Textures, Composition, Distribution and Diagenesis of Non Clastic: Limestones and Dolomite

Limestones are those rocks in which the carbonate fraction exceeds the non-carbonate fraction. The carbonate fraction is composed primarily of calcite [$CaCO_3$] or aragonite [$CaCO_3$], and the term dolomite is reserved for those rocks composed primarily of the mineral dolomite [$CaMg(CO_3)_2$].
Polygenetic: Mechanical/Detrital and Chemical and/or Biological precipitates
Limestones are polygenetic. Some are fragmental or detrital and mechanically transported and deposited; others are chemical or biological precipitates and formed in situ. The first type of limestones exhibits hydrodynamic textures and structures, e.g. current bedding; while those formed in situ commonly show growth bedding.

Distribution and Occurrence

Carbonates are by far the only volumetrically important nonsiliciclastic sedimentary rock type. carbonate rocks make up about one-fifth to one-quarter of all sedimentary rocks in the stratigraphic record. They occur in many Precambrian assemblages and in all geologic systems from the Cambrian to the Quaternary. Most are marine, and thick sequences of carbonate rocks occur in all the continental blocks a surviving record of the transgressions and regressions of shallow marine (epeiric) seas that repeatedly blanketed the stable continental cratonic areas from time to time. Dolomite is the dominant carbonate rock in Precambrian and Paleozoic sequences, whereas limestone is dominant in carbonate units of Mesozoic and Cenozoic age
Modern marine carbonate sediments, whose formation is favored by warm, shallow water, are presently being deposited in a broad band straddling the Equator.

Classification of carbonates

Based on the environment of deposition, carbonates can be classed as
Shallow water marine deposits: although shallow water marine carbonates were very extensive in the geologic past they are today found in only a few places. The best known and largest occurrences include those of the Florida-Bahama region. The deposits include calcareous sands, both skeleton and oolitic, carbonate mud and reef carbonates. These deposits have accumulated in several distinct sub-environments like reef, tidal flat, open bank or shelf and sub-aerial dunes.

Deep sea carbonates: they belong to two classes: (a) Turbidite or basinal deposits; (b) Pelagic deep sea deposits. Turbidites, although less expensive, are more common in the geologic record. Pelagic carbonates, the most widespread lime deposits in the modern world, are poorly represented in the ancient record. The pelagic pterapod and globigerina oozes are the most wide spread deep sea carbonates, the latter much more widespread. Globigerina ooze accumulates at an average depth of 2000 meters, consisting mainly of planktonic foraminiferal tests. The carbonate content of ooze ranges from 30 to over 90 %, averaging 65%. These deposits are most abundant where salinity is highest, but are absent, however, where the ocean floor is deepest, apparently because the tests tend to dissolve in deeper, colder eaters. Carbonates are virtually absent below 6000 meters. Turbidites have a shallow water origin, but are deposited in basins some thousands of meters deep. Sediments of this type are associated with and derived from reefs and banks and transferred to the deep water environment by turbidity flows.

Fresh water sediments: these include tufa and travertine. Tufa is spongy, porous material that forms thin, surfacial deposits about springs and seeps, by the evaporation of water. Travertine is a dense, banded deposit, especially common in limestone caverns as stalactites and stalagmites, and forms relatively small deposits. Both are restricted mainly to recent or quaternary periods.

Evaporitic carbonates: these form minor accumulations of calcium carbonate associated with arid climates. Caliche (or calcrete) is the most widespread. This impure lime-rich deposit is found in the soils of semi-arid regions. Capillary actions draw lime bearing waters to the surface where, by evaporation, lime rich caliche is formed. Because it forms in regions of limited rainfall, it is an important climatic index.

Eolian carbonates: small deposits of carbonate sand debris from offshore reefs accumulate on beaches and in dunes associated with these beaches.

Mineral composition

Essential minerals in limestones include Calcite , Aragonite and Dolomite which is mostly a replacement product of Calcite or Aragonite.
Other minerals include Ankerite [$Ca(Fe,Mg,Mn)(CO_3)_2$], and Siderite [($FeCO_3$)].
Non carbonate minerals: Silica (Chalcedony), Feldspar And Clay Minerals.
Minor constituents such as Glauconite [$(K, Na)(Fe^{3+},Al, Mg)_2(Si, Al)_4O_{10}(OH)_2$], Collophane ($Ca_5(PO_4)_3.(OH,F,Cl)$) And Pyrite [FeS_2] may also occur in limestones

Texture

Limestones normally contain a variety of textural elements these include

Allochems: The coarse clastic constituents are referred to as allochems. These include Intraclasts, skeletal grains, ooids, and pellets.

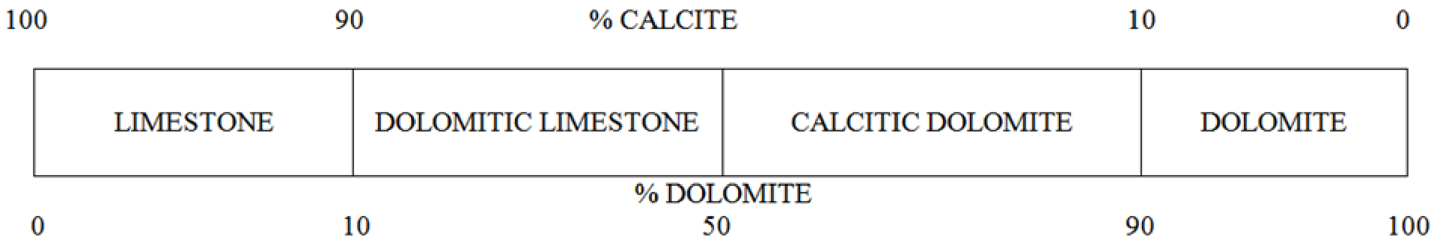
Skeletal grains: many kinds of marine invertebrates precipitate calcium carbonate to form their skeletons the remains of these normally broken hard parts give rise to skeletal grains in limestones.
Ooids: are nearly spherical grains consisting of a grain of calcareous or noncalcareous material serving as a nucleus around which successive layers or shells of calcium carbonate are precipitated or accreted while the particle is moved in flowing water that is supersaturated with respect to calcium carbonate.
Pellets: are rounded grains of very fine-grained aragonite and calcite, a few tenths of a millimeter to about a millimeter in size.
Intraclasts: are fragments of carbonate sediment, usually fine-grained, that was deposited and then later ripped up by strong currents to be redeposited with other carbonate sediment.
Micrit: The term micrite is used for the carbonate mud (microcrystalline calcite mud) which commonly is a matrix for larger elements.
Spar: The term spar is used for the sparry i.e. coarsely crystalline calcite cement.

Structures

Detrital limestones generally exhibit hydrodynamic structures such as Cross-bedded, Graded bedding, Small scale rippling, Sole markings which are commonly seen in clastic sedimentary rocks
One of the structures uniquely seen in limestones include
Stromatolites: These are large, layered structures built up by mats of cyanobacteria.
Structures such as nodular bedding are also seen, nodular bedding consisting of scattered to loosely packed nodules in matrix of like or unlike character.
Other structure seen in limestone is Stylolite. These are sedimentary structure consisting of a series of relatively small, alternating, interlocked, toothlike columns of stone. These are common in limestone.

Dolomites

Dolomite ($CaMg(CO_3)_2$) is another carbonate mineral, but *dolomite* is also the name for a rock composed of the mineral dolomite, although some geologists use the term dolostone to avoid confusion.
Dolomites are those varieties of limestone containing more than 50% carbonate, of which more than one half is dolomite.
Rocks intermediate in composition between limestone and dolomite have been variously named as limestone, dolomitic limestone, calcitic dolomite and dolomite shown if the figure below:



All of the dolomite found in ancient rocks has been formed through magnesium replacing some of the calcium in the calcite in carbonate muds and sands. This process is known as dolomitization, and it is thought to take place where magnesium-rich water percolates through the sediments in carbonate tidal flat environments.

Diagenesis of Carbonate rocks

During diagenesis of carbonate sediments, significant chemical and textural changes take place. e.g. Aragonite which is metastable is converted to more stable low-magnesiun calcite.

Replacement: e.g., Silicification and dolomitization, Silicification occurs early in diagenesis, at low pH and temperature, and contributes to fossil preservation. Diagenesis may include conversion of limestone to dolomite by magnesium-rich fluids.

Cementation is where new minerals stick the grains together.

As carbonate sediments are increasingly deeply buried under younger sediments, chemical and mechanical compaction of the sediments increases. Chemical compaction takes place by pressure solution of the sediments. This process dissolves minerals from points of contact between grains and redeposits it in pore space, reducing the porosity of the limestone. Pressure solution produces distinctive styolites, irregular surfaces within the limestone at which silica-rich sediments accumulate.

Dissolution: When overlying beds are eroded, bringing limestone closer to the surface, the final stage of diagenesis takes place. This produces secondary porosity as some of the cement is dissolved by rainwater infiltrating the beds.