International Research Journal of Earth Sciences _____ISSN 2321 – 2527
Vol. **13(2),** 1-6, August **(2025)** *Int. Res. J. Earth Sci.*

Limestone Deposits of Gratabal and Saderkote, Kashmir, India

Mohsin Noor*and Feroz Ah. Jagoo
Department of Geology and Mining, Srinagar-190018, India
noormohsin0@gmail.com

Available online at: www.isca.in
Received 29th November 2024, revised 20th May 2025, accepted 8th June 2025

Abstract

The Gratabal and Saderkote limestone belt falling under the administrative control of District Ganderbal and Bandipora, Kashmir, India was taken up for the reconnaissance mapping during the Annual Geological Field Programme 2023-2024 over an area of 50 square kilometers on 1:50000 scale with collection of 50 numbers of Bedrock samples for assaying purposes. The main objective of the present investigation was to delineate different limestone bands, for determination of grade and their suitable use in allied industry. The Gratabal and Saderkote limestone outcrop, forms the northeastern part of Kashmir Basin wherein Palaeozoic to Quaternary rocks of diverse origin are exposed. The main stratigraphic units constituting the bedrock and the surrounding mountains ranges include the Panjal Volcanics of Late Carboniferous age and Limestone of Late Triassic age, which are exposed eastwardly all along the hilly tract and constitutes the eastern slope of the study area running in north northwest to south southeast direction, dipping gently towards northwest. The Gratabal and Saderkote limestone outcrop is unconformably overlain by the alluvium of Recent to Sub-Recent age. The Saderkote Limestone outcrop, lies in the interior part of Dudh Nar and Gujar Nar valley which is about 3 kilometers long and 6 kilometers wide valley, whereas, the Gratabal Limestone outcrop, lies in the interior part of Bod Nar valley which is about 3 kilometers long and 1.2 kilometers wide valley. The principle rock of the study area is comprising of limestone, with occasionally interbedded dolomitic/magnesia bands observed at Gratabal, Ganderbal. The limestone is generally dark grey to bluish grey in colour, massive and thick bedded. Structurally, the limestone deposit strike north east – south west with dip amount ranging between 25 to 43 degrees due northwest. In order to assess the qualitative nature of the Gratabal and Saderkote limestone deposits for its suitability in the industrial sector, 50 numbers of bedrocks samples, i.e., 20 no's from Gratabal and 30 no's from Saderkote were collected from different lithological units along the dip direction of the deposit for assaying purposes. From the perusal of geochemical analysis of bedrock samples of Saderkote limestone outcrop, it is revealed that the Saderkote limestone is of cement grade, however, the Gratabal limestone reveals high content of Magnesia.

Keywords: Reconnaissance mapping, Kashmir basin, Limestone, Grade, Allied Industry.

Introduction

The study area is falling under the administrative control of District Ganderbal and Bandipora, comprising the foothills of Khrushu (3138 m) and Tragbal (3279 m) mountain range trending south-east to north-west in direction. The area under investigation is bounded by the geographical coordinates between latitudes 34°15′00″ to 34°19′00″ North and longitudes 74°39′00″ to 75°43′00″ East, covered by Survey of India (S.O.I) topographic map bearing reference no 43 J/11 (Scale 1:50000) [1,2]. The study area is approachable by means of 25kilometer long Srinagar-Ganderbal metallic road from Regional Headquarters Srinagar. The topography of the area is extremely rugged and is characterized by high peaks and precipitous slopes. The surface elevation ranges from 1594 meters to 3138 meters above mean sea level[3]. The area is drained by Bod Nar Stream on the south-eastern side while as north-western side is drained by Gujar Nar, Dudh Nar and Margi Gul Streams. Many seasonal nallas emerging from the snow fed mountain peaks of Khrushu (3138 m) and Tragbal (3279 m) which gush forth fresh surface water during summers as a part of snow melt.

The Bod Nar, Gujar Nar and Dudh Nar flows in the east-west direction while as the Margi Gul stream, flows in the southeast - northwest directions with a total longitudinal distance of 4.5 kilometers before entering the valley[1,2].

Geological Setup of the Study Area: The Kashmir Basin (KB) representing a complete tectono-stratigraphic sequence of marine Phanerozoic aeon which is bounded by two linear mountain ranges - the Pir Panjal Range (PPR) and the Zanaskar Range (KR) trending northwest-southeast in direction[4]. It contains one of the finest developments of the stratigraphic succession right from Proterozoic to Recent. The Gratabal Spur and Saderkote limestone outcrop, forms the northeastern part of Kashmir Basin wherein Palaeozoic to Quaternary rocks of diverse origin are exposed[2]. The main stratigraphic units constituting the bedrock and the surrounding mountains ranges include the Panjal Volcanics of Late Carboniferous age and Limestone of Late Triassic age, are exposed eastwardly all along the hilly tract which constitutes the eastern slope of the study area running in North Northwest to South Southeast direction and dipping gently towards North Northwest.

The Gratabal and Saderkote limestone is unconformably overlain by the alluvium of Recent to Sub-Recent age lies in terraces at various levels comprising of typical chocolate brown clays with kankar concretions, liberally distributed through them. The limestone outcrops in the area exhibit a thickness exceeding 100 meters, as reported by Mohsin Noor [3]. The outcrops strike northeast-southwest and dip gently at an angle of 30-35° northwest, indicating moderate tectonic influence. The investigations culminated in the preparation of a surface geological map of the Gratabal and Saderkote Limestone (Figure-1).

Table-1: The stratigraphic sequence of the geological Formations found in the study area is tabulated as under.

Recent to Sub-Recent	Alluvium unconformity
Lt Triassic	Limestone, dark grey to bluish grey in colour, massive and thick bedded *(Gratabal and Saderkote Limestone)*
Panjal Trap *(Lt Carboniferous)*	Basic, thickly bedded lava flows in upper parts with thinly bedded andesitic lava flows in basal parts.

Materials and Methods

To facilitate surface geological mapping of the Gratabal and Saderkote Limestone blocks, the authors initially consulted Survey of India topographic maps (43J/11 and 43J/12, Scale 1:50,000) to delineate the study area. Subsequent mapping employed Google Earth imagery, ASTER 30 digital elevation models (DEMs), and Global Mapper software (v. 22) to generate map attributes. To assess the suitability of Gratabal and Saderkote limestone deposits for industrial applications, 50 bedrock samples (20 from Gratabal and 30 from Saderkote) were collected along the dip direction from various lithological units. These samples underwent geochemical analysis for CaO, MgO, SiO_2, Al_2O_3, Fe_2O_3, and Loss On Ignition (LOI)[3]. Field measurements utilized a hand lens and measuring tape to record limestone bed thickness. Resource categorization allocated 30% of the total determined resources to the proved reserve category, with the remaining resources assigned to probable and possible reserves.

Results and Discussion

Geochemistry of Limestone blocks*:* In order to assess the qualitative nature of the Gratabal and Saderkote limestone deposits for its suitability in the industrial sector, 50 numbers of bedrocks samples, i.e., 20 no's from Gratabal and 30 no's from Saderkote were collected from different lithological units along the dip direction of the deposit for assaying purposes. The chemical analyses of the bed rock samples of Gratabal limestone block is detailed as under in the form of ternary diagram (Figure-2) showing the average wt. % age of major oxides. Most of the samples were demonstrated as CaO, MgO and SiO_2 with 81.12, 14.66 and 4.21 respectively. In this regard, the main calcite mineralogy of the carbonate rocks was detected based on the ternary diagram plot of CaO-MgO-SiO_2 compositions[5].

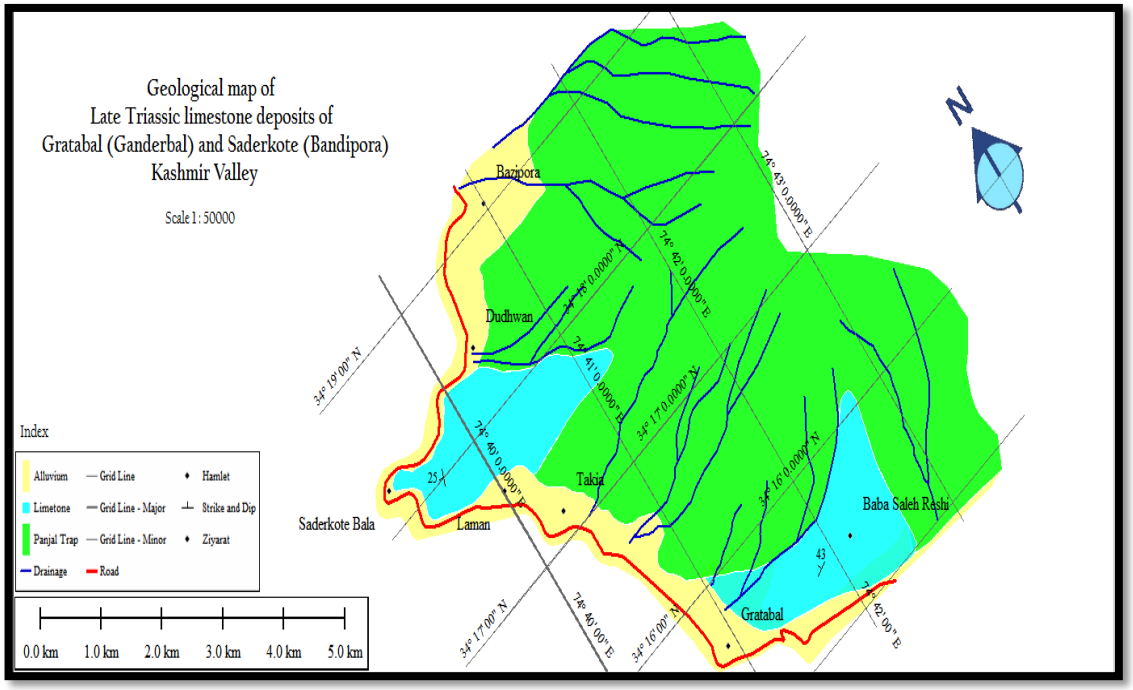

Figure-1: Surface Geological Map of Gratabal and Saderkote Limestone.

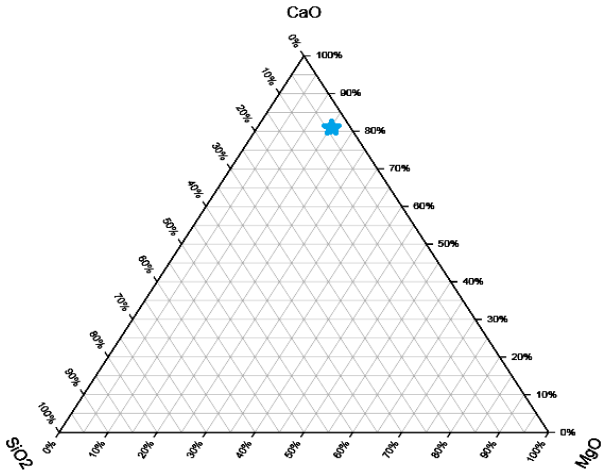

Figure-2: Chemical analyses of the bed rock of Gratabal limestone block.

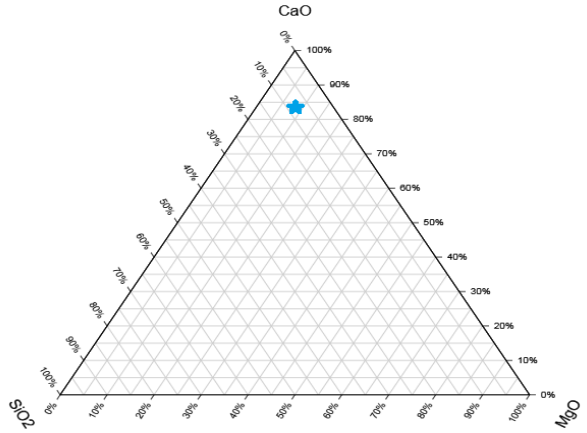

Figure-3: Chemical analyses of the bed rock samples Saderkote limestone block.

The chemical analyses of the bed rock samples Saderkote limestone block is detailed as under in the form of ternary diagram (Figure-3) showing the average wt % age of major oxides. Most of the samples were demonstrated as Cao, MgO and SiO_2 with 84, 7.74 and 8.26 respectively. In this regard, the main calcite mineralogy of the carbonate rocks was detected based on the ternary diagram plot of CaO-MgO-SiO_2 compositions. The geochemical results (Table-2) show that the limestone from the Saderkote block is of good quality, indicating its potential use as a raw material for clinker manufacture.

According to the Bureau of Indian Standards (BIS)[6], New Delhi, the limestone blocks of Saderkote meet the requirements for Cement Grade-II, as outlined in Table-3.

The National Council for Cement and Building Materials (NCCBM)[7], New Delhi, recommends the following broad chemical specifications for Cement Grade Limestone (Run-of-Mine) used in cement manufacturing, as presented in Table-4.

Table-2: Geochemistry of Gratabal and Saderkote Limestone Blocks.

Geochemical Parameters	Gratabal	Saderkote
CaO	44.268	46.6
MgO	7.895	4.3
SiO_2	2.302	4.6
Al_2O_3	0.87	1.7
Fe_2O_3	0.7195	1.1
L.O.I	43.441	41.6
Grade (As per BIS)	Not suitable	Cement Grade

Table-3: Limestone blocks of Saderkote.

Constituents	Grade-I (%)	Grade-II (%)
CaO	53(min)	44(min)
MgO	1.5(max)	4(max)
SiO_2	1.5(max)	6(max)
Total Acid Insoluble (TAI)	2(max)	10(max)
Alkali Content	0.2(max)	0.2(max)

Table-4: Chemical specifications for Cement Grade Limestone.

Oxide component	Acceptable range for manufacturing of cement (%)	Limiting values, scope of Beneficiation and blending (%)
CaO	44-52	40(min)
MgO	3.5(min)	5.0(max)
SiO_2	Tosatisfy LSF, Silica	-
Al_2O_3	Modules and alumina	-
Fe_2O_3	Modules	-
Free Silica	<8	<10
TiO_2	<0.5	<1.0
Alkalies	<0.6	<1.0
Total S as SO_3	<0.6	<1.0
Mn_2O_3	<0.5	<1.0

Resources and Reserves of Limestone Blocks: A comprehensive evaluation of the limestone blocks was conducted through integrated surface geological mapping, geological cross-sections (Figure-4a,4b,4c), and geochemical data analysis to determine their potential reserves and resources[8-10].

Methodology and Assumptions: i. Reserve and resource calculations considered sampled points, bed thickness, continuity, and area of influence. ii. Measurements for length, width, and thickness were recorded in meters. iii. A density of 2.5 was assumed for limestone tonnage calculations. iv. Tonnage was calculated using the formula: Tonnage = A × T × D, where A is the sectional area, T is thickness, and D is density[11].

Reserve Calculations: The computed reserves are presented in Table-5.

Table-5: Reserve Calculations.

Block No	Block Name	Sectional Area (A) sq. m	Thickness (T)	Density (D)	Tonnage
1.	Gratabal	350000	3	2.5	2.63 million
2.	Saderkote	800000	3	2.5	6 million

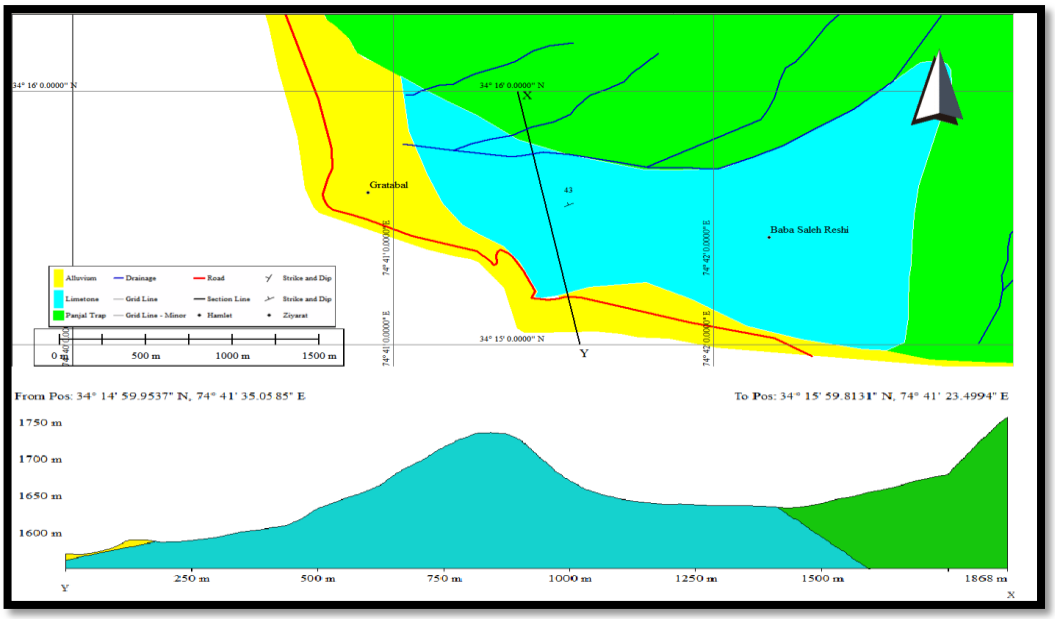

Figure-4a: Geological Cross-Section of Gratabal Limestone along Y-X.

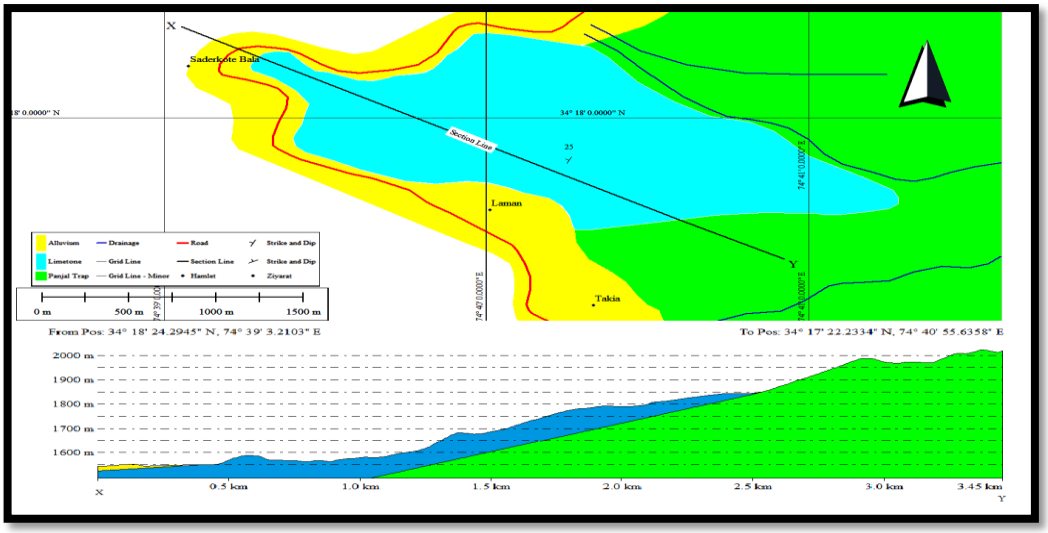

Figure-4b: Geological Cross-Section of Saderkote Limestone along X-Y.

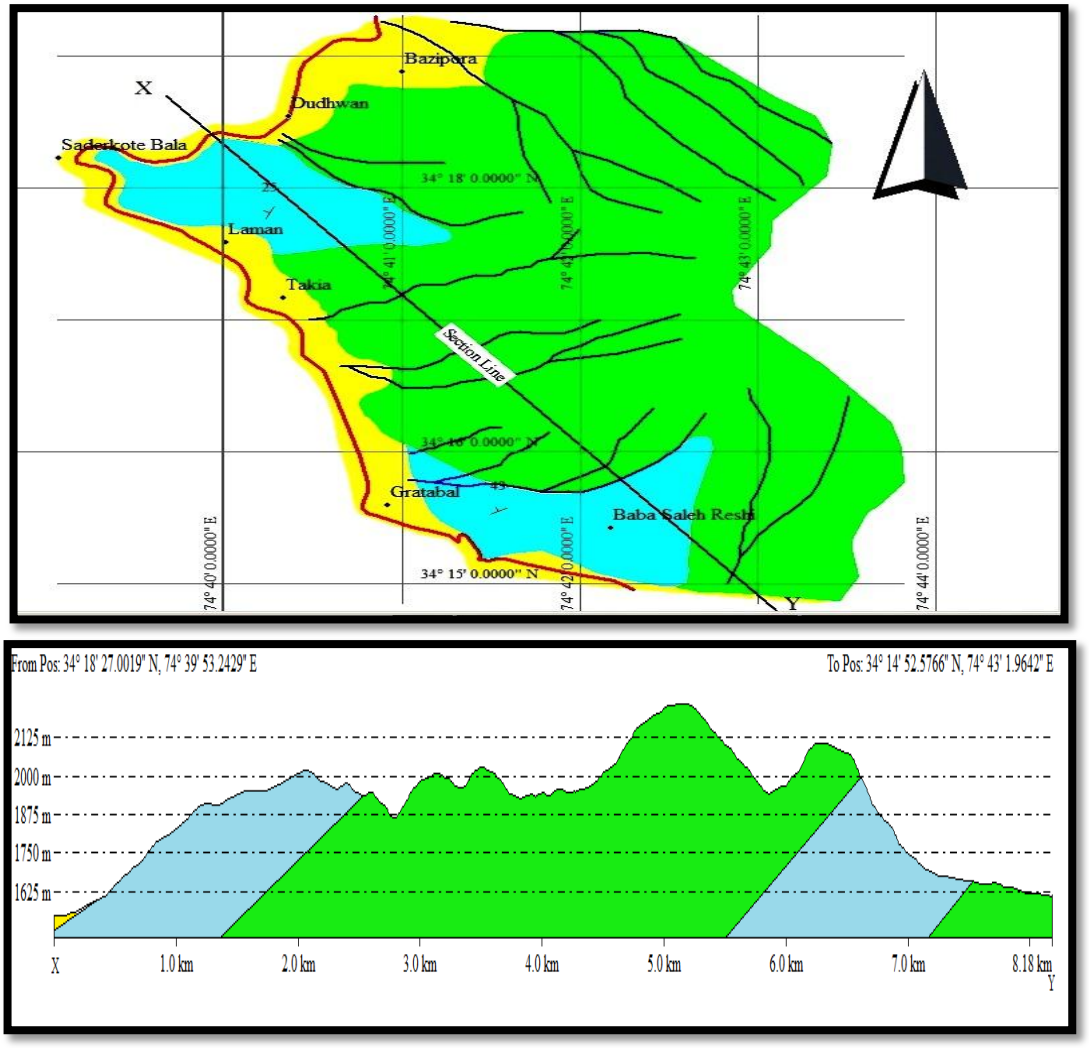

Figure-4c: Geological Cross-Section of Gratabal and Saderkote Limestone along X-Y.

Conclusion

A comprehensive evaluation combining surface geological mapping and geochemical analysis of surface samples successfully determined the grade and tonnage of the Saderkote limestone block. Geochemical results confirmed the limestone's commercial viability, adhering to cement industry standards as outlined by the Bureau of Indian Standards and the National Council for Cement and Building Materials, New Delhi.

Quality-based reserve estimation yielded 6 million tons of proved limestone reserves within 3 meters of the surface at Saderkote. In contrast, the Gratabal limestone deposits were found to have elevated magnesia levels, rendering them less suitable for cement production[12].

References

1. Mohsin Noor (2018). District Survey Report Ganderbal. Department of Geology and Mining, Srinagar. (Unpublished Report).

2. Mohsin Noor (2018). District Survey Report Bandipora. Department of Geology and Mining, Srinagar. (Unpublished Report).

3. Mohsin Noor and Sarafraz Shaban (2019). Limestone deposits of Saderkote Bandipora Kashmir. *International Journal of Scientific Research in Engineering and Management*, 3(7).

4. Mohsin Noor (2020). Landslide Hazard Zonation Mapping of Aragam, Erin and Bandipora. *International Research Journal of earth Sciences*, 8(2), 22-30.

5. Mansouri Daneshvar, M. R., & Pourali, M. (2015). Hydrogeochemical and geomorphological investigation of travertine deposition in the Garab Spring region, NE Iran. *Sustainable Water Resources Management*, 1(3), 253-262.

6. BIS (2004). Flux Grade limestone for use in Iron and Steelmaking – Specification. Second Revision by Bureau of Indian Standards (BIS), New Delhi, India. IS10345.

7. IBM (2013). Lime stone and other calcareous Minerals. 52nd Ed, Indian Mineral Yearbook 2013 (Part III: Mineral Review) Indian Bureau of Mines (IBM), Nagpur, India.

8. Mohsin Noor (2021). Cement and Flux Grade Limestone Blocks of Mallapura-Dudwan Area of Gund Saderkote Bandipora Kashmir India. Al Hajar Magazine Geological Survey of Oman, Issue/Vol. 30th April 2021, page 28.

9. Stephan Marshak and Gautam Mitra (1988). Basic Methods of Structural Geology. Part-I and Part-II, Elementary Techniques. Prentice Hall, Eaglewood Cliffs, New Jersey 07362.

10. Woodward, N. B., Boyer, S. E., & Suppe, J. (1989). Balanced geological cross-sections. *Short course in geology*, 6, 132.

11. GSI (1975). Manual of Mineral Exploration. Miscellaneous Publication No. 33. Geological Survey of India, 1975.

12. Mohsin Noor and Feroz Ahmad (2024). Reappraisal of Limestone Deposits for identifying Geological Potential Area in District Ganderbal and Bandipora, Kashmir, Union Territory of Jammu and Kashmir. Department of Geology and Mining, Srinagar. (Unpublished Report).