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A Chemical Study of Dolomites

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A CHEMICAL STUDY OF DOLOMITES.

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Deodat Dolomieu was born in Dolomieu, France, June 23, 1750, and died November 16, 1801. In infancy he was created a Knight of Malta and seemed precocious in many directions. When nineteen years of age he quarreled with a companion and killed him. He was condemned to die for his crime, but after nine months' imprisonment, he was pardoned on account of his youth. He early became interested in geology and mineralogy, and wrote some important treatises on his favorite subjects, especially while residing in Metz, the interesting old capital of Lorraine.

He discovered dolomite while making an extended tour and observations among the Alps in 1789-90. The mineral was first described by him in 1791, and the name was bestowed upon it in honor of the discoverer.

The dolomite mineral and rock are important and interesting from both a theoretical and practical standpoint. Much work has been done upon them, and the mineral can be artificially produced by a number of different methods.

Marignac was probably the first to make it synthetically. His method was to heat calcium carbonate and a solution of magnesium chloride to 200° under a pressure of fifteen atmospheres. In a closed gun barrel J. Dorocher heated porous limestone and dry magnesium chloride to about 1200°. The vapor of the chloride permeated the porous limestone, which was partly transformed into dolomite. In a similar way, it has been suggested, the heat in the neighborhood of volcanoes may produce the mineral and rock.

One of the simplest methods was devised by C. Sainte-Claire Deville. He saturated chalk with a solution of magnesium chloride and heated the mixture upon a sand-bath. More or less of the materials changed into dolomite.

By heating powdered calcite with magnesium sulphate to 200° in a closed tube von Morlot obtained a mixture of dolomite and calcium sulphate. It has been suggested by Haidinger that this reaction accounts for the frequent association of dolomite and gypsum.

T. Sterry Hunt conducted a long series of experiments on the

precipitation of calcium and magnesium carbonates, from which he reached the conclusion that dolomite is simply a chemical precipitate. This view has not been generally adopted.

In more recent times, 1909, G. Linck published a report of a new method of making dolomite. He mixed solutions of magnesium chloride, magnesium sulphate, and ammonium sesquicarbonate, and then added a solution of calcium chloride. An amorphous precipitate came down, which on gentle heating for some time in a closed tube became crystalline. This had the composition and optical properties of dolomite. Linck believes that his experiment explains the formation of marine dolomite, and that the ammonium salt necessary can easily result from the decomposition of organic substances.

The ideal dolomite, $CaCO_3 \cdot MgCO_3$, would contain:

	PER CENT
$CaCO_3$	54.35
$MgCO_3$	45.65

But such a dolomite is ideal and does not exist in nature.

The Niagaran dolomite, the formation in northeast Iowa, which has, indeed, a wide distribution, being found in many states, is an approach to the ideal. The composition of different layers varies, but a fairly typical specimen would or might reveal:

	PER CENT
$CaCO_3$	54.35
$MgCO_3$	43.65
SiO_2	1.00
Al_2O_3 and Fe_2O_3	1.00
	100.00

We have examined dolomites, so-called, from many different countries and find some that are properly termed dolomites, while others are magnesian limestones, with only a small percentage of magnesium. Some contain very little of either calcium or magnesium, but are quite pure sandstones.

1. *Specimen from New Almadin, California.*—This is a hard, greyish-white variety. It consists of large compact crystals, with one surface coated with a brown deposit. The specific gravity is 2.8

	PER CENT
SiO_2	0.40
Fe_2O_3	8.57
Al_2O_3	0.00
$CaCO_3$	53.58
$MgCO_3$	37.86
	100.11

2. Hell Fire Rock, Wahsatch Mountains, Utah.—The analysis revealed that it is quite a pure sandstone, and can not be classed with the dolomites. The rock is white, crumbly, and fine granular in appearance. The specific gravity is 2.2.

	PER CENT
SiO_2	95.29
Fe_2O_3	2.88
Al_2O_3	1.68
$CaCO_3$	0.16
$MgCO_3$	0.00
	100.01

3. Specimen from Hurley, Wisconsin.—The sample contained a number of quartz crystals, also iron pyrite and siderite. The exterior bore a number of dolomite crystals of a pinkish hue, and only the dolomite crystals were taken for the analysis. The specimen proved a fairly typical dolomite. We did not determine the specific gravity.

	PER CENT
SiO_2	2.56
Fe_2O_3	0.27
Al_2O_3	0.00
$CaCO_3$	48.52
$MgCO_3$	40.02
	100.37

4. Specimen from Brosso, Piedmont, Italy.—This sample has a peculiar appearance, and consists of large olive-green crystalline lumps, resembling clay balls. They are very compact and are held together by ferric oxide. The specific gravity is 2.91. From the analysis the specimen may be fairly classed as a dolomite.

	PER CENT
SiO_2	4.97
Fe_2O_3	6.44
Al_2O_3	0.00
$CaCO_3$	50.46
$MgCO_3$	37.82
	99.69

5. Specimen from Georgetown, New Mexico.—Dull white rhombohedral crystals. The analysis shows the mineral is quite a pure calcite rather than a dolomite. The specific gravity is 2.46.

	PER CENT
SiO_2	0.57
Fe_2O_3	0.00
Al_2O_3	0.55
$CaCO_3$	98.32
$MgCO_3$	0.88
	100.38

6. Specimen from Lancaster County, Pennsylvania.—The pure white rhombohedral crystals are a fairly typical dolomite. The specific gravity is 2.31.

	PER CENT
SiO_2	0.48
Fe_2O_3	1.58
Al_2O_3	1.63
$CaCO_3$	56.60
$MgCO_3$	40.50
	100.79

7. Specimen from Diembachkogel, Styria, Austria.—It is a typical dolomite, with large white rhombohedral crystals, having a specific gravity of 2.89.

	PER CENT
SiO_2	0.40
Fe_2O_3	1.52
Al_2O_3	0.00
$CaCO_3$	54.39
$MgCO_3$	43.51
	99.81

8. A dolomitic limestone from Kasota, Minnesota.—The specimen is massive, gray, soft and porous, with a reddish coloration on the surface. The specific gravity is 2.61.

	PER CENT
SiO_2	9.41
Al_2O_3	1.74
Fe_2O_3	0.96
$CaCO_3$	53.67
$MgCO_3$	34.82
	100.60

9. Specimen from St. Louis, Missouri.—The rhombohedral crystals are on the surface of a light gray compact, massive rock; they contain an admixture of silica. The specific gravity is 2.52.

	PER CENT
SiO_2	25.70
Fe_2O_3	0.00
Al_2O_3	24.65
$CaCO_3$	47.34
$MgCO_3$	2.98
	100.67

10. Specimen from Orange County, New York.—Pink and white rhombohedral crystals with a specific gravity of 2.74.

	PER CENT
SiO_2	2.59
Fe_2O_3	0.57

Al_2O_3	0.00
$CaCO_3$	56.80
$MgCO_3$	39.39
	99.35

11. Specimen from Fassathal, Tyrol.—A dark gray central mass covered with a layer of dark rhombohedral crystals. A mixture of both portions was taken for the analysis. The specific gravity is 2.82.

	PER CENT
SiO_2	00.79
Fe_2O_3	00.23
Al_2O_3	0.71
$CaCO_3$	60.32
$MgCO_3$	38.78
	100.83

12. Specimen from Columbia, Pennsylvania.—This sample is a black rock containing rhombohedral and irregular shaped crystals, soft and with a bright lustre. The analysis shows it to be a limestone rather than a dolomite. The specific gravity is 2.69.

	PER CENT
SiO_2	0.80
Fe_2O_3	0.31
Al_2O_3	0.20
$CaCO_3$	95.08
$MgCO_3$	3.53
	99.92

13. Specimen from Lockport, New York.—The rocks belong to the Niagaran formation, and are similar to those found in northeastern Iowa. The specimen consisted of pink and white rhombohedral crystals of a pearly lustre, over a dark gray compact interior. The specific gravity is 2.84.

	PER CENT
SiO_2	0.01
Fe_2O_3	2.07
Al_2O_3	2.39
$CaCO_3$	55.78
$MgCO_3$	39.35
	100.45

14. Specimen from Cumberland, England.—The crystals are both rhombohedral and irregular in form. There is a variety of color, including pink, white, black, brown and slate; also irregular masses of hard, compact, reddish crystals. The analysis was made

from a mixture of the entire specimen. The specific gravity is 2.84.

	PER CENT
SiO_2	6.05
Fe_2O_3	8.04
Al_2O_3	3.40
$CaCO_3$	59.43
$MgCO_3$	22.85
	99.77

15. Specimen from Freiberg, Saxony.—The interior is finely granular and marble-like. The rhombohedral crystals on the exterior are brownish in color. The specific gravity is 2.87.

	PER CENT
SiO_2	0.55
Fe_2O_3	11.53
Al_2O_3	2.55
$CaCO_3$	54.37
$MgCO_3$	31.45
	100.45

16. Specimen from Lee, Massachusetts.—This rock is hard and white, resembling marble, with small shining rhombohedral crystals. The specific gravity is 2.87.

SiO_2	0.64
Al_2O_3 and Fe_2O_3	0.20
$CaCO_3$	65.30
$MgCO_3$	33.04
	99.98

17. Specimen from Eiserfeld, Westphalia, Germany.—It is composed of large white crystals, irregularly set together, and is accompanied by calcite and chalcopyrite. A few of the crystals are slate gray. The specific gravity is 2.80.

	PER CENT
SiO_2	0.64
Fe_2O_3	11.49
Al_2O_3	2.28
$CaCO_3$	61.89
$MgCO_3$	23.24
	100.41

18. Specimen from Niagara Falls, New York.—Irregular shaped crystals, which are pink, yellow, slate and black and are accompanied by calcite and selenite. The specific gravity is 2.8.

	PER CENT
SiO_2	1.01
Fe_2O_3	1.26

Al_2O_3	5.42
$CaCO_3$	66.41
$MgCO_3$	20.33
	100.43

19. Specimen from Cumberland, England.—The interior consists of a mass of white crystals, and the surface is composed of large red and irregular crystals. We mixed together both kinds for the analysis. Specific gravity 2.91.

	PER CENT
SiO_2	0.68
Fe_2O_3	11.09
Al_2O_3	2.85
$CaCO_3$	57.36
$MgCO_3$	28.42
	100.40

20. A dolomitic limestone from Rochester, New York.—A slate-colored rock with brown crystals on the surface. The specific gravity is 2.79. Both portions of the specimen were ground together for the analysis.

	PER CENT
SiO_2	3.05
Al_2O_3 and Fe_2O_3	0.31
$CaCO_3$	43.75
$MgCO_3$	52.96
	100.07

21. Specimen from near Gouverneur, New York.—The rock is a mixture of gray and white crystals and resembles ordinary marble.

	PER CENT
SiO_2	1.17
Al_2O_3	2.72
Fe_2O_3	0.17
$CaCO_3$	67.24
$MgCO_3$	29.88
	100.40

22. Specimen from Cape Breton Island.—This was kindly sent by the Honorable D. Ross MacDonald to whom we express our thanks.

	PER CENT
SiO_2	5.19
Fe_2O_3	0.41
Al_2O_3	2.54
$CaCO_3$	58.12
$MgCO_3$	38.40
	99.75

23. Specimen from Tuchshoe, New York.—Traces of iron color the otherwise milk-white crystals. They are rhombohedral in form, hard, and possess a bright lustre. The specific gravity is 2.84.

	PER CENT
SiO_2	0.45
Fe_2O_3	1.10
Al_2O_3	0.16
$CaCO_3$	52.16
$MgCO_3$	46.80
	99.76

24. Specimen from Guanajuato, Mexico.—The specimen is white, with visible traces of iron oxide. The crystals are hard and hexagonal in form. We were not able to determine the specific gravity.

	PER CENT
SiO_2	86.76
Fe_2O_3	5.50
Al_2O_3	4.33
$CaCO_3$	0.75
$MgCO_3$	2.11
	99.45

25. Specimen from Clayton, Iowa.—This takes a good polish and then it resembles brown marble. It belongs to the Platteville formation of the Ordovician system. The specific gravity is 2.69.

	PER CENT
SiO_2	0.87
Al_2O_3 and Fe_2O_3	1.01
$CaCO_3$	53.34
$MgCO_3$	44.44
	99.66

26. Specimen from Dubuque, Iowa.—It is of a gray color and quite compact in texture. It belongs to the same geological formation as the preceding.

	PER CENT
SiO_2	7.29
Al_2O_3 and Fe_2O_3	3.00
$CaCO_3$	46.94
$MgCO_3$	42.89
	100.12

27. Specimen from White Pine, Nevada.—The rhombohedral crystals are on a brown and gray surface, and are rather soft. The crystals on analysis were found to contain a small amount of copper. We were not able to determine the specific gravity.

	PER CENT
SiO_2	2.16
Fe_2O_3	0.00
Al_2O_3	24.24
$CaCO_3$	72.83
$MgCO_3$	0.31
Cu	0.86
	100.40

The specimen is in no sense a dolomite, but a limestone containing only a small amount of magnesium.

Professor LeRoy D. Weld has called our attention to "a soluble white incrustation sparsely deposited in some of the crevices in one of the Oneota dolomite caves on the Mississippi." The cave is situated near Marquette (North McGregor), Clayton County. On bringing to his laboratory and testing a portion of the incrustation, he finds it to be magnesium sulphate. Professor Weld accounts for this soluble sulphate by the action of sulphuric acid in the atmosphere on the magnesium carbonate of the rock. The cave is near the Milwaukee railway, and it is exposed to the smoke from the coal which usually contains a small quantity of sulphuric acid.

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