary dolomites are rare though. One of the more unusual primary occurrences of dolomite (where dolomite is precipitated directly from a fluid, rather than forming as an alteration of a pre-existing mineral) occurs in the kidneys of Dalmatian dogs! It appears this geologic peculiarity is unique to Dalmatians, as other dogs do not precipitate dolomite kidney.

Secondary sedimentary dolomites can be broadly separated into two informal groups. Many sedimentary dolomites occur from alteration of calcite and aragonite relatively soon after their own formation, resulting in regionally extensive masses of bedded dolostone. Other secondary sedimentary dolomites form from alteration of calcite and aragonite long after these minerals had originally formed. These latter dolomites tend to form dolostone masses along fractures and faults that serve as pathways for magnesium-bearing fluids that altered the calcite and aragonite deposits. The resulting dolostone tends to cut across the rocks’ original bedding rather than follow the bedding texture. In both groups, the alteration of calcite and aragonite to dolomite may be very selective. Fossils composed of pure calcite may be less likely to be altered and may remain as calcite fossils in an otherwise dolomite rock. As calcite dissolves more easily than dolomite, such calcite fossils can later be dissolved to leave fossil molds in the dolostone rock.

Dolomite crystals also line or fill pores in carbonate limestone and dolostone rocks or in hydrothermal veins. Other important dolomite occurrences include marble rocks

formed from the alteration of sedimentary dolostone, and dolomite associated with altered ultramafic igneous rocks like serpentinite.

In sedimentary dolostones, dolomite is most often associated with calcite, aragonite, gypsum, anhydrite, chert, and halite. Vein deposits of dolomite occur with quartz and other common vein minerals, such as calcite, magnesite, fluorite, siderite, and sphalerite, or with metallic ore minerals such as galena, pyrite and chalcopyrite. Although uncommon, when dolomite occurs in altered ultramafic igneous rocks, it may be associated with magnesite, serpentine, and talc.

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In Our Society: The Economic Importance of Dolomite

Dolomite shares a broadly similar chemistry with other carbonate minerals like calcite and aragonite, and consequently is used in much the same way. By volume, the most important uses of dolomite are in the production of concrete and as aggregate construction material. Significant amounts of dolomite are also used as dolostone and dolomitic marble building stones and in the manufacture of glass and ceramic glazes.

In industry, dolomite is an important source for magnesium and calcium metals, and is used as a flux for metallurgy. A flux is a material that melts easily and can be used to remove impurities from metal ores or to make the slag produced by metal ore smelting more fluid so it can be disposed of more easily.

In agriculture, powdered dolomite is also an important component of many fertilizers and animal feeds. Smaller amounts of dolomite are also used for human consumption as a mineral supplement and as an antacid, although to a lesser degree than calcite. Dolomite is even used in facial creams and toothpaste.

Usually minerals are named after a famous geographic locality where they occur, but dolomite was named for a French geologist named Deodat de Dolomieu (1750-1801) who first identified its chemical composition, and whose scientific career had a rather inauspicious beginning. Deodat de Dolomieu's earlier choice of a military career came to an abrupt end after he was condemned to death at the age of eighteen for killing a fellow soldier in a duel. He was pardoned, but decided to spend the remainder of his life pursuing rocks and minerals rather than military glory. One of the areas where he worked was a mountain range in northeastern Italy that was later christened the 'Dolomites' after Deodat de Dolomieu.

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Dolomite in the Upper Midwest:

Dolomite is abundant throughout most of the upper Midwest, being the primary mineral comprising most of the Paleozoic carbonate units that cover this region. Thousands of quarries in these rock units provided the bulk of the carbonate used locally for concrete in building and road construction. One of the more common, relatively inexpensive building stones used in the region is a porous dolostone known by the geologically incorrect label of 'Winona Travertine'. A true travertine is a porous carbonate rock that is precipitated from groundwater at a spring or in a cave. In

contrast, the ‘Winona Travertine’ is a dolostone that formed as an alteration of a marine limestone. Its pores are the void spaces left by the dissolution of calcite fossils and fragments. Trace fossils of burrowing organisms also extend throughout this dolostone, giving it a decorative pattern that increases its worth as building stone.

Although dolomite is not as soluble as calcite, the abundance of local dolomite also contributes to the ‘hard’ water problems common to Upper Midwest.

Dolomite is best identified on the basis of its softness, well-developed rhombic cleavage, and its reaction with dilute acid when dolomite is crushed into a powder. It will not react as vigorously with dilute acid as calcite and aragonite, the only other common minerals that effervesce in dilute acid.

Calcite (and Aragonite):

Calcite and aragonite are polymorphs of one another that often exhibit a similar appearance to dolomite, and share many of its physical properties. All three minerals often share a related origin from marine sedimentary deposition, so it is not unusual for them to be associated together. The easiest way to distinguish dolomite from calcite or aragonite is that the latter two will easily react with dilute acid at room temperature. In contrast, dolomite will only react with dilute acid to effervesce (form bubbles) if the acid is heated or if the dolomite is first crushed into a powder to increase its surface area. As heating acid can be a dangerous proposition, in earth science classrooms a nail is usually used to crush part of a sample into a fine powder to test with room temperature dilute acid.

Gypsum:

Gypsum can also form translucent crystals and may be associated with dolomite, but gypsum only has one very well developed cleavage plane, while dolomite has three that form well-developed rhombs. Unlike dolomite, gypsum does not react with dilute acid to form bubbles even if it is crushed to produce a powder, although the gypsum powder may simply dissolve without producing bubbles.

Quartz

Quartz crystals and masses may have the same luster as dolomite, but quartz does not exhibit cleavage and is much harder than dolomite. Unlike dolomite, quartz cannot be easily scratched by a nail and will easily scratch a glass plate.

Chert

Chert is a rock composed of very small microscopic quartz crystals. It can be distinguished from dolomite because it is much harder than dolomite. Chert cannot be easily scratched by a nail and will easily scratch a glass plate. It also will not react with dilute acid as dolomite powder does.

Potassium or Plagioclase Feldspar

The feldspar minerals may have the same color and luster as some dolomite varieties, but they can be easily distinguished on the basis of their hardness. Unlike dolomite, feldspar minerals are harder than glass and cannot be easily scratched by a nail. Cleavage faces in feldspar minerals also meet at right angles, unlike dolomite's rhombohedral cleavage. Finally, feldspar minerals will not react with dilute acid as dolomite powder will.

Dolostone

Confusing dolostone and dolomite is not an error in identification, but is simply a minor error in terms. Dolostone is the name for a rock that is primarily composed of the mineral dolomite. Distinguishing between rock and mineral terms is important though, as a dolostone rock may contain other minerals in addition to its dolomite.

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