



GEO-CHEMICAL ANALYSIS OF UNABDEO HOT SPRING IN TAPI RIVER VALLEY, JALGAON DISTRICT OF MAHARASHTRA-INDIA.

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Abstract

Unabdeo Hot Spring belongs to Jalgaon districts of Maharashtra state. Geo-structurally, it is situated along the faults and fractures. Geologically this area is a part of Satpura Mountains and comes under the Deccan Trap province. There are numerous faults and fractures in the Satpura Mountain. They are almost parallel to the strike line of southern Satpura foot hill or Tapi valley lineament. The geothermal water emerges on the surface through these faults and fractures. The water gets heated due to the geothermal gradient of interior of the earth. Unabdeo hot spring is perennial. The discharge of water from hot spring is constant with discharge rate 25 l/minute throughout the year. The temperature of hot spring fluctuates 440 C. However, there is a small seasonal fluctuation in temperature of hot spring water.

The chemical characteristics of thermal water discharged from Unabdeo hot spring is sodium by carbonate (NaHCO₃) type. The source of the saline component (Cl) is attributed to ancient formation waters trapped in the geological formations, or magmatic or hydrothermal fluids. The percentage of total cation and anion (Na-HCO₃) is found to be a good indicator of hotness of water discharging from this spring. The concentration of SO₄ ion in the hot spring waters is small. This unusual concentration reveals that the origin of SO₄ ions in the hot spring water is related to pyrite (FeS₂) minerals in the rock formation. The recently this hot spring experience rise in temperature of water of this fact may be attributed to the recent interior activities of this area.

Keywords: Tapi Valley, Unabdeo Hot Spring, Satpura hills, Deccan trap, Geochemistry.

Introduction:

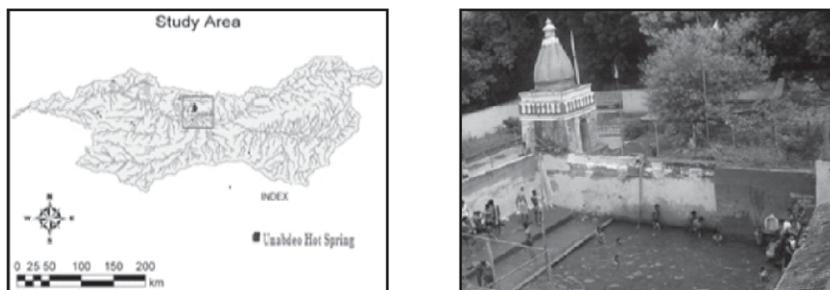
Middle Tapi valley covers Jalgaon, Dhule and Nandurbar districts of Maharashtra state of India. The study area experiences numerous faults, fractures and dykes. Geo-structurally, most of the hot springs are situated along the dolerite dyke, faults and fractures. Geologically this area is in Satpura Mountain and comes under the Deccan Trap province. They are almost parallel to the strike line of southern Satpura foot hill or Tapi valley lineament. The geothermal water emerges on the surface through these dykes, faults and fractures. The water gets heated due to the geothermal gradient. Unabdeo hot spring is one of perennial amongst them situated on faults and fractures to the North of Tapi channel. Its astronomical location is 21°16'N: 75°26'E.

Unabdeo is well defined hot spring in this area and discharges hot water at a constant rate of 25 L/minute. The temperature of the water is 440C. Recently the temperature of this hot spring is increased. Therefore it has great geo-chemical significance. The aim of the present investigation is to study chemical characteristics, geology and structure of Unabdeo hot spring.

The Study Area:

The study area belongs to middle Tapi Basin. There are numerous hot springs in middle Tapi. Unabdeo is most striking and accessible amongst them. It is famous as a tourist spot in Middle Tapi. It is the representative of middle Tapi hot springs. The striking feature of the middle Tapi basin is as follows.

Figure-1 :- Location Map of Study Area



Striking Features of Hot Springs Area Of Middle Tapi Basin:

- a) Tapi valley is pre-existing graben between Satpura and Ajanta Satmala off shoots of Western Ghat.
- b) The numerous hot springs are originated from the stream of channel Devganga affected by the post trappean and Quaternary tectonism resulted in faulting, fracturing of Trappean rocks and emplacement of dykes.

The study area is covered with thick colluviums and comprised of numerous cracks, fissures, fractures, faults, joints, lineament etc. in which hot spring are located in the exposed dyke by stream. Unabdeo hot spring is situated at the southern foothill of Satpura in the vicinity of Adawad village in Jalgaon District of Maharashtra. Astronomically, it extent at 21°16' N: 75°26' E. Unabdeo belongs to Chopada tahsil of Jalgaon district

Objectives:

- i) To understand the geo-structure of hot spring.
- ii) To understand chemical characteristics of hot spring.

Methodology:

Unabdeo hot spring visited frequently during 2011-12 for the observation of site situation and geo-structural information. Water sample from discharging outlet of hot spring collected season wise for chemical analysis in the laboratory. Spot temperature and discharge data is also associated. The major emphasis is laid on estimation of pH, hardness and turbidity, cation and anion properties to understand the geo-chemistry of Unabdeo hot spring.

Geology :

Study area predominately covered by Deccan Basalts which is Cretaceous to Lower Eocene age and Quaternary alluvium along the Tapi river courses. Different types of lava flows have been reported from southern part of study area. The lava flows varies in physical characteristics and categorised as a transition from the 'Aa' type and 'Pahoehoe' type. The basaltic rocks represents a sequence of eruptions with fine grained texture, vesicular, amygdaloidal, fractured and jointed, porphyritic and massive layers of basalts. Each flow consisting of upper amygdular middle massive and lower vesicular basalt. Successive lava flows are separated by inter trappean red bole which is varying thickness from 0.5 to 1 meter. Northern part of study area covered by thick alluvium of Quaternary age which is silt and clay layers.

Geomorphology:

The drainage pattern in this area is dendritic to sub dendritic and soil type is black cotton. The study area shows two geomorphic units viz. 1) Northern part of study area is represented by thick alluvium of Tapi River tract. The Younger and Older Alluvium are represented by interbedded layers of silt and clays with varying thickness of 70 m. The Jalgaon, Dharangaon and Yawal block is covered by thick alluvium of silt and clay. The maximum thickness of Alluvium is over 140 M. at Adawad Area. 2)

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Southern part of study area exhibits detached hills of Deccan Trap (Erandol Block).

Geological Set Up:

The Unabdeo belongs to Jalgaon district. The entire Jalgaon district covers two major geological formations. The Deccan traps formation with subsequent dykes and alluvial formation. Bagh beds of Cretaceous period are exposed at some places in the Akkalkuwa Tahsil of Nandurbar district in the vicinity of study area.

Fig-2 Hydrogeological map of Jalgaon district



(Source: - Ground Water Information Jalgaon District Maharashtra)

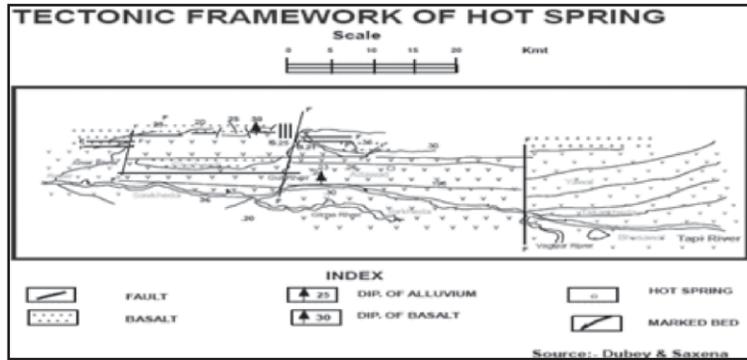
The Tapi valley forms a graben between Satpura Mountain to its north and Ajanta Satmala hills to its south. The structure of the basin was severally affected by series of step faulting processes during the geological history. The graben was occupied in a pre-existing weaker zone in the Mesozoic sediment.

The pre-existing graben is covered by the lava outpouring during the mass scale volcanic activities in the later period. The thickness of the lava is comparatively less in the basin. (Kaila – 1988). Besides the trap formation was disturbed by the tectonic activities during late geological period (i.e. period of Himalayan orogeny). The structure of basis was severely affected by series of faulting, fracturing, displacement activities during the past and they have been imprinted in the basin. The Tapi basin is traversed by number of faults and fractures. Some of them are parallel to the main channels of river Tapi. Others are across the main channels. The intersections of such faults have a greater significant in respect of hot spring because much hot springs lie on the intersection nodes. The structure and tectonism of the hot spring have been described here in respect of three sections in the hot spring area. (Fig. N0.3– Tectonic framework of hot spring)

On the basis of thickness of alluvium, trend of marker bed and occurrence of inliers, it has been possible to evaluate on overall tectonic framework of the area. The area has undergone intense changes and as a result several fault block have been recognized which have moved both laterally and vertically with respective one another. The enormous thickness encountered in borehole data suggest narrow depression, even below the sea level as at Adawad and Yawal to

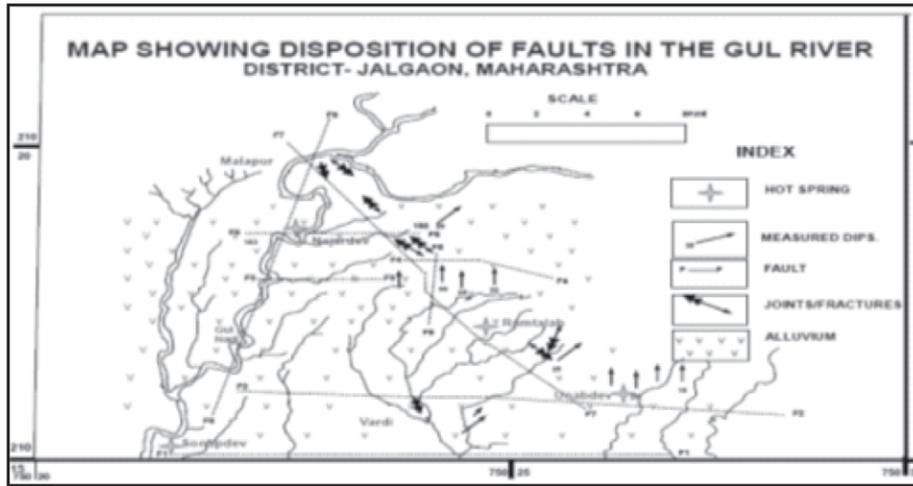
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Fig. N0. 03 – Tectonic framework of hot spring



The south of the Satpura, limited by east - west trending fault on either side. This depression occupied by alluvium has been further offset by the cross fault trending NNW - SSE to NNE - SSW which have been deciphered on the basis of lateral discontinuity of the marker bed. Along the foothill of Satpura, disconnected exposures of this fault is seen between Aner river and Yawal (21010':75042') indicating lateral shifts along this cross faults. The foot hill fault trending almost E-W passing through Lasur (24018':74017') and Malapur (20000': 75024') has been shifted appreciably by the NNE-SSE trending Gul river fault and then passes through immediately south of Unapdev hot spring and continue, eastward along the base of the hill.

Figure No. 4 – Map Showing Deposition Of Fault In The Gul River.



Source:- (Dubey 1984).

Thermal Manifestation Of Hot Spring:

The discharge temperature and estimated temperature of Unapdev hot spring is 440C and 900C with a discharge rate of 25 l/minute.

Table – 1
Location, Discharge and Temperature of hot spring

Sr. No.	Hot spring	Location	Discharge Rate (lpm)	Surface Temp.in ⁰ C	Estimated Temp. in ⁰ C
01	Unapdev	21 ⁰ 16'N : 75 ⁰ 26'E	40	60	130

The computed base temperature of the thermal spring varies between 1140C.

Table – 2
Geochemically computed base temperature of hot spring of Tapi basin aera

Sr. No.	Location	T ⁰ C (Na -K)	Rise in T ⁰ C(Na -K -Ca) B=1/3	T ⁰ C B=4/3	Silica ----- Adiabatic Cond.	Chalkedomy
01	Unapdev	42.0	112	69	114 114	84.0

(Ref.- Saxena-1984)

Chemical Characteristics :

Table-3 contends that the relative low temperature of the thermal fluid is due to cooling by conduction.

The cation like Ca, Mg, Na, K and anion like CO₃, HCO₃, Cl, SO₄ etc. have been attempted.

Table – 3
Chemical analysis of Unapdev hot spring in middle Tapi basin

Hot spring	pH	Na	K	Ca	Mg	CO ₃	HCO ₃	Cl	SO ₄	TDS	TH
	ppm	ppm	ppm	ppm	ppm	ppm	p pm	p pm	ppm	p pm	p pm
Unapdev	9.7	57.8	1.0	2.9	1.3	18.4	Nil	55.0	21.5	249.0	12.0

pH: The pH value of Unapdev water is 9.7 which indicates that water is slightly alkaline.

TDS: The amount of TDS of hot spring is 249 ppm. The salinity is directly proportional to TDS.

Total Hardness: TH means the total hardness of the hot spring. The hot spring of Unapdev has low value of hardness i.e. 12 ppm. The hardness is based on various cationic and anionic proportions in the hot spring water.

Cationic Classification:

On the basis of cationic concentration i.e. composition of alkalies and alkaline earth metal. It reveals that the proportion of (Na+K) is greater than (Ca+Mg). In pair of Na+K the proportion of K is negligible as compare to Na, thus on the basis of highest cationic proportion the hot springs can be categorized as a Sodium type.

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Anionic Classification:

On the basis of anionic pair of weak acid (CO₃+HCO₃) and strong acidic (Cl+SO₄), the Unapdev hot spring reveals that the proportion of (CO₃+HCO₃) i.e. weak acid is less than (Cl+SO₄) i.e. strong acid. The Unapdev hot springs are respectively strong acid type i.e. Chloride and Sulphate type.

Classification on the basis of cationic and anionic combination, the Unapdev hot spring depict the highest proportion of Na cation and highest proportion of SO₄ anions consequently this hot spring can termed as Chloride and Sulphate type.

Conclusion :

Unapdev hot spring discharge hot water can be defined as the spring water is at least appreciably warmer than the surrounding with temperature of 60°C. The hot water emerges from the cracks and fissures. It is heated by geothermal gradient. The estimated temperature of this hot spring is 130°C. The pH of hot spring water is slightly alkaline. However in the basis of anionic and cationic concentration it is Chloride and Sulphate type.

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