

Geochemical Aspects of Serpentine Bodies off Embilipitiya, Sri Lanka and their Effect on Human Health

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Abstract : Serpentine is a mineral rich with Nickel, Chromium, Cobalt and Iron. Weathering of Serpentine rock can liberate such elements into the environment. Excessive exposure to such elements can damage human health by means of skin rashes, redness of skin, and Kidney diseases. Previous studies carried out in the Ginigalpelessa area off Ambilipitiya has concluded that major part of the area is underlain by serpentinite bodies and high amount of such elements are present in the soil, weathered rocks and fresh rocks of the area. To identify health issues associated within the area, a questionnaire was carried out in Gingigalpalessa village and in Angunakolapalessa village which is located about 15 km away from Ginigalpelessa area, where similar weather conditions, cultivations and social activities are found but not geology. Data gathered from the questionnaire shows skin rashes are common among the people living in Ginigalpellassa area. The survey also revealed that 54% of the patients are children, age below 15 years and 38% of them are adults, age above 45 years. Furthermore such diseases are common among the families living in the area for a longer period. The results also reveal that majority of the patients live in highly concentrated zones of such elements in Ginigalpelessa area and no such cases are found in Angunukolapellessa village where geological conditions are different.

Keywords: Ginigalpelessa, Agunukolapelessa, Serpentine, Health Issues, Chromium, Skin Rashes

1. Introduction

Serpentine is a group of minerals which can be illustrated by the formula, $X_{2-3}Si_2O_5(OH)_4$, where, X can be identified as ions like, Mg, Fe^{2+} , Fe^{3+} , Ni, Al, Zn, Co, Cr, or Mn. In some cases one of two Si ion can be replaced by Al or Fe. The most common elements of the group are Antigorite $(Mg,Fe)_3Si_2O_5(OH)_4$ and Chrysotile $Mg_3Si_2O_5(OH)_4$. Hence it is clear that the mineral is rich with Ni, Co, Cr, Fe and Mg.

Serpentine bearing rock can be found along the boundary of Highland Complex and Vijayan Complex in Sri Lanka. Well identified such deposits can be found in following areas;

Yudhaganawa, Ginigalpelessa
Indikolapelessa and Ussangoda.

The study area of the research is area around Ginigalpalessa in Embilipitiya. Previous studies show that, the concentration of Ni found in rock is between 2250 - 3340 ppm while over 180% - 172% increase of the same element can be found in soil. In soil the Cr content is also over 10000 ppm [1]. Higher concentration of such elements may result in releasing of them to the environment as contaminants [2], which depends upon the mobility of the elements.

When Cr is considered, there are many adverse effects. In drinking water the level of chromium is usually low, but contaminated water may contain the

toxic Cr⁶⁺; hexavalent chromium [3 and 4] . For most people eating food that contains Cr³⁺ is the main route of chromium uptake, as Cr³⁺ occurs naturally in many vegetables, fruits, meats, yeasts and grains. Presence of Ni is also hazardous to human health, shown below are the diseases associated with an uptake of large quantities of such elements, Skin rashes [5], Weakened immune systems, Kidney [6] and liver damages.

2. Material and Methods

Followings are the methods of investigation of the serpentine body.

2.1 Desk Study

A desk study was carried out with the aid of literature reviews of the related serpentine, study of the interested area by referring maps of the area.

2.2 Field Study/Work

Questionnaire to get the details about life style of the people, drinking water sources, number of family members and age groups, diseases and number of years living in the area, were distributed among people living within the Serpentine body and the adjacent area.

Similar survey was carried out in Angunukolapelessa area which is about 15km away from Ginigalpelessa. People of Angunukolapelessa area have similar life style, water sources, climatic conditions and geomorphological conditions when compared with Ginigalpelessa area.

3. Results and Discussion

3.1 Results

Following results were obtained from data gathered in questionnaire survey (refer Figure 1)

Table 1: Questionnaire survey results, Ginigalpelessa

House No.	Remarks on health issues found	No. of persons
1	Skin Rash	1
2	Not found	0
3	Not found	0
4	Not found	0
5	Not found	0
6	Skin rash, Kidney disease	2
7	Skin Rash	1
8	Skin Rash	1
9	Skin Rash	1
10	Skin Rash	1
11	Skin Rash	1
12	Skin Rash	1
13	Skin Rash	1
14	Not found	0
15	Not found	0
16	Skin Rash	1
17	Skin Rash, Skin redness	1
18	Skin Rash, Kidney disease	1
19	Not found	0
20	Not found	0
21	Skin Rash	1
22	Not found	0
23	Skin Rash	3
24	Not found	0
25	Not found	0
26	Not found	0

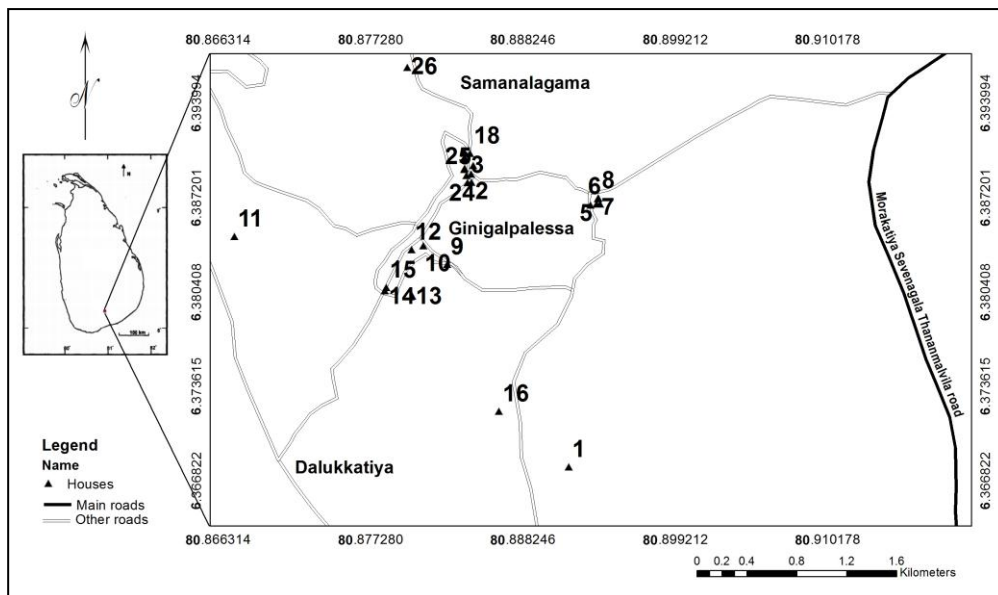


Figure 1: Distribution of houses in Ginigalpalessa

3.2 Discussion

Out of 107 occupants found in 26 houses and adjacent to the Serpentinite body, 16 of them are suffering from severe skin rashes and one of them is suffering from a kidney disease. Similar studies carried out in Angunukolapelessa area reveals non existence of such diseases among people in the area

As per Figure 2, 54% of the population with health issues are children below 15 years of age, 38% of the population with health issues are adults of age greater than 45 years of age, 8% of the population are people between the ages of 15 and 30 years. Hence, majority of the sick are small children. The area considered was inhabited less than forty years back. The majority having health issues (children below the age of 15 years) were born in this area, they are not among the people contributed to colonize the area forty years ago. It is the nature of children to play in gardens of their homes, they

may play with soil, rocks on their garden. Children may get contacted with soil or rocks more than other ages concerned in the study. Hence higher number of the impacted are children. Most of people that colonized the area are farmers, they always get contacted with soil, rocks on the ground, which will give raise to their ill health. The people in middle region of the ages considered are mostly people who are doing jobs other than farming, when considering the attitude change of generations. Hence, these section of people are not much exposed as the other considered categories of age, making them a very little quantity in the Figure 2. Majority of the illnesses are skin rashes. It is clear that this could be due to direct contact of concerned ions (Chromium, Nickel, Cobalt and Iron) on the skin, which could happen by getting into contact with soil, dust and rocks.

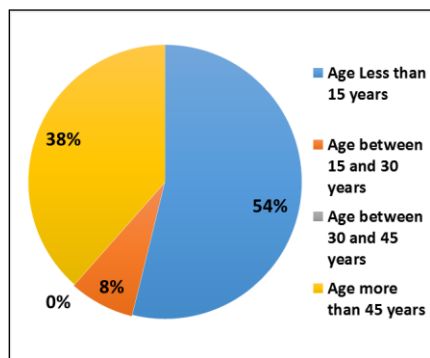


Figure 2 : Variation of health issues and age

The cause of redness of skin can also be concluded like this. Kidney disease was a minority but several cases were reported. Simply this could happen due to contamination of groundwater altering the chemical nature or the composition of water. These elements could get accumulated inside the human body for a longer period of time and giving raise to kidney damage. According to results of the questionnaire survey all found cases for kidney disease was people greater than the age of 45 years, which will give plenty of time for these elements to get accumulated in the human body.

Figure 3, clearly illustrates the presence of health issues and the residency of people considered. According to the figure it can be seen that there is a dramatic increase of health issues when the period of residency goes up.

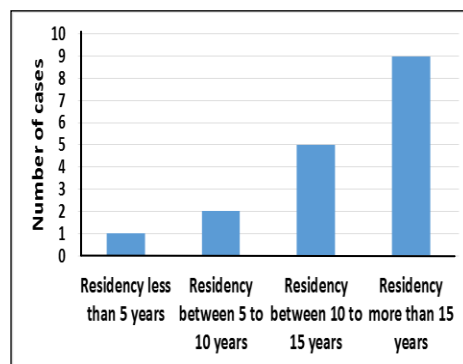


Figure 3 : Variation of health issues and period of residency

The reason for this is clear, people living for a significant period of time than the rest would have been exposed for a longer time to the environment around, which have been exposed for a longer time to the environment around, which have given rise to elevated number of cases.

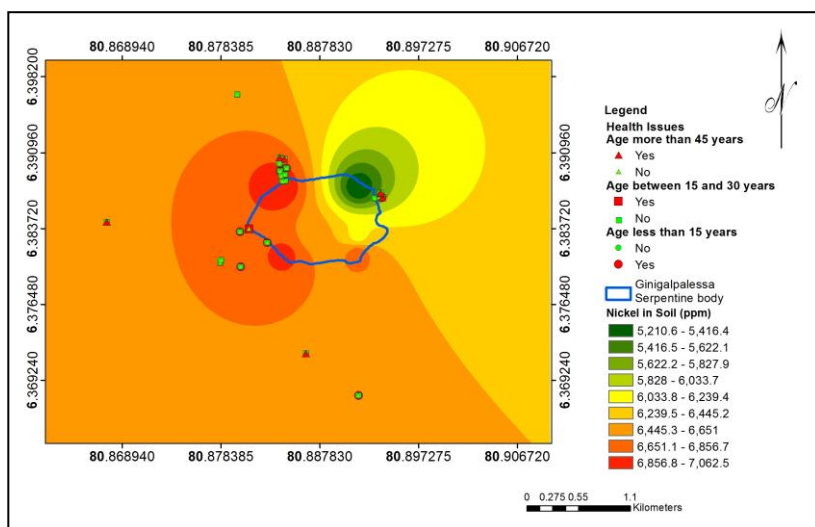


Figure 4 : Variation of Nickel concentration in soil and distribution of health issues

When, figure 4 is considered, it illustrates the variation of Nickel concentration in soil. When it is overlapped with the houses, it can be seen that majority of the houses where health issues have been found overlaps on highly concentrated area of Nickel. Same scenario can also be seen in variations of chromium, iron and cobalt in soil. It provides that these diseases may have happened due to chemical nature of the deposit.

The previous work show very high concentration of chromium in soil. When compared to normal levels of such elements in soil [7].

5. Conclusions

As per research outcome of the study, following conclusions can be made.

- Skin diseases are common in the area. Similar type of village with similar weather conditions, geomorphology, social life and habits (but different in underlain geology) do not show such diseases in the area. This also support the restriction of the diseases to the underlain geological condition.
- Distribution pattern of houses with patients who are having skin diseases show they are located in area with higher concentration of Cr, Ni, Fe and Co.
- Medical evidences show high Cr could cause skin diseases such as dryness, erythema, fissuring, papules, scaling, small vesicles, and swelling [1] and [3].
- It is also evident that younger generation are vulnerable to skin diseases than older generation.

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