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A RECENTLY DISCOVERED NICKELIFEROUS SERPENTINITE FROM UDA WALAWE, SRI LANKA

C. B. DISSANAYAKE[1] & B. J. VAN RIEL[2]

INTRODUCTION

Nickel-bearing deposits have never been recorded in Sri Lanka. Even though serpentinites have already been observed, their economic potentials have never been evaluated.

A reconnaissance survey of the Uda Walawe area was conducted in 1970, followed by more detailed geological, petrological and geochemical work in 1976 by the Department of Geology, University of Sri Lanka.

Since, up to now, Sri Lanka's mineral wealth has been thought to be rather poor – only graphite, mica, beach sands and apatite being mined – a positive assessment of the mineral potential of the serpentinite in the Uda Walawe basin would prove worth while from an economic point of view.

The area lies in the lowlands of Sri Lanka and is part of the drainage basin of the Walawe river (Fig. 1). The serpentinite covers an area of approximately 7 km² and is surrounded by migmatitic gneisses and marbles.

A typical tropical climate, characterized by well marked wet and dry seasons and long periods of drought, is prevailant here. The alternation of the dry and wet seasons causes the groundwater table to fluctuate to a considerable degree. These factors are highly conducive to weathering with resulting leaching and concentration of certain elements like Ni and Al. The vegetation on the serpentinite body differs from that of the surroundings: no crops could grow there as a result of which the entire area had been abandoned by the farmers.

GEOLOGY

Relatively little detailed petrological and structural work has been done in Sri Lanka and this is the reason why its geologists still anticipate a general nomenclature for the Precambrian rocks.

Based upon the grade of metamorphism and lithology the Precambrian is divided into three main units:

(a) the Highland Series: quartzites, marbles and calcgneisses metamorphosed under granulite facies conditions;
(b) the South-West Group: mainly charnockites and pelitic gneisses, characterized by the presence of cordierite and the absence of marbles;
(c) the Vijayan Series: migmatites and granitic gneisses metamorphosed under amphibolite facies conditions (Fig. 1).

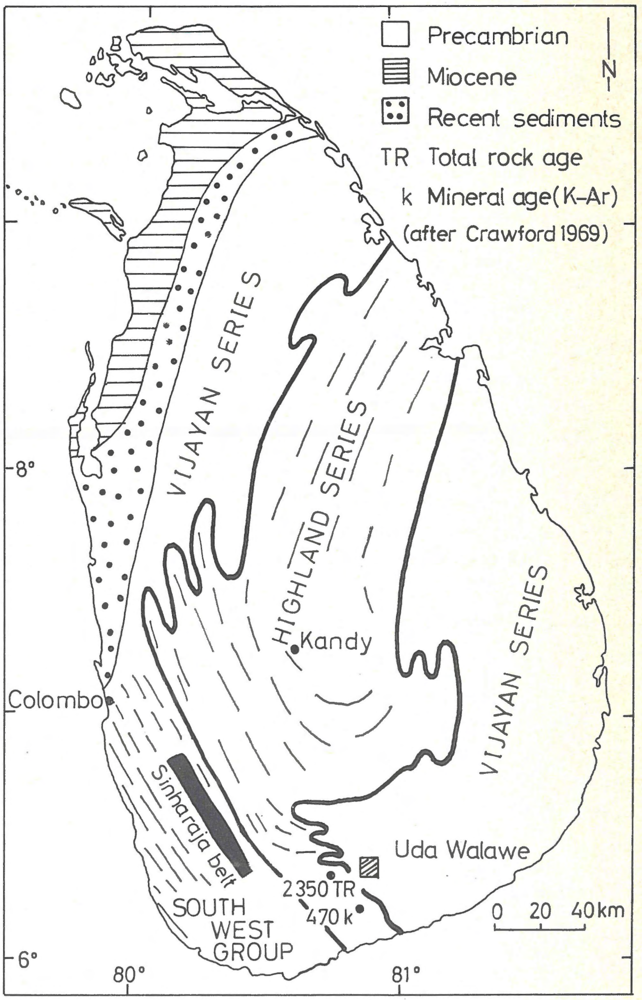

Fig. 1
The main geological divisions of Sri Lanka (after Katz, 1972). The inset near Uda Walawe shows the location of the area under investigation.

[1] University of Sri Lanka, Dept. of Geology, Peradeniya Campus, PERADENIYA, Sri Lanka.
[2] UNESCO House, 40-B Lodi Estate, NEW DELHI, India.

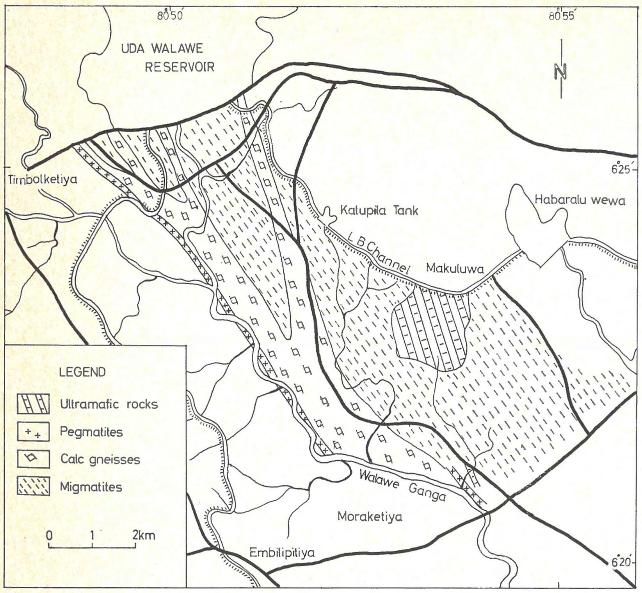

Fig. 2
The geology of the area around the serpentinized ultramafic body of Uda Walawe.

The Uda Walawe region shows characteristics of all three units (Fig. 2): charnockites, calcgneisses, migmatites and cordierite bearing rocks being present. Most rocks still exhibit high-grade metamorphic features, but the main part seems to be retrograded to amphibolite facies.

Due to the critical geological setting of the region and also because of possible obliterating effects of serpentinization upon its surroundings a detailed analysis of the geological history appears to be difficult. The structural pattern is relatively simple: a general NW-SW strike is apparently not influenced by the emplacement of the serpentinite body, while only in the NW we find three folds with opposite plunging axes. At the W-side of the Walawe river the area is overlain by charnockites, bounded along the river by a concordant pegmatite layer of 100 m thickness. It probably intruded in a zone of weakness representing the tectonic contact between two different tectonic blocks.

The scarcity of exposures made it difficult to find unambiguous relationships (zoning, contact-metamorphism) except at the northern contact of the serpentinite with the migmatites, where rounded serpentinite boulders are embedded in a schistose gneiss indicative of shearing movements.

The serpentinite rocks are completely serpentinized and only occasionally contain remnants of pyroxene and tremolite. They are composed of vesicular and platy serpentine minerals (chrysotile and antigorite) associated with varying amounts of silica and carbonates. Magnetite when present forms disseminated dust-like grains.

WEATHERING

The weathering profile on the serpentinite is that characterized by products developed from weathering as seen in a tropical terrain. The upper part of the profile consists of a lateritic iron-rich duricrust. This is composed mainly of secondary iron oxides and hydroxides. Iron has been leached out and reprecipitated by solution activity.

Below this crust is the zone of weathered serpentinite. Associated with it is secondary silica which occurs as agate, chert and chalcedony in veinlets, as boxworks and as cavity fillings. Some of the veinlets contain bluish green chalcedony and chert characteristic of nickeliferous laterites and serpentinites.

GEOCHEMISTRY

The chemical analyses, carried out by X-ray fluorescence spectroscopy, atomic absorption spectrometry and spectrophotometry show a Ni-variation of 1 - 2%. Since the study of the mineralogy has revealed that Ni-bearing sulphide solutions had not existed it appears likely that Ni was in the silicate form throughout its history. There does not appear to be any evidence for the introduction of Ni-bearing solutions from outside during the process of serpentinization such as the formation of special Ni minerals. No Ni-source other than the parent ultramafic body can be envisaged. Since Ni is known as a substitute for Mg during leaching and weathering and the Mg/Ni ratio of the weathered serpentinite samples is fairly constant it can be assumed that the Ni-concentration was due to a residual enrichment. Also the movements of the groundwater level and changes of pH might have attributed to this Ni concentration into Ni-Mg-silicates.

Cobalt occurs in much smaller quantities (0.07 - 0.12%) than Ni. The Ni/Co ratio varies between 9 and 15. In serpentinites Co is expected to be associated with Mn, which in this case is present in secondary silica.

Chromium occurs in similar amounts (0.07 - 0.17%) as Co in Cr-spinel (picotite). Zinc is expected (0.03 - 0.09%) to reside in magnetite and picotite. The low Cu-content (40 - 300 ppm) could perhaps be attributed to the high solubility of the element, thereby being depleted during the process of weathering.

ECONOMIC CONSIDERATIONS

The nickel content of the samples analysed seems to be sufficient to be considered economical. The suitable location and easy accessibility are certainly advantageous for exploitation of the serpentinite. Further detailed work, particularly on the variation of elements with depth is essential before ore-reserves can be worked out. The exposures made while cutting canals for irrigation purposes, have revealed a weathered serpentinite zone of more than 12 m thickness and it is possible that this zone extends much deeper, bearing in mind the intense weathering that prevails in a tropical country like Sri Lanka.