

Comparative Analytical Studies of Crystalline and Noncrystalline Limestone of Bihar

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Limestone is an important raw material chemically known as a double carbonate of calcium and magnesium. There are two types of limestone found in Bihar. The first is the non-crystalline variety, whose origin is sedimentary. It is found in Rohtas area of Bihar in huge amount. The crystalline variety is of different nature. It has got a crystalline shape. It is found in Hazaribag, Ranchi and Palamau Districts. According to geochemistry it is believed that crystalline limestone is a product of alteration of basic rocks. These basic rocks are dark coloured, hard and contain muscovite, biotite, horn blende and quartz. These basic rocks are host country rocks and it is believed that crystalline limestone of these areas is an alteration product of the same due to high grade metamorphism. However a comparative analytical study has been carried out in this paper to throw light on the genesis of these two types of limestone. Moreover, the limestone of Hazaribag is not used extensively. The utilisation aspect shall also be studied here.

INTRODUCTION

Limestone is an industrial material of alkaline earths. It has got widespread use in various industries like cement, iron and steel, sugar, chemical and glass industry, etc. According to Bates and Jackson¹ limestone is a sedimentary rock consisting chiefly of calcium carbonate primarily in the form of the mineral calcite with or without magnesium carbonate. The standard quantified definition tells us that limestone contains 95% calcite and less than 5% dolomite. Limestones are formed either by organic or inorganic process and may be detrital, chemical, oolitic, earthy crystalline or recrystallised. Many are highly fossiliferous. According to a most recent statement it is probable that most calcitic limestones are of organic origin because biogenic limestones are more common than the limestone formed by inorganic processes.

According to the renowned geochemist Rankama², calcitic limestone may contain more than 90% CaCO₃ along with highly siliceous sediments. Rankama *et al.*² advocate that calcium unlike magnesium is usually unstable to crystallise from rock melts in the form of simple orthometallic silicates. A calcium carrier is the mineral anorthite in organic rocks. The nonsilicate minerals of calcium are

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calcite (CaCO_3), dolomite $\text{CaMg}(\text{CO}_3)_2$, gypsum $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$, anhydrite CaSO_4 , fluorite CaF_2 . Among³ the better known minerals are calcite, limestone, Iceland spar, dolomite, anhydrite, gypsum, fluorite, fluorspar and apatite. Calcium is found in nearly all mineral springs, artesian wells and river water, principally as bicarbonate and oxalates. It occurs in plants as phosphate and in the bones of animals. It is an essential constituent of many rocks forming minerals.

EXPERIMENTAL

A few samples were collected from Banjari areas of Rohtas, Bihar and some samples were also collected from Patratou area of Hazaribag and Chuttupalu area of Ranchi, Bihar. Analyses were carried out using complexometric titration method and indicators employed were Patton reeder indicator and erichrome black-T. Crystalline limestones were also taken to make thin sections. These thin sections were subjected to optical microscopic studies to identify by different spectrophotometric methods using methyl thymol blue.⁴⁻⁶

ANALYTIC DATA (PARTATAU AREA):

Sample no.	SiO ₂ and other insolubles	CaO	MgO	R ₂ O ₃	LOI
1.	25.0	35.0	5.5	4.5	32
2.	19.0	42.0	3.0	3.0	37
3.	18.5	45.0	3.0	3.5	37
4.	17.5	32.5	7.5	3.5	32
5.	20.5	30.5	7.7	3.5	30
6.	19.0	30.5	8.5	4.1	30

Inference: Crystalline limestone.

ANALYTICAL DATA (CHUTTUPALU AREA)

Sample no.	SiO ₂ and other insolubles	CaO	MgO	R ₂ O ₃	LOI
1.	24.90	41.40	0.40	2.00	32.00
2.	—	43.68	2.40	—	—
3.	10.01	48.16	1.23	2.69	38.10
4.	19.46	44.80	1.20	0.50	34.10
5.	19.50	43.30	1.20	1.00	34.30
6.	25.50	40.89	1.20	2.00	31.20
7.	20.64	43.10	1.60	1.50	35.51
8.	5.23	50.40	0.70	1.89	42.56
9.	11.70	48.10	2.80	1.50	37.00
10.	16.80	45.30	1.60	1.50	35.00

Inference: Crystalline limestone.

ANALYTICAL DATA (BANJARI, ROHTAS AREA)

Sample no.	SiO ₂ and other insolubles	CaO	MgO	R ₂ O ₃	LOI
1.	14.5	45.5	5.5	3.0	39.5
2.	16.2	46.1	2.5	2.5	36.5
3.	17.1	47.1	2.5	2.5	39.5
4.	13.5	46.5	2.0	2.5	35.0
5.	15.6	48.5	3.0	2.0	39.0
6.	5.50	49.5	3.5	3.0	40.0
7.	5.00	50.0	1.5	3.0	40.0
8.	4.50	50.0	1.5	3.0	40.5
9.	3.00	49.5	2.0	2.0	39.5
10.	2.50	51.5	0.5	1.5	39.5

Inference-Cement grade limestone (non-crystalline variety)

Microscopic studies of thin sections of crystalline limestone

Areas Hazaribag, Ranchi, (Bihar)

Megascopic The rock is greyish white in colour, medium grained, hard and compact. Dilute HCl gives effervescence.

Microscopic The rock is medium grained, crystalloblastic in texture. The slide shows presence of anhedral calcite in major amount quartz and diopsides are in minor amounts.

Inference Crystalline limestone.

Area Hazaribag

Megascopic The rock is greyish white in colour, hard and compact. Dilute HCl produces effervescence which indicates the presence of carbonates

Microscopic The rock is medium grained crystalloblastic in texture. The minerals recognised are predominantly calcite; other minerals recognised are quartz and sphene.

Inference Calcium silicate rock.

Areas Karmajara (Gola Hazaribag)

Megascopic The rock is greyish white in colour, medium grained. It gives effervescence with dilute HCl,

Microscopic The rock is medium grained, crystalloblastic texture. It is full of calcite minerals (colourless, cleavage perfect and rhombohedral, polysynthetic; a few pieces of dolomite, quartz, tremolite, diopside are also seen.

Inference Crystalline limestone.

Discussion on crystalline limestone of Hazaribag, Ranchi, Palamau, Dhanbad, Munger (Bihar)

In the light of the above chemical and petrological data, it is quite obvious that there is a difference between the chemical composition of crystalline and noncrystalline limestone. The noncrystalline limestone is of sedimentary origin. It is found in Rohats areas.⁷⁻¹⁰ It extends towards U.P. in the west and from Ramdihra, Sasaram (Bihar) to Kaimur hills in the east. The limestone deposits are used in cement industry. The crystalline varieties of Hazaribag are generally fine grained and contain silica. It is also mixed with dolomite. Hence the origin and genesis of crystalline limestone is quite different from noncrystalline limestone. Trace element studies and differential thermal analysis shall reveal more information regarding their origin. Presently M/s Durga Cement Ltd. Ramgarh is utilising it as blending material.

Discontinuous small lenticular bands of crystalline limestones are found associated with calcareous phylites and calcium silicate rocks belonging to the Archean age in parts of Hazaribag, Ranchi and Palamau districts, forming a discontinuous zone extending westward from near Degodih ($22^{\circ}28' : 85^{\circ}52'$) of Gola through Ramgarh, Bhurkunda and Patratau within Hazaribag district to Khelari, Ray area in Ranchi district and again further west in Palamau district from Demu, Nareshgarh near Latehar to near Daltonganj in the west

The deposits^{11, 12} in Hazaribag, Ranchi and eastern parts of Palamau are low in magnesia but slightly high in silica content, The deposits of Ray and Khelari areas in Ranchi district are being utilised for cement manufacturing by A.C.C Limited after sorting and blending so as to maintain 14% silica, 45-50% CaO and 3% MgO. If we go further west, the limestone becomes more dolomitic and is no longer suitable for cement.

General Remarks

The most important limestone deposits in Bihar are associated with Vindhyan group of rocks which are found in western Shahabad and Palamau districts (High grade limestone useful as flux in steel and cement industry). Some deposits of crystalline limestone are also found associated with the older (Archean) rocks in Hazaribag, Ranchi, Munger and Palamau districts (deposits are small and vary in grade and are of dolomitic nature). Fine grained noncrystalline limestone is also found within the Kolhan series of rocks in the locality of south of Chaibasa (Singhbhum) extensively used as better raw material for A.C.C. cement plant at Jhikpani (though it is dolomitic in nature). Some impure limestone deposits are also found in Shivaliks of Champaran district (Bihar).

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