

MINERAL AND SRI LANKA



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INTRODUCTION

Sri Lanka is a mineral rich country it called ‘Ratna Deepa’ since ancient era. But today sadly it becomes lower Middle income country. From This “Magazine” issue on wards I would write an article series about Sri Lanka Minerals and Mineral resource also, how it will benefited to the country’s economy. First Article will gives brief introduction about minerals and the sources of minerals.

MINERAL HISTORY

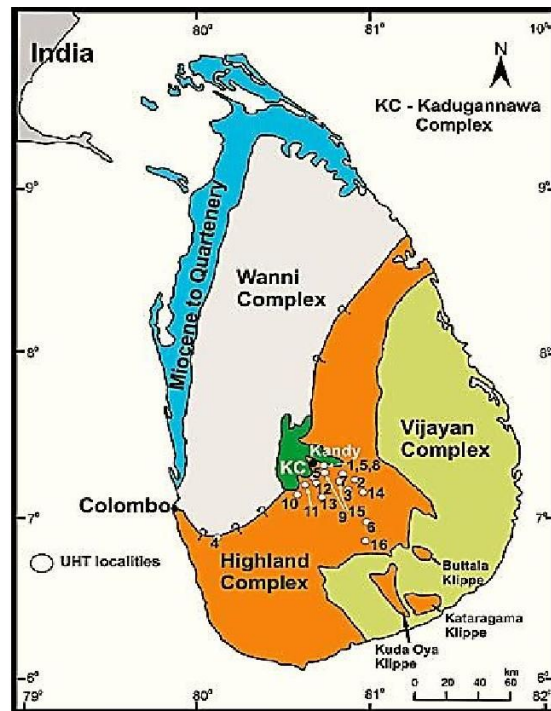
Sri Lanka’s gem and mineral industry has a very long history. Sri Lanka was warmly known as Ratna-Dweepa which means Gem Island. The name is a reflection of its natural wealth. The writer Marco Polo wrote that the island had the best sapphires, topazes, amethysts, and other gems in the world. The 2nd century “Ptolemy”, astronomer recorded that beryl and sapphire were the mainstay of Sri Lanka’s gem industry. Records from sailors that visited the island states that they brought back “jewels of Serendib”. Serendib was the ancient name given to the island by middle – eastern and Persian traders that crossed the Indian Ocean to trade gems from Sri Lanka to the East during the 4th and 5th century.

Sri Lanka, geologically speaking is an extremely old country. Ninety percent of the rocks of the island are of Precambrian age, 560 million to 2,400 million years ago. The gems form in sedimentary residual gem deposits, eluvial deposits, metamorphic deposits, skarn and calcium-rich rocks.

GEOLOGICAL BACKGROUND

When consider about the geological background of Sri Lanka, It has been divided to four main geological categories. These are,

- I. Highland complex
- II. Vijayan Complex
- III. Wannni Complex
- IV. Kadugannawa Complex.



I. The Highland Complex (HC)

This complex is composed of inter-banded metamorphic rocks, broad; running across the center of the island from southwest to northeast.

Included rocks: – Granulite faces rocks Charnokitic gneiss, Marble, Quartzite, Quartzo feldspathic gneiss

ii. Wannu Complex (WC)

No clear boundary between HC and WC in this group of rocks the most common rock types are gneisses of hornblende and biotite.

Included rocks: – Hornblende bearing gneiss, Pink granite

iii. Vijayan Complex (VC)

In the Vijayan region, a low range of low pressure, low temperature, hot springs, alloys, hot springs, whole mineral salts, magnetite, zirconated vane quarts, Cu-magnetite are well-established. Orangal and biotite can be identified in low-grade variables.

iv. Kadugannawa Complex (KC)

This complex is originated due to high temperatures and pressures associated with the process of metamorphism and commonly no agreement on the origin of these rocks.

Included rocks: -Biotitic-hornblende gneiss and Amphibolite

ROCKS AND MINERALS

Earth crust consists of three kind of rocks

- I. Igneous Rocks
- II. Metamorphic rocks
- III. Sedimentary rocks



Mineral Sample



Rock Sample

ROCK: Rock is solid mass consisting of one or more minerals

MINERALS: Minerals is a solid substance of natural, inorganic material with a defined crystal structure and chemical composition.

ROCKS

Igneous Rocks

These are formed by solidification of magma (lava) generated through volcanic activities. When Lava solidification takes place on the surface, these rocks are called extrusive rocks. If lava solidified inside the earth crust then it's called intrusive rocks



Igneous rocks from left to right: gabbro, andesite, pegmatite, basalt, pumice, porphyry, obsidian, granite, and tuff

Metamorphic Rocks

When igneous rocks and sedimentary rocks are subjected to metamorphism, that is subjected to very high pressure and or high temperature, the minerals present in these rocks are recrystallized or reacted in solid or semi solid state to form new minerals of new types of rock. This newly formed rock is known as metamorphic rock.



Sedimentary Rocks

When igneous and metamorphic rocks exposed to various different weather conditions and other erosion activities (living organism etc), they break in to parts. These broken pieces will be transported by gravity, water, wind, glacial etc and deposited and later covered with other materials like clay and other debris. These material will be compacted to form a hard solid mass called sedimentary rocks.

In Sri Lanka 90% covered by precambrian (over 600 million years old) metamorphic rocks. The other 10% which is in the Northern part of Sri Lanka consists of Miocene age (0-25 million years) limestone. Few Jurassic age outcrops are also available in this area. Most of these rocks are covered by recently formed clay laterite, red earth and soil deposits.



ECONOMIC MINERALS

Similarly, minerals are naturally-occurring, solid substances composed of chemical elements. This means that minerals, ranging from salt to rubies, are made up from the elements that appear on a periodic table. They are inorganic, not living or made up of living things. Minerals form a crystalline structure which gives rocks their 'rough' texture. In Sri Lanka have two Government regulating bodies to control mineral activities. Which are The Geological Survey and Mines Bureau (GSMB) and National Gem and Jewellery Authority (NGJA) GSMB evaluates the extension of the mineral reserve and conduct research on the quality of the resource. Two sub sections are responsible by GSMB such as economic minerals and economic rocks. NGJA Solely built up to regulate gem mining and gem marketing activities.

Economic minerals are classified into 4 major groups such as;

- I. Energy minerals
- II. Ferrous and ferroalloy group
- III. Non-ferrous group
- IV. Non-metallic group

ENERGY MINERALS

Uranium, Urinate, Thorite (the silicate of thorium), Thorianite (the oxide of thorium) and monazite have been found in Sri Lanka. Uranium and thorium minerals are mostly found in detrital deposits in Kalaoya area and Rathnapura, Pelmadulla areas respectively. Monazite is found as placer deposits around Induruwa and Polkatuwa area near Beruwala along the southern beach, heavy mineral concentrates in gem bearing sediments in Rathnapura as well as in Pulmoddai as beach sands.

FERROUS AND FERROALLOY GROUP

Most common ferrous and ferroalloy minerals found in Sri Lanka are magnetite, hematite and iron oxides. This deposit is considered as surface as well as subsurface reserve. Recently found magnetite-hematite deposit at Wellawaya is one of the best ferrous and ferroalloy mineral deposits we have in Sri Lanka. Several small magnetite reserves are found in Wilagedara and Panirendawa around Sandalanka and Chilaw respectively. These are mostly surface deposits.

Seruwawila Cu-Magnetite The copper-magnetite deposit at Seruwawila also important. This was discovered by the Department of Geological Survey in 1971. Magnetite and Sulphide massive sections can be found in here. Those are about 1-10 m in thickness. About 40% of the reserve is considered as iron while 2% is estimated as copper. However, since this reserve is located underground, the extraction cost would be very high. Ferroalloy Serpentine deposit is rich in Nickel, Cobalt, Manganese and Chromium. Most popular serpentine deposits are found at Ussangoda and Udawalawe.

NON-FERROUS MINERALS

Pulmoddai beach sand deposit is the most important non-ferrous mineral reserve in Sri Lanka to date. It contains minerals which consist of one of the most expensive and important metals in the world that is titanium. Ilmenite (FeTiO_2) and rutile (TiO_2) found in enormous concentrations in the Pulmoddai beach sand deposit. This deposit extends from Nilaveli to Kokilai lagoon mouth. The distance is about 7.5km. The average width of the sand deposit is about 60 m. Several sand types are found in here; ilmenite (70-72%), zircon (8-10%), rutile (8%), silimanite (1%) as well as monazite (0.3%). Geological explorations have estimated the total reserve is about 4 million tons of sand in Pulmoddai deposit while three closer deposits consist of another 7 million tones more. Exporting sand from this deposit started on 1959. Ilmenite and rutile in this deposit are rich in TiO_2 . Experiments have shown that TiO_2 concentration of Ilmenite is about 53% while that of rutile is about 95%.

NONMETALLIC MINERALS

Sri Lanka is rich in nonmetallic minerals such as Gems, Graphite , Vein quartz , Apatite , Dolomite ,Feldspar , Mica ,Clays , Kaolinite , Sands , Garnet sand ,Silica sand

MINERAL RESOURCES IN SRI LANKA

Gemstones



Sri Lanka is famous for high quality Blue Sapphires and Star Sapphires. Various varieties of gemstones such as corundum (Blue Sapphire, Ruby, Yellow Sapphire, Pink Sapphire, White Sapphire etc.), Spinel, Almandine Garnet, Grossular Garnet, Tourmaline (complex borosilicate), Zircon, Chrysoberyl (Cats eye), Beryl (Aquamarine) and quartz are available in Sri Lankan gem beds. Other than the above mentioned gem varieties, rare gem varieties like Cordierite, Andalusite, Apatite, Kornerupine, Sinhalite, Tarfite and Ekanite are also occasionally found in Sri Lankan

gem beds.

Gems are valuable because of scarcity (rare), high hardness, chemical resistance and its beauty. If it is not beautiful they are not considered as gems. For example there are corundums without any luster and totally opaque, which are not considered as gems. There are corundums showing milky colour and translucent or semi transparent material known as geuda. These geuda could be transformed to gem variety/Blue Sapphire through a heat treatment process. These heat treatment processes were initially developed by Thailand gem traders and later it is being practiced and mastered by Sri Lankan gem traders by their own way.

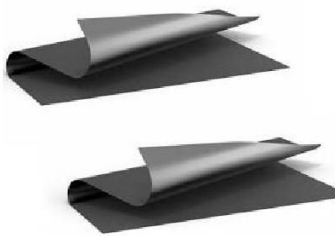
Gems are formed due to igneous activities as well as due to metamorphism. When the heavy minerals (Iron & Magnesium rich minerals) are crystallized and separated, the remaining magma will become rich in volatile matter. When this volatile rich magma cools at a slow rate gem varieties are formed (eg: in pegmatites). Gems are also formed during metamorphism, specially in contact metamorphism. Gems found in Sri Lankan gem beds are of secondary origin.

That means, gems formed in igneous and metamorphic rocks get separated due to weathering of those rocks and transported by running water and deposited in low lying areas. In Sri Lanka, in addition to these sedimentary gem beds, gems are also found in *in-situ* deposits. That is, gems are found in the weathered rock/soil. These are characterized by the original crystal shape, whereas the secondary deposits are rounded in shape due to wear and tear during transportation. Example for an *in-situ* deposit is the gem deposit recently found in Kataragama. Other than the heat treatment for corundum, some other techniques are also used to enhance the colour of some other varieties of gems. One of them is X-ray/gamma treatment for Topaz to change/enhance colour.



GRAPHITE

The use of graphite in Sri Lanka has a long history, from 1675. Sri Lankan graphite is very popular all over the world for its high purity (97%-99%). Chemically graphite is Carbon (C), and it is in layer form, hence it is very soft. Because of its softness and layered structure it slips very easily. Because of this slippery nature it is used in making pencil and as lubricating materials. Graphite is good electrical conducting material and is used in electrical industry as carbon brushes in motors, electrodes, high temperature electrical elements under reduction conditions etc.



Graphene Sheets

Graphite commercially mined at Bogala, Rangala (both in Kegalle District) and Kahatagaha mine is about 650 meters deep. The total production from these mines are exported without any value addition (raw graphite) other than grading (matching Carbon percent and partial size). Other than these three localities graphite is also available in the South Western region of Sri Lanka, but currently there are no mining operations in this area. The processed graphite products including graphite Nano particles and Nano tubes, are very expensive. The latest product developing using graphite is graphene, which has a wide applications in electronic industry. Presently raw graphite is exported US \$1 per kg. Whereas the price of graphene is over US \$ 100- 200 per 1g. currently the most expensive mineral by product in the world.

MINERAL SAND DEPOSITS

Well known mineral sand deposits in Sri Lanka is at Pulmuddai, North of Trincomalee. The major minerals in this deposit are ilmenite and rutile. Other associated minerals are Zircon, Monazite, Garnet, Silimanite and few other heavy minerals. This is the only commercially exploited mineral sand deposits in Sri Lanka, although several other mineral sand deposits are available as beach mineral sand deposits. Some of them are along the beach north of Trincomalee (Nayaru and Nilaveli), Induruwa (Galle district) and along the Manner beach (Kudremali). Ilmenite is black in colour and raw rutile is of a dark honey colour, Therefore, all these Ilmenite rich beach mineral sand deposits can be easily identified



Ilmenite Sand Pulmuddai

Due to their unique Black colour. The ilmenite content of the Pulmuddai deposit around 70%, while Zircon is about 9% and rutile is 8%. These minerals are separated by physical separating techniques using spiral classifiers, magnetic separators, high voltage separators etc.



Titanium Sand Deposit Puttalam

The important chemical element in ilmenite and rutile is Titanium. Titanium minerals used to extract the Titanium metal and also to produce the titanium pigment. Titanium metal and also to produce the titanium pigment. Titanium metal is strong, light weight and can stand high temperatures. Therefore, it is used in the air craft industry and also in space travel. Titanium pigment, rutile, is extensively used in the paint industry to impart whiteness, opacity and brightness. It is also used in paper, rubber, plastic and other industries.

In addition to the above mentioned ilmenite rich beach mineral sand, garnet sand rich beach mineral sand deposits are available in the southern coastal area (Dondara and Hambantota) These deposits are not commercially extracted. All these beach mineral sand deposits are formed by the depositing of heavy minerals brought to the beach by sea currents and waves. The lighter material, silica sand is washed back leaving the heavy mineral on the beach. All the heavy and light minerals are components of the inland rocks. When the rocks are weathered, these minerals are separated, and the separated particles are washed away by running water through rivers and finally carried to the ocean, and then they are brought back to the beach by sea currents

APATITE DEPOSIT



Eppawala Phosphate Deposit

Chemical composition of apatite is Calcium Phosphate with Fluorine, Chlorine and hydroxide. Apatite is also called as rock phosphate. Rock phosphate is commercially used as fertilizer to provide Phosphorous (P) to plants and (P) is needed to for the physiological process of plants. The rock phosphate deposit in Sri Lanka is at Eppawala in the Anuradhapura District. This deposit covers on area over 7.5 km² and the estimate quantity is over 50million tones, The P₂O₃ content of this apatite is around 35%, but its solubility is low to use as a phosphate supplement for short term crops likely paddy. Powdered rock phosphate is used as a fertilizer for long term crops like Tea, Coconut and Rubber etc., the solubility

Could be improved by mixing with sulphuric acid to convert phosphate in to super phosphate. The reaction improves the solubility by about 20%.The solubility could be further improved by the action of phosphoric acid, and converting it to triple super phosphate. The treatment of rock

phosphate with these acids is not environmental friendly process. The Eppawala apatite deposits presently being mined and ground to powdered by Government owned Lanka Phosphate Ltd.

DOLOMITE, CALCITE AND MAGNESITE DEPOSITS



Dolomite

These are known as crystalline lime stone and also as marble. Dolomite is a combination of Calcium Carbonate and magnesium carbonate and its magnesium content may go up to 22%. Calcite and magnesite are nearly pure calcium carbonate respectively. The term dolomitic lime stone is also used when MgO content is 10 to 18 %. Generally crystalline limestone is white in colour, but other colours like ash, green, yellow etc., are also found as small pockets. Crystalline lime stone deposits

are scattered through the Highland – South Western, Vijayan and Wannu complexes. Some of the well-known localities for limestone deposits are Anuradhapura, Habarana, Matale, Kandy, Rathnapura, Balangoda, Badulla, Bibila, Welimada, Ambilipitiya, Hambantota, and Katargama etc.

The Dolomitic lime stone is the most abundant type of material, while calcite is occasionally found as pockets within dolomite and dolomitic lime stone. Well known occurrence of calcite deposits are in Balangoda and these are mined calcite. Other calcite pockets found in other areas are too small. The only Magnesite deposit is in Randeniya (Wellawaya) which is also surrounded with dolomite. The quantity is estimated to be about 4000 tons.



Balangoda Calcite Mining

Dolomite is presently being mined and powdered for use as a fertilizer to provide Magnesium for plants. For this purpose MgO content should be higher than 18%, this powdered material is also used to stabilize the soil and to adjust the pH value of soil. Dolomitic limestone is mined to produce quick lime and slaked lime for the building industry. For this purpose dolomitic limestone with low MgO content is preferred. Pieces of Dolomitic limestone (4-7 mm size) are heated (burned) at around 900-950 °C in a vertical kiln to produce quick lime. This burning process is a continuous process loading from the top as alternate layers (about half a meter thick) of limestone and undried logs. Product is unloaded from the bottom. This burnt lime is marketed as quick lime or as hydrated lime powder after adding water or as slaked lime, as a paste. This dolomite lime becomes important as a substitute for coral lime, since coral mining has been



Butthala Magnetite Deposit

banned to protect coastal erosion. Other than the above mentioned major uses, dolomitic limestone is also used as a minor raw material in ceramic and glass industry. Powders are also used in the rubber and paint industries as a filler material, and also to produce wall finishing materials. Sri Lankan crystalline lime stone cannot be cut into marble slabs due to its coarse crystallinity nature.

Calcite is softer than the other two varieties (calcite is 3 and other two are around 4 in the Moh's scale), and hence it could be ground easily. Therefore calcite powder is used as a filler in industries. Calcite is also used in other industries as a minor raw material, filler, soft abrasive materials, etc.

LIMESTONE DEPOSIT

There are four main Lime Stone deposits available in Sri Lanka.

- (i) Crystalline limestone (Marble-Dolomite, Calcite etc)
- (ii) Sedimentary limestone deposits.
- (iii) Coral limestone deposits (inland and shallow sea waters)
- (iv) Shell deposits the entire peninsula and northern coastal area from Puttalam (several kilometers into the country) is covered with Miocene age hard compacted sedimentary limestone.



Aruwakkulam Lime Stone Deposit

Calcium carbonate content varies widely from low values to over 95 percent. Sand is present as large particles of impurities. Most of the area of the deposit is covered with a thick overburden. The only limestone quarry in operation is at Aruwakkali about 20km away from Puttalam. It is an open cast mine from the cement factory at Puttalam. CaCO_3 content of the limestone should be more than 75 % for use in cement manufacturing (unless it is blended and matched). Presence of silica and clay is not a problem because limestone is mixed with clay (Alumino

Silicate) before fed into the rotary kiln to produce clinker. (Clinker is the output of kiln, which is ground and mixed with small amount (less than 5%) of gypsum to produce cement. Coral limestone is found in many parts of the coastal line around the country. Well known coral beds are found along the southern coast, especially in Ambalangoda and Hikkaduwa. Inland coral deposits are also found in the southern area, which are covered by sand, silt and mud. Extraction of coral from the sea was banned to protect erosion, but there are no restrictions to mine inland coral, provided no environment damage is caused. Inland coral is used to produce MgO – free quick lime and hydrated lime.

A huge collection of sea shells is found in Hungama covering an area of about 3km x 3km to a depth of about 3m from the surface. A lime processing plant was in operation under the Ceylon Ceramic Cooperation during the 1970s and the 1980s in Hungama. These inland sea shells were also used to produce precipitated Calcium Carbonate, which was used as a raw material for tooth paste.

VAIN QUARTZ DEPOSITS



Randeniya Vain Quartz Mine

Chemical composition of quartz is SiO_2 and the name vain quartz is used for the quartz deposits in the form of a vein, which had originated due to igneous activities. Vein quartz deposits of high purity (over 98% Silica) are found in many parts of the country. Some of them are in Galaha (Kandy), Rottota, Balangoda, Pelmadulla,

Embilipitiya, Rathnapura etc. High purity quartz are important to produce fused quartz and Silicon, which are used in computer chips and other electronic devices. Other than that there is a demand for high purity silica powders of submicron size in various industries. Grinding of quartz is comparatively difficult because of high hardness (Moh's scale hardness is 7). In Sri Lanka vein quartz is mainly used in the ceramic industry as a major raw materials.

FELDSPAR DEPOSITS

Feldspar is an Alumino silicate of potassium, sodium and calcium, and occurs due to igneous activities as veins or dykes (as pegmatites). Feldspar deposits are found in many parts of Sri Lanka. Some of them are in Rattota, Namaloya, Koslanda, Balangoda etc. In Owella (Rattota) deposit feldspar occurs with other pegmatite minerals such as



Feldspar and Quartz Mine in Balangoda

Quartz, Biotite (mica) and fluorite (calcium fluoride), as thick bands with clear boundaries. This deposit occurs up to more than 600 meters below the surface. Feldspar is one of the major raw material in ceramic and glass industries.

MICA

Mica is a group of minerals of the hydrated Alumino silicate of iron (Fe), magnesium (Mg), potassium (K), Sodium (Na) etc. Mica could be easily identified by its unique flaky structure. The most common types of mica in Sri Lanka are Phlogopite (Mg rich mica) and biotite (Fe rich mica) so occur in certain areas (Kabitigollawa). Some of the mica deposits are found in Matale, Talatu Oya, Badulla, Maskeliya, Haldumulla, Kabitigollawa, Balangoda etc. One of the underground mines is at Wariyapola, Matale for Phlogopite and muscovite was mined in Kabitigollawa.

Mica mining in Sri Lanka reported even prior to 1900. During the Second World War period the demand for mica increased. Presently the important commercial variety is muscovite, which is white or colourless. Phlogopite is also in demand if it is in large sheets. Mica is graded into sheets, scrap, flake and powders mixing and processing of mica has to be done with extra care, to avoid contact with eyes and also in inhaling. The flakiness nature of mica tends to adhere to eyes, lungs etc., and is also difficult to remove.

Mica can withstand high temperatures, high dielectric strength, and is an electrical insulator. Because of these properties sheets mica is used in electric and electronic industries. Mica powder is used as a filler in plastics, paints some printing inks and papers. Ground mica is also used as lubricant for special purposes, and also for heat and electric insulating purposes.

SILICA SAND

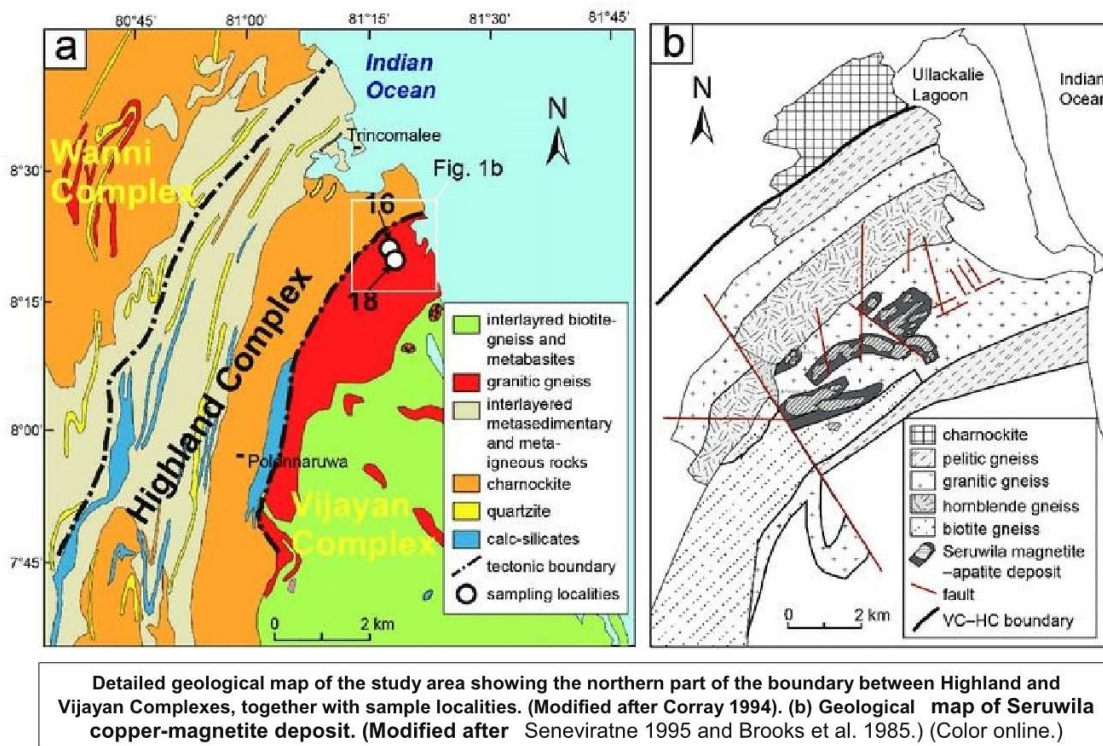
Silica sand can be grouped in to three types, river sand, and industrial sand. River sand is a material derived from weathered rock and transported by running water. River sand is mainly used in building construction, especially for concrete, since it does not contain chloride and sulphate, which adversely affect (corrosion) rain forced steel in concrete. Due to the rapid growth of the construction industry, river sand was extracted extensively creating a shortage of river sand. Because of this reason it has become a necessity to use sea sand was extracted extensively creating a shortage of river sand. Because of this reason it has become a necessity to use sea sand for construction. Now sea sand is pumped to form dunes and allowed to wash away chloride and sulphate by rain water, till sand become good enough to use in building construction. Washed sea sand is characterized by the presence of high shell content.

White colour high purity (over 98 % SiO₂) Silica sand deposits are found in Marawila, Nattandiya and Madampe (in Chilaw District) and also in Ampara and Jaffna peninsula. Silica sand is extracted from Nattandiya and Madampe areas for use as a major raw material in glass and ceramic industries.

IRON ORE

There are few iron ore deposits discovered in Sri Lanka. Identified three main deposits are at Wilagedara, Panirendawa and Seruwila. The Wilagedara deposit is too small to mine. The deposit at Panirendawa has been estimated to contain around 5.6 million tons of magnetite, but they are four separate blocks and these occur underground about 25 – 170 meters below the surface. Therefore currently excavation of this deposits is costly and not economically. The Seruwila copper–magnetite deposit discovered by the

Geological Survey Department (GSD), (present GSMB) in 1971 is the first base metal find in Sri Lanka. The mineralized area was divided into (a) Block "C", (b) Arippu and (c) Kollankulam and covered an area of about 250 square kilometers. The area to the south east of the mineralization namely south of the Verugal River was not investigated due to the thick jungle and also terrorist activities at that time. The outcome of the exploration program has indicated a total of 3 million tons of ore for only the Arippu deposit with an average of 1.06 per cent copper and 41.4 per cent soluble iron up to a depth of only 70 meters. The Kollankulam area and Block "C" were not investigated in detail as the mineralization was disseminated with poor copper values.



A host of mineral suites were identified in the Arippu prospect and include (a) Phosphates (apatite) 25 per cent by volume of the non-magnetite fraction. (b) Carbonates- calcite, siderite, malachite- azurite (copper minerals), (c) Oxides –magnetite iron mineral with many generations.(d) sulphate- pyrite, cubanite, bornite, chalcopyrite, idaite -copper minerals (e) carrollite, pentlandite, bravoite, millerite, smithite ,mackinawite – nickel minerals (f) sphalerite –zinc mineral (g) carollite-cobalt mineral (h) hessite – silver tellurium mineral and(g) native gold. Further high cadmium values of 50 -100 parts per million indicate presence of zinc. High values have also been recorded for tin, tungsten, bismuth, cobalt and lead.

However, the iron content is high, but considerable amount of copper (in the form of Chalcopyrite) is also associated in these magnetite ore. Therefore, the direct smelting process cannot be used to extract iron from this ore. In Sri Lanka there are no iron extraction industries from iron ore. There are few companies producing iron and steel from scrap iron. Iron smelting process consumes very high energy.

CLAY

Clay is not a primary mineral and it is a product of weathering of primary minerals. Chemically it is hydrated Alumino silicate. Clays, characterized by fine grain become plastic when mixed with water. Clay deposits are basically into two types.

- (i) Primary or residual or in situ clay deposits: This type of deposits are formed due to weathering of primary rock minerals or due to action of hydrothermal solution on primary minerals mainly feldspar and mica. These deposits are characterized by large grain (particle) size compared to secondary clay deposits and also by the presence of other mineral particles like quartz, feldspar, mica, ilmenite etc.
- (ii) Secondary or sedimentary clay deposits: When rocks are weathered some of the rock forming minerals (eg: Feldspar, mica) gets converted to clays. These clays are carried away by air, water and glaciers (mass of ice) and get deposited in river banks, river mouths (delta) lakes, sea etc. to form sedimentary clay deposits, and these processes of transportation and sedimentation continue for a very long period. Clay of this type is characterized by fine grain (particle) size and contaminated with organic matter.

The main clay minerals presents in clays are Kaolinite, Montmorillonite and micaceous clay minerals differ from each other, hence characteristics of clay are governed by the percentage of these clay minerals in the deposit. Kaolinite is comparatively less plastic and of high refractoriness (stand for high temperatures of about 1600 C^o). Montmorillonite is highly plastic and of less refractoriness. Hydrous mica clays give intermediate plasticity and refractoriness.

Clay is the main raw material in the ceramic industry. Two varieties of clays, that is Kaolin and Ball clay, are mixed to obtain the required properties. Kaolin (also known as China clay) consist of mainly Kaolinite and deposits are formed by weathering of feldspar. This kind of raw clay has to be refined to remove other associated mineral particles (Silica, Ilmenite, etc.) before it is used in the ceramic industry. Well known Kaolin deposits in Sri Lanka are located at Boralasgamuwa deposit has already been extracted and exhausted, but there are few more deposits nearby by cannot be mined because the area is urbanized. Kaolin deposits are available under the Nugegoda town, but they cannot be mined. A new Kaolin deposit has been found in Millaniya (Bandragama) and extraction has already started. Kaolin is mainly used in paint, rubber, paper and some other industries.

Ball clay deposits are a kind of sedimentary clay deposit characterized by very fine particles, high plasticity and is usually gray in colour but turns to white or cream colour on firing. Ball clay is added to the ceramic body mixture to improve the plasticity. There are ball clay deposits in flood plains of rivers in Kalutara

Area. A well-known ball clay mine is at Dediawala (Kalutara) which has been mining for the last forty years.

Alluvial clay deposits are formed by sedimentation of clays in river banks and lakes. These are characterized by the presence of high organic matter and impurities. Some of the alluvial deposits in the dry zone of Sri Lanka are characterized by comparatively higher amounts of montmorillonite. Alluvial clay deposits are wide spread in the country and are being mined in a small scale for brick, tile and pottery industries.

ROCK (STONE) DEPOSITS

Rock (stones) cut to slabs or into different shapes and sizes (dimension stone) are used in building industry with or without polishing. The commercial name for this is granite, and it is used is as a floor tile or wall

tile. Rocks are also used to produce monuments and also as paving blocks. Other than the above mentioned purposes, rocks are crushed in to pieces to be used as coarse aggregate for concrete and road construction. These types' quarries are wide spread throughout the country. Other than the above mentioned mineral deposits, there are few minerals deposits, there are few minerals deposits in small quantities, which are not sufficient to excavate economically. They are wollastonite: This is in fibrous form in veins of 2 to 7 centimeter width, in the calcic gneisses in Ambalangoda and Galle areas. Wollastonite could be used as a fluxing material in the ceramic industry, and as a filler material in paint, rubber and paper industries.

SERPENTINE DEPOSITS

Two Serpentine deposits occur at Udawalawe and Rupha (Walapane). The Udawalawe deposit is dark green in colour and occur at several meters below ground. Rupha deposit is associated with marble, and is also called green marble, and is exposed to the surface.

PEAT

Peat is available in Muturajawela swamp, but cannot be used as a fuel due to high moisture content,

RARE EARTH ELEMENTS (REE)

Rare earth elements are the elements from atomic numbers 57 to 71. In Sri Lanka some of these have been found in small quantities, but recently carry out a survey for these minerals by several foreign parties.

Monazite is one of the mineral resources that contain REE and it is found in mineral sand deposits (about 0.3 percent) in Sri Lanka. Monazite is also found in many places in Matara, Nuwaraeliya, Teldeniya, Balangoda etc.

Thorinite and Thorite have been reported from Bambarabotuwa (in Sabaragamuwa), in Galle District and in Balangoda.

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