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The Geology and Tectonic Setting of the Copper-Iron Ore Prospect at Seruwila – North East Sri Lanka

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1. Introduction

The occurrence of copper-iron ore at Seruwila, N.E. Sri Lanka, was discovered by the Geological Survey in 1971, during the systematic mapping programme of the Island on the reconnaissance scale of 1: 63, 360 (1 inch to a mile). Detailed investigations at this prospect commenced in 1972, and included large scale mapping of the mineralized area, ground magnetometer reconnaissance and detailed surveys. A geochemical prospecting programme which included the collection of soil samples along the geophysical grid lines was initiated in 1976, but was abandoned as the area was found to be highly disturbed due to the past mining and agricultural activities. Abandoned pits with scattered magnetite and secondary copper minerals were traced and found to lie along the negative magnetic anomalies which show a high concentration of ore.[6] The area which is thickly forested is inaccessible and the access was from the survey lines set out on a grid of 20 metres. Drilling investigations carried out so far have revealed that the ore bodies containing magnetite and copper sulphides are lenticular in shape and concordant with the dip and strike of the host-rocks. The lenses of ore could vary from 1-10 metres in thickness. A report released by the Geological Survey in June 1977, incorporates the exploration work carried out up to the end of 1976. Since this prospect is the first base-metal find in Sri Lanka, the need for a detailed exploration programme, with the main objective of the assessment of grade and quantity was essential for the proper evaluation of the ore minerals present.

The feasibility studies for the exploitation of ore, if proved in economic quantities, will follow and a decision will be taken by the Government of Sri Lanka on the financing and execution of this mining venture. Since the Geological Survey is not properly geared to undertake an exploration programme of such magnitude, a world-wide tender was called for this project in 1977 with technical assistance from existing aid programmes in various countries. The offers were evaluated at the Ministry of Industries and Scientific Affairs and the B.R.G.M. in France was successful in getting the tender in early 1979. The detailed exploration programme at Seruwila commenced in July 1979 and was carried out jointly by the French BRGM and the Geological Survey Dept. The State Mining and Mineral Development Corporation provided all the infra-structure facilities to successfully complete this programme three months ahead of schedule. The author was offered a fellowship to undergo training in various aspects of mineral exploıation at the Institute of Geological Sciences in Great Britain under the Technical Assistance Scheme of the Colombo Plan from March-October 1978. During this training period the Seruwila-ore samples were studied in detail under the guidance of Mr. P. R. Simpson of the Applied Mineralogy Unit. This report incorporates the work carried out in U.K. with the main objectives of identifying the various ore minerals and also to unravel the tectonic setting and thus understand the genesis. This work also included a geochemical study of the ores and host-rocks.

2. General Geology of the Prospect

Seruwila falls on the boundary of the 1″ Geological sheets of Trincomalee and Katheraveli and the area is underlain by high grade metamorphic rocks of Precambrian age. To the north-west of the area of mineralization, granulite facies rocks such as charnockites and quaıtzites are predominant and to the south-east, granites granitic gneisses and hornblende-biotite gneisses are the major rock types. The former rocks are grouped under the Highland Series and the latter forms the Vijayan-Series. These two lithological zones are the major divisions of the Archean terrain of Sri Lanka.[2] The reconnaissance and detailed mapping of the Seruwila area reveal ed that the ore mineralization was at the boundary of the Highlands and the Vijayans.

The Seruwila area is flat but the distribution of outcrops is good. The main exposures are granites with pink feldspar, granitic gneisses, hornblende biotite gneisses (Vijayan) and charnockites and quartzites (Highlands). Dolerite dykes were observed mainly in the mineralized zone and these dolerites have tholeiitic affinities. Magnetite outcrops varying from 1-5 metres in length were seen in the mineralized zone. The host-rock for mineralization is an ultra-basic rock, highly weathered on the surface with secondary copper minerals such as malachite and azurite. Fresh host rocks were examined in detail after the surface drilling commenced and the minerals present are scapolite, hornblende, fluor-tremolite, apatite, diopside, with subordinate plagioclase (sodic-oligoclase), rare olivine and perthite. These ultrabasic rocks are highly altered and fractured with filling of secondary carbonate minerals. Some drill cores have shown veins of anhydrite in the host rocks. It is difficult to study both the mineralogical and chemical composition of the original rock due to the high degree of alteration. Nevertheless the host rocks appear to have gabbroic affinities that grade into monzonites. Rocks similar to granodiorites are also associated with the ultra-basic rocks and exposed to the north-east of the prospect. Scapolite forms an important constituent of the ultra-basic rock and crystals upto 2 cms long were seen in some cores. The granites and granitic gneisses occur as low outcrops which are concordant to the ultra-basic rocks and the ore-bodies. These rocks are mainly composed of orthoclase and perthite with biotite and hornblende and grade into the hornblende biotite gneisses which are exposed to the south-east of the prospect.

A band of limestones (Marble ?) was seen at the contact of the mineralized zone with the country rocks to the north-east and is highly weathered. This limestone is coarse-grained with olivine (fayalite). A coarse grained Anorthosite was observed closely associated with the limestone. The composition of the plagioclase in the anorthosite is labradorite. This is the first recorded occurrence of anorthosite in Sri Lanka and can be compared with other Precambrian anorthosites in India, Africa, Madagascar and Antarctica as seen in the fits for Gondwanaland.[12] The regional strike of the area in N 50° E with steep dips of 70° - 80° to the northwest.

In a stereographic projection of the attitude of rocks in the Seruwila area there is evidence for parallel repetition of beds thus indicating isoclinal folding.

3. Ore - Mineralogy

Nine three-inch core samples of ore, disseminated ore, host rocks, limestones and granites were examined under both reflected and transmitted light in order to understand the relationships of silicate minerals to the ore minerals. Most of the samples were from Hole 16 put down at the southern part of the Seruwila prospect. This hole was selected as it had intersected limestones at depth and these samples have disseminated sulphides. The ore-mineralization at Seruwila is mainly catagorised as:-

(*a*) Massive magnetite - sulphide ore.

(*b*) Disseminated magnetite - sulphide ore.

(*c*) Trace-mineralization in ultra-basic host.

The massive magnetite-sulphide ore bodies vary in thickness from 1-10 metres and are very coarse-grained with magnetite, chalcopyrite, pyrrhotite and pyrite. The disseminated ores are mainly composed of magnetite, chalcopyrite, pyrrhotite, pyrite and the gangue minerals are scapolite, apatite, tremolite, diopside and hornblende. It was observed that chalcopyrite is comparatively well-developed in the massive ores compared with the disseminated ores, thus giving a higher copper content for the massive type. In drill hole 14 the reverse order was seen and thus the earlier observation cannot be generalized for the entire area.

The sulphides in the limestone (marble) sample S/16/22 were of special interest as this sample showed a very coarse grained texture. The sulphides are mainly pyrrhotite, pyrite with less chalcopyrite and magnetite. Pentlandite in the form of exsolution flames were seen in well developed pyrrhotite crystals and these flames were oriented parallel to each other and at right angles to the crystal length. The section was also studied under the electron microprobe using energy dispersive analyses and the "flames" were confirmed as pentlandite with a composition of approximately Fe 32-37% Co 13-19% and Ni 8-13%. The cobalt content of the pentlandite was higher than the nickel and this fact was also revealed by the trace-element data for the sample determined on the emission spectrograph.

The limestones are coarse grained with calcite as a major constituent. Apatite and olivine occur as accessory minerals. Secondary carbonate veins were seen along fractures of the section and these veins contain sulphide minerals. Valleriite ($Cu FeS_2$) ($Mg Al Fe (OH)_2$) was also identified in these veins. Valleriite has also been recorded from Palaborawa carbonatites with copper mineralization[8] and the occurrence of Valleriite in the Seruwila ores may pose problems in the floatation of sulphides as encountered at Palaborawa. The electronmicroprobe studies have also rerevaled smythite (51.1% Fe 45.2% S) occurring as an alteration product of pyrrhotite in the limestones. Secondary veins containing serpentinite, anhydrite or gypsum are also present.

The sections examined revealed that secondary carbonate veins are present in the massive ores, disseminated ores, host-rocks carrying ores and limestones. These veins have sulphides (mainly pyrite, chalcopyrite and pyrrhotite) and secondary, magnetite. Therefore two phases of mineralization have been identified at Seruwila an earlier phase of massive magnetite and sulphides and a later phase of secondary magnetite and sulphides. The host rocks and their silicate minerals were examined in detail in order to understand the genesis of the ore. Scapolite is the most predominant mineral and occurs as well developed laths showing straight extinction and is closely associated with sodic-plagioclase. Well developed laths of tremolite showing high birefrengence were also seen. Hornblende was present in the form of large crystals with a pleochroism from green to brown. In the sections examined, augite and diopside are subordinate to hornblende, scapolite and tremolite. Plagioclase is of the sodic variety and was seen as large laths with alteration to sericite. Apatite was mainly in the form of sub-rounded to oval grains with numerous cracks and commonly seen as inclusions in magnetite. One granite sample (3/16/48) was studied and the mineralogical composition was mainly quartz and perthite with scarce hornblende. The section was from the contact of the granite with the ultra-basic rock.The contact was sharp and the granite did not show ore minerals except for a few scattered grains of sulphides.

4. Geochemistry of the Ore and Host Rocks

20 samples were analysed for the major and trace elements in order to ascertain the genetic relationships of the ore minerals to the host rocks and the granites. The samples were arranged into four groups (a) massive sulphide-magnetite ore (b) disseminated ore (c) ultra-basic rock with trace mineralization (d) granites and granite gneisses.

The major elements were determined on the Telsec-/β probe by direct electron excitation X-ray spectrometry and the trace elements on the Jarrell-Ash emission spectrometer at the Geochemical Division. Prior to the analyses each sample was scanned on the X-ray fluorescene spectrometer to get an idea about the trace-elements present. Copper could not be determined by emission-spectrometry as most of the ores (massive and disseminated) and host rocks had values far above the range of upper values of the standards. The iron values as total Fe_2O_3 were extremely high especially for the ores and thus the results are questionable. The high iron and copper values may have a certain amount of interference on the results of the other elements. The ultra basic rocks have a silica content varying from 34.70% to 51.61% and this variation could be related to the total iron content. The silica in the the disseminated ore showed a high variation from 7.39% - 36.30% and could be again related to the total iron. The massive sulphide - magnetite ores are extremely rich in iron with values up to 99.05% Fe_2O_3 (as total iron). The typical host rocks analysed are comparatively low in magnesia with high calcium and sodium.

The most interesting feature in the increase of fluorine with the total iron content (Fe_2O_3) and this variation was observed for all the samples examined except for the granites. The mineral phases that contain fluorine in the assemblages are apatite, tremolite and hornblende but it appears that there is a preferential enrichment by fluorine in magnetite as compared to the silicate and phosphate. The significance of this discovery will be discussed later. However the interference of iron on the fluorine values by the β - probe method cannot be ruled out at this stage and further work on this result will be carried out on the separated pure magnetite samples by analysing for fluorine by another method.

The trace-element data have revealed that the massive sulphide-magnetite ores are enriched in Co, Ni, Zn, Bi, Be, Ag, Pb and V as compared with the disseminated ore, ultra-basic rocks and the limestones. All these elements show a general tendency to increase with iron pointing to the fact that the trace-element concentrations may be in the magnetite and the sulphides or existing as discrete mineral phases intergrown with the major opaque phases. The low chromium and manganese values in all the samples analysed show that these elements are depleted in the environment of mineralization. The limestones analysed are depleted in the traces that are significant from the massive and disseminated ores but show the presence of silver (1.5 - 2.8 ppm) and comparatively high manganese values (437-754 ppm). The high Y, La, Sr and Ba values in limestones as compared with the other rocks are significant but it cannot be conclusively proved that the limestones are carbonatites without the presence of indicator minerals such as pyrochlore. The ultra-basic rocks are comparatively high in Cr, Mn and Zr. The high chromium values in the ultra-basic rocks may be attributed to the presence of pyroxene and rare olivine. The granites and granitic gneisses are enriched in Sr, Ba and Rb, depleted in all heavy trace elements but shows the presence of beryllium. This may be due to the albitisation of these granites and gneisses.

5. Tectonic setting of the Seruwila Prospect

As described earlier, the Seruwila copper-magnetite prospect is at the margin between the Highland Series and the Vijayan Series-both composed of high grade metamorphic rocks of Archean age. A recent gravity survey of the entire Island on a grid of approximately 4 miles indicated a significant gravity low of an amplitude of approximately - 25 milligals. This gravity low was observed running along the eastern boundary of the Highland Series.[3] The geological interpretation of this gravity low shows that the contact between the Highlands and the Vijayans is a trust zone. The Highland Series is overthrusting the Vijayan Series at a fairly high angle. The geological evidence for a trust contact along this boundary is :-

1. The presence of brecciated silicified rocks and calc-gneisses with tectonic breccias in the eastern part of the Polonnaruwa sheet.[14]

2. The presence of circular domes of serpentinite along the Highland - Vijayan contact in the south-east of the Island.

3. The submarine canyon with wall 1,350 meters high at Trincomalee contiguous with the Highland-Vijayan contact.

The highly crushed and altered nature of the host rocks at Seruwila at the Highland-Vijayan contact clearly indicates that the mineralization is at a tectonic trust-plane that appears to be extensive and could extend along the belt which is approximately 10 miles wide and 230 miles long. This belt runs along the Highland boundary from the north-eastern coast to the south-eastern coast of the Island.

An attempt is now made to understand the genesis of the Seruwila ores with the assembled ore-mineralogical and geochemical data in the light of its tectonic setting along a trust plane.

6. Genesis of the Seruwila Ores

It is quite clear from the examination of the host-rocks that the silicate minerals, scapolite, tremolite, apatite, hornblende and pyroxene are predominant. The unusual development of scapolite was given much thought as this mineral is comparatively rare in ore-assemblages. From the mineralogical examination of the samples it is clear that scapolite is post-magmatic. The association of scapolite with magnetite has been reported from mineral deposits characterised by very large metal resources specially in Russia - Kacharskoya, Sarabayskoe and Sokolotskoe from the Kazakhstan USSR.[13] In these deposits the amount of scapolite is comparable with the quantity of magnetite. Scapolite has also been recorded from near-ore metasomatites in a metasomatic magnetite deposit of Katanga.[5] Scapolite is also recorded from the magnetite deposits of the Swedish Lapland and in Kiruna ores. It is thus apparent that the association of scapolite with the Seruwila ores may be significant and help in understanding the genesis of the ore. The association of scapolite and apatite clearly shows that the ore-forming solutions were rich in chlorine and fluorine thus pointing to an association with a marine environment. Regional scapolitization can also take place when the original sedimentary-volcanic sequence has significant intercalations of evaporite minerals such as halite, gypsum and anhydrite. Such beds are sources of Cl, S, B, Na, Ca and possibly Sr.[11] Scapolite is generally formed from alkaline solutions and the reactions tend to proceed with increasing acidity of the environment. The entry of fluorine into the apatite at this stage may be due to its higher electronegativity as compared to chlorine and possibly the acidic nature of the ore solutions.

From the ore-mineralogical studies there is evidence of scapolite being later than the ore. The scapolite replaces the ore and cuts it completely. This feature may be a result of serpentinisation processes effecting the host-rocks at shallow depth as part of a system reacting with circulating sea water. The circulation of sea-water may have been driven by a convecting cell attributed to a central hot-spot from the upper mantle. Thus there is evidence to conclude that the Seruwila ores were formed in a marine environment due to the interaction of sea-water with the ore bearing solutions. It was also observed that the fluorine content of the massive and disseminated ores increase with the increasing iron-content. If this discovery is proved beyond doubt by determining the fluorine content on the above by an alternative method, then the fluorine acted as a mode of conveyance for the mineralized fluids. Thus there is evidence to conclude that two generations of oxides are present in the Seruwila ores.

1. Oxides related to formation of the rocks or initial ore development. (Primary magnetite, chalcopyrite, pyrite, pyrrhotite).
2. Oxides formed as a result of late oxidation reactions (secondary magnetite, chalcopyrite, pyrite, pyrrhotite).

Attention is now drawn as to how the Seruwila ores reached the present areas of deposition in relation to the tectonic setting and an application of the modern plate tectonic theories to environments of ore deposition may be considered. Although the relation ship of ore genesis to plate tectonics is not generally clear in Old Precambrian shield areas, there are certain schools of thought who believe that global tectonic processes in rocks dating back to 600 m.y. and possibly up to 2200 m.y. are similar to those that occurred in relatively younger geological periods. An attempt is now made to reconstruct the events that took place during the emplacement of the Seruwila ores. It must be emphasised that it is rather premature to construct a plate-tectonic model with the available data, but analogies to younger ophiolite belts are drawn to bring out the similarities of the Seruwila ores to the tectonic environments of such belts. An ophiolite belt could be identified by its tectonic setting and also by lithological groups which characterise a marine influence. The trace-element study of the magnetite at Seruwila has pointed to a volcanogenic-sedimentary origin[6] *et al.* and may have been deposited by volcanogenic-sedimentary processes.

The scattered occurrence of chert beds in the mineralized zone may also strengthen the case for a sedimentary environment. The limestones which have secondary serpentinite veins and also anhydrite may be of a sedimentary nature, but the possibility of these limestones being carbonatites cannot be resolved due to the lack of geochemical data. The ultra-basic rocks which have gabbroic affinities may also fit into an ophiolite sequences. The tectonic emplacement of serpentinite bodies to the south along the Highland-Vijayan thrust contact is also significant. The granites at Seruwila have some affinities to Hercynian granites in Europe due to the high content of barium and rubidium and may be considered to be post collision type.[1] Thus the above lithological types have some similarities to idealized complete ophiolite sequences from various parts of the world such as Cyprus, Red Sea, etc. The tectonic setting at Seruwila also indicates that the ophiolites have been significantly altered and crushed into a 'melange'.

The limestones at Seruwila contain magnetite, apatite and subordinate sulphides. Such limestones are common in the Pacific basin along the line of orogenic activity in the eastern margin of the American continents and spreads to Japan, Australia and Malaya.[10] In this paper[10] there is a reference to a mine at Kamishi in Japan where a body of granodiorite and associated igneous rocks intrudes a sequence of Mesozoic limestones, shales and sandstones. An extensive skarn and hornfels zone developed along the contact and lenticular bodies of massive magnetite were deposited in and adjacent to the skarn. Minor amounts of haematite, chalcopyrite, bornite, pyrite and pyrrhotite, sphalerite, Gelena, gold and silver are disseminated in the magnetite. The trace element data on the Seruwila ores and the presence of limestones with magnetite and apatite points to a similar mode of ore formation as at the Japanese occurrence. The probable sequence of events for ore-mineralization at Seruwila can be summarised as follows:-

1. Volcanic eruption below the ocean floor (submarine volcanism) in the form of a strato-volcano giving rise to magma at depth.
2. A deep seated rift in the oceanic and continental crust reaching the mantle brought up the ore bearing fluids and magma thus giving rise to massive copper-magnetite ores and original host rocks (gabbros).
3. The movement of the above magma and separated ore, solutions was in a fluorine and chlorine rich environment (due to marine influence) thus giving rise to a second generation of oxide formation due to late oxidation reactions. At this stage widespread scapolitisation of the host rock took place.

4. The thrusting of the ocean floor over the Vijayan Series. This tectonic movement may have been caused by excess pressure on the Vijayan in a north-west direction. The ocean floor was thus obducted to form a 'melange' at the margin of the Highlands and Vijayans.

It is not clear as to the stage at which granites and limestones were formed in the above sequence. The granites may be post-collision in nature and formed after the Vijayans collided with the Highlands and may be deep-seated younger granites. If this assumption is correct the granites have to be younger than the ore mineralization at Seruwila. The limestones may be igneous in origin and formed from a carbonate magma or may be metamorphosed calcareous sediments of the ocean floor.

The above sequence of events point to the fact that the mineralization at Seruwila was of a submarine-volcanic type and formed due to the fumarolic activity of a strato-volcano below the ocean floor. The mineralized solutions were brought to the areas of deposition by sea water circulation driven by a convecting cell with the heat generated from a central hot - spot. The formation of ores is thus a part of the obducting process (uplift) and the ores have formed due to the reaction of ore solutions with convecting sea-water. Later oxidation reactions of the hydrothermal fluids thus gave rise to late oxide ores which is a second phase of ore formation. The lenticular nature of the oıe-bodies was the result of the overthrusting thus giving rise to a 'skarn' type similar to the Japanese occurrence described earlier. Therefore the overall charateristics of the tectonic setting at Seruwila is similar to that of an obducted ophiolite belt and the mineralization has similarities to a 'besshi type' formed by continental collision.[9] Such types of ore bodies are generally absent or rare in the Archean.[4] Pyrite - chalcopyrite ore bodies of this nature are common in ophiolites that show an early stage of orogenic activity and are generated at ocean ridge - rift environment during the initial stages of separation of continental blocks. The abundance of copper and iron in cupreous pyrite deposits suggest that these metals in the volcanogenic family of deposits aıe mainly of ocean crust-mantle derivation.[4]

7. The Relationship of Mineralization at Seruwila to Continental drift by Ocean Floor Spreading

The recent reconstruction of Gondwanaland fits Sri Lanka at the interspace between Antarctica, Africa, Madagascaı and India. Smith and Hallam[12] detached Sri Lanka from India and by inspection fitted it further south. This fit is at 130 m. y. and the present position of Sıi Lanka with respect to India was reached at about 100 m. y.[7] In the spreading history of the southern Indian Ocean from 130 m.y. to the present it is observed that Sri Lanka underwent an anti-clockwise rotation with its movement with the Indian sub-continent north-wards. The eastern margin of Sri Lanka at 130 m. y. (upper cretaceous) was in line with the continental margin of Antarctica and with the separation of the Island from Antarctica, a deep rift at the eastern part of Sri Lanka developed, thus giving rise to a narrow opening between the Highlands and the Vijayans. The sub-marine volcanic activity giving rise to strato-volcanoes may be related to this period (Upper Cretaceous). With the northern flight of Sri Lanka with the Indian sub-continent much pressure was applied on the Vijayan and the narrow opening of the sea between the Highlands and Vijayans closed thus obducting the ocean floor. Thus the mineralized belt at Seruwila which runs south for over 250 miles may have characteristics of a narrow oceanic crust of a marginal sea. It must be stressed that this interpretation is somewhat speculative and it will be critical at this stage to date the sulphide mineralization to prove this point. It is thus tentatively suggested that the ore-mineralization at Seruwila may have taken place during the Upper Cretaceous period (130 - 100 m. y.) and is extensive along the Highland-Vijayan boundary.

8. Present Interpretation of the Tectonic Environment at Seruwila and its Bearing on Future Exploration Programmes

It is now evident that the ore-mineralization at Seruwila is along a deep seated thrust zone at the contact between the two major lithological divisions-Highlands and Vijayans. This deep seated thrust is tentatively interpreted as an obducted ophiolite belt which has undergone a very high degree of alteration and deformation due to the collison and overiding of the Highlands/Vijayans. Thus the lithological characteristis and the tectonic setting at Seruwila is similar to a 'melange' from ophiolite belts in other parts of the world specially in Cyprus and the Red Sea.

This obducted ophiolite zone (melange) is mineralized at Seruwila and is rich in iron (magnetite) and sulphides (mainly copper). There are indications of minor amounts of nickel (pentlandtite rich in cobalt) silver and bismuth. The limestones which are exposed at the north-western contact of the mineralized zone with the country rocks were examined in detail for the first time and contain sulphides with traces of silver. This contact zone has to be very carefully studied for possible cobalt-nickel mineralization. The tectonic interpretation of the Seruwila ores attempted in this paper leads to new ideas of ore mineralization and it appears that hot magmatic or recirculating brines were involved. Thus this marine environment will be encouraging for extensive base-metal mineralization along this thrust contact (ophiolite belt ?) which runs for about 250 miles. Metals such as copper, cobalt, nickel and zinc are a possibility along this zone. It is noted that precious metals such as gold and silver may be encountered in such an environment. The possibility of hydrothermal platinum ores have to be kept in mind as most platinum minerals are associated with chalcopyrite. In the New Rambler Mine, Wyoming,[8] the platinum metals are derived by the hydrothermal leaching of a meta-gabbroic complex similar to Seruwila. The presence of circular bodies of serpentinite to the south of Seruwila along the thrust zone is encouraging and these bodies have not been examined in detail so far. Kimberlites too occur in deep seated fractures and this fact has to be kept in mind when the mineralized belt is examined in detail.

The work carried out at the Geochemical Division of the Institute of Geological Sciences in London has conclusively proved that the tectonic setting and the host rocks at Seruwila are definitely favourable for base metal and possibly precious metal ore-emplacement. Therefore a detailed exploration programme has to be initiated to examine in detail this entire belt which is approximately 2500 sq miles in extent.

The Geological Survey of Sri Lanka can undertake such a task with assistance from foreign surveys under existing technical assistance programmes. It must be stressed that embarking on such an exploration programme very early may eventually pay very rich dividends and give an unimaginable boost-up to the Sri Lankan economy if base metals and possibly precious metals are proved to be present in large quantities which would warrant exploitation.

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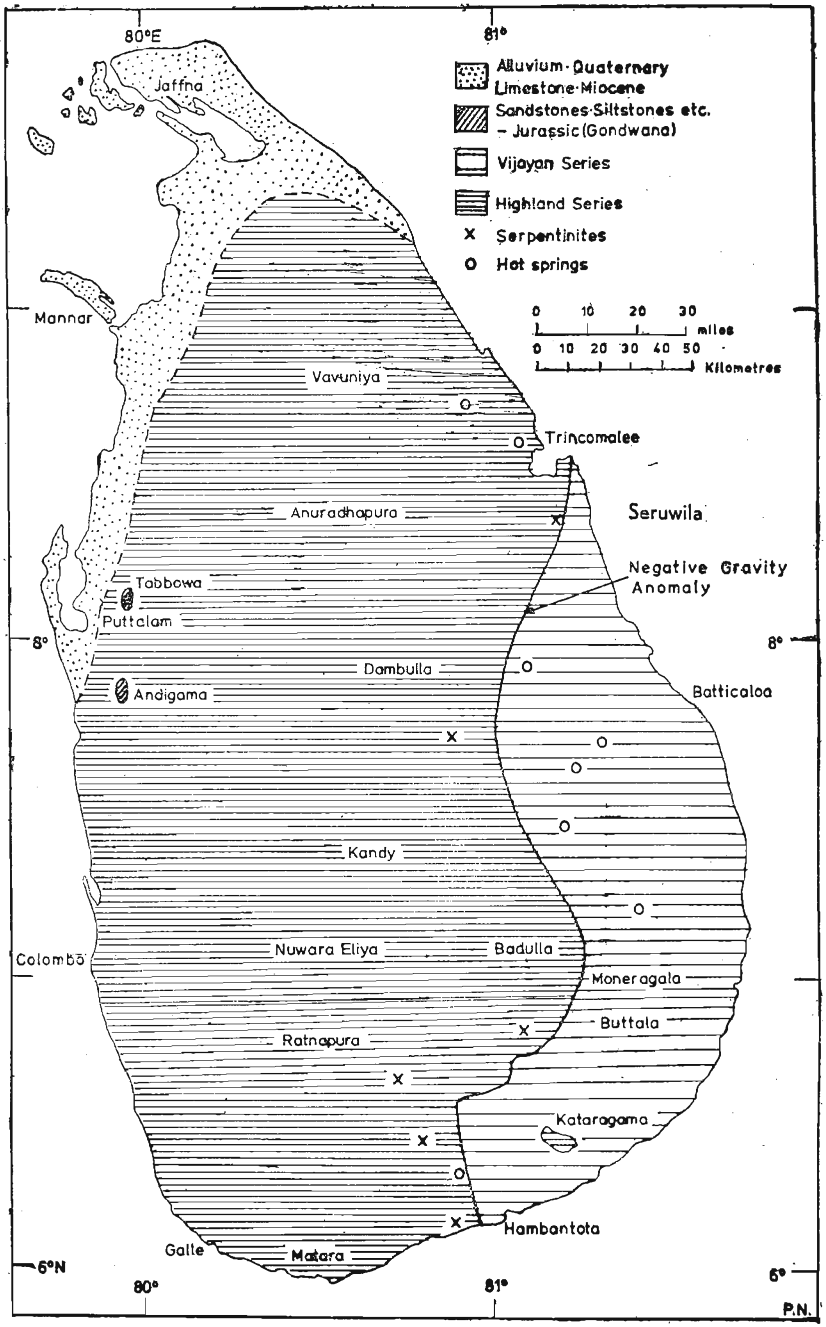
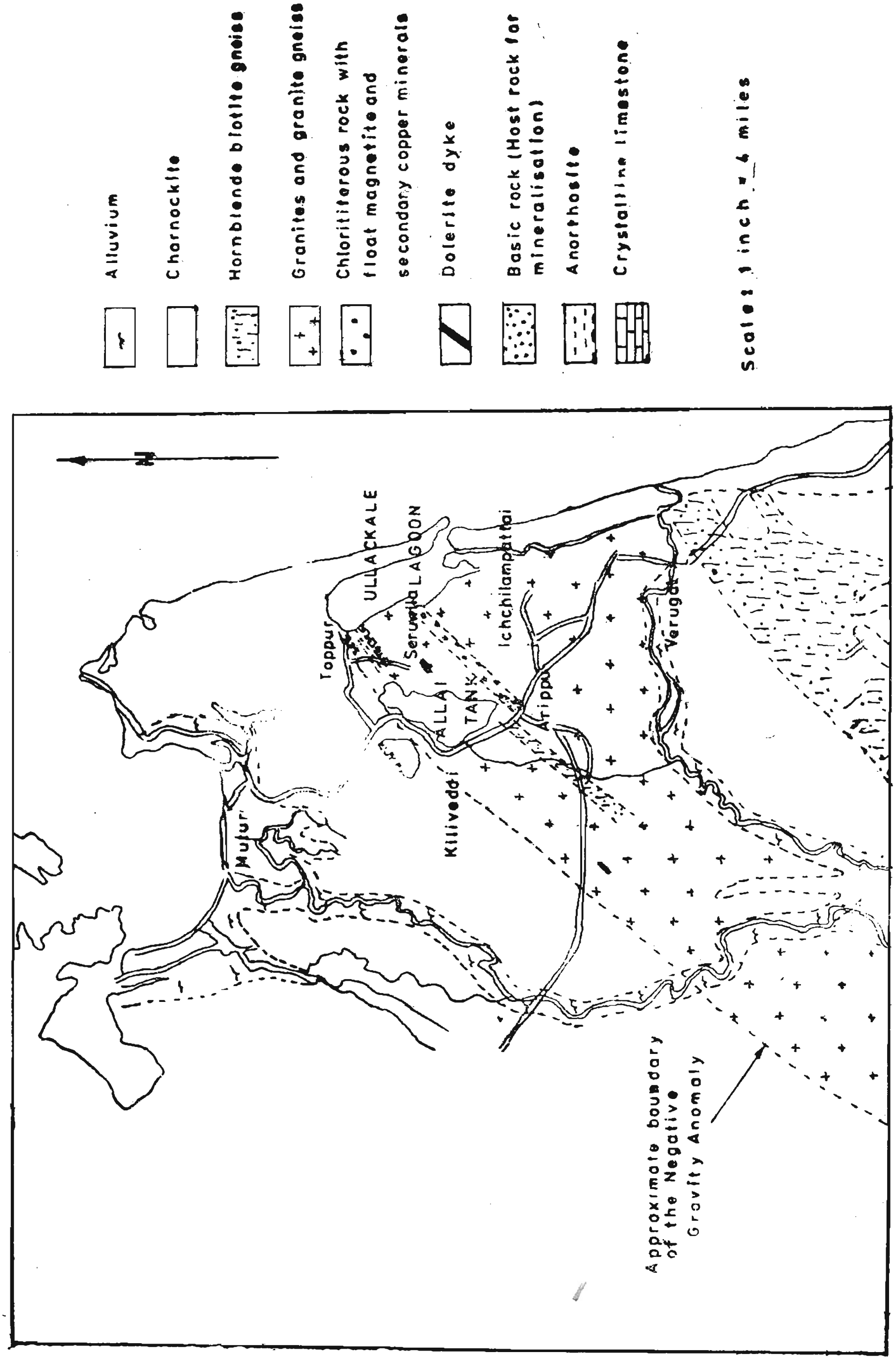


GEOLOGICAL MAP OF SRI LANKA

MAP SHOWING THE REGIONAL GEOLOGY AROUND SERUWILA AREA



References

1. BROWN (1973). *In Volvanogenic Processes in Ore Genesis. Special publication.* Institute of Mining and Metallurgy—London (1976).

2. COORAY, P. G. (1967). *An introduction to the Geology of Ceylon National Museums of Ceylon.* Colombo. 324 pp.

3. HATHERTON, T., PATTIARACHI, D. B. & RANASINGHE, V.V.C., (1975). *Gravity Map of Ceylon, Professional Paper No.*3, Geological Survey Department. Sri Lanka (Ceylon).

4. HUTCHINSON, R. W. (1973). *Volvanogenic sulphide deposits and their metallogenic significance- Econ. Geol.* **68** : No.8.

5. JAMOTTE, A. (1950). *Computer Renkus du. Congr. Sci.* 50 - & *Ann. C. S. K.* Elisabethville, 3.

6. JAYAWARDENA, D. E. DE S. & PADMASIRI, S.- *Report on the Copper – Magnetite occurrence at Seruwila-Arippu Prospect.* Mineral Reconnaissance Report MS/015/77-Geological Survey Department, Sri Lanka(Ceylon) Unpublished.

7. JOHNSON, B. D., POWELL C. McA, VEEVRS, J. J. (1976). *Spreading history of the Indian Ocean and Greater India's northward flight from Antartica and Australia. Geol. Sec. Amer.* **87** : 1560-1566.

8. MCALLUM, M. E., LOUCKS, P. R., CARLSON R. R., COOLEY, E. F. & DOERGE, T. A. (1976) *Platinum metals associated with hydrothermal copper ores of the New Rambler Mine, Medicine Bow Mountains, Wyoming. Econ. Geol. Vol.* **71,** 1976 pp. 1429-1450. *Palaborawa Mining Company Ltd.*, (1976). Mine Geological and Mineralogical Staff· *The Geology and the Economic Deposits of copper, iron and vermicullite in the Palaborawa Igneous complex. A brief Review. Econ. Geol.* **71**—p. 177.

9. MITCHELL & GARSON M. (1970). *Volvanogenic Processes in Ore Genesis.* Special Publication. Geological Society of London. (1976).

10. PARK, JR. C. F. (1972). *Iron-ore deposits of the Pacific Basin. Econ. Geol.* **37** (3) p. 339-349.

11. SHAW, D. M. (1960). *The Geochemisty of Scapolite, Parts* 1 & 2. *Journal of Petrology* **1,** p. 218.

12. SMITH, A. G. & HALLAM, A., (1970). *The fit of the Southern Continents, Nature* **225** p. 139-144.

13. SOKOLOV, G. A. & PAVLOV, D. I. (1965). *The sources and role of chlorine in Magmatogene Ore deposits .Int. Geol. Congress, India* (1965). Section Ore Genesis.

14. VITHANAGE, P. (1959). *Geology of the country around Polonnaruwa. Memoir No.* 1 *Geological Survey Dept.*