

# Identifying Phlogopite Mica Mineralization in the Area around Rathnapura and Suggesting Suitable Mining Methods for Sustainable Exploitation

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**Abstract:** Investigation carried out in the area around Rathnapura shows occurrence of economically valuable phlogopite mica mineralization in the area. Such deposits are concentrated in Hindurangala, Palkumbura, Pathagammana, Yakodiyadeniya, Thambandeniya and Kosgala. Although historical data show systematic underground mining has been carried out in some places, present mining activities are restricted to very small scale pits dug haphazardly. Vein thickness of the phlogopite mica varies from 2 cm - 1 m and extends in N 35°- 50° W direction. They generally follow the foliation pattern of the metamorphic country rocks and three major mineralization zones extending over 10 km have been found in the area. In some locations veins follow joint directions of the area. Variation in physical properties such as colour, expansion and permanent colour changes due to heat are found in the same mineralized zone in different locations.

**Key words:** Shear zones, Underground Mining, Vein Thickness, Foliation Pattern, Joint Direction

## 1. Introduction

Major part of Sri Lanka is underlain by Pre-Cambrian metamorphic rocks (Geology map of Rathnapura, GSMB) which belong to the granulite and amphibolite facies. The area around Rathnapura belongs to the South Western group of Sri Lankan metamorphic rock classification and common rocks found in the area are Granite, Biotite Gneiss, Granite Gneiss, Garnet sillimanite Biotite Gneiss, Quartzite and Marble. The area is characterized by NW - SE trending ridge and valley structures. Two Principle Rivers of Kelani River and Kalu River drain the area westward.

Historical records indicate that phlogopite mica mining has been carried out in Sri Lanka over 100 years.

Although Muscovite and Biotite mica occurrences have been found in association with pegmatite dykes, except Phlogopite mica, no economically valuable other mica deposits have been found in Sri Lanka.

Such Phlogopite mica deposits are found in the area around Rathnapura, Badulla, Kandy, Anuradhapura, Dehiaththakandiya, Polonnaruwa, Matale, Ambilipitiya, Kolonne and Naula as shown in Figure 1-Locations of Phlogopite mica deposits found in Sri Lanka

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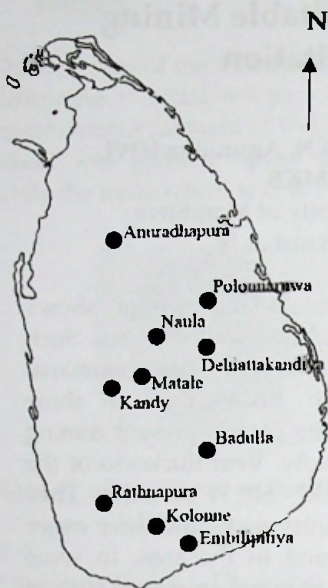


Figure 1-Locations of Phlogopite mica deposits found in Sri Lanka

## 2. Methodology

The study is carried out in an area of about 350 km<sup>2</sup> where there are evidences of phlogopite mica mineralization. Data have been collected by referring available records, discussions with local residents in the field followed by detailed field work.

In the field, dip and strike of foliations, joints and other geological information were collected. Using a hand held GPS, location of existing pits; historical pits and geological information were plotted.

Samples were collected from existing pits. Colours of the different mica samples were identified by visual inspection in day light by keeping thin slide of mica pieces on a white tile. Variation of colours was used to prepare a colour chart.

To check the heat resistance, samples were heated by Bunsen burner for a particular time period. Permanent colour changes and swelling observed were used to categorize the different heat properties of the samples.

## 3. Results

### 3.1 Historical details of mining

Over 100 years back, during the time of British governance phlogopite mica has been mined in several locations throughout the country. Among them Palkumbura mines is located in the study area. Over 25 m deep shaft with tunnels extending of over 250 m, along the veins have been reported in Palkumbura. Similar mining methods have been used for mica mining elsewhere in the country.

### 3.2 Present Mining

Present mining activities are carried out haphazardly. Small pits are dug in areas where pieces of mica are exposed to the surface. No proper mining methods are used for exploitation of mica. Miners have no knowledge of veins, vein directions and dip of the veins. Thus, after digging for about 10-20 feet they used to abandon the pits. However, there are no detailed studies carried out to identify their geological settings, type of mineralization, quality and quantity available and proper mining method to be used.

This study is marking an attempt to cover details such as geological settings, type of mineralization, quality and quantity available in the phlogopite mica deposits found in the area around Rathnapura.



### 3.3 Geological details

**Table1 - Geological details of the sites visited**

<b>1. Hindurangala</b>	
GPS co-ordinates	01 43 035 E 01 74 245 N
Colour	Dark honey brown
Vein Width	15cm- 2m
Vein Direction	N 30 °W
Foliation	N 30° W
Joint pattern	N 60° E
Associated Rock type	Garnet Sillimanite Biotite Gneiss

<b>2. Palkumbura</b>	
GPS co-ordinates	01 42 715 E 01 74 851 N
Colour	honey brown
Vein Width	Over 100cm
Vein Direction	N 30° W- N 40° W
Foliation	N 30° W- N 40° W
Joint pattern	N 60° E
Associated Rock type	Granite Gneiss

<b>3. Palkumbura</b>	
Location GPS	01 41 847 E, 01 78 117 N
Colour	-
Vein Width	-
Vein Direction	N 30° W-N 60°E
Foliation	N30° W
Joint pattern	N 60°E
Associated Rock type	Granite Gneiss

<b>4. Pathagammana</b>	
GPS co-ordinates	01 52 039 E 01 73 552 N
Colour	Dark honey brown
Vein Width	100 cm
Vein Direction	N 30° W-N 60°E
Foliation	N30° W
Joint pattern	N 60°E
Associated Rock type	Garnet Sillimanite Biotite Gneiss

<b>5. Yakodiyadeniya</b>	
GPS co-ordinates	A) 001 53 019E 001 71 033N B) 001 53 039E 001 70 960N
Colour	Dark Brown
Vein Width	50 cm - 100 cm
Vein Direction	N 30 °W - N 60°E
Foliation	N30° W
Joint pattern	N 60°E
Associated Rock types	Garnet Sillimanite Biotite Gneiss - Granite Gneiss

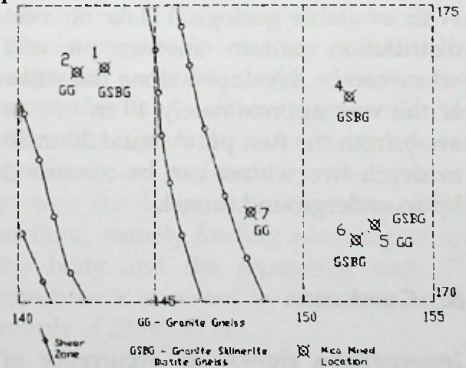
<b>6. Dodampe ,Thambandeniya</b>	
GPS co-ordinates	01 48 092 E 01 70 961 N
Colour	honey brown

Vein Width	100 cm
Vein Direction	N 30° W - N 60°E
Foliation	N30° W
Joint pattern	N 60°E
Associated Rock type	Garnet Sillimanite Biotite Gneiss

<b>7. Kosgala</b>	
GPS co-ordinates	001 52 270 E 001 70 659 N
Colour	Dark honey brown
Vein Width	
Vein Direction	N-S
Foliation	N 60° E
Joint pattern	N 70° E
Associated Rock type	Garnet Sillimanite Biotite Gneiss

Geological details show the existing foliation pattern of the area varies from N 30° W to N 50° W with approximate dip of about 45°- 60° towards North East.

Three major shear zones extending in the NNW-SSE have been identified in the area. Data collected from the area show that the mineralization is associated with such zones and parallel to the foliation pattern. In several locations mineralization follows the joint pattern as well.



**Figure 2-Locations of Phlogopite mica deposits found Rathnanura area.**

### 4. Discussion

The study shows the importance of understanding the geological setting of the veins, their thickness, quality and quantity available. In addition it is also

necessary to use proper mining methods for better utilization of the mineralization.

In this detailed study two major directions of veins have been identified. Further, number of veins, the vein thickness and the area extending have also been identified to quantify the amounts available.

Physical properties of mica show the variation of the quality within the same vein. Present mining activities are carried out haphazardly without getting the maximum recovery.

It is sufficient to have a surface opening of about 2.5 m × 2.5 m to start the mining activities for mica deposits found in the area around Rathnapura. A winze system can be used to recover mica along the dip of the mica veins. Timber supports could be used to avoid collapse of the wall. Proper ladder system should be used for the accessed to the mine.

With available geological data on vein distribution pattern another pit and winze can be developed along the strike of the vein approximately 40 m - 50 m away from the first pit. Around 20 m-30 m depth two winzes can be connected by an underground tunnel.

## 5. Conclusion

Investigation shows the occurrence of economically viable Phlogopite mica deposits in the area. There are three major zones of mineralization extending in the direction of NNW-SSE. Mineralization follow the foliation direction of N 30°- 50° W of the country rocks. However veins following major joint pattern N 60°-70°E of the area is also visible. Thickness of the veins varies from 2 cm -1 00 cm extending over

distance of about 10 km. Dip of the mica veins are 45° - 65° east. Vein thickness vary from 1.5cm - 1 m. 60% of the mica deposits consist quality A and B mica according to heat test and 30 % of the mica samples contained very high amount of Mg content. No systematic mining is carried out in the area. Proper mining method such as cut and fill has to be implemented.

Mining along the vein and dip direction, using winze system and tunnels will become more economically viable at deeper levels of the veins.

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