

Curable Properties of Hot Water Springs in Odisha Related to Eastern Ghats Minerals: A Review

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Abstract: *The water in all three-acrothermal hot water spring located in Eastern Ghats in Odisha maintains a steady temperature of 54 to 55 degree centigrade throughout the day. Physico-chemical study points to the presence of sulphur, NaCl and other salts. The water is alkaline in nature (ph=8.8) and the ph decreases with decrease in temperature. Further, the crystal clear water of the Atri - sulfur spring is believed to have medical values that have curative powers, it can cure several heath related issues. This could be due to microorganisms, Sulphur and salt present in the water. The dissolved salts in the spring water have been derived from the water-rock interaction; sulphur is produced due to reaction of meteoritic water with pyrites and pyrrhotites of Eastern Ghats rocks. This review describes the origin of sulfur of thermal springs in Odisha and their medicinal importance to make a clear view of the relation between tectonics and source reactions.*

Key Words: *Hotspring, Sulphur, Curative power, Pyrite, Eastern Ghats*

I. INTRODUCTION:

There are three hot sulfur water spring in Odisha namely Atri, Tarabalo and Taptapani. The significance of the springs of Odisha are characterized by sulfurs and very popular because of its touristic nature and curative powers of the spring water. These springs also popular in the religious point of view as well as the devotional aspects in the country (Mahala et al., 2012). Atri is specifically extremely popular because of the hot water sulfur springs and curable properties in Odisha. It is situated in the middle of paddy fields, and bears a distinct odor of sulfur. Taptapani is located at the hill top sat a long distance of 50 Kilometers from famous city of Berhampur. The water of the Taptapani and Atri springs are believed to have some natural and effective medical properties that can cure diseases of skin and internal body parts (Pradhan and Jena, 2016). The Deulajhari hot spring nearly located to Athamalik and Angul city. The Deulajhari sulfur spring is famed and spreads over an extremely large area and always characterized by a high degree of temperature (Mahala et al., 2012). The hot water spring of Deulajhari area can be found as collected in 36 manmade ponds and it is a tourist place because is circumscribed by the temple of lord Shiva (Mahala et al., 2012). 50 percent of the thermal springs in this region are associated with the cold springs, which is a miraculous phenomenon as the gift of nature (Mahala et al., 2012). Hot water springs are sometimes dangerous because of the high temperature that may originate from metamorphic origin, magmatic activity, geothermal heat, as well as the heat generated due to faults and fissures (Day, 1939).

Several scientist and researchers from different parts of Odisha have conducted various research on these thermal springs. Medical properties of these thermal springs are natural that can heal a number of diseases in the body. Therefore curative properties of these hot springs is attributed to microorganisms, Sulphur, sodium chloride with high temperature (Roy S and R Rao, 1996). The main motivation of this review discussion is to understand the main reasons of these hot springs sulfur properties and to understand the internal aspects of the various hot springs. This review conducted to provide some effective and valuable information about the characterization of thermal springs as well as the properties of water that can help the researchers to apply in their research in a scientific way.

Table. 1 Adopted from the research paper published by (Pradhan and Jena, 2016).

| S. No | Name | Temperature (C) |
|-------|------------|-----------------|
| 1 | TAPTAPANI | 55° |
| 2 | ATRI | 50° |
| 3 | DEULAJHARI | 40°-60° |
| 4 | TARABALO | 56° |

II. DISCUSSION

2.1 Some vegetation in soil after hot water overflow and their medical properties source (Drugs.com).

There are several varieties of vegetation that can be found in the thermal spring waters in Odisha. They belong to different family as well as classes of biological sciences. These plants have some medical properties that are used and applied for the humankind. Some of this vegetation are described below.

Acanthecea - Acanthaceae belongs to antifungal and anti-inflammatory category and characterized by anti-viral potential.

Comelinacea- It is another type of vegetation can be found in hot water springs. The medicinal properties of this plant can be useful for the stomach ailments, insect bites as well as sore throats.

Cyperaceae- It is extremely important for its medicinal purposes. Its different parts are used to prepare tonic, stimulant, stomachic and astringent.

Poaceae- This is mostly used as a medicinal plant comes under Poaceae family. These are the source of starch and used in pharmacy for various productions. Other medicinal constituents of this plant are generally used as anticancer agents. These plants are used for the treatment of gastrointestinal ailments and other diseases (K. Kmiec, 2007).

Mimosae- This is used for the several health problems of anxiety, depression, and stress to relieve pain (Drugs.com).

Euphorbiacea- Used for Asthma, Bronchitis, Digestive issue, Coughs, High fever etc.

1.2. Relationship between Eastern Ghats and hot springs in Odisha

The Eastern Ghats granulite belts contain pyrite-pyrrhotite-chalcopyrite-galena specks disseminated in Charnockitic rocks in different parts of Odisha (Mahala et al., 2012). Reaction between the circulated water and pyrite produces sulphur generally in these three hot springs in Odisha (Mahala et al., 2012). Due to the weathering and erosion activity pyrite-pyrrhotite structure breaks and passed off by the surface water as well as the ground water (Mahalik et al., 2013). The circular movement of water makes reaction and produces the sulfur rich water. Several reactions and the characteristics of all the reactions are described to understand the origin of sulfur in thermal springs of Odisha that has some curable medical properties (Guha, 1986). The details of the reactions described below were adopted from (<http://www.ei.lehigh.edu>).

Oxidation reaction of pyrite characterized by oxygen that leads to produce ferrous iron as the main product. The first reaction of Oxidation happened due to the weathering of pyrite in association with water and oxygen. Sulphate and ferrous iron are generally released along with the acidity. For every mole of pyrite, reaction released two moles of acidity. The reaction is described below.



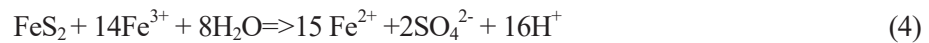
Ferrous iron converted to ferric iron in this reaction. This conversion reaction generally consumes acidity of one mole. Some bacterial activity increases the oxidation rate. This reaction depend on the Ph with a slow reaction proceeding. This reaction produces ferric iron as well as the water and the Ph of the water must be around 5. The reaction equation is described below.



The third one is hydrolysis reaction of iron that can occur after the ferric iron production. Hydrolysis is specifically the one that divides the water molecule. The main by product of this reaction is three moles of acidity. Many metals are capable of undergoing hydrolysis. Ferric hydroxide is the main product of this reaction that is ph dependent. In general, solid materials form with ph 3.5 however, if the Ph is 3.5, there is no precipitation of solids form. The details about this equation are described in equation 3.

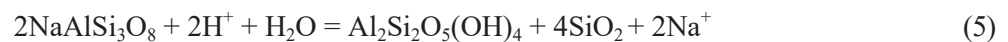


It is a reaction in between pyrite and ferric iron. The ferric iron is the product of the previous reaction. However, it is the cyclic as well as the self propagating part of the major reactions that may occur in the Eastern Ghats region. It is extremely rapidly and reaction continues until the depletion of pyrite. Therefore, in this case of reaction the oxidizing agent is Fe not oxygen.



Pyrite+Ferric Iron+Water=>Ferrous Iron+Sulfate+Acidity

There are many more reactions can be observed in the Eastern Ghats region to observe that can produce the sulfate. CO₂ plays the major reactive role in these reactions through liberation of H⁺ ions creating the reactions with wall rock silicates and releases the alkalis. Because of these reactions the depletion of H⁺ in water resulting in the increase of alkalinity occurs. Therefore, through these processes of reactions sulfate release that comes in contact with the hot water springs. Some more sources of sulfur can be understood from the reactions described below.



plagioclase + hydrogen ions + water = kaolinite (a clay) + silica + sodium ions



orthoclase + hydrogen ions + water = kaolinite (a clay) + silica + potassium ions

Thermal spring water of Atri, Tarabalo and Taptapani are rich in sodium chloride along with sulfur. The hot water spring (57 °C) characterized by some doses of Sulphur flavour when heated to 100 °C (Mahala et al., 2012). Therefore, it is clear that sulfur comes from the reaction 4 that is described while reactions 5 and 6 describes the percentage of sodium concentration in the thermal spring water. Therefore, it is clear that the Eastern Ghats is rich in pyrite and pyrrohtite that comes under several reactions and produces sulfur rich water. This water moves through the cyclic process and is exposed to high-grade metamorphic rocks making the water sulfur rich as well as high temperature in all the three hot springs in Odisha (Roy and Rao, 1996).

Finally, the model shows the cyclic movement of water along the fault at a depth of 13 to 15 feet from ground surface after the Eastern Ghats Super Group rock and water interaction forming three Sulphur springs. Due to the cyclic movement of water at a depth of 13 to 15 meter and interconnected fractures, the temperature of water varies in different hot springs (Roy and Rao, 1996).

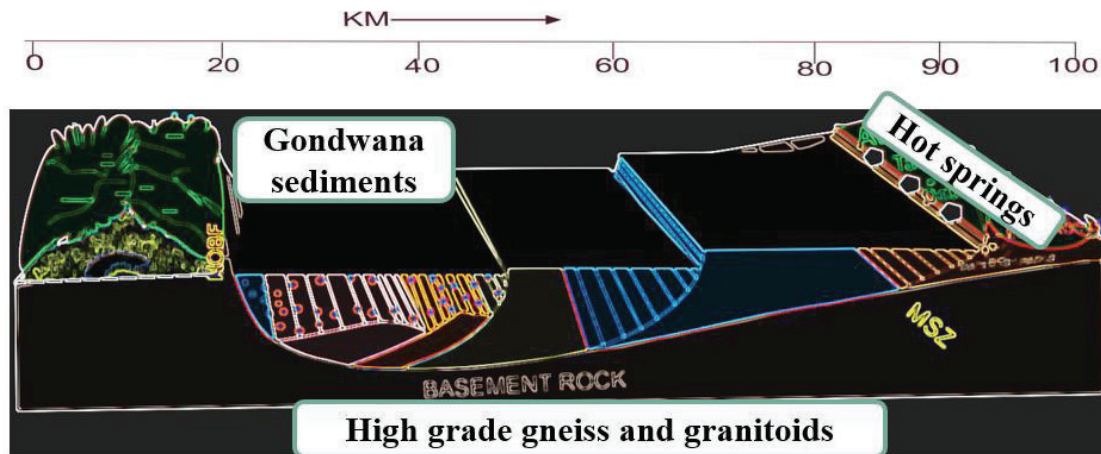


Figure 1. Adopted from the research paper published by (Pradhan and Jena, 2016).

1.3. Micro-Organism

A rod-shaped bacterium that can be found in the soil specifically called as *Bascillus-licheniforms*. This bacterium can be found at a temperature of 50-55 degree Celsius (Mahala et al., 2012; Pradhan and Jena, 2016). Therefore, this bacterium is available in the Atri, Tarabalo, and Taptapani hot springs. It has an ability of dental applications in medical science. *Bascillus stearothermophilus* is also rod shaped but as a member of *Firmicutes*. However, this bacterium can survive at a temperature of 30-75 degrees Celsius (Mahala et al., 2012; Pradhan and Jena, 2016). Therefore, these are also found in the thermal springs of Odisha.

Table 2. Microorganisms present in the different thermal springs in Odisha. + (availability), - (non-availability)

| Hot spring | Temperature(degree Celsius) | Bascillus-licheniforms | Bascillus stearothermophilus |
|------------|-----------------------------|------------------------|------------------------------|
| Atri | 50-55 | + | + |
| Tarabalo | 54 | + | - |
| Taptapani | 55 | + | - |

1.4. Benefits of Sulphur

Sulfur can be found in any living body. Therefore, it is the abundant mineral for our body. It is characterized with antibacterial effects. Therefore, it has many effective medical aspects that can be useful as a curable product for many diseases. The Origin of sulfur we have clearly described in the discussion part that is related to the Eastern Ghats minerals(Kumar et al., 2007).Therefore, we explained some information about the application of sulfur and the key symptoms.

Table 3. Information collected from (<http://naturesnutrition.com>).

| Useful for: | Key Symptoms: |
|--------------------|-----------------------------|
| Unhealthy Approach | Burning heat, soles of feet |

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| | |
|----------------------------|---|
| Skin Problem | Itching, skin burning, scratching in the body infected injuries applied for lips, nose, anus and mouth bathing |
| Eczema | skin eruptions, dryness, scaly structure itching and burning |
| Conjunctivitis | Red pimples, burning eyelids |
| Colds | Stuffed nose Red eruptions from nose Dry pieces in nose, nose bleeding |
| Digestive Problems | Little eating problem fats problem fatty body eating problems |
| Nausea | pregnancy |
| Constipation | Itching and anus burning problems dark and dry stools large stool and painful anus diarrhea |
| Hemorrhoids | Burning & itching |
| Diarrhea | Constipation problem different color stools |
| Shortness Of Breath | diarrhea in the morning drives from bed mid night diarrhea Relieved by sitting up chest load sensation |
| Better During | Dry and warm weather, Atmospheric changes, Standing |
| Worse During | Bathing, bed warmth, affected limbs, Sweating, Open air movement |

III. CONCLUSIONS

The sulfur rich water is pyritic origin of Eastern Ghats source. The sulfur rich water gets heated up due to the circulation along faults and fissures as well as with the contact of metamorphic gneiss and granitoids. Sulphur, sodium chloride salts are derived from pyrite and pyrohtite by water rock interaction in Eastern Ghats region. Therefore, for this sulfur rich composition of hot water springs in Atri, Tarabalo and Taptapani Eastern Ghats is responsible that has curative power within the thermal water. Therefore, analysis on the sources of Eastern Ghats geology, chemistry and tectonic behavior need to understand for the future research.

Doctors for skin diseases people mostly advise taking bath in hot water with sodium chloride. The benefits of taking bath in sulfur water spring are described below.

1. Salt-water will remove the dangerous toxins and heavy metals out of the body skin because of elimination power of sulfur as well as the skin.
2. To enhance the health condition sulfur is important for the body that can be absorbed by the skin.
3. Sulfur water can remove the bacteria from the skin, making the body fresh and rejuvenated.
4. A salt-water bath is helpful enough to relive muscular pains and the sore joints problems.
5. Blood circulation will be increase because of sulfur and salt-water bath.

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