Phlogopite Mica Mineralization in the Central Part of Sri Lanka and Identify Suitable Areas for Mining

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Abstract: Phlogopite mica has a significant importance as it has excellent thermal and electrical properties when compared to other types of mica. Sri Lanka is blessed with high quality Phlogopite mica mineralization and such deposits occur in Kebithigollawa, Medawachchiya, Rathnapura, Matale, Dambulla, Ambilipitiya, Kollonne, Dehiaththakandiya, Naula and Mailapitiya of Kandy. Mica mining in the central part of Sri Lanka in Mailapitiya off Kady has been carried out during the British regime before 1948. Investigations carried out in the area around Kandy - Mailapitiya shows occurrence of economically minable Phlogopite mica mineralization. The vein thickness of the Phlogopite mica varies from 0.1 cm – 0.8m and extends in N10°-20°W direction. They generally follow the joint pattern of the metamorphic country rocks. Mica found in the area have similar properties although show slight variation in quality due to difference in degree of weathering. Phlogopite mineralization occurs in association with a pyroxenite body which has been intruded into the area prior to Phlogopite mica mineralization. The pyroxenite bodies show higher concentration of Nickel and Gold. Thus, it is worth to carry out detailed investigations of the pyroxenite body while conducting the mining operations in the area.

Key words: Phlogopite, Joint pattern, Mailapitiya, Mineralization, Pyroxenite

1. Introduction

Sri Lanka is blessed with number of minerals deposits from which the majority is industrial minerals. The demand for minerals is continuously increasing due to the rapid industrial development. Mica is one such strategic mineral because of its unique and excellent industrial properties. Mica is a phyllosilicate mineral that exhibit a layered or platy structure. Mica family has seven categories namely Biotite, Phlogopite, Muscovite, Paragonite, Zinnwaldlite, Lepidolite and Lepidomelane. The commercially important mica minerals are

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muscovite and Phlogopite.

Phlogopite mica is found in areas of metamorphosed sedimentary rocks into which pegmatite rich granite rocks have been intruded. Phlogopite mica has been mined in several locations throughout the country due to unique combination of elasticity, toughness, flexibility, heat resistivity and transparency when compared to other mica types.

Mica has a wide range of industrial applications especially an extensive use in electrical and electronics industries. It is used in the manufacture of every electronic and electric component due to its valuable dielectric and insulating properties.

Although there are many mica deposits available in the country, mining is only carried out in few locations. It is basically due to the lack of knowledge about the value of mica and more importantly there are no detailed studies carried out to identify their geological setting.

Therefore, what is needed is a greater sense of involvement in research and development and continuous upgrade of the industry. Mica is a versatile material so that any investment on mica mining will not go waste.

2. Methodology

The study is carried out in an area of about 50 square km where there are evidences of phlogopite mica mineralization. Geological and physiographic maps were referred to identify area geological setting and other relevant information such as accessibility, population, road network etc. In addition, data have been collected by referring available records, discussions with local residents in the field followed by detailed field work.

The maps were prepared with grids and centering the study area before each field visits. It was helpful in navigation and identifying the locations. The grid map was arranged with Kandawala coordinate system as it can be easily handled with a handheld GPS device. 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 and samples were collected from existing pits and other exposed areas. To check the heat resistance samples were heated by Bunsen burner. Permanent color changes and swelling were used to categorize the different heat properties of the samples. Petrological and analytical analyses were used to study the mineralization of the associate rock bodies.

3. Results

3.1 Historical mining activities

There is evidence of Phlogopite mining in the Mailapitiya area during the British period over 150 years back. British age abandoned mine was found within the area with a rectangular shaft extending up to a depth of 60 ft. Mica has been extracted by driving along the vein direction. This shows the existence of systematic mining during that period. Similar mining activities have been reported some other parts of the country especially around Ratnapura area.

3.2 Present mining activities

Most of the present mining activities are carried out haphazardly. More commonly small pits are dug in areas where veins of mica exposed on the

surface and no proper mining methods are used for exploitation which leads to less recovery of ore because of lack of knowledge of veins, vein directions and dip of the veins. After digging for about 10-20 feet pits have been abandoned. However, some mines have been developed up to 80ft depth with use of machinery. In such places, mining is carried out in a proper way achieving a higher degree of recovery and ensuring safety as well.

3.3 Geological setting

The field study data were used to map the mica mineralization around the Mailapitiya area. The vein directions together with the locations of mica exposed were helpful in identifying the distribution of mica mineralization.

The area is underlain with Pre-cambrian metamorphic rocks which have been identified as 'Highland Series' rocks. They have undergone granulite facies metamorphism. The common rocks found in the area are Charnokitic Biotite Gneiss, Marble (usually coarse grained, dolomitic and locally high calcite marble present), Granite Gneiss, Quartzite (Coarse grained). The rocks in the area follow NNW direction and dip towards SW with an angle of about 60^0. Adjacent areas show major fractures (shear zones) extending in N40W and S-S directions. An antiform and synform are located in the adjacent area with N20W fold axes. The antiform found in the area is Digana (Rajawella) and the synform is Galaha.

Figure 1: Geological map around the study area with locations of Phlogopite mica

The Phlogopite mineralization in Mailapitiya area found in contact with crystalline limestone (marble) rocks and charnokite rocks. A basic pegmatite (very coarse grained Pyroxenite body) has been intruded into the area. The pegmatite body covers approximately 2.5m x 6m area in Mailapitiya – Polwatta area.

Figure 2: Mica mineralization and pyroxenite body Mailapitiya - Polwatta area

3.4 Petrography of Pyroxenite bodies

Visual examinations show Basic Pegmatite bodies rich of Plagioclase feldspar, Hypersthene, Hornblende and hydrothermal alterations. Hydrothermal alterations are rich of pyrite mineralization and preliminary analysis show high content of Ni. Furthermore, the Pyroxenite bodies are in association with apatite mineralization in addition to Phlogopite.

3.5 Analytical results of Pyroxenite body

Four samples collected from the Pyroxenite bodies were analyzed in the analytical lab to check the Ni content (Partial analysis). As a high content of sulphide mineralization was observed it was decided to analyse for Au.

Table 1: Concentrations of Ni in rock samples

Sample	Concentration of Ni (% by wt)
SD/MP/R/1	0.030
SD/MP/WR/3	0.068
SD/MP/WR/4	0.038
SD/MP/R/5	0.013

Table 2: Concentrations of Au in rock samples

Sample	Concentration of Au (ppm)
SD/MP/R/1	0.07
SD/MP/R/5	0.04
SD/MP/WR/3	0.04
SD/MP/WR/4	0.02

3.6 Thin section analysis

The country rock consists of very coarse grain interlocking crystals of microperthetic feldspar and pyroxenes. Quartz is almost absent. A prominent mafic vein is seen cutting across the centers of both thicknesses. The vein consists of a finer grain aggregate of clynopyroxene, scapolite, brown mica (probably phlogopite) and associated sulphides.

In many places a transition zone is observed between the vein and the country rock where a high relief elongated minerals appears perpendicular to the walls of vein. In this zone plagioclase feldspar replaces the mainly micro pathetic potassium feldspar of the country rock.

In overall, almost no quartz is seen. Sometimes patches of clynopyroxene appear within the country rock. Sulphides are almost always associated with it.

High concentrations of Ni in chemical analysis show Ni mineralization in the pyroxenite body. Thin section studies show concentration of an isometric mineral which may be classified as Penlandite (Fe Ni sulphide). Co with certain amount of high Au content in the sulphides may lead to find PGM such as Pt and Pd.

3.7 Joint pattern analysis

The analyses of joint patterns were carried out to identify the relationship between vein pattern and joints if any.

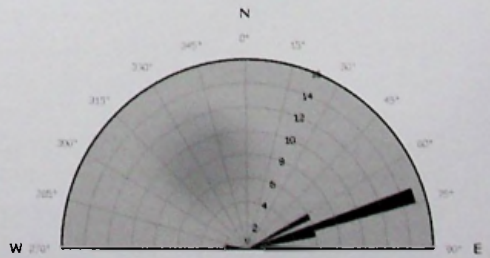

Figure 3: Half circle rose diagram for joint pattern analysis (with respect to dip direction)

4. Discussion

The area around Milapitiya has been identified as Phlogapite Mica mineralized zone. Mining has been carried during British regime by shaft sinking and tunneling.

Study carried out shows present mining activities are scattered and haphazardly done in the top most part of soil overburden. Most of the mines have been started at locations where vein is exposed to the surface. In general no proper mining methods are used for exploitation of mica. Majority of mines have been abandoned with remaining mica after digging for about 10 - 20 feet.

The mining activities mainly carried out with human labor. There is a lack of skilled labor in the area for mica mining and therefore a steady production cannot be guaranteed. Other major problems observed were difficulties with access roads and obtaining lands for mining. Due to hilly terrain, the access was difficult to some areas around the mineralization. In addition, although there are adequate quantities of mica in certain lands, some owners are not willing to give their lands for mining. These reasons have also limited the production of mica. Deep water table has enable economic exploitation of mica as no water pumping is required.

Associated rocks were used for exploration purposes of the initial stage of the study. The associated country rock of Pyroxenite shows a pyrite mineralization. Occurrence of Ni bearing sulphides Fe_2S and higher concentration of Ni and Au may lead to identify more platinum group of minerals (PGM) in the pyroxenite body.

5. Conclusion

The quality of Phlogopite found in the area is high quality. Because the collected mica was honey brown in color and show splitting well. The variations of the quality were only observed with degree of weathering. The main Phlogopite mineralization follows NNW - SSE joint pattern existing in the area. Geological mapping shows the larger vein with a thickness 1 - 2 m extend over 5 - 8 km in the area.

The three main veins following fracture pattern have been identified in the area and occurrence of xenoliths of Pyroxenite bodies inside mica veins show late stage injection of Phlogopite mica veins. The apatite mineralization (with developed crystals) has been identified in contact zone with marble. Visual identification of Pyroxenite bodies shows hydrothermal alterations with pyrite mineralization which contain Ni and Au. The Ni and Au concentrations are much higher than background values of Ni and Gold for Pyroxenite bodies. The presence of Ni bearing sulphides and Au implies presence of other associated elements such as PGM group of minerals.

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