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Potential impacts of mining on the Fly River

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PREFACE

Sixteen years ago the United Nations Conference on the Human Environment (Stockholm 5-16 June 1972) adopted the Action Plan for the Human Environment, including the General principles for Assessment and Control of Marine Pollution. In the light of the results of the Stockholm Conference, the United Nations General Assembly decided to establish the United Nations Environment Programme (UNEP) to "serve as a focal point for environmental action and co-ordination within the United Nations system" (General Assembly resolution 2997 (XXVII) of 15 December 1972). The organizations of the United Nations system were invited "to adopt the measures that may be required to undertake concerted and co-ordinated programmes with regard to international environmental problems", and the "intergovernmental and non-governmental organizations that have an interest in the field of the environment" were also invited "to lend their full support and collaboration to the United Nations with a view to achieving the largest possible degree of co-operation and co-ordination". Subsequently, the Governing Council of UNEP chose "oceans" as one of the priority areas in which it would focus efforts to fulfill its catalytic and co-ordinating role.

The Regional Seas Programme was initiated by UNEP in 1974. Since then the Governing Coucil of UNEP has repeatedly endorsed a regional approach to the control of marine pollution and the management of marine and coastal resources and has requested the development of regional action plans.

The Regional Seas Programme at present includes ten regions[1] and has over 130 coastal States participating in it. It is conceived as an action-oriented programme having concern not only for the consequences but also for the causes of environmental degradation and encompassing a comprehensive approach to combating environmental problems through the management of marine and coastal areas. Each regional action plan is formulated according to the needs of the region as perceived by the Governments concerned. It is designed to link assessment of the quality of the marine environment and the causes of its deterioration with activities for the management and development of the marine and coastal environment. The action plans promote the parallel development of regional legal agreements and of action-oriented programme activities[2].

The idea for a regional South Pacific Environment Management Programme came from the South Pacific Commission (SPC) in 1974. Consultations between SPC and UNEP led, in 1975, to the suggestion of organizing a South Pacific Conference on the Human Environment. The South Pacific Bureau for Economic Co-operation (SPEC) and the Economic and Social Commission for Asia and the Pacific (ESCAP) soon joined SPC's initiative and UNEP supported the development of what became known as the South Pacific Regional Environment Programme (SPREP) as part of its Regional Seas Programme.

The Conference on the Human Environment in the South Pacific was convened in Rarotonga, from 8 to 11 March 1982. It adopted: the South Pacific Declaration on Natural Resources and Environment; the Action Plan for Managing the Natural Resources and the Environment in the South Pacific Region; and agreed on the administrative and financial arrangements needed to support the implementation of the Action Plan and on the workplan for the next phase of SPREP[3].

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1 Mediterranean, Kuwait Action Plan Region, West and Central Africa, Wider Caribbean, East Asian Seas, South-East Pacific, South Pacific, Red Sea and Gulf of Aden, Eastern Africa and South Asian Seas.

2 UNEP: Achievements and planned development of UNEP's Regional Seas Programme and comparable programmes sponsored by other bodies. UNEP Regional Seas Reports and Studies No. 1, UNEP, 1982.

3 SPC/SPEC/ESCAP/UNEP: Action Plan for managing the natural resources and environment in the South Pacific Region (UNEP Regional Seas Reports and Studies No. 29, UNEP, 1983.

The legal framework of the Action Plan was developed through several meetings of legal and technical exports from the South Pacific Region. It was adopted by the plenipotentiary meeting of the High level Conference on the Protection of the Natural Resources and Environment of the South Pacific Region convened by the Secretary-General of SPC in Noumea, New Caledonia, from 17 to 25 November 1986.

The legal framework adopted by the Conference consists of the following instruments[4].

> Convention for the Protection of the Natural Resources and Environment of the South Pacific Region;
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> Protocol Concerning Co-operation in Combating Pollution Emergencies in the South Pacific Region;
>
> Protocol for the Prevention of Pollution of the South Pacific Region by Dumping.

The convention is a comprehensive umbrella agreement for the protection, management and development of the marine and coastal environment of the South Pacific Region. It lists the sources of pollution which require control: pollution from ships, dumping, land-based sources, seabed exploration and exploitation, atmospheric discharges, storage of toxic and hazardous wastes, testing of nuclear devices, mining and coastal erosion. It also identifies environmental management issues requiring regional co-operation: specially protected areas, pollution in cases of emergency, environmental impact assessment, scientific and technical co-operation, technical assistance, and liability and compensation for damage resulting from pollution.

Considerable support to the implementation of the Action Plan is received from a number of South Pacific research and training institutions. Periodic consultative meetings of these institutions are convened to discuss the environmental problems of the region which may be mitigated or solved through the Action Plan and to identify activites which may contribute toward the goal of SPREP. The present report was commissioned by UNEP as such a contribution. The report has been prepared by a number of scientists from the University of Papua New Guinea and the sponsors of the study would like to express their gratitude to the authors of the report and to their institutions.

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[4] Convention for the protection of the natural resources and environment of the South Pacific Region and related protocols, UNEP 1987.

EDITORS' NOTE

This volume brings together a number of papers, some of which were originally presented to the 3rd Consultative Meeting of Research and Training Institutions held in Guam in June 1986. Also included are papers derived from related work undertaken by scientists of the University of Papua New Guinea as part of their research programmes. Financial support for these studies was derived from various sources including the United Nations Environment Programme (UNEP via the South Pacific Regional Environment Programme (SPREP), and the University of Papua New Guinea Research Committee.

These papers represent an important contribution in that they document the state of the environment prior to the commencement of mining at the large Ok Tedi gold and copper mine. In particular the papers dealing with the Lakes of the middle Fly region represent the sole base-line data for these systems. Ongoing work as part of the SPREP work programme for 1986-1988 is designed to establish what changes if any are detectable in the Fly River and Delta, following the onset of copper production.

In addition to the pre-mining situation an evaluation of the effectiveness of the current company operated Environmental assessment programme is presented, together with an assessment of the toxicity of mine tailings and some predictions concerning the impacts of mining on this system.

It is to be hoped that this volume will provide useful data not only for the specific project examined here but of more widespread applicability to large scale mining projects throughout the Asia-Pacific Region.

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THE OK TEDI MINE: ENVIRONMENT, DEVELOPMENT AND POLLUTION PROBLEMS.

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ABSTRACT

One of the largest open-cut copper and gold mines in the world commenced operation in May 1984 in the Star Mountains of Papua New Guinea. Waste rock and tailings are currently dumped into the Ok Tedi, a tributary of the Fly River. Mine development has been surrounded by controversy concerning the potential environmental impacts of this major development. This paper outlines the environment in which the mine is situated; details traditional resource use in the area; reviews the history of mine development and evaluates the current situation with regard to waste disposal. Details of the current concerns expressed both within and outside the country about the long-term impacts of this project are also presented. As such this paper serves as a background to the other papers in this volume, which examine issues such as tailings toxicity; heavy metal levels in fish; the complexing capacity of waters in the drainage basin; and the limnology of lakes associated with the Fly River flood plain.

INTRODUCTION

The Ok Tedi mine is located in an isolated area of the Western Province of Papua New Guinea (Figure 1). It is based on the exploitation of a porphyry ore body with an overlying gold rich cap. This ore body constitutes Mount Fubilan which on cessation of mining activity will cease to exist. The life expectancy of the mine is some thirty years.

Mount Fubilan and the mine itself are located on the borders of the West Sepik and Western Provinces of Papua New Guinea; whilst the Fly River forms, for a short part of its length, the international boundary between the Indonesian Province of Irian Jaya and the Western Province of Papua New Guinea. In addition at the mouth of the Fly the maritime boundary between Australia and Papua New Guinea reaches within a few kilometres of the coast and discharge from the Fly River enter the Torres Straits area of Australian territorial waters.

The Torres Straits are the northern extension of the Australian Great Barrier Reef system. Development of resources in the Torres Straits and control of land based sources of pollution affecting the area are regulated by the Torres Straits Agreement, an international treaty between Australia and Papua New Guinea. In addition, both Papua New Guinea and Australia are signatories to the recently promulgated SPREP Convention, under which Papua New Guinea has certain obligations to Australia in terms of controlling land based pollution which may have impacts on Australian territorial waters. The mine and its impacts have therefore international as well as national implications.

THE NATURAL ENVIRONMENT

Mount Fubilan is part of the Star mountains complex which rise to a height of 3,000 m above sea level and form part of the central cordillera of the island of New Guinea. This central chain of mountains forms a major divide separating the drainage basins to the North from those to the South. The Star mountains are located in the divide between the catchments of the Fly River to the South and the Sepik River (the largest river in New Guinea) to the North. The Fly River is the second largest river in New Guinea with a discharge of approximately 200,000 million tonnes of water a year.

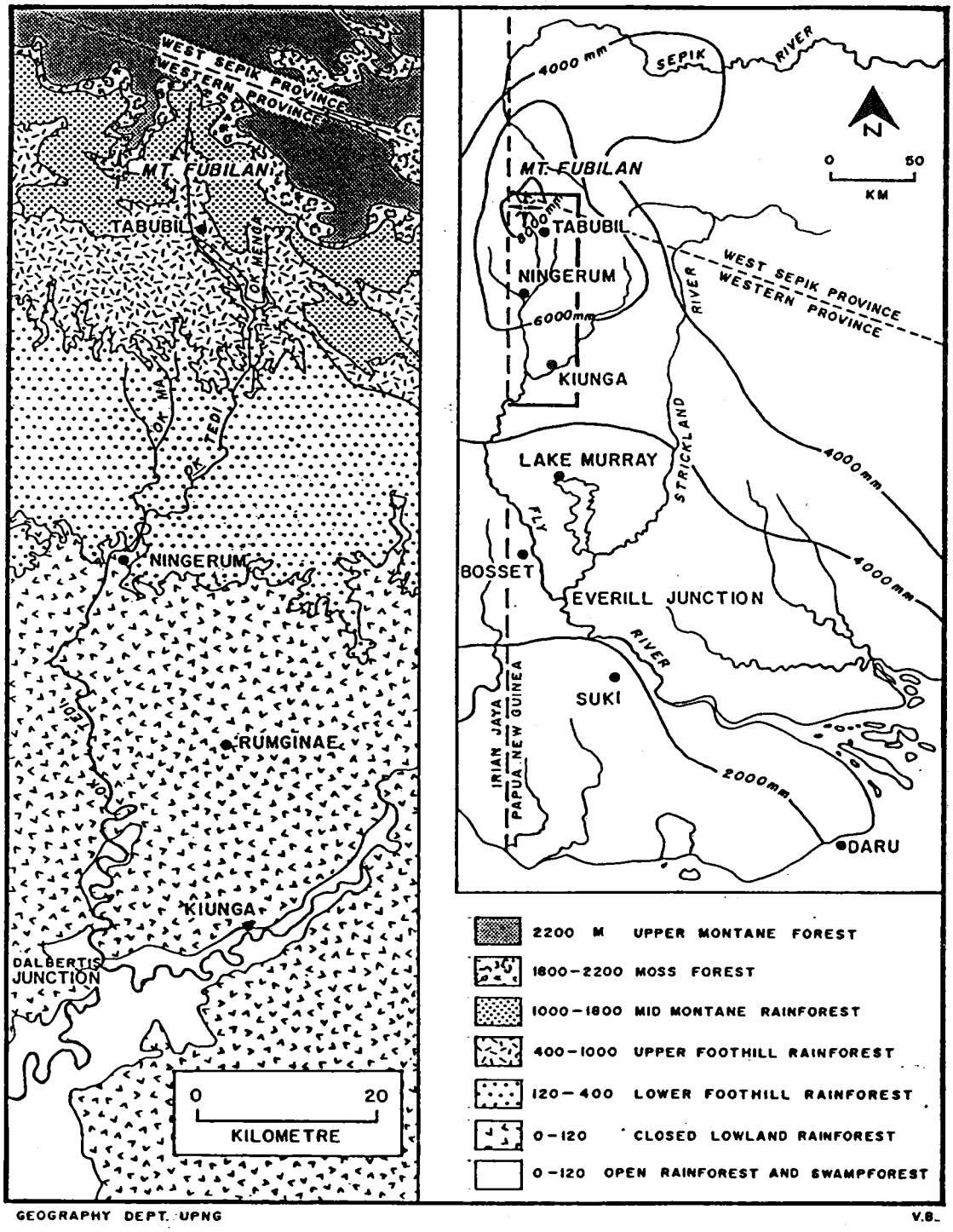

Figure 1. The Fly River area of Papua New Guinea, showing the location of the Ok Tedi Mine at Mt. Fubilan, rainfall and vegetation.

Various aspects of the natural environments and habitats of the Fly River basin and Ok Tedi catchment are summarised in the Ok Tedi Environmental Study (Maunsell, *et al* 1982) which covers vegetation; climate; fauna (both aquatic and terrestrial and the present levels of use); water chemistry and physical limnological parameters; and some data on heavy metal levels in aquatic organisms.

The environs of the mine are humid, tropical with a natural vegetation of moss forest between 1800 and 2200 m and upper montane (cloud) forest beyond. Rainfall is extremely high with over 8 metres/annum being recorded on the mine site, more in the mining town of Tabubil. Mt Fubilan is itself located close to the Ok Tedi and a number of its tributaries. In this region the river is fast flowing with a high natural sediment load. The fish diversity is low (Gwyther, 1980; Roberts, 1978), most fish species in this area are confined to tributaries and branches of the main river and serve as a small but significant protein resource for the people of the area (Hyndman, 1979).

As the Ok Tedi drops towards the mining town of Tabubil the environment changes from the dense tropical rain forests typical of the montane region to a characteristic lower montane forest association of the foothills, still with a closed canopy. At D'Albertis Junction, where the Ok Tedi River joins the Fly, open rain forest and swamp forests commence. These habitats gradually merge with a more open, seasonally flooded savannah vegetation which dominates the middle Fly to the estuary. As one moves down river the climate becomes drier with annual rainfalls at Suki on the lower Fly of under 2000 mm/annum.

The altitude of Kiunga is only around 30 metres above sea level hence for the bulk of its length (800 kilometres of river) the Fly is more slowly moving than the fast flowing Ok Tedi. In this region the river meanders between levees, frequently changing course, forming ox-bow lakes and seasonally flooding the surrounding low-lying land. A major tributary, the Strickland River, joins the Fly below Obo, near Lakes Pangua and Daviumbu. The river finally discharges through its mangrove lined estuary into the Gulf of Papua, an area of extensive commercial prawn and lobster fisheries.

In the middle Fly region the river meanders form a belt around 7 km wide, within an area 16 km wide of low-lying swamp forest and grassland. At Kiunga the main river channel is 200 m wide; at Obo 300 m wide whilst below the junction with the Strickland it spreads to 500 m wide. The lakes of the middle Fly region receive water from the main river channel to varying degrees; in some lakes this may be almost continuously year round; in others only during periods of high water flooding. These lakes have been identified as potentially susceptible to heavy metal pollution from the mine (see Chambers, this volume; Osborne & Polunin, this volume).

TRADITIONAL RESOURCE USE

Hyndman (1979) and Hyndman and Pernetta (1982) have reviewed traditional terrestrial and aquatic resource use from the headwaters of the Fly to the estuary. In the Ok Tedi region fish, frogs and reptiles form a small portion of the total dietary protein for the Min people. Access to these resources is however, culturally restricted to women and children for whom they form an important component of the diet. Women and children are culturally excluded from eating marsupial mammals which are eaten only by initiated men (Hyndman 1979). This has important implications for the interpretation of the health risk of heavy metal loadings in fish from this area (see Kyle, this volume).

Below Kiunga, the diversity of the fish fauna increases greatly as does the mean size of the species. Fish and aquatic reptiles such as turtles and crocodiles form an important component of the diet of the Ningerum and Boazi peoples (Hyndman & Pernetta, 1982). The Kiwai people of the delta and associated coast rely more on marine fish, turtles and dugong (Hyndman and Pernetta, 1982; Olewale & Sedu, 1979). For the Kiwai peoples, the dugong is an important cultural and trade animal, as well as being a major source of dietary protein (Haddon, 1912). The traditional and commercial exploitation of coastal resources along the coast of Papua are extensively reviewed by Pernetta & Hill (1981).

The Fly River contains five species of turtle, of which two (*Chelodina parkeri* and an unnamed *Elsya* species) are endemic to this river system, and one (*Chelodina siebenrocki* is confined to the Western Province of Papua New Guinea and Southern Irian Jaya. Two crocodiles, *Crocodylus novaeguineae* and *Crocodylus porosus*, occur in the river system: the former is endemic to New Guinea, and both species are on the appendices of the CITES Convention. Crocodiles are farmed commercially at Lake Murray, drained by the Herbert which is a tributary of the Strickland River. Smaller, village based farms are found throughout the area (for a review of crocodile farming in Papua New Guinea see Burgin, 1982). In addition barramundi are fished both commercially (200-250 tonnes/annum) and for subsistence consumption in the lower reaches of the Fly River (for details of this fishery see Anon, 1976).

DEVELOPMENT OF THE MINE

The history and development of the Ok Tedi mine have been reviewed by Jackson (n.d.) in his book "Ok Tedi: the Pot of Gold". The present brief overview is largely based on this masterly review which provides rare insights into the tensions and interactions involved in the development of a multi-national owned mine, from the initial discovery of the ore body.

The first discovery of gold in the Ok Tedi may be attributed to Lawrence Hargreave, captain of the launch Neva who, on its historic exploration of the Fly River, panned some gold flecks from the Ok Tedi above D'Albertis Junction. The Neva was at that time under the direction of the explorer naturalist, Luigi Maria D'Albertis; the date 1876.

Fifty years later in the early 1930s, the area had still been visited by only a few Europeans and an early gold dredging operation near the site of present day Kiunga failed to discover gold. In 1950 the Australian authorities established a permanent patrol post at Kiunga but it was not until 1968 that the first team of field geologists discovered copper anomalies in the sediments of the Ok Tedi system. Late 1968 saw the discovery of ore outcrops, resulting in further work during the succeeding years to "prove" the extent of the ore body. By 1971 the ore body was believed to contain 150 million tonnes of ore with an average grade of 0.9% copper and a cut-off grade of 0.4%. Given the world copper and gold prices at this time Kennecott, the company concerned, estimated that development of the project was marginal, yielding between 14 and 20% return on investment. The company therefore extended exploration in the area in an attempt to improve the financial viability of the project by increasing the size of the available ore resources which could be processed through the plant.

Around this time increasing concern was being expressed by prominent Papua New Guineans about the terms of the existing mining agreement under which the Bougainville Copper mine was operating. Under this agreement, Bougainville Copper announced total profits of 158 million Australian dollars in 1973, the largest profits ever made by an Australian listed company to that date. This led to scepticism on the part of Papua New Guineans about Kennecotts claim that Ok Tedi was a marginal