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Some thermal springs in Kameng District, Arunachal Pradesh

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Abstract

Four thermal springs exist in the vicinity of Central Crystalline Thrust within a shear zone in Dirang Formation in the Diggin valley of Kameng district, Arunachal Pradesh. These springs are luke warm at the surface but have higher base temperature – about 200°C. The water samples from these springs were hydrochemically analysed for Ca, Mg, Na, K, SO_4 Cl, HCO_3, B. Chemistry reveals that these springs are fed from a deeper source. The author has made an attempt to study these thermal springs with a view to understanding the Geothermics in the area.

A passing reference to three of the springs, located about 2 km west of Dirang has been made by Bakliwal *et al.* (1971). The fourth spring was located in Bishum village by the present author while carrying out preliminary systematic geological mapping for base metals in the area.

Hitherto, the hot springs in the Northeastern Himalayas have not received adequate attention of the geoscientists and hence the potentiality of geothermal conditions in this part of Himalaya is yet to be explored.

Geological set up

Diggin valley occupying the western part of Kameng district trends in an east-west direction and encloses both, Central Himalayan and its adjoining Lesser Himalayan range. The following generalized sequence from NW to SE was observed in the Diggin valley in the vicinity of thermal springs:

NW

Sela Formation	Garnetiferous gneiss, migmatites with mica, tourmaline, pegmatite veins, lit-par-lit biotite gneisses, granulite, high grade schist
	Central Thrust
Dirang Formation	Phyllitic quartzite, quartzite with marble bands, quartz-chlorite-mica schist, garnetiferous mica schist with pegmatite intrusions and occasional bands of kyanite schist, intrusions of amphibolite ≈ Dalings
	Thrust
	Bomdila Gneiss ≈ Darjeeling Gneiss

SE

The general foliation varies from N10°W – S10°E to N25°W – S25°E and the amount of dip is up to 70° towards west. Two sets of master joints have a trend of N75°E and N10°W.

Thermal springs

Three of the hot springs located about 2 km west of Dirang issue out of the highly shattered and jointed quartzite and phyllitic quartzite emitting sulphurous smell. These springs are located on the right bank of river Diggin; one of these is situated in the river bed very near to the right bank.

The fourth spring north of Dirang, is located at Bishum in Sangti valley. The discharge of water is from the fractured and shattered chlorite-mica schist with specks of pyrite (Dirang Formation). The garnetiferous mica schist exposed there, has a E-W foliation with a dip of 40° towards north. There is a cold water spring

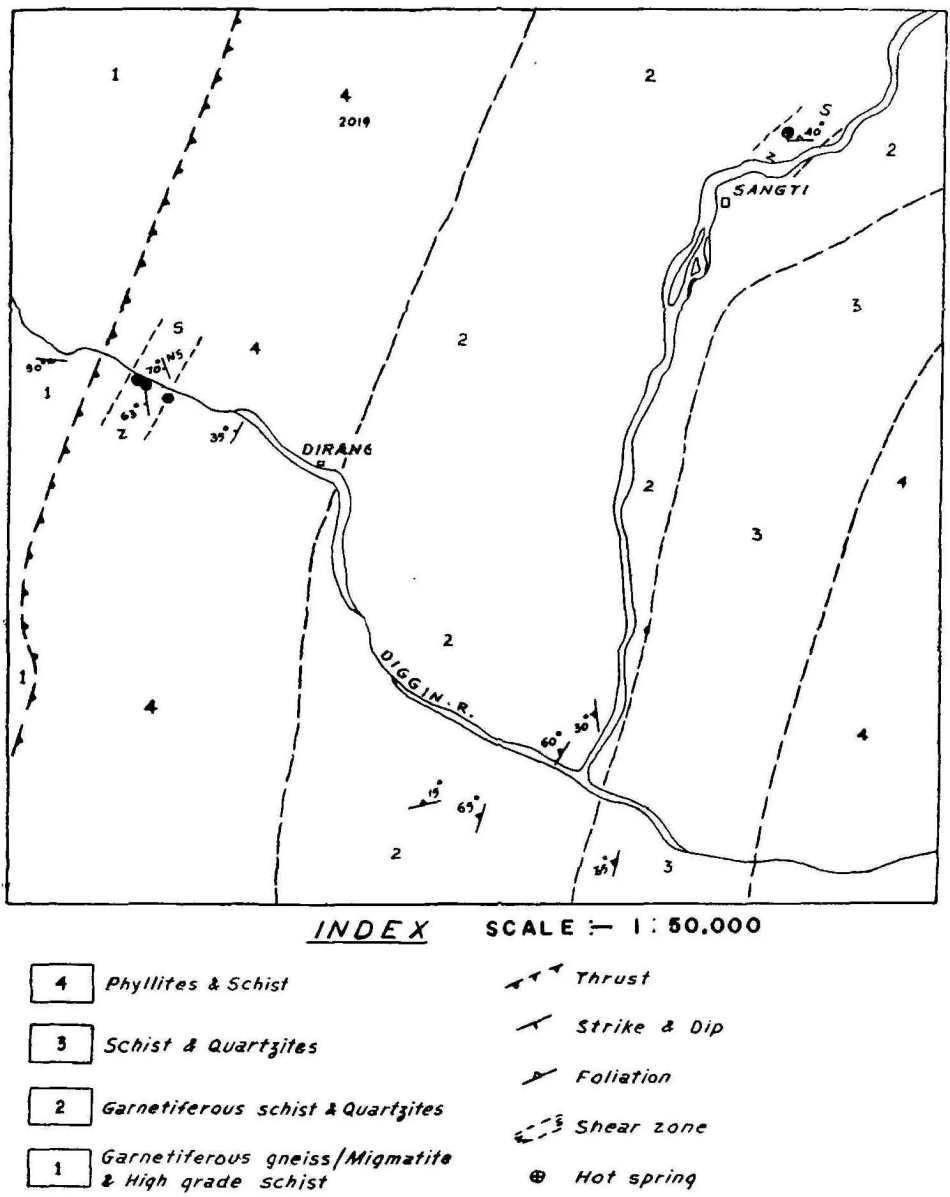

Figure 1. Geological map of part of Diggin valley, Kameng district, Arunachal Pradesh.

issuing out of the same strata and is at a distance of only 2 m from this hot spring. The water sample from this cold water spring was also analysed hydrochemically. The discharge of the hot spring according to visual estimate was less than 5 ltrs/sec.

These thermal springs are primarily recharged by snow melt.

Water chemistry and geothermics

The hot spring water was slightly turbid and contained dissolved gases (probably H_2S). Thin film of very light yellowish to whitish material was seen on the surface of hot spring water that had accumulated in a pool. The water had sulphurous odour. Water sample was analysed for the following elements given in Table I.

Three of the springs near Dirang are feebly alkaline (pH 7.1 to 7.9) while the springs at Bishum are feebly acidic (pH = 6).

TABLE I

Sample No.	Location	pH	Sp Conductance at 25°C Mhos/cm	Ca	Mg	Na	K	Cl	HCO_3	CO_3	Tds	Total Hardness as $CaCO_3$	SO_4	B	Na/K
DRH-5	Dirang	7.3	425	27	8	50	9	20	77	N	—	100	—	—	9.35
DRH-6	-do-	7.9	1700	81	12	250	45	123	316	I	—	253	—	—	9.35
DRH-7	-do-	7.1	1150	58	9	150	35	85	240	L	—	182	—	—	7.31
SB-116A	Bishum	6.0	—	524	5	—	—	6	75	N	1992	1340	1240	<0.5	
SB-116C*	-do-	6.0	—	8	tr.	—	—	5	31	L	50	20	tr.	<0.5	

*Sample of cold spring only 2 m away from SB-116A.

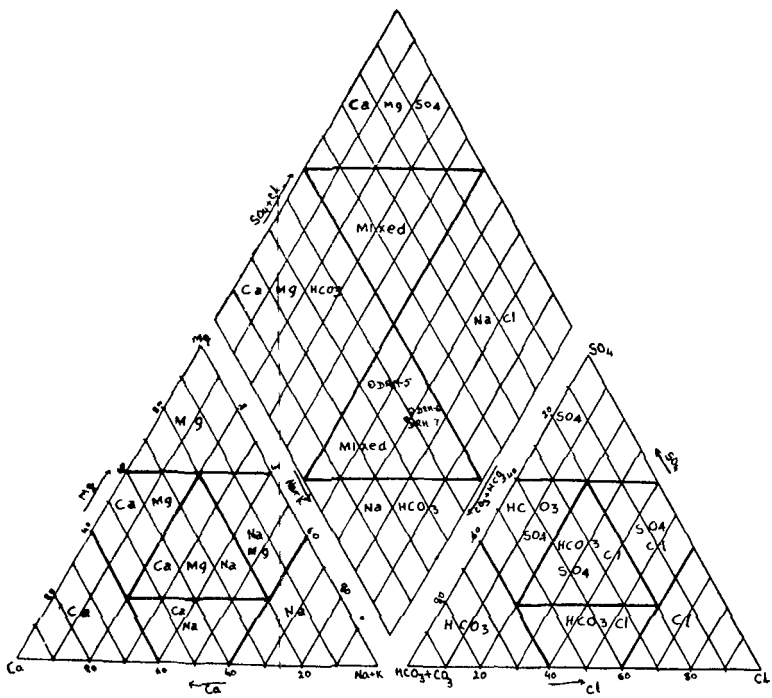

Figure 2. Trilinear diagram for pipers geochemical classification of water.

The surface temperature of these hot springs ranges from 21°C to 32°C while that of cold spring and river is 2°C (atmospheric temperature being 5.5°C). The lukewarm nature of the spring water at the point of discharge can be explained by the dilution of hot spring water. This explanation is supported by the low Na/K ratio (7-9), which may either be due to dilution of hot water from depth with surface spring or rapid ascent of hot water to the surface through faults or permeable formation.

To calculate the base temperature of thermal spring at depth Ca-Na-K Thermometry is utilized in the present case and is expressed as:

$$t = \frac{1647}{\log \frac{Na}{K} + \beta \log \frac{\sqrt{Ca}}{Na} + 2.24} - 273$$

where, t = base temperature

$\beta = \frac{1}{3}$ or $\frac{4}{3}$.

The base temperature thus computed for the three springs are given below in Table II.

TABLE II

Sl. No.	Sample No.	Location	Base Temp.
1.	DRH-5	Dirang	81.1°C
2.	DRH-6	-do-	208°C
3.	DRH-7	-do-	217°C

Conclusion

It is evident that the hot springs are luke warm at the surface due to dilution but at depth its temperature is very high – as high as 217°C. The high temperature of the springs can possibly be attributed to the circulation of contaminated meteoric water along the numerous joints and faults associated with Central Crystalline Thrust. This contamination is infered by concentration of sodium and potassium, higher than normal and which has possibly been derived from some magmatic source. The location of these springs in an area of low evaporation and subsequent concentration with high chloride content suggests it to be supplied from deeper source. Exploration to prove the reservoir and geothermal gradient in the area will be helpful in proving the potentiality of these springs.

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