



**GENERAL ARTICLE**

# Geomorphological and Structural Analysis of Waterfalls' Formations in the Northwest Part of Kanger Valley National Park, Chhattisgarh, India

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**Study Area: Kanger Valley National Park, Jagdalpur, Bastar, India**

**Coordinates: 18°46'N 81°59'E**

Keywords: Subterranean Caves, Solution Caves, Waterfall,

## Abstract

Kanger Valley National Park was formed in 1982 to protect the forest resources and the Solution Caves found in its territory. From the very beginning, there were three recorded perennial waterfalls in the area, namely Kanger Dhara, Tirathgarh and Shiv Ganga. With the time-lapse, there are a few more perennial waterfalls that have been identified whose scientific documentation is not available anywhere. The present paper is the first scientific documentation of the geomorphological analysis of the new waterfalls located in the park region.

## Introduction:

Chhattisgarh is divided into three physio-graphical zone namely Northern Hills, Central Plains and Southern Plateau, where the Kanger Valley National Park lies in the Southern Plateau of the State i.e., in between latitude 18° 56' 27.29" to 18° 47' 11.56" N and longitude 81° 52' 21.94" to 82° 09' 42.47" E. It comes under the Darbha block of Bastar district. The rainfall details of the area is given below in Table-1 & 2.

Table-1: Rainfall Variation Source (Reports of Planning Commission for Chhattisgarh)

|                                    |       |
|------------------------------------|-------|
| Block Darbha                       |       |
| Seasonal Rainfall Intensity (mm/h) | 20.53 |
| Average Seasonal Rainfall (mm)     | 1263  |
| Annual Rainfall Intensity (mm/h)   | 19.49 |
| Average Annual Rainfall (mm)       | 1530  |

Table-2: Average Annual Rainfall Variation (Source: Annex-12, Gazette Notification of the Kanger Valley National Park, Jagdalpur)

| Year        | Rainfall (in mm) | Year | Rainfall (in mm) |
|-------------|------------------|------|------------------|
| 2000        | 1305.5           | 2001 | 866.2            |
| 2002        | 1339.7           | 2003 | 1314.2           |
| 2004        | 1590.6           | 2005 | 1400.2           |
| 2006        | 1700.8           | 2007 | 1288.5           |
| 2008        | 1567.5           | 2009 | 1244.8           |
| Mean 1361.8 |                  |      |                  |

## Geology of the Study area

The northeast portion of Tirathagr Village is considered our study site, which falls in the northwest part of Kanger Valley National Park (Map-1). The area comprises of

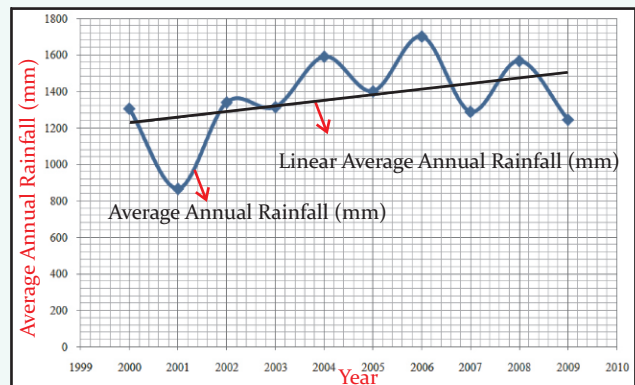
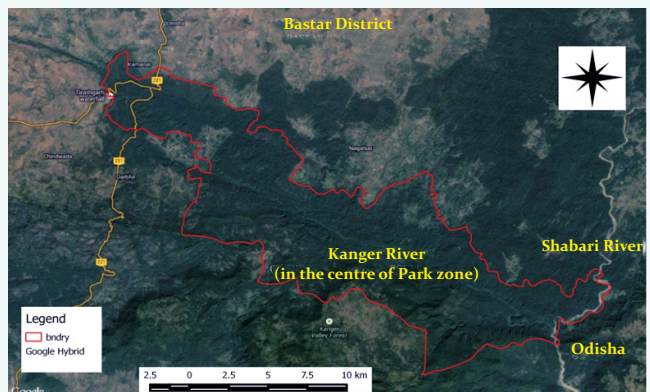


Figure-1: Scattergram showing Variation in Average Annual Rainfall in KNVP, Jagdalpur (year- 2000 to 2009)

Tirathagarh and Cherakur Formation of the Indravati group of rocks of the Meso to Neo-Proterozoic Period. The works of Crookshank (1963), Dutt (1963), Schnitzer(1977),



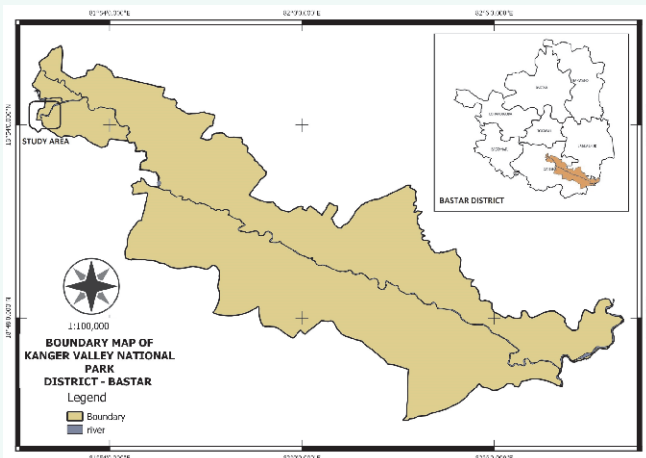
Map: Aerial View of Kanger Valley National Park

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and Ramakrishnan (1987) classified the stratigraphical formation of the Indravati Basin based on which the stratigraphic classification of the study area is in the given graph.

**Geomorphology of the Study area:** The North portion of the study area is moderate to highly sloping cuesta, while the south of the study area is a pediment. There is one stream, Kundru Nala flows between the study area and is a tributary of Munga Bahar Nala, which is one of the major tributaries of the Kanger River, which flows through the middle of the park area. The middle part near the confluence of Kundru Nala and Munga Bahar Nala are the

| Stratigraphical Classification of the Study area: (After Ramakrishnan, 1987) |  |
|--|--|
| <b>Indravati Group of Rocks</b>  | <b>Jagdapur Formation</b>  |
|  | <b>Kanger Formation</b>  |
|  | <b>Cherakur Formation</b> ---> Purple Shale with Arkosic Sandstone, chert pebble, conglomerate, grit   |
|  | <b>Tirathgarh Formation</b> ---> Quartz Arenite (Chitrakote Sandstone Member)<br>Sub-arkose and conglomerate (Mendri Member)<br>-----Unconformity-----<br>Granite and Supra-crustals |



Map No. 2: Map showing study area in Kanger Valley National Park where new waterfalls have been notified.



Map No. 3: Map showing site location of newly documented waterfalls.

plateaus slightly dissected by each other. Kundru Nala makes narrow steep gorges of 700 to 900 dip towards the stream channel. All the places where it follows the undulations of height 10 m or more make a waterfall. A few of the waterfalls have been notified from Kundru Nala, they are:

(a) **Jhulna Darha Waterfall:** ( $18^{\circ}54'17.50''N$ ,  $81^{\circ}51'46.90''E$ ) Located nearly 1.5 km to the south-west of Tirathgarh, Kundru Nala descends from a height of 25 feet to form this cascade, which after 100 feet of traverse drains out its flow to a steep narrow gorge (completely steep about 90° dip). The upper part of the waterfall shows thick to medium-bedded sandstones, while the lower part shows laminated to thinly bedded sandstones. A no. of sedimentary structures can also be noticed from the upper part of this waterfall like cross-beddings (Normal or trough cross-bedding), ripple marks (current and oscillation ripple marks), trace-fossils, cast of trace fossils etc. (Figure No. 01 to 06). This site shows a no. of conjugate joints whose trends are as follows:

| Type of Joints | No. of Joint Sets | Dip Amount & Direction | Strike Direction |
|----------------|-------------------|------------------------|------------------|
| Conjugate      | 1 set             | 90°                    | Due North, N80°E |
| Conjugate      | 1 set             | 90°                    | Due North, N65°E |

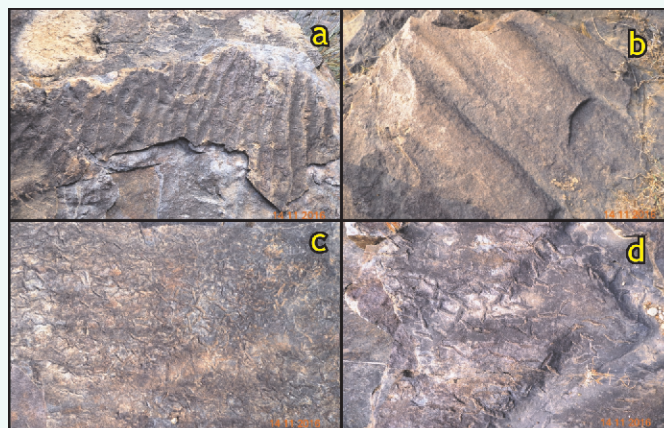


Figure-2: a) Current Ripple Marks, b) Oscillation Ripple Marks, c) trace-fossils, d) Cast structure of Trace-fossils



Figure-3: Normal or trough Cross Bedding



Figure-4: A view of Jhulna Darha Waterfall

(b) **Shiv Ganga Waterfall** (18°54'24.57"N, 81°52'0.01"E): Located nearly 1km Southeast of Tirathgarh Waterfall, Kundru Nala falls from a considerable height of 60 feet to form this waterfall in three stages, where each stage has a height of about 20 feet. The upper part of the waterfall shows thick to medium-bedded sandstones, while the lower part shows laminated to thinly bedded sandstones (Fig.-05).

(c) **Bhunbhuni Waterfall**: Nearly 1km to the South-east of Tirathgarh fall, following the down-stream slope of Shiv Ganga Waterfall, Kundru Nala takes a traverse of 420m (approx.) and falls from a height of about 25 feet to form Bhunbhuni Waterfall in two stages, with nearly 70m away from each other.

(d) **Chiknarra Waterfall** (18°54'39.94"N, 81°52'9.25"E): Being the last waterfall, Chiknarra makes the end of the series of waterfalls in Kundru Nala, where Kundru Nala descends from a height of nearly 25 feet to form Chiknarra Waterfall. After a traverse of 500m, Kundru Nala meets Munga Bahar Nala as its tributary at the confluence (Fig.-6).

(e) **Kunduru Nala Waterfall** (18°53'46.594"N, 81°51'2.459"E): Located nearly 2.5 km to the south-west of Tirathgarh, in the village of Chhindawada, Kundru Nala falls from a height of 15 feet to form this cascade. The upper part of the waterfall shows thick to medium-bedded sandstone with medium-sized ripple marks (oscillation ripple marks) on the top and middle beds underlying the fall. The gently dipping sandstone of the site has a trend of strike S500E and dip 60SE with numerous joint sets of conjugate and parallel joints.

This waterfall contributes as the first waterfall of this series, but as the site lies to the east of Chhindawada Village, this waterfall has been discussed later in this paper.

| Type of Joints | No. of Joint Sets | Dip Amount & Direction | Strike Direction |
|----------------|-------------------|------------------------|------------------|
| Conjugate      | 2 sets            | 90°                    | N5°E, N73°E      |
| Parallel       | 1 set             | 90°                    | N73°E,           |

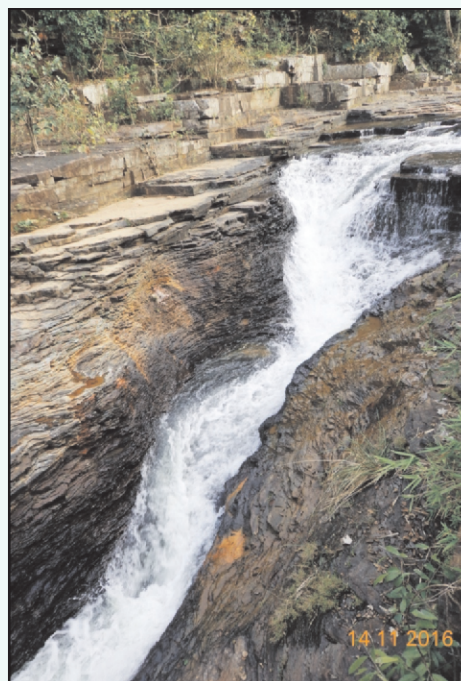


Figure-5: Shiv-Ganga Waterfall



Figure-6: Chik Narra Waterfall

### Conclusion

The serial formation of waterfalls in a series along the same river stream shows a type of contour along the river's flow pattern. The rock exposed along the base of the waterfalls mentioned above, indicates medium to thick-bedded sandstones as well as laminated to thinly-bedded sandstone and the average rainfall of the respective block, Darbha reaches up to the maximum average of the rainfall recorded in the district, the turbulence of the amount of water flow deeply cuts the basement rocks, resulting into the formation of the waterfalls.

Indravati basin is dissected by various faults, where the southern flank of the basin is occupied by en-echelon faults which also adds to the reason, that the river stream (Kundru Nala) follows the path in a minor lineament manner.

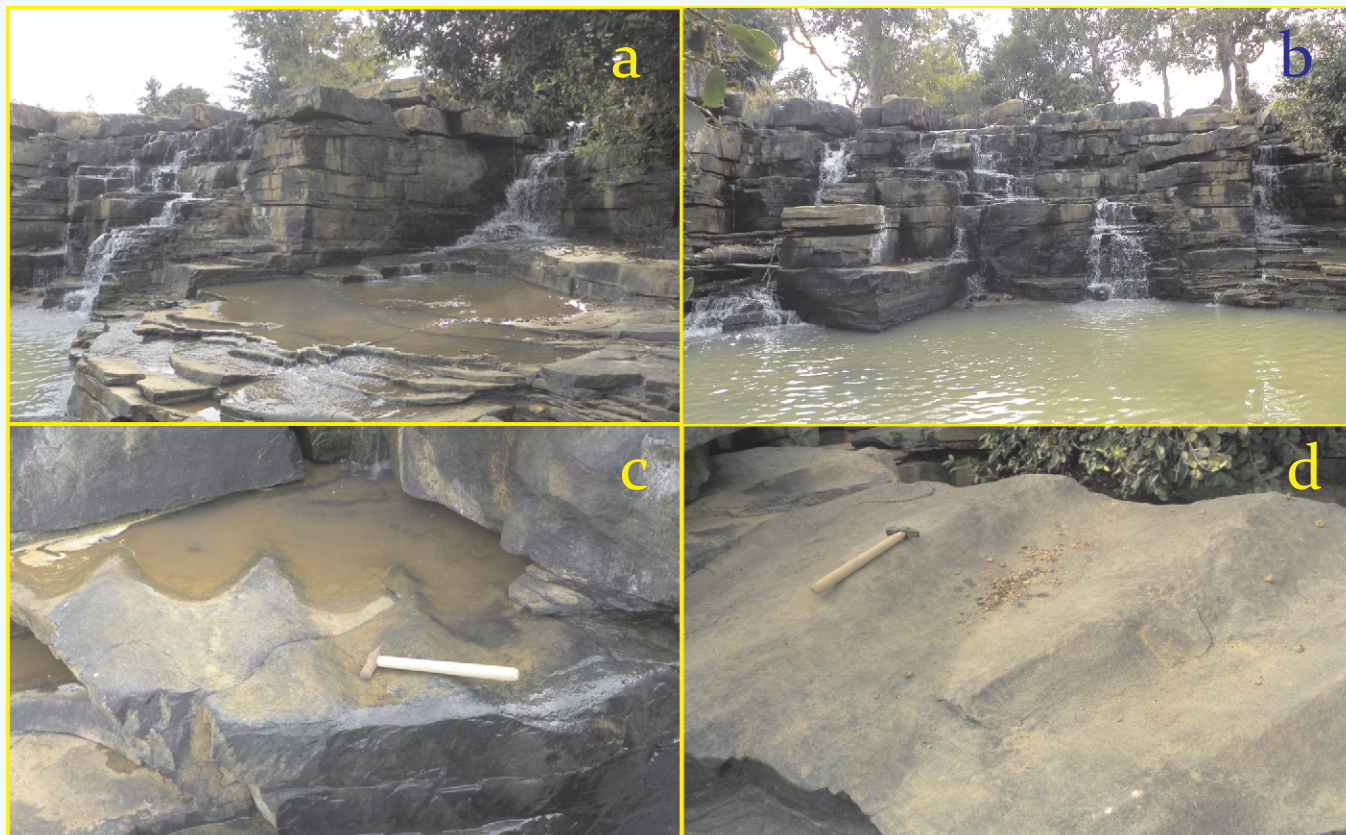


Figure-7: a) Left View of Waterfall, b) Front view of Fall showing reservoir along with, c) Thick bedded Sandstone showing medium-sized Oscillation Ripple Marks, d) Giant Oscillation Marks on the top of the thick bedded Sandstone



Figure-8: Conjugate Joints on thick bedded Sandstone.

#### Acknowledgements:

I am thankful to our Director, Dr Jayant Biswas, National Cave Research and Protection Organization for his unreserved help and encouragement to complete this work.

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