

SCIENCE | ENGINEERING | TECHNOLOGY

e-ISSN: 2319-8753 | p-ISSN: 2347-6710

EDIA

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 10, October 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.569

9940 572 462

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| e-ISSN: 2319-8753, p-ISSN: 2347-6710| <u>www.ijirset.com</u> | Impact Factor: 7.569|

Volume 10, Issue 10, October 2021

DOI:10.15680/IJIRSET.2021.1010089

Significance of Geological Events in the Kangerdhara area with Special Reference to the Development of Kotamsar and Dandak Cave

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ABSTRACT: In the present study Kanger Dhara area of Bastar region has been taken into consideration with a view to study that does the Kanger Dhara area have any implication on the Development of Kotamsar and Dandak cave? To find out the significance of geological events which took place in the Kanger Dhara Area, detailed field investigation carried out in the area. Structural signatures responsible for the development of exotic caves in the nearby surroundings were also collected. There are thick carbonate rocks present near the surface. Intrusive bodies, fold, faults and joints are also observed in the area. The study area is mainly occupied by Meso Neo Proterozoic plate of Indravati Basin. Presence of sandstone pieces inside the Kotamsar and Dandak cave indicates that provenance was uplifted and weathering and erosional activities took place and Tirathgarh sandstone which is the lowest member of the Indravati basin moved in the downstream direction, where subterranean flow was taking place in the Kotamsar and Dandak caves and these broken pieces were deposited.

KEYWORDS: Karst topography, Speleothems, Palaeo geography

I. INTRODUCTION

There are thick carbonate rocks at or near the surface, in the study area. Presence of joints, movement of surface water upon the surface of exposed carbonate rocks and migration of surface water along the planes of weaknesses to the subsurface and pronounced solution activity is observed. All of these ultimately lead to sub terranean turbulent flow and formation of gigantic chambers and exotic structures. In the later stages shifting of underground stream to close by region and tickling down of ground water through joints and formation of exotic speleothems is very well preserved in this region. Isolated hillocks of carbonate rocks i.e., Hums indicate the earlier extension of lime stone rocks in the entire region. Apart from that, it has also been noticed intrusive bodies, folds, faults and joints. Indravati Basin usually does not show these kinds of structural peculiarities in most parts of the basin. Tirathgarh Sand stone, Cherakur shale and sandstone, Kanger lime stone and Jagdalpur shale and dolomite members are usually undisturbed and undeformed and very gently dipping, but in this region these members are highly disturbed. Study area covers the toposheet No. 65 I/4 of the Kanker Dhara region. The coordinates of Kanger Dhara regionare N 18°52.449', E081°55.415 and it lies at altitude of 475 m. above sea level. Geological features which played important role in the development of Karst topography in the region are: 1. Igneous intrusive activity near Kanger Dhara, 2. Kanger Dhara fault, 3. Folds near Kanger Dhara, 4. Joint near Kanger Dhara. (Jha, A.S,2015)

II. METHODOLOGY

Detailed geological mapping at the Kanger Dhara and adjoining areas was done because this region has very peculiar geological structures. In our opinion these structures have significant role in the development of the topographical features in this Kanger valley region. To accomplish this objective, we have done very detailed geological mapping in the 1:200scale. During field work, we have identified indication of intrusive activities which are responsible for the evolution of very interesting and exclusive topography of this area. We have identified several folds, joints, fault and intrusive bodies. We also mapped several joints and tried to establish their relationship with the stress prevailed during the geological past. We have also made an effort to prepare palaeogeographical reconstruction of the area.

For the proper information of the ancient land form and processes involved our team has collected some valuable information, these findings may help to know much about the palaeogeography and developmental processes of the past.(Paul, W., 2008)

International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET)

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Volume 10, Issue 10, October 2021

DOI:10.15680/IJIRSET.2021.1010089

III. INDRAVATI BASIN

The Late Proterozoic (approximately 570 to 880 million of year back) to Intra-cratonic Indravati basin has a roughly concentric distribution of ortho-quratzite –shale –carbonate suite resting non-conformably on the Archaean granitic (Granite is a coarse-grained igneous rock consisting essentially of quartz, alkali feldspar and mica) terrain of the Central Indian Craton. (Pati, A.K., 2002)

Litho-stratigraphic analysis of the 500 m thick, flat –lying sediments have favoured a fourfold classification of the Indravati Group in to Tirathgarh and Cherakur formation, Kanger limestone and Jagdalpur formation in the ascending order. The Tirathgarh formation is divided into a lower Mendri Member (basal arkose and conglomerate) and an upper Chitrakot sandstone Member (quartz arenite).Cherakur Formation encompasses a shale sand stone facies derived from a modified definition of the older lithologic units. Kanger limestone is broadly divisible into three informal units of lower, middle and upper..(Guhey, R., 2017) Jagdalpur formation is predominantly shaly with stromatolitic (Stromatolytes are organosedimentary structures; they were formed in the Indravati Basin during Neo-proterozoic period 1100-700 million years back, when this portion was occupied by shallow sea water. Intertidal palaeo-environmental condition favored the luxuriant growth of blue green algae, favored the formation of massive stromatolytic features in this region.) dolomite mounds of the Machkot Dolomite Member. (Shah, R.A., 2018)

These lithologies are grouped into five sedimentary facies representing a shallow shelf with relict shoreline facies, near shore heterolithic facies and carbonate platform facies, finally culminating in a muddy to carbonate tidal flat. Inter tidal environments have not yet been demonstrated for the lower terrigenous classics of Indravati Group. Pro-grading shelf to shore profile typical of the modern beach face was also not identifiable. These sedimentary facies, therefore, favour a shallow shelf sea depositional model for the Proterozoic Epeiric Basin. The Indravati and Sukma basin represent faulted and eroded remnants of the Bastar Chattisgarh Super Basin. It links with the Purana basin of Cuddapah, Kaladgi and Pakhal remain to be explored. This super basin appears to have evolved by crustal down warping associated with the anorogenic thermal event of the continent around 800 Ma after the ressation of the Satpura Cycle. (Sankhyan, A.R, 2011)

LITHOSTRATIGRAPHY

In the present state of stratigraphic knowledge of Indravati basin, however, it is expedient to adopt a more flexible approach, keeping in view the fundamental guiding principle of nomenclatural stability and clarity of defined units, while leaving sufficient room for later detailed classification. The current stratigraphic revision is backed by the geological map of the entire basin (Fig. 2). (Ramakrishna, M.,1987)



LOCATION OF THE INDRAVATI BASIN (Geological map of India, 1988)

GEOLOGICAL MAP OF THE INDRAVATI BASIN

e-ISSN: 2319-8753, p-ISSN: 2347-6710 www.ijirset.com | Impact Factor: 7.569



Volume 10, Issue 10, October 2021

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Table 1 : Stratigraphic Knowledge of Indravati Basin

STRATIGRAPHICAL COLUMN OF INDRAVATI BASIN						
Jagdalpur Formation(200m)-	Purple shale with purple and grey stromatolitic dolomite (Machkot Dolomite Member).					
Kanger Limestone (150-200m)-	Purple limestone and shale Grey limestone					
Cherakur Formation-	Purple shale with arkosic sandstone, chert, pebble, conglomerate, grit					
Tirathgarh Formation-	 Upper Member-Quartz arenite (Chitrakot Sandstone Member) Lower Member - Subarkose and conglomerate (Mendri Member) 					
Granite and Supracrustals						

KOTAMSAR AND DANDAK CAVE

Kotamsar and Dandak caves are situated near the bank of Kanger River, a tributary of Kolab River. The nearest village is Kotamsar village nearly 38 km away from the Jagdalpur city of Chattisgarh state of India. The coordinates of Kotamsar Cave are N18°52.229', E081°55.971' (WGS84) and it lies at an altitude of 524 m. above sea level. The coordinates of Dandak cave are N18°51.890', E081°56.255' and it lies at an altitude of510 M. above sea level. (Gautam, P.K., 2014)

Both the caves represent very beautiful Karst topographical features.

Our main objective is to study the conditions which favoured the development of both the caves in this region and the role of the geological events which took place in the close proximity i.e., in the KangerDhara water fall area. Structural signature and related intrusive events in the Kanger Dhara water fall area were collected.

SPELEOTHEMSENTRANCE OF DANDAK CAVE





| e-ISSN: 2319-8753, p-ISSN: 2347-6710| <u>www.ijirset.com</u> | Impact Factor: 7.569| || Volume 10, Issue 10, October 2021 || | DOI:10.15680/LJIRSET.2021.1010089|

THE ROOF PENDANTS IN THE DANDAK CAVE





GEOLOGY AT THE KANGER DHARA

The, shale with sandstone/siltstone intercalated, conformably overlying the Tiratgarh sandstone is presently included under the separate unit of Cherakur Formation. As originally defined by Ramakrishanan and Dutta (1970), the lower boundary of Cherakur Formation was marked by a quartz-chert pebble conglomerate within purple shales. Recurrence of similar pebble beds at vertical intervals and its lateral impersistence have reduced its stratigraphic value, and hence the lower boundary is now shifted to the top of Tiratgarh Orthoquartzite. The Cherakur Formation as presently defined includes the Kapari Shale underlying the chert-pebble conglomerate, Cherakur Sandstone, and the overlying Lohanliguda Shale of Ramakrishnan etal (1987). A full complement of lithologies of this formation is exposed in the Cherakur type area as well as in the northern part of the basin. In the remaining part of the basin, this formation tapers out into thin shale unit. This persistent lithic unit, which was given the status of a member (Upper Member of Tiratgarh Formation by Sharma (1975), now stands promoted to Cherakur Formation. The arenaceous facies of Indravati Group does not extend upward of this formation. (Thornbury, W.D., 1986)

KangerDhara Water Fall is in the Cherakur Formation

Kanger Dhara is very close to the Dandak and Kotamsar Caves. Kanger Dhara fall is small but magnificent. Kanger Dhara waterfall was formed by a profound violent event which took place in the geological past as a result of which silicic magnatism took place and the overlaying shale got deformed.

Here we can observe different kinds of folding (Small domes, basins, similar folds, symmetrical, asymmetrical folds, plunging antiformal and Synformal folds) joint patterns and mild metamorphism of shale.

The reason for the formation of the Kanger Dhara fall is most probably silicic magmatism accompanied by seismic activity in this region.



CHERAKUR SAND STONE AND SHALE RESTING OVER THE SILICIC INTRUSIVE BODY

| e-ISSN: 2319-8753, p-ISSN: 2347-6710| <u>www.ijirset.com</u> | Impact Factor: 7.569|



Volume 10, Issue 10, October 2021

DOI:10.15680/IJIRSET.2021.1010089

• STRUCTURAL FEATURE AT KANGER DHARA AND THEIR SIGNIFICANCE

S. No.	BRUTON LOCATION	FOLD TYPE	FOLD AXIS		FOLD LIMB		LIMB AMOUNT		FOLD AXIS LENTH
			DIRECTION	PLUNGE	1	2	1	2	
1.	A -110 B -269	Plunging Anticline	55*-235*	15*	330*	145*	21*	19*	2.0 m
3.	A -115 B -252	Anticline	10*-190*		100*	280*	30*	41*	1.40 m
4.	A -120 B -245	Plunging Syncline	350*-170*	28*	260*	80*	49*	44*	1.80 m
5.	A -115 B -245	Asymmetrical Synformalfold	20*-100*		290*	110*	62*	25*	1.85 m
6.	A -125 B -240	Asymmetrical Synformalfold	5*-185*		275*	95*	45*	35*	1.60
8.	X - 130 Y -158	Asymmetrical Antiformal fold	270*-90*		183*	253*	33*	90*	24 m
7.	A-165 B-245	Dome			285* 39*	105* 219*	24* 9*	8* 15*	7.
8.	A -135 B -235	Asymmetrical Antiformal fold	160*-240*		250*	70*	75*	10*	3.2 m
9.	A -135 B -230	Symmetrical Synformalfold	315*-135*		225*	145*	45*	46*	3.0 m
10.	A -135 B -235	Dome			80*	260* 355*	13* 0*	12*	10.
11.	A -125 B - 220	Doubly Plunging Antiformal fold	185*-5*	185*/6*	275*	<u>95*</u>	23*	36*	8.0 m
12.	C -58 D -308	Plunging AsymmerticalSynformal fold	355*-175*	355*/11*	265*	85*	62*	36*	10.40 m
13.	C- 62 D -307	Plunging Antiformal fold	359*-179*	359*/11*	269*	89*	40*	51*	9.0 m
15.	A -135 B -250	Plunging Antiformal fold	123*-303*	123*/14*	33*	213*	39*	27*	3.40 m
16.	C -25 A -133	Plunging Synformal fold	120*-300*	120*/10* 300*/20*	210*	30*	47*	40*	4.50 m
17.	C -23 A -155	Synformalfold	160*-340*		70*	250*	33*	36*	7.30 m
18.	Z -60 X -122	Plunging Antiformal fold	265*-85*	85*/8*	355*	165*	30*	29*	25.0 m
19.	Z -53 X -123	Antiformal fold	93*-273*		3*	183*	63*	1*	25.0 m



| e-ISSN: 2319-8753, p-ISSN: 2347-6710| <u>www.ijirset.com</u> | Impact Factor: 7.569|

|| Volume 10, Issue 10, October 2021 ||

DOI:10.15680/IJIRSET.2021.1010089

20.	Z -55 X -125	Plunging Antiformal fold	90*-270*	90*/20*	360*	180*	19*	28*	4.0 m
21.	Z -55 X -120	Plunging Chevron fold	93*-273*	93*/11*	3*	183*	22*	63*	2.5 m
22.	Z -35 X -115	Doubly Plunging Antiformal fold	276*-96*	276*/12* 96*/9*	6*	186*	25*	22*	14.0 m
24.	Z -36 X -112	Dome			6* 240*	155* 235*	16* 5*	9* 11*	24.
29.	X -82* Z -40*	Dome			75* 5*	270* 90*	11* 22*	10* 19*	29.

S. No.	LOCATION	STRUCTURE	DIRECTION
	X -97*	Joint	70*-250*
	Z -39*		
27.	X -93*	Joint	55*-235*
	Z -42*		
28.	X -92*	Joint	70*-250*
	Z -39*		
30.	X -63*	Joint	50*-230*
	A -93*		
31.	X -73*	Joint	190*-10*
	A -106*		
32.	X -73*	Joint	234*-55*
	A -106*		
33.	X -73*	Joint	80*-260*
	A -106*		
34.	X -70*	Joint	100*-280*
	A-101*		



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| e-ISSN: 2319-8753, p-ISSN: 2347-6710| <u>www.ijirset.com</u> | Impact Factor: 7.569| || Volume 10, Issue 10, October 2021 || | DOI:10.15680/IJIRSET.2021.1010089|





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| e-ISSN: 2319-8753, p-ISSN: 2347-6710| <u>www.ijirset.com</u> | Impact Factor: 7.569| || Volume 10, Issue 10, October 2021 || | DOI:10.15680/IJIRSET.2021.1010089|





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| e-ISSN: 2319-8753, p-ISSN: 2347-6710| <u>www.ijirset.com</u> | Impact Factor: 7.569| || Volume 10, Issue 10, October 2021 || | DOI:10.15680/LJIRSET.2021.1010089|





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STRUCTURAL ANALYSIS OF THE KANGER DHARA REGION

After doing detailed geological mapping of the KangerDhara Region, following points have been observed: -

1. Area had undergone polyphase deformation.

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- 2. Several kinds of folds and superimposed folding observed.
- 3. Major and minor reverse faulting is observed which is uncommon feature in the Indravati basin.
- 4. Major and minor joints have been recorded and their relationship with the principle deformation events have been established.
- 5. This Kangerdhara area had experience the phase of violent intrusive activity as a result of which major faulting, jointing and folding took place.
- 6. Apart from this localized silicic intrusive event probably adjoining deformational events also severely affected this area. In the Tirathgarh area one basic intrusive body is seen nearly which might be responsible for an episode of stress in this region.
- 7. Kimberlitic intrusive body of Tokapal and pegmatitic bodies of Darbha and adjoining region must have affected the rocks of Kanger valley region because these intrusive bodies are not far away from this area.

MAJOR STRESS DIRECTIONS IDENTIFIED

- One silicic intrusive body more than 105/square meter dimension forcefully intruded after the deposition of Indravati group of rocks. As a result of which KangerDhara area was uplifted, folded, faulted and jointed. Which acted in the vertical direction and in our opinion created KangerDhara fault.
- Several episodes of deformational forces acted in this area. One such principal stress axis direction is 35° -215°
- Another principal stress direction acted was in the direction $0 180^{\circ}$
- ➤ Another major force came from 90°- 270° direction

IV. CONCLUSION

On the basis of structural and geomorphological evidences, we can conclude on the origin of Kotamsar and Dandak caves that –

- 1. Presence of faulted, folded and jointed rock formation adjacent to these caves indicates tectonic activity has taken place in the area.
- 2. The presence of structurally controlled steams indicates dominance of structural features in the study area.
- 3. Presence of ill-sorted patches (broken pieces of sand stone, shale) of inside the caves indicates erosion of rock occurred in the area. It may be mechanical or chemical weathering.
- 4. Presence of sand stone pieces inside the Kotamsar and Dandak caves indicates that provenance was uplifted (as a result of Tirathgarh,Keam,karka,fault) and weathering and erosional activities took place and Tirathgarh sandstone

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Volume 10, Issue 10, October 2021

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which is the lowest member of the Indravati basin moved in the downstream direction where subterranean flow was taking place in the Kotamsar and Dandak caves and these broken pieces were deposited.

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Impact Factor: 7.569





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