A Pilot Study on the Mineralogical and Geochemical Characteristics of a Recently Discovered In-Situ Beryl Occurrence at Kaltota, South Central Sri Lanka

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Abstract: Recently discovered in-situ beryl occurrence at Kaltota, southcentral Sri Lanka was studied by a pilot study of soil survey to probe its mineralogical and geochemical characteristics. Overall mineralization of the occurrence comprises of beryl, garnet, tourmaline, quartz, topaz and zircon. Beryl and tourmaline occur mainly as scattered detrital grains and as gravity-enriched elluvial concentrations within the overburden. Geological evidences suggest subsurface extension of the mineralization in host pegmatite and in contact zone. Total of 18 soil samples were collected from a pre-planned grid within the site and, mineralogical analysis was performed on the panned heavy mineral concentrates of soils. In chemical analysis, soil samples were treated with both aqua regia digestion and alkali fusion method followed by Atomic Absorption Spectrometry (AAS). With the better results, alkali fusion method was chosen to obtain be concentrations in the soils. The results of the mineralogical analyses shows an existence of beryl and other gem minerals in different proportions in the heavy concentrates, which are in comparison with the anomalous Be concentrations found in the chemical analyses of soils. The results are to be further examined by a detailed study, probably followed by drilling to elucidate subsurface distribution of the mineralization.

Keywords: Beryl, Chemical analysis, Host rocks, Mineralogical analysis, Pegmatite

1. Introduction

Sri Lanka is home to over 40 varieties of gems out of 85 varieties available in the whole world (Fernando, 2004). Some rare gems like ceylonite, sinhalite, and ekanite are known under special names affiliated to Sri Lanka as their first historical record was in this country. More than 25% of the total land area of Sri Lanka is thought to be potentially

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Highland Complex, particularly in southwest and in restricted zones of northeast. However, very few studies have been conducted on in-situ gem occurrences in the country and their geochemical and mineralogical characteristics.

An in-situ beryl occurrence hosted by a pegmatite was discovered recently at Kaltota near Balangoda in the Southcentral Sri Lanka. The discovery was made by the Geological Survey and Mines Bureau (GSMB) and the Earth Resources Engineering Department (ERED) during a joint study on the proposed National Geo-Park at Balangoda in 2006 (Siriwardana et. al., 2006). Although, In-situ occurrences of other gemstones such as corundum and chrysoberyl have been reported previously, this is probably the first of the kind recorded in Sri Lanka. Overall mineralization comprises of precious to semi-precious stones including beryl, garnet, tourmaline, quartz, topaz and zircon.

The main objective of this pilot study was to study basic mineralogical and chemical characteristics of the in-situ beryl occurrence by means of a soil survey to plan a detailed survey. Such a detailed survey will be necessary to find out general configuration of the host rock and the distribution of beryl mineralization within the area with respect to the host rock/contact

2. Methodology

2.1 Reconnaissance geological mapping

Reconnaissance geological mapping program (scale 1:2000) was conducted in the area with the aid of GPS to study field relationship of the pegmatite and the contact zone.

2.2 Soil Geochemical Survey

The present survey aims to study Be distribution pattern of the area to identify anomalies (if any) correspond to beryl mineralization in subsurface.

2.2.1 Sample grid

The survey was conducted on a pre-planned sample grid within the study area. Grid was laid out using a chain survey with the aid of GPS. Base line of the grid is oriented N-S with E-W traverses at 40 m interval. Total of 18 samples collected with a Sampling interval of 20 m within the traverse.

2.2.2 Sample collection and preparation

Soil samples of 1 kg each, were collected from B-horizon (the undisturbed soil layer just below the uppermost layer containing organic matter) at points of a grid which GPS locations were known, packed in polythene bags and, labeled.

Samples were oven dried at 110°C for four hours and each sample was reduced to 200g by coning and quartering method. Next, each sample was divided into two equal portions for further use of mineralogical and chemical analysis.

2.2.3 Chemical Analysis

Chemical analysis for 18 soil samples was performed in three steps, sample preparation and sample digestion followed by Atomic Absorption Spectroscopy (AAS) analysis.

2.2.4 Sample Digestion

The most suitable method for the digestion of silicates is hydrofluoric (HF) acid digestion method. Because of the lack of resources for this method, we had to try aqua regia method and alkali fusion method as alternatives.

2.2.7 Sample Analysis

Determination of concentration of beryllium (Be) in the prepared solutions was done by Atomic Absorption Spectroscopic (AAS) analysis.

2.3 Mineralogical Analysis

Microscopic analysis was done for 18 representative samples to check the availability of gem crystals.

3.0 Results and Discussion

3.1 Microscopic Analysis Results

Possible minerals are listed as Beryl (green), Garnet (pink), Zircon (yellow), Quartz (white), Tourmaline(black).

3.2 AAS Test Results

Table 1. Weight percentage of Beryllium & Minerals [Beryl-B, Garnet-G, Zircon-Z, Quartz-Q and Tourmaline-T] (See figures 2 and 3)

Sample label	Minerals	Be (%) ppm
J9	G,Z,Q,T	1.17453
E9	G,Z,Q,T	0.867023
G9	G,Z,Q	0.59982
L9	G,Z,T	0.797687
L11	G,Z,Q,T	1.949805
E11	B,G,Z,Q,T	1.083744
N11	B,G,Z,Q,T	0.636631
G11	B,G,Z,Q,T	0.674933
G13	G,Z,Q,T	0.917295
J13	G,Z,Q,T	0.62475
N13	B,G,Z,Q,T	0.58588
L13	G,Q	0.7996
J11	G	0.53243
E13	Z,T	0.548027
G15	Z,T	0.810185
J15	B,G,Z,Q,T	0.796495
L15	T,G	0.343676
N9	B,G,Z,Q,T	0.329877

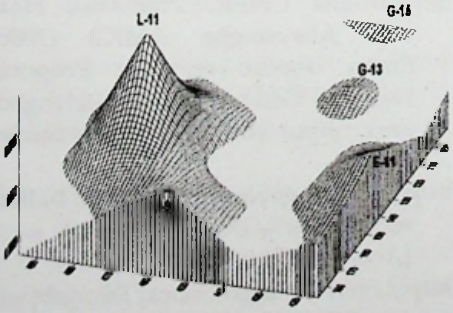

Figure 2. Distribution of Beryllium (Be) concentration

Reconnaissance geological mapping is an important tool to elucidate the sub-surface behavior of an ore body (e.g. shape, dimensions, mineralogy, genesis etc.), particularly when it is aided with drilling. In this study, the geological mapping was able to outline the host pegmatitic body, although its critical contacts were masked by the superficial deposits. This tool was also useful in deciding the sampling area (without employing any geophysical techniques). According to the field evidence, this pegmatitic body to a certain extent follows a lineament, which is running several kilometers along north-south direction. The pegmatite has a maximum thickness of about 100m.

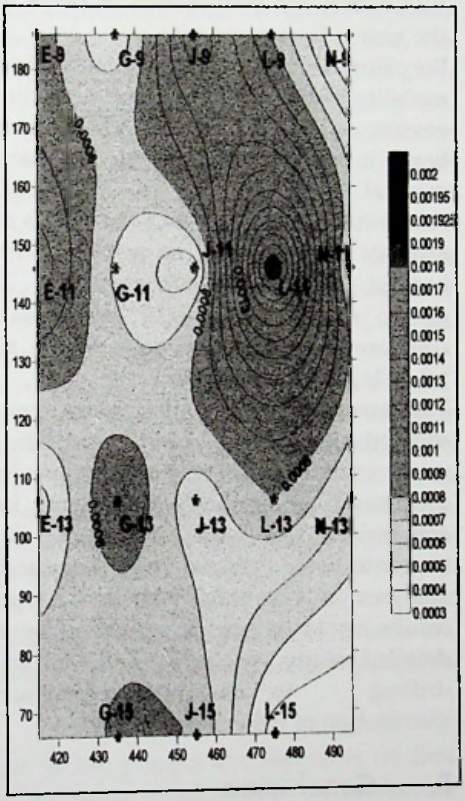

Figure 3. Surface layout of distribution of Beryllium (Be) concentration

In mineralogical analysis of panned samples of soils, beryl, garnet, tourmaline and zircons are found in variable proportions. During the investigation, some detrital beryl and tourmaline crystals were found in

surface soil strata. Garnet is mainly found as large crystals in the contact zone of pegmatite and garnetiferes gneisses. Some vein quartz deposits also found in the area.

Beryllium is a small atom in comparison with other elements in silicates. Thus it is not incorporated in silicate lattices in early phase of magma crystallization and tends to enrich in late melts such as pegmatites. Association of beryl with the underlying pegmatite is shown by reconnaissance geological mapping and mineralogical and chemical analyses shows that the provenance of beryl in the area is from pegmatite.

Beryllium (Be) is has a low geochemical mobility in both oxidizing and reducing environments. On the other hand, beryl is a highly weathering resistant mineral. Therefore, very low beryllium concentrations; recorded in the chemical analysis of soils can be justified. The highest Beryllium concentration is shown at the point L-11 and, some comparatively higher concentrations at J-9, E-11, G-13, and G-15.

The results of the mineralogical analyses showed an existence of beryl and other gem minerals in different proportions in the heavy concentrates, which are in comparison with the anomalous Be concentrations found in chemical analyses of the soils. However, the results are to be further examined by a detailed study, probably followed by drilling to elucidate subsurface distribution of the mineralization.

5. Conclusion

The study shows that source of the detrital beryl found in the surface soil strata is underlying pegmatite Beryl and other gem minerals in different proportions in the heavy concentrates, are generally in comparison with the anomalous Be concentrations found in chemical analyses of the soils. However, the results are to be further examined by a detailed study, probably followed by drilling to elucidate subsurface distribution of the mineralization.

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