ENVIRONMENTAL CASE STUDIES

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South Pacific Study 1

THE EFFECTS OF MINING ON THE ENVIRONMENT OF HIGH ISLANDS: A CASE STUDY OF NICKEL MINING IN NEW CALEDONIA

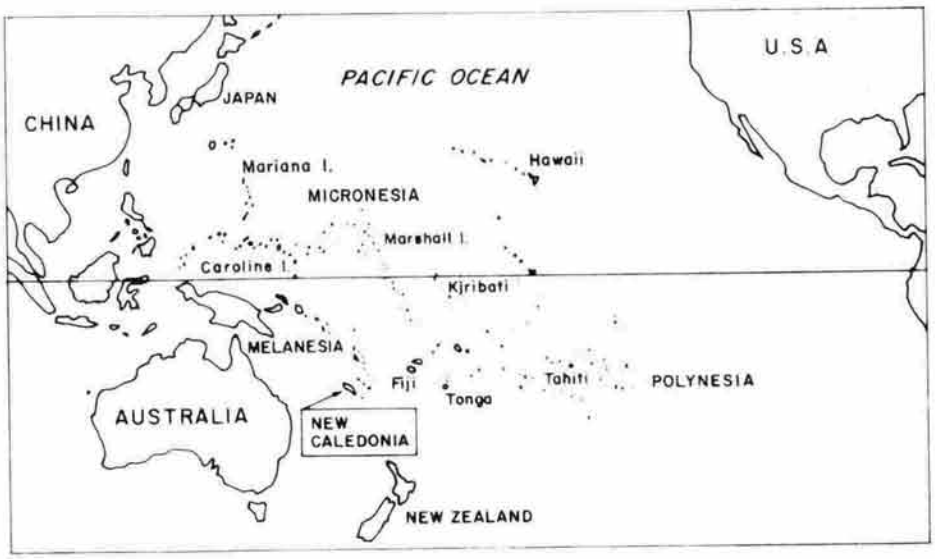
In the islands of the tropical Pacific, the beginnings of the mining industry coincided with the extension of European settlement last Century.

Extraction of mineral wealth from the subsoil has actively continued since that time in Papua New Guinea, New Caledonia, and Fiji. It has also been carried out, to a lesser extent, in the Solomon Islands, and in Vanuatu.

In the coral islands, which have a less diversified geological and mineralogical structure, mining has been confined to phosphates. Nauru is the most striking case, but phosphates have also been exploited at Banaba (Ocean Island), and on Makatea in French Polynesia.

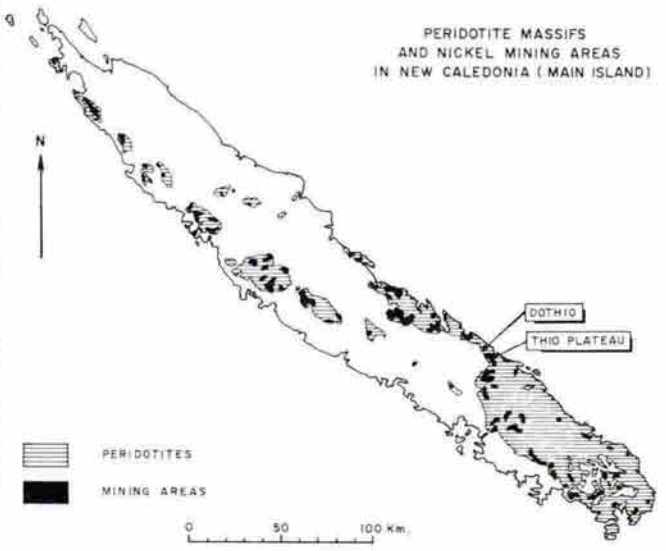
In most cases, whether the resources are copper, nickel, iron and manganese ores in the high islands of continental and volcanic origin, or phosphates in the coral islands, their exploitation was, and often still is, carried out by open-cut techniques. It leads to various types of environmental damage.

The scraping away of the surface earth (stripping), which is necessary to reach the ore, directly destroys the vegetation. The resulting loose waste earth, all the more vulnerable to erosion by water as it is often dumped down steep slopes in rugged country and in climates featuring intense and strong seasonal rains, also causes extensive damage. The loose material is washed down into the river valleys where it forms thick deposits, burying the vegetation on the banks and often killing it, as well as the animal life in the water. It raises the bottom of the mean water channel and thus causes the repeated flooding in the flood plain and in the downstream parts of the water courses. When the loose material reaches the sea, it causes aesthetic pollution along the beaches. The accumulation of fine earth particles washed into the sea, especially during heavy rains, damages the coastal flora and fauna. However, the long-term damaging effects of such pollution, very obvious in the case of corals, have not yet been well identified.



In southern Melanesia, the main island of New Caledonia contains 40% of the world's known nickel deposits, and 20% of the oxidised ore deposits. It offers a striking example of the damage that can be done to a Pacific island environment by intense and poorly controlled mining activity.

In this mountainous island, nickel is present in rock formations that occupy about a third of the total area and are covered with a slow-growing scrub vegetation that regenerates with difficulty.



1943

1976

Elsewhere the primary forest, quite extensive in olden times, has suffered through pre- and post-colonial human activities, e.g. clearing by slashing and burning and, after the arrival of European settlers, wide-spread cattle farming.

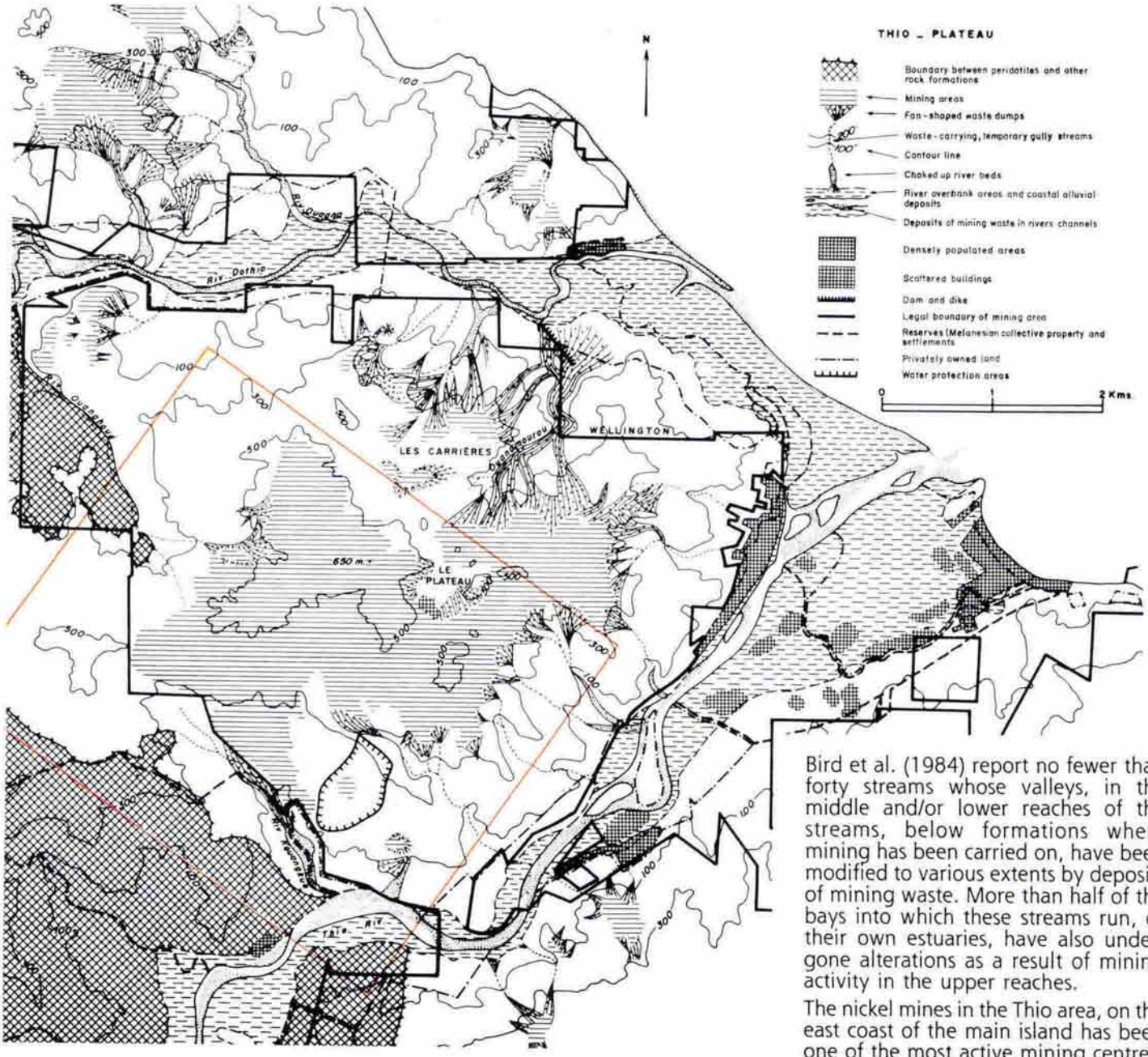
The nickel ore, exploited for over a century, is found on the ultramafic rocks in a zone of concentration lying under a layer of weathered material that can be up to 30 metres thick. Large-scale extraction on the mountain ridges and plateaux, is done by scraping off this surface layer and has increased with the progress of machinery. In less than 100 years, 110 million tonnes of ore have been extracted, resulting in the mobilisation of a mass of waste at least 5 times greater by weight, its volume being between 220 and 280 million cubic metres at the very least.

THE THIO MINING CENTRE

Nickel mining has not always proceeded at the same pace. In 1981, there were only about thirty operational mines compared with over 130 ten years earlier, out of the approximately 330 mines opened since the beginning of mining activity in New Caledonia.

The present slump in the country's nickel industry started at the beginning of the 70s, after a short period of intensive and uncontrolled exploitation which was triggered by the high market price of nickel. This boom considerably aggravated the most visible impacts of mining activity on the environment.

The closing down of a large number of mines over the past few years has slowed down the progress of stripping, the destruction of the vegetation and reduced the production of the loose waste. Erosion is nevertheless continuing on the extensive stripped areas resulting from open-cut mining which, within just a few decades, has transformed many high-altitude sites that used to be remarkable for their original flora into absolutely desolate areas often extending down through the river valleys right to the lagoon of the main island.



Extraction benches, access roads and dumped waste materials in THIO Plateau mine.

Bird et al. (1984) report no fewer than forty streams whose valleys, in the middle and/or lower reaches of the streams, below formations where mining has been carried on, have been modified to various extents by deposits of mining waste. More than half of the bays into which these streams run, or their own estuaries, have also undergone alterations as a result of mining activity in the upper reaches.

The nickel mines in the Thio area, on the east coast of the main island has been one of the most active mining centres. The main mine (mine du Plateau) and its extension (mine des Carrieres), located between the Thio river in the south and the lower course of the Dothio river in the north, form the core of this complex. These two mines alone supplied 17% of the total amount of ore produced since the end of last century, without a single break in production since 1935.

The Thio centre provides, especially by its Plateau mine, the most striking example of the environmental damage caused by mining activity in New Caledonia.

The Plateau-Carrieres (Quarries) mining complex occupies about 1 600 ha. The whole upper portion of an ultramafite mountain mass in contact with the volcanic and sedimentary materials of the central range has been scraped away for the extraction of the nickel ore. The other mines of the Thio centre are located to the north of the Dothio river and to the south of the Thio river.

The Thio mining centre has yielded about 20 million tonnes of nickel ore since the beginning of the 20th century and mobilised at least 100 million tonnes (or nearly 40 million cubic metres) of waste.

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Mining was conducted on a much larger scale after World War II, and particularly from the 1950s, as a result of the use of ever more sophisticated machinery, utilisation of lower-grade ore, and increased demand for nickel, notably in the 1960s. This acceleration of mining activity is borne out by a comparison of old aerial photographs (1943 – USAF, 1954-55 IGN) and recent shots (1976 – IGN).

In 1943 and 1954/55, exploitation was confined to the summit ridges where maximum ore concentrations were more easily reached. Subsequently, the whole central portion of the mountain masses was cut off from 400 m above sea level upwards. Extraction proceeds in horizontal cuts forming giant benches 5 to 8 m wide which reproduce in relief the pattern carved out of the ore-bearing layers, as can be seen on the Panguna copper mine at Bougainville (Papua New Guinea), and enable the ore to be easily loaded and trucked away.

Massive dumping of waste material down the slopes located below the extraction sites has had very serious consequences for the environment adding to the local destruction of the vegetation in the stripped areas. Huge amounts of loose materials have been washed into the valleys by water, clogging the minor bed of streams and thus causing flooding in the major river bed and covering the fertile agricultural lands of the valleys.

Strikingly obvious in a number of the tributaries on the left bank of the Thio river, for example the Kouanghoue, these barren accumulations are quite as spectacular in the channel of the main river, which is choked up with many alluvial islets and deposits sediment along the banks.

Downstream, the Thio delta has undergone rapid changes as a result of increase in the solid load carried by the river. Continental deposits progress to the north of the delta along the beaches in the direction of the coastal currents. The fine clay particles settle in the lower part of the river and on the sea bottom along the coast. Effects on the aquatic flora and fauna are yet ill-defined. Consequences are clearly damaging for swimming and touristic activities (reddish sea-water during heavy rains).

North of the mining area, the valley of the Dothio river also receives, from several ravines running down from the plateau on its right bank, considerable quantities of waste. Other mines opened on the ridges of the mountain mass lying north of the Dothio valley also feed waste materials into this river from the left bank. As on the Thio, several sand and clay banks that clog its mean water channel, the extension of the little delta of its mouth and the pollution of the coastal waters by suspended deposits may be observed. On the right bank, the accumulated materials that have been dumped below the Carrieres mines and those that have filled in the Ouanamourou valley, below the Plateau mines are striking.

The Dothio river valley and the Carrieres mine.

Coastal mining pollution in New Caledonia.

HOW TO LIMIT THE DAMAGE

The striking effect of large-scale mining from the last few decades using particularly devastating new techniques, may have been compounded by a number of factors. The thickness of the weathered laterite layer covering the exploitable ultrabasites naturally seems to account for the abundance of fluviatile deposits (deltas, deltaic plains) in the streams which flow through the mining areas (Bird et al. – 1984).

Roadworks, access tracks hastily bulldozed out to mining or prospecting sites, have often given rise to intense erosion. Systematic dumping of waste into the natural drainage system spreads pollution down to the marine base line. The existence, around the main island, of a barrier reef enclosing one of the largest lagoons in the world has heightened the risk of environmental damage by allowing continental deposits to accumulate in generally calm and shallow waters.

The cases of similar mining pollution occurring in the region are much more localised and associated with completely different mining techniques (Fiji, Papua New Guinea). For example many thousands of cubic metres have been disposed of every day since 1972 into the Jaba river basin, Bougainville, PNG. It is in South-east Asia, in tropical America and in Africa that mining procedures comparable to those in New Caledonia can be found, often in continental countries and with the same consequences on the natural environment and on the farm lands. In New Caledonia the low population density, the almost complete absence of human settlements in the high-lying areas, and the insignificance of farming activities as compared with mining from which this country has long derived 90% of its export income, account for the rather belated awareness of the need to defend the environment against the effects of mining.

The location of the exploited ore, prevents a different mining technique from being used. On the other hand, systematic replacement of the waste and subsequent consolidation through reaf-forestation, are theoretically feasible. They prove difficult to apply however, for the nickel mines are located in very rugged country, on summits and ridges, and this naturally jeopardises the stability of the waste materials. Even if the roots of the planted vegetation can be expected to gradually reinforce it, regeneration of the plant cover on land that has been completely disrupted by mining is a difficult and very slow process.

However, in those river valleys where mining on the surrounding mountains ceased several decades ago, Bird et al. (1984) noted signs of a return to normal: rebirth of the vegetation on the banks, gradual disappearance of the fine clayey deposits of lateritic origin, tendency of the delta accumulations to become stabilized. On the other hand, the extensive denuded areas and the fan-shaped patches of dumped spoil-earth furrowed by erosion are all the more visible in the landscape as they were multiplied in the course of the decade before last.

The long-term persistence of these direct impacts and of their secondary effects stem both from the considerable size of nickel reserves in New Caledonia, where open-cut mining can be continued for many centuries yet, and from the great difficulty the vegetation has to recolonise the devastated areas.

The soil conditions of the spoil-dumps are indeed particularly unfavourable for plant growth: low content of mineral nutrients, high content and consequent toxicity of certain minerals, high porosity preventing good water retention. The spoils should therefore be appropriately improved in structure and chemical composition so as to lend themselves better to recolonisation by naturally growing or replanted vegetation. Soil-improvement and planting trials have been carried out but have so far not been conclusive.

A protective dam of boulders traps the finer materials on a spoil-dump.

Legislation introduced about fiteen years ago provides that before the opening of a new nickel mine an authorisation must be obtained from the Department of Mines with the approval of a Commission for the assessment of the environmental impact hazards. The central and local authorities, both administrative and customary, as well as scientific experts are consulted within this Commission. If the authorisation is given, the mining company is required to carry out protective works to reduce erosion on the spoil-dumps and to prevent the waste materials from sliding downwards.

Canalising the polluted rivers, enhances the scouring effects of high-flow currents. Terracing slopes of spoil-dumps, each step being held firm by a wall built of boulders, stabilises these loose waste materials.

Building of rock dams and settling ponds below the mining zones also aims to intercept these materials as they are being carried downstream. An example can be found in the works carried out by the Nickel Company (SLN), which operates the Plateau mines in the Thio area, on the lower portion of the Ouanamourou, a right-bank tributary of the Dothio, to reduce the amount of material transported beyond the Wellington waterfall. Dikes were made by bulldozer to channel the coarser materials and a diversion dam built to trap the finer ones.

Lastly, whenever new mines are opened, companies must take appropriate measures to maintain access roads and service tracks in good condition to avoid erosion.

These measures will not suffice to halt the seabound transport of the finest materials mobilised at high altitude sites. A huge investment would be needed to extend such measures to all the mining areas, particularly the most recent ones.

On the other hand, the establishment of totally protected areas in certain pilot sites, should assist in setting up and monitoring a long-term programme for rehabilitation. However, the success of such a programme is closely linked to protection and regeneration of forests over the whole country.

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