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# The Geological Features and Rock Studies of Doodhpathri, Budgam (Kashmir)

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**ABSTRACT**

*The present study deals with the assessment of geological features and rock studies of Doodhpathri area, situated in district Budgam of Kashmir valley, located about 42 km from Srinagar. The study was conducted from June to Dec. 2014 with primary objectives to gain preliminary understanding of the geology of the area, study the geology of the area by understanding the Contours with the help of Remote Sensing, study the rocks of the area and understand the soil profile of the area along with some parameters which help in understanding the type of the soil in that area. For carrying out the study, the following methodology was adopted. The Contour map was developed using the GIS software i.e. ARCVIEW and ERDAS and image developed the Contour map was Land sat 1992. Rock samples were obtained from out cut by using geological equipments. The soil profile cut was done with varied depth at particular places. The slope is very steep to very Gentle ranging from3250-2300m (a.m.s.l). During the study a number of rocks including Traps , Limestone, Quartzite, Quartz, Sandstone, Sand Concretions, and Quartz Arenite were found in the type of rocks present in Doodhpathri area seems to belong to the lower Carboniferous area with Syringothyris Limestone with 300m thickness. The Lithology of Doodhpathri makes it evident that the area belongs to Palaeozoic era. The soil profile thickness varied ranging from 15cm to >90cm at different sites. Doodhpathri is geologically complex and ecologically diverse and as such fragile. Therefore utmost care needs to be taken to prevent its falling a prey to the disastrous developmental approaches. As such, a sustainable and ecofriendly approach needs to be adopted.*

***Keywords :, Contours, Doodhpathri, Geology, Remote Sensing, Soil profile***

## I. INTRODUCTION

The Jammu and Kashmir state is located mostly in the Himalaya Mountains and shares a border with states of Himachal Pradesh and Punjab to south. Jammu and Kashmir has an international border with china in the north and east and the line of control separates it from the Pakistani –controlled territories of Azad Kashmir and Gilgit Baltistan in the west and northwest, respectively. The valley of Kashmir lies between 33-20` and 34-54` N Latitudes

and 73-55` and 75- 35` E Longitudes, covering an area of 15,948 sq.km. Topographically, it is a deep elliptical bowl-shaped valley bounded by lofty mountains of the Pir Panjal range in the south and south west and the great Himalayan range in the North and East, with 64% of the total area being mountainous. Its length (from southeast to northwest corner) is 187 km, while the breadth varies considerably; being 115.6 km along latitude of Srinagar (Kaul, 1977).The altitude of the floor of the valley at Srinagar is 1600m (above mean sea level).The geology of the Kashmir region displays a chronological record of the great Alpine orogeny, including the sedimentations, tectonics and volcanicity that followed the Himalayan Orogeny. In addition to exhibiting on its surface the rock specimens belonging to all ages, beginning from Achaean complexes which formed the floor of the Himalayan Geosynclines right up to the recent alluvium, the region also displays remnants of glacial deposits at lower altitudes as evidence to climatic changes in the past. The evidences of dynamic structural deformations like folds, faults, thrusts, nappers and huge igneous intrusions are also discernible. Geology (geo- earth, logy – science) is the science which deals with the study of the earth, with reference to its origin, age, history, structure and composition (mineral wealth). Physical geology is the branch of geology deals with various forces and agencies that bring major changes in the earth's surface. It deals with the physical forces and processes that bring major changes in the earth's crust on account of their prolonged existence and action. While as structural geology deals with the structural features of the earth's surface such as folds, faults, joints, un –conformities. These are certain forces which disturb the arrangement of the rocks forming new structures. Geological features are all around us, on the earth's surface and beneath our feet, and they are part of the landscape. The term can be defined as any physical feature of the earth's surface – or of the rocks exposed at the surface – that is formed by a geologic process. Many geological features influence the shape of the ground surface and can be described by the perhaps more familiar terms topography, landscape or land forms. Rocks constitute the important aspect of the geological and Geomorphological studies. Rocks are classified according to how they formed, in most cases; we don't see a rock during its formation, so we rely on observable clues to infer their formation. Two ways that indicate a rocks formation are: its composition and texture. Keeping in view the information furnished by the study of the geological features and rocks, it was felt important to carry out a preliminary study pertaining to the same in Doodhpathri area in the Budgam District of Kashmir. The area is an important ecological reserve; however, very less work pertaining to its geology has been carried out so far. The present study was carried out with the following objectives:

- To gain a preliminary understanding of the geology of the area.
- To study the geology of the area by studying the contours of the area with the help of remote sensing.
- To study the rocks of the area.
- To gain an understanding about the soil profile of the area.

## II. MATERIALS ND METHODS

### A. Study area

The present study pertaining to the geological features and rock identification was carried out in Doodhpathri area of Kashmir. Doodhpathri lies within the geo-coordinates of 33o 54´ 23 N latitude and 74o 36´ 15 E at an elevation of 2544 mtrs above sea level, in the Budgam district of Kashmir. The Budgam district of Kashmir is 42 kms away from Srinagar has an area of 1291 km sq. In north, it is surrounded by Baramulla and Srinagar districts. District Pulwama is present on the south and Poonch border occurs on the south west. Pir Panjal and the karewa as foothills, separate it from the Chenab valley and the Jammu region (Najar and Khan, 2011; Lone and Ramsoo, 2011). The area has a topography exhibiting altitudinal extremes of 1550 m to 4700 m above mean sea- level. The climate is temperate. The mean annual temperature is 20.2$^{o}$C. Winter receives heavy snowfall and the average rainfall in the area is 669.1 mm (Rashid *et al.,* 2011). The soils in the area are generally of three type's viz loamy soil, karewa soil and poorly developed mountain soil (Raza *et al.,* 1978). (Fig.1).

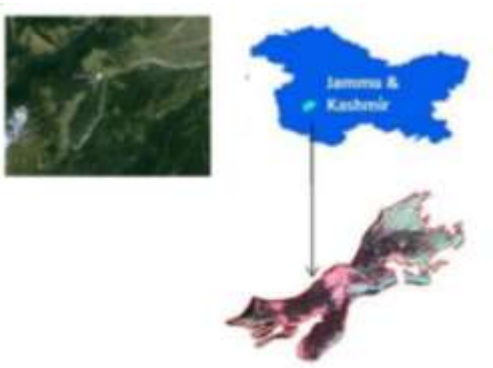


**Fig. 1: Showing the entire geographic area and study area**

The region until some decades ago had abundance of wildlife and was famous for the large number of deer population that inhabited the region. Doodhpathri has huge potential for the economic development of the region and poverty reduction strategy for the local area. Sukhnag and Shaliganga flowing in the north and south directions make the destination further attractive for local as well as national tourists. The forest area of Doodhpathri is encompassed with the tree species comprises of, *Picea simithiana, Abies pindrow, Pinus wulluichiana, Salix fragilis, Juglans regia* and *Populas Alba*.

### B. Study Sites

For the purpose of present study, three study sites (S-1, S –2, S -3) were selected in Doodhpathri area of Kashmir for observing the geological features and rock studies.The description of the study sites is as follows

**Site -1: Doodhpathri**

This site lies at an altitude of 2543 m above mean sea level within the geographical coordinates of 33-54`03 N and 74-36`02 E. This site was a mixed site having forests as well as meadows.

**Site- 2: DOBIVAN**

This area lies within the Doodhpathri and Parihasan meadow, the site is covered by forest. It lies at an altitude of 2611 m above the mean sea- level within the geographical co-ordinates 33- 52`06 N and 74-34`44 E. The area was having soil dunes covered by rocks and grass.

**Site-3 PARIHASAN**

This site comprises a lush green meadow. It lies at an altitude of 2611m above the mean sea –level within the geographical co-ordinates of 33-52` 27 N and $74^{o}$- 34` 33 E.

## III. METHODOLOGY

For carrying out the present study, the following methodology was adopted during June-Nov, 2014 in Doodhpathri area Budgam.

**A. Contour Map**

The contour map was developed using the GIS software i.e. ARCVIEW and EREDAS. The image used to develop the contour map was Landsat, 1992.

**B. Rocks**

The rock samples were obtained from out cut by using geological equipments like geological hammer, chiesel. The rock sampled were labelled and packed in transparent polypacks. The geo-coordinates were obtained on the spot with the help of GPS and the coordinates are given at site I, II, III respectively.The identification of samples was carried out using standard manuals and expertise from the department of Geology, S.P College Srinagar.

**C. Soil Profile**

The soil profile cut was done by using the equipment's as spade, khurpi, and scale by usual Interpretation method and it depended upon that the area selected for obtaining soil profile. The soil profile cut was done with varied depth at particular places e.g. in Grassland (at 4cm), Forests (at 1ft.), Agriculture (at 6cm).

## IV. RESULTS AND DISCUSSION

The present study on Doodhpathri area of Budgam was carried out from June- November, 2014. The study revealed the following results which are presented and discussed as

**A. Contours**

As is evident from the Fig.2, the slope is very steep between the altitudes of 3250m above mean sea level-2850m above mean sea level. However there is a decrease in the steepness from 2850m above mean sea level-2500m above mean sea level. The slope is observed to be very gentle from 2500m above mean sea level-2300m above mean sea level.

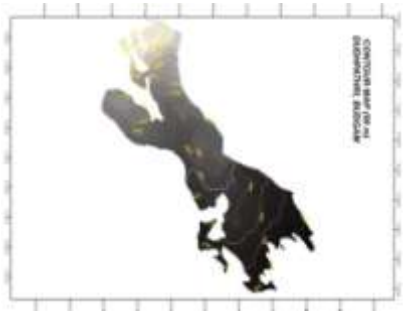

**Fig. 2: Showing Contour map of Doodhpathri**

**B. Rocks**

During the present study a number of rocks including traps, limestone, quartzite, quartz, sand-stone, sand concretions and quartz arenite were found at S-I, S-II and S-III .

Table 1:Showing presence of different rocks at different sites in Doodhpathri area from June-November, 2015.

| **Rocks →** | **Traps** | **Lime-Stone** | **Quarti-Zite** | **Quartz** | **Sand-Stone** | **Sand-concretions** | **Quartz-arenite** |
|---|---|---|---|---|---|---|---|
| **SITES↓** | | | | | | | |
| **I** | √ | √ | √ | √ | X | X | X |
| **II** | √ | X | X | X | √ | √ | √ |
| **III** | X | X | X | X | X | X | X |

The rocks found at different study sites during the present study as described as follows:

**1) Traps**

Traps were found at site 1 and site-2. Trap is fine grained, non-granitic intrusive or extrusive igneous rock. Trap derives its name from Swedish word "Trappa" which means "stair step". Some of the trap rocks are basalt, peridotite, diabase and gabbro. The slow cooling of magma either as a sill or as thick lava flow sometimes creates systematic vertical fractures within the resulting in a layer of trap rock. (Neuendorf*et al*., 2005; Maitre 2002).

**2) Lime stone**

Limestone was found to be present at site-1only. It is a sedimentary rock composed largely of the minerals calcite aragonite, which are different crystal forms of calcium carbonate ($caco_3$). It makes up about 10% of the total volume of all sedimentary rocks (Kranjc and Andrej 2006; Trewin*et al*., 1999; Folk, 1974).

### 3) Quartzite

Quartzite rock was also found to be present at site-1 only. It is a hard, non-foliated metamorphicrock, which was originally pure quartz sandstone. Sandstone is converted into quartzite through heating and pressure usually related to tectonic compression within orogenic belts. When sandstone is cemented to quartzite, the individual quartz grains recrystallize to form an interlocking mosaic of quartz- crystals. Orthoquartzite is pure quartz sandstone composed of usually well roundedquartz grains cemented by silica. It is often 99% $sio_{2,}$ with minor amounts of iron oxide and trace minerals such as zircon, retile and magnetite (Powell 2009; Krukowski and Stainley, 2006).

### 4) Quartz

Quartz was found to be present at site-1 only. It is abundant mineral in the earth's crust. It is made upof a continuous framework of $sio_{4.}$ There are differentvarieties of quartz, several of which are semi-precious gem stones. (Deer *et al.,* 1966).The undulatory and coarsely polycrystalline nature of quartz- grains along with the minerals and rock fragments suggests a mixed and metamorphic source area were quartzite , gneisses and perhaps granites were exposed.

### 5) Sandstone boulder

Sandstone boulder was found to be at site-2. It is a clastic sedimentary rock composed mainly of sand–sized minerals or rock grains. Most sandstone is composed of quartz and or feldspar.Rock formation that are primarily composed of sandstone usually allow percolation of water and other fluids and are porous enough to store large quantities, making them valuable aquifers and petroleum reservoirs.(Eddensor and Drew, 2012; Stow, 2005; Boggs, 2000).

### 6) Sand concretions

Sand concretions were found only at site-2. A concretion is a hard compact mass of matter formed by the precipitation of mineral cement within the spaces between particles and is formed in sedimentary rock or soil. Concretions formed within layers of sedimentary strata that have already been deposited. They usually form early in the burial history of the sediment, before the rest of sediment is hardened into rock. This cement often makes the concretions harder and more resistant to weathering than the host stratum (Agha *et al*., 1995; Boles *et al.,* 1985).

### 7) Quartz- Arenite

Quartz-Arenite is found only at site-2. It is sandstone composed of greater than 90%detrital quartz. It can have higher than average amounts of resistant grains, like chert and minerals. It is a rock with sand sized grains. Quartz-Arenite are the most mature sedimentary rocks possible and are often referred to as ultra or super mature and are usually cemented by silica. They exhibit both textural and compositional maturity.The two primary sedimentary depositional environments that produce quartz Arenite are beaches upper shore face Aeolian processes, due to their high residence time, high transport density and are high energy environment. Most of the time, these sediments are reworked over and over, even being eroded out of a lithified rock and becoming a brand new sediment and rock. This is known as multicycled sand. (Blatt *et al*. 1996;Prothero*et al*., 1996).

As is evident from table -1 and the type of rocks present in Doodhpathri area, the area seems to belong to the Lower Carboniferous area with Syringothyris Limestone with 300m thickness.

**Table-2: Showing geological setup of Kashmir Himalayas.**

| **Age** | **Formation** | **Thickness in meters** | **Lithology** |
|---|---|---|---|
| Recent | Recent Alluvium | 150m | Loam and clay |
| Plio-pleistocene | Karewa group | 1300-1800m | Conglomerate,slit,clay,lignite,sandglacier moraine and loess paleosol |
| Cretaceous | Drass volcanic and equivalents | 200m | Shale, agglomeratic conglomerate and volcanic |
| Jurassic | Wuyan formation | 300m | Limestone, sandstone, shale, conglomerate and pumice |
| Triassic | Khrew formation | 750-850m | Shale interbedded with limestone, dolomites and clay |
| Permian | Zewan formation | 250m | Sandstone, limestone, shale, conglomerate and pumice |
| Upper-carboniferous | Panjal volcanic complex, agglomeratic slate | 2400m | Shale,quartize,limestone lava flows, tuffs,andesitic and basaltic traps,pyroclasticssalte(agglomeratic) |
| Middle carboniferous | Fenestella shale | 600m | Quartizite,shale,(carboniferous), sandstone, limestone |
| Lower carboniferous | Syringothyris limestone | 300m | Limestone, shale, sandstone, quartizite |
| Devonian | muthquartizite | 900m | Quartizite, siliceous shale |
| Silurian | Lidder valley | 50m | Sandy shale, sand stone, lime stone |
| Ordovician | Muhauma syncline, tregham, lidder valley | 50-150m | Areneceous shale, ferruginous shale, greywacke, quartizite, limestone |
| cambrian | Dogra slates | 1525m | Slates, phyllite, gneisses, schist |
| Pre-Cambrian | Sal lahala series | - | Quartizizte, phyllite, gneisses, schist |

***Source**: Present geological setup (litho logy) of Kashmir Himalayas (D.N Wadia, 1976)*

As reflected in Table-2, Fig.2 (Raza *et al.*, 1978) the Lithology of Doodhpathri makes it evident that the area belongs to the Palaeozoic Era.

(**Table–3: Showing formations of Kashmir valley.)**

| **Era** | **Period** | **Age** | **Formations** | **Localities** |
|---|---|---|---|---|
| Cenozoic | Quaternary | Recent | Recent alluvium | Jhelum river valley |
| | | Pleistocene | Older alluvium, karewa deposits, river terraces | Karewa uplands, bordering the valley, river terraces in the upland valleys |
| | Tertiary | Eocene | Nummuilitics, Ranikot series | Southwestern flank of the pirpanjal range |
| Mesozoic | | Cretaceous | Shales, agglomerates, agglomeraticconglomerates and volcanic series | Astor,burzil, Drass, Ladakh |
| | | Jurassic | Spitishales, kiotolimestones | Banihal |

| | | | | |
|---|---|---|---|---|
| | | Triassic | Pirpanjal traps, Triassic shalesinterbedded limestone dolomites | Sind valley, Lidder valley and Norther slopes of pirpanjal range |
| Palaeozoic | | Permian | Zewan beds, products shales, dark arenacious, shales and limestones | Pir-panjal, uppersind and lidder valleys |
| | | Carboniferous | Panjal trap, agglomerates, limestones and shales | Pir-panjal range, Zanskar range, banihal valley |
| | | Devonian | Muthquartizites | lidder valley, pir-panjal (southern flank) |
| | | Silurian | Sandy shales, shally sandstone and yellow limestones | Lidder valley (Ananthnag) |
| | | Ordovician | Quartzite, limestones,greywackes | Sind and lidder valleys |
| | | Cambrian | Soft quartzites, massive clays, limestones | Baramulla and Ananthnag,Pir-PanjalBanihal valley. |
| Archaean | | Precambrian | Fundamental gneisses, intruded granites | Great Himalayan range, Pir-panjal |

**Source:**Raza*et al.* (1978)

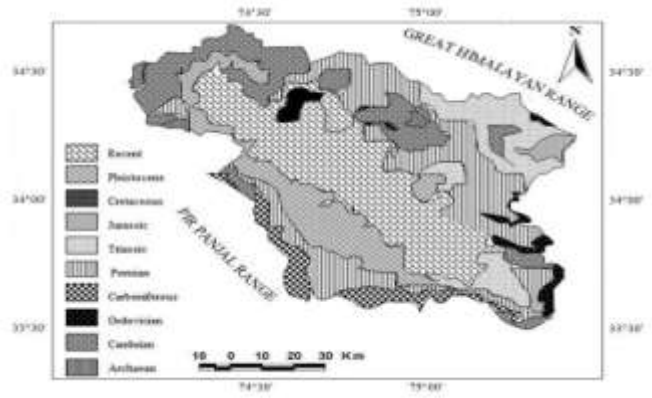


**Fig.2: The Kashmir valley, showing distribution of geological strata: Source:** Raza *et al.* (1978)

## C. Soil Profile thickness

Soil profile is 'the sequence of the horizons (layers) superimposed one above the other and exposed in a pit-section dug through the soil mantle. A layer which is approximately parallel to the soil surface and have properties produced by soil forming processes but they are unlike those of adjoining layers called horizon' (Sharma-2013). Horizon may usually be identified in the field but they also have chemical and physical characteristics which can be diagnosed in the laboratory.

1. **The 'O' Horizon:** -an organic horizon forming above the surface of the mineral matrix, mainly composed of fresh or partially decomposed organic matter.

2. **The 'A' Horizon:** - these are mineral horizons formed either at or adjacent to the surface. These are rich in organic matter and show downward loss of soluble salts.

3. **The 'B' Horizon:** - these are mineral horizon forming below the surface; it contains enrichment with in washed clay, iron, aluminum, residual enrichment with sesquiooxides, alteration of the original rock material to give silicate clays or oxides in conditions.

Soil profile thickness varied at various sites Table-4. The thickness of the 'O" horizon varied from 15cm (Site-1) to 20cm (Site 2 &3) while the 'A' horizon thickness was highest at Site-2 (90cm) followed by site-3 (80cm) and site-1(65cm). The 'B' horizon thickness was highest at Site-2 (>100cm) followed by Site-3 (>90cm) and Site-1(>65cm). Soil profile depends upon the nature of parent matter and other factors- climatic, topographic and biological etc. Soils are identified by references to their profiles (Sharma-2013). At all the sites (1, 2&3) it was observed that the thickness of the 'A' and 'B' horizons (mineral horizons) was more or less uniform, however the thickness of 'O' horizon (organic horizon) was considerably less than the other two horizons. Site-2 which is mostly occupied by rocks had higher thickness of the mineral horizon, followed by site-3 which is a meadow. However, site-1 which is a mixed site, having both forests and rocks had lesser frequency of the rocks and as such lesser thickness of the mineral horizon. Site-1 is also subject to maximum anthropogenic pressures with regard to the temporary habitations of the migratory population and also being used as a parking area for the vehicles entering Doodhpathri, which is reflected in the lesser thickness of the 'O' horizon as compared to the other two sites.

**Table-4: Showing the thickness of soil profile at Doodhpathri (June-Nov. 2014).**

| | **SITE -1** | **SITE-2** | **SITE -3** |
|---|---|---|---|
| **"O" Horizon** | 15cm | 20cm | 20cm |
| **"A" Horizon** | 65cm | 90cm | 80cm |
| **"B" Horizon** | >65cm | >100cm | >90cm |

## V. CONCLUSION

From the results obtaining during the present study conducted from june-november, 2014 in Doodhpathri in Budgam. It can be concluded that the area has three different types of slopes ranging to very steep to gentle.Varying from an altitude of 3250 mts(a.m.s.l)- 2300 mtrs(a.m.s.l).

A number of rocks including traps, limestone, quartzite, quartz, sand-stone, sand concretions and quartz arenite were found in the area. Traps were found at site 1 and site-2. Limestone was found to be present at site-1only. Quartzite rock was also found to be present at site-1. Quartz was found to be present at site-1. Sandstone boulder was found to be at site-2. Sand concretions were found only at site-2. Quartz-Arenite is found only at site-2.The area seems to

belong to the Lower Carboniferous area with Syringothyris Limestone with 300m thickness. The lithology of Doodhpathri makes it evident that the area belongs to the Palaeozoic Era. Soil profile: Soil profile thickness varied at various sites with varied thickness ranging from 15cm to >90cm.

Doodhpathri is geologically complex and ecologically diverse and as such fragile. Therefore utmost care needs to be taken to prevent its falling a prey to the disastrous developmental approaches. As such, a sustainable and ecofriendly approach needs to be adopted.

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