

Mining of Graphite in Sri Lanka

by

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Abstract : The first mention of the presence of graphite in Sri Lanka dates back to 1675. The industry grew mainly during the 19th century and it peaked in 1899 with a production of 31,761 mt coming from about 3,000 pits.

The graphite of Sri Lanka commanded, at that time, a high premium due to its exceptional quality. However, in 1912, shallow deposits which matched in quality those of Sri Lanka, were discovered in Malagasy. This resulted in stiff competition, the Malagasy graphite being extracted at a lower cost. The Sri Lanka production declined slowly but inexorably, with some outbursts of revival during World Wars I and II.

The share of Sri Lanka, which was half the world trade in graphite prior to 1912, had fallen to less than 2 per cent in 1980.

The main reason of this decline, apart from the foreign competition, is probably that the graphite occurrences of Sri Lanka are in thin veins of small extension scattered over a large area. This structure was favourable to manual methods of mining by cheap labour, as long as mechanization was not very developed world wide. However, as the pits had a very small production and as their owners did not have the means to invest in a minimum of mechanization when the time came to be so, their exploitations became unprofitable. Furthermore, the labourers were attracted by the tea plantations where the work was less painful.

Only the mines of the Bogala, Kahatagaha and Kolongaha complexes resisted this trend because they had a concentrated higher production and their sales allowed them to invest in shaft sinking and equipment purchasing.

Graphite was known to occur in Sri Lanka for centuries, but it is only within the last 150 years, that it has been systematically mined. Mining had been intensified during the two World Wars and it is believed that nearly 6000 pits and shallow workings were operated during these periods. The total reserves of graphite in Sri Lanka have not been ascertained but it is believed to be appreciable as the past mining had been confined to very shallow depths of less than 100 feet from the surface.

The known graphite occurrences in Sri Lanka are confined to a belt almost 10 miles wide running in a South-east-north-north easterly direction from the southern sector of the island to the northern sector. The principal mining centres can be roughly grouped into 3 areas a) Ragedera - Maduragoda - Ruwanwella area in the North (b) the Kalutara area and the clusters of small pits in Galle (c) Hambantota - Matara districts in the South. Graphite has been mined from shallow pits in the Vavuniya district in the North Central Province.

At present graphite mining industry is concentrated in the South-West sector of the island and the State Mining and Mineral Development Corporation operates two deep mechanised mines at Bogala and Kahatagaha. The Bogala Mine which is in the Sabaragamuwa Province is one of the most productive graphite mines in the World. This mine produces high quality vein graphite of the crystalline variety with grades as high as 99% carbon. At present this mine is at a depth of 1200 feet and the cost of production had been considerably high due to deep mining. A lateral expansion programme to explore the productive veins at shallow depths was launched in 1971 and the results obtained so far are encouraging. In 1977 the Mining and Mineral Development Corporation drew up plans to rehabilitate abandoned workings in and around Bogala. The Pussahena area close to Bogala Mines was surveyed in detail and the potential for productive graphite veins was assessed by carrying out geophysical surveys using electro-magnetic methods.

The Kahatagaha Mines is located in the Kurunagala district of the North Western Province of Sri Lanka. This mine has now reached a depth of 2000 feet and the veins encountered are mostly narrow veins. The Kolongaha and Walakatahena Mines in close proximity to Kahatagaha have been connected underground and most of the old workings are now opened.

The Ragedera Mines north of the Kahatagaha mining area has also been worked on an experimental basis. The Rangala Mines in the Kegalle District started as an experimental mine and has reached a stage where the initial capital invested has been recovered with the tonnage extracted. Further ground geophysical surveys are being carried out in order to expand the mining activities at Rangala.

The Mining and Mineral Development Corporation has also embarked on a programme to commence experimental mines at Siyambalapitiya in the Kegalle District and Yakupitiya in the Agalawatta area of the Sabaragamuwa Province. These experimental mines are being opened up at the request of the Hon. Members of the National State Assembly who have allocated funds from the decentralised budget to meet such initial costs.

At present there are no large scale mining activities for graphite by the Private Sector in Sri Lanka. The reasons for such inactivity in the graphite mining field by the private sector is mainly due to the high capital investment. The Corporation is encouraging the private sector and the small miner to open up some of the abandoned graphite workings and has proposals to give the technical advice when needed. An attractive purchasing price is also worked out so as to encourage the private sector to actively engage in graphite mining. It is the policy of the Government to channel the graphite exports through the Corporation so as to make this mineral commodity competitive in the world markets.

Most of the graphite mined in Sri Lanka is of high quality crystalline type with the carbon content ranging from 60 - 99%. The quotations are made on the basis of the carbon content and the size range.

Mining in vein deposits is carried out by the out and fill method. From the main shafts are established sublevel drives which are connected by sub shafts or winzes. By this method the ore body is blocked out exposing four sides. The ore is extracted by light blasts or by bar down the graphite. The empty space left is then filled with waste rock obtained from development drives, prospecting drives or from stopes which contain narrow veins of graphite and have been widened for working space for men.

Underground transport of ore is carried out by hand trammed trolleys running on rails. These are trammed to the shaft and hoisted to surface.

45/50 kg. jack hammers with 1.5 integral drill steels are used for lock drilling. For blasting, 80% gelatine with safety fuse and plain detonators are used for cross cuts and drives.

When the graphite vein in the roof of development drives exceed about 0.5M, timber roof supports are used to prevent fall of graphite lumps. Presently round timber and planks are used for underground supports.

Ventilation used in the mines is forced ventilation.

Graphite is marketed in varying percentages of carbon content and particle sizes. Powdered varieties are also offered for sale. The Corporation has also the equipment for upgrading the low quality graphite from mines waste by the flotation principle. The graphite that is mined in Sri Lanka is mainly of the vein type of high quality and low-grade disseminated deposits such as those encountered in Madagascar are not worked.

The home consumption of graphite in Sri Lanka is negligible as compared to the export orders received. Most of the graphite is utilised locally in the pencil industry and for making dry cell and wet batteries. A small plant to manufacture graphite crucibles has been established. The Mining and Mineral Development Corporation is exploring the possibilities for collaboration with foreign organizations on establishing large scale graphite based industries such as crucibles, carbon electrodes etc. Such industries could now be established in the Export Promotion Zone with the Corporation as the local collaborator. The terms and conditions for such investments are now attractive with tax holidays and other subsidised infra-structural facilities.

Geological Surveys have been carried out by the Geological Survey Department in order to understand the mode of mineralization of graphite and also to ascertain any tectonic controls on such mineralization. These detailed studies have revealed that graphite mineralization is mainly in the form of veins which are fillings of joints. Such veins show a "pinch and swell" nature and pockets upto 20 feet wide had been encountered. Detailed structural studies aimed at are at known areas of graphite mineralization have indicated that most of the productive veins are confined to the cores of antiforms in high grade precambrian crystalline rocks with the veins at right angles to the fold axes. Geological maps

where the attitude of the veins, lithology and the structural details are entered, have been prepared for most of the workings mines of the Corporation. In addition to the above detailed geological investigations, some of the areas where shallow mining had been carried out during the two World Wars, have been examined. The main objectives of such geological studies were to ascertain the attitude of the productive graphite veins, depths of such workings and the reasons for termination of mining activities.

Such studies have revealed that the reasons for abandoning these shallow workings were mainly the low price for this mineral commodities during the past and the lack of mechanised equipment to de-water the pits.

Studies carried out in the past by the Geological Survey Department have also revealed that the region between Vavuniya and Anuradhapura in the North-Western Province contain productive graphite veins. The mining in the region is relatively cheaper as the area has a deeper water table compared to the traditional mining areas in the South-Western sector. This area is a good target for exploration and initiation of a joint venture with foreign collaboration. It will be advantageous to open up a mechanised mine in this areas as it could be properly planned.

The rehabilitation of surface workings specially in the Sabaragamuwa Province has to be carried out carefully due to the water logged nature of their abandoned pits.

Quality Analysis of Graphite

Graphite mined in many parts of Sri Lanka can on the average be considered to have approximately similar percentage of minerals. However, graphite ore may vary in appearance (eg.) Dull, Shiny etc. from place to place. A typical analysis of high grade Bogala Graphite is given below :-

CARBON	99.15	
ASH	0.85	
	<u>100.00</u>	
SILICA	(SiO ₂)	77.89%
IRON OXIDE	(FeO)	20.18%
CALCIUM OXIDE	(CaO)	0.38%
ALUMINIUM OXIDE	(Al ₂ O ₃)	0.59%
MAGNESIUM OXIDE	(MgO)	0.41%
SODIUM OXIDE	(Na ₂ O)	0.01%
POTASSIUM OXIDE	(K ₂ O)	0.06%
TITANIUM OXIDE	(TiO ₂)	0.05%
MANGANESE OXIDE	(MnO)	0.16%
LEAD OXIDE	(PbO ₂)	0.02%
NICKEL OXIDE	(NiO)	0.03%
MOLYBDENUM OXIDE	(MoO ₃)	0.01%
COPPER OXIDE	(CuO)	0.21%