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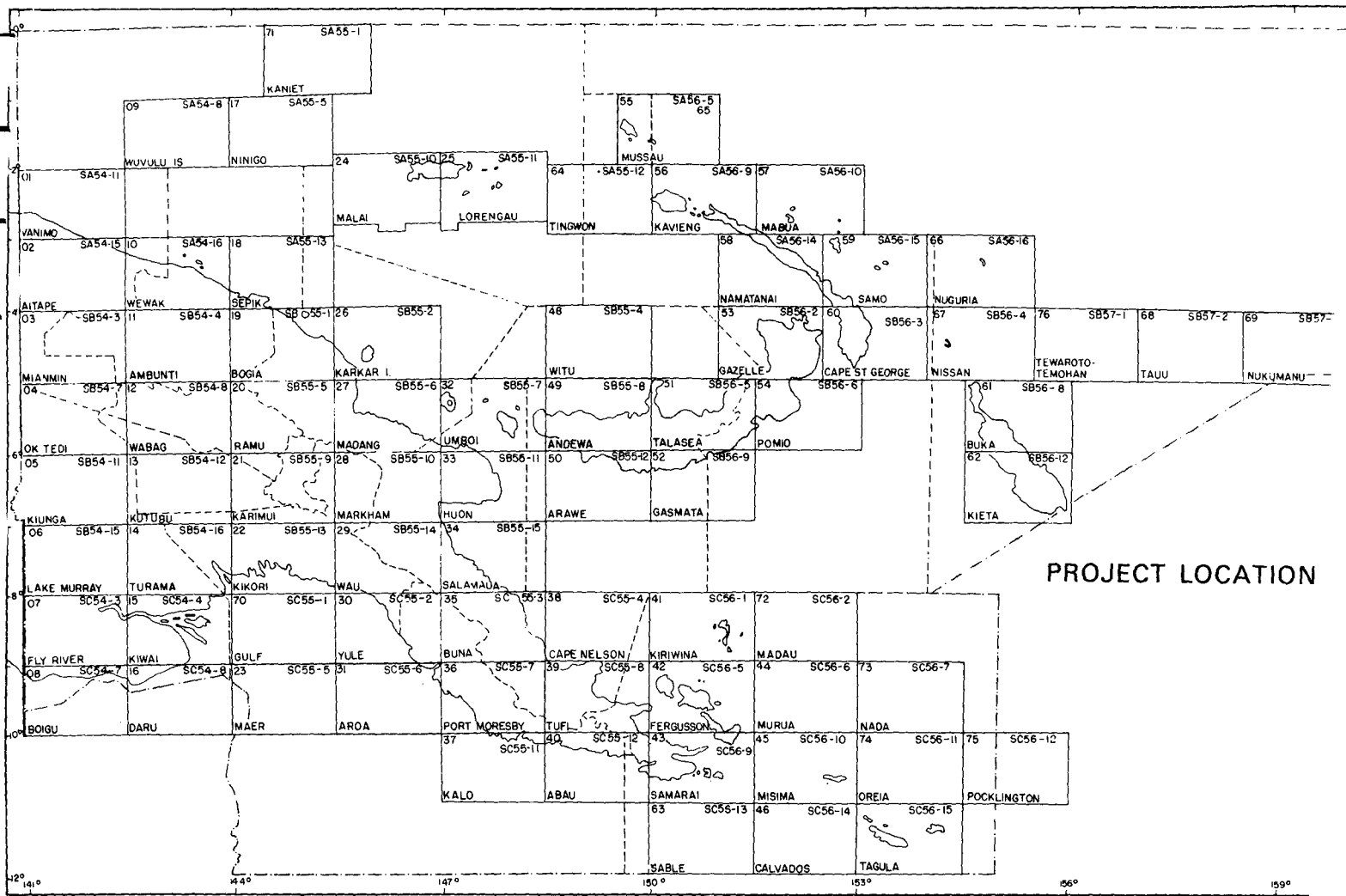
SEISMICITY AND TSUNAMI WARNING

IN PAPUA NEW GUINEA

by

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PROJECT LOCATION

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GEOLOGICAL SURVEY
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TABLE OF CONTENTS

SUMMARY

1. SEISMIC ZONES AND MAJOR EARTHQUAKES IN PAPUA NEW GUINEA.	1
2. TSUNAMIS IN PAPUA NEW GUINEA WATERS.	3
3. TSUNAMI WARNING AND EARTHQUAKE PREPAREDNESS.	4
CONCLUSIONS	6
REFERENCES	7

SUMMARY

The main seismic zones of Papua New Guinea and some recent damaging earthquakes that have occurred in Papua New Guinea at Kokopo, Wewak, Madang and Rabaul are described. Efforts being made to reduce the effects of earthquakes and tsunamis in Papua New Guinea include international co-operation with the World Data Centres in accurate earthquake hypocentre locations, introduction of a Building Code for the Papua New Guinea earthquake region by the Department of Works and Supply, deployment of a regional accelerograph network by the Geophysical Observatory, and participation in the Pacific Tsunami Warning System.

1. SEISMIC ZONES AND MAJOR EARTHQUAKES IN PAPUA NEW GUINEA.

Papua New Guinea is one of the most earthquake prone regions of the world. Potentially damaging earthquakes have occurred regularly since the beginning of existing records (Everingham, 1974; Ripper, 1979). As the economic development of the country advances, so does the likelihood of economically disastrous earthquake damage.

The main seismic zone extends from northwest to southeast across northern New Guinea between the Highlands and the north coast, northeast through New Britain and southeast through the island of Bougainville and the Solomon Islands. The north Solomon Sea region between northeast New Britain and northwest Bougainville is possibly as seismically active as anywhere else in the world.

Secondary seismic zones cross the Bismarck Sea between Wewak and the Gazelle Peninsula, and trend southeast through the Papuan Peninsula and eastward across the Solomon Sea to the New Georgia Islands.

Recent damaging earthquakes in Papua New Guinea include:-

1. 13 August, 1967 at Kokopo in the Gazelle Peninsula of New Britain. A series of small earthquakes, maximum magnitude 5.9, caused damage of \$172,000 (Heming, 1969).
2. September and October, 1968 at Wewak in the Sepik region of northern New Guinea. The earthquake magnitudes were all less than 7, but damage costs exceeded \$20,000 (Denham, 1974).
3. Madang, 31 October, 1970. Magnitude 7.0. Fifteen people were killed, and damage amounted to \$1,700,000, including \$550,000 for repairs to the SEACOM cable. Extensive landsliding occurred, particularly in the Adelbert Range near the epicentre (Everingham, 1975,a).
4. North Solomon Sea, July, 1971. Two magnitude 8 earthquakes strongly shook the Gazelle Peninsula, and caused tsunamis in the North Solomon Sea and Rabaul harbour (Everingham, 1975,b).

More recently, in 1977 and 1978, the two Papua New Guinea earthquakes which caused the most damage (they both broke the SEACOM submarine telecommunications cable near Madang) occurred beneath Madang on 26 April, 1977 and 26 January, 1978. The earthquakes were of relatively small magnitude, 5.4 and 4.5 respectively. The two earthquakes which caused the most concern in 1977 and 1978 occurred in the Southern Highlands on 6 September, 1977 and in southeast Papua on 11 April, 1978. These earthquakes were also of relatively small magnitude, 5.5 and 5.9 respectively, but the local inhabitants who felt the earthquakes were alarmed because they mistakenly associated the earthquakes with possible volcanic activity. Civil action, including visits by officers of the Rabaul Volcanological Observatory and the National Emergency Service, was undertaken to reassure the people. The Southern

Highlands earthquake caused several landslides but little building damage. The southeast Papua earthquake damaged several village houses in the Wanagela area near Mt. Victory.

Two notable earthquakes that have occurred in Papua New Guinea so far in 1979 were the 09 March southeast Papua earthquake, magnitude 6.3, and the 25 June Madang earthquake, magnitude 6.5. The southeast Papua earthquake caused some damage in Port Moresby, and created panic in multi-storey buildings. The 25 June earthquake broke the SEACOM cable in both its Madang-Guam and Madang-Cairns sections, caused building damage at Goroka, and probably triggered an immense landslide 8 km. east of Kundiawa which started moving slowly on 01 July and disrupted electrical power transmission in the Highlands.

2. TSUNAMIS IN PAPUA NEW GUINEA WATERS

The first clear record of a tsunami in Papua New Guinea is in 1856, on the 'Maclay' coast of northern New Guinea. A village was completely swept away by tidal waves following an earthquake, and almost all the inhabitants were drowned. Since then, tsunamis in which the water level rises about five metres have occurred on an average of every ten years somewhere in Papua New Guinea (Everingham, 1976).

The majority of tsunamis in Papua New Guinea have been caused by local earthquakes. A notable tsunami in recent years followed the 26 July, 1971, magnitude 8 earthquake in the north Solomon Sea. Waves reached a height of 10 metres on southernmost New Ireland and at Wide Bay. In Rabaul harbour, the water rose 2½ metres, flooding parts of the town.

Both the magnitude 8 earthquakes of 23 May, 1960 at Chile, South America, and 28 March, 1964 at Alaska, caused tsunamis in Papua New Guinea waters. Several sea waves of heights 1-2 metres occurred along the Bougainville, New Britain, Manus and northern New Guinea coastlines 22 hours after the Chilean earthquake, and the Alaskan earthquake generated a tidal oscillation of about 0.4 metres recorded in Rabaul harbour (Everingham, 1977).

Tsunamis are also caused by volcanic eruptions and submarine slides. The most disastrous tsunami known to have occurred in Papua New Guinea followed the Ritter Island volcanic explosion of 12 March, 1888. Waves higher than 10 metres occurred along the north coast of New Britain, and northern New Guinea, causing considerable loss of life.

3. TSUNAMI WARNING AND EARTHQUAKE PREPAREDNESS

The best warning of the approach of a tsunami following a large local earthquake is the earthquake itself. Should a strong earthquake be felt at medium strength for what seems to be a long period, coastal people should prepare for a tsunami. The tsunami may follow immediately after the earthquake, or up to about an hour later. Sometimes, the first indication of the tsunami is the sea receding from the shore, exposing normally covered coral reefs. The rise in sea level then follows.

A simple precaution against damage from most tsunamis is for all buildings to be placed 2-3 metres above the high tide level (Everingham, 1976). Special precautions should be made for buildings supplying essential services, however, as is seen by the \$300,000 damage caused to a government communications station at Torokima, west coast of Bougainville, by a 2 metre tsunami following a magnitude 7.7 earthquake in the east Solomon Sea, on 20 July, 1975 (Everingham et al, 1977).

Papua New Guinea is now participating with other countries in the Pacific Tsunami warning System, and has been invited to become a Member State of the International Coordination Group for the Pacific Tsunami Warning System (ICG/ITSU). Communications with the Network Headquarters in Honolulu are carried out through the Civil Aviation Agency and the Aeronautical Fixed Telecommunications Network. On receipt of a request from Honolulu, or if a large earthquake has occurred, the Port Moresby Geophysical Observatory relays earthquake arrival time data from Papua New Guinea seismograph stations to Honolulu. The earthquake data is collated with data from other countries to obtain a rapid accurate location of the earthquake and allows the Network Headquarters to determine whether a tsunami may have been generated. The Headquarters then requests tide gauge tsunami information from circum-Pacific countries. Official Papua New Guinea Tsunami Warning tide gauge stations are the Bougainville Copper Ltd. station at Anewa Bay, near Kieta, and the Department of Transport tide gauge stations at Rabaul, Port Moresby and Vanimo. The Rabaul station is operated by the Volcanological Observatory. Tide gauge tsunami information is relayed to Honolulu so that, if a tsunami has been generated, the magnitude and extent of the tsunami can be determined, and tsunami warnings issued to countries which will be affected.

Specific prediction of earthquakes is not yet possible in Papua New Guinea, and will not become a reality for many years. There is no Earthquake Prediction Program currently underway in Papua New Guinea, as the budget and manpower requirements of such a program would be astronomical. (Japan and the United States of America spend over 10 million dollars each year in earthquake prediction research). The Port Moresby Geophysical Observatory operates a network of seismic stations throughout the country, and this network is supplemented by volcano surveillance stations of the Central Volcanological Observatory, Rabaul. Immediate preliminary hypocentres are determined by the Port Moresby and Rabaul Observatories from visual seismograph readings, using STD telephone communications to obtain readings from other network

stations. Stations at Mt. Lunaman in Lae, and Mt. Lamington are telemetered to the Port Moresby Observatory. Earthquake arrival time data are telexed to the World Data Centre operated by the United States Geological Survey, which computes earthquake hypocentres on a global basis using all available information. Final hypocentres are computed about two years later by the International Seismological Centre in Great Britain. The international cooperation between the World Data Centres, Papua New Guinea and the seismograph stations of other countries throughout the world, has enabled the seismic zones of Papua New Guinea to be clearly defined. Polarity data from Papua New Guinea seismic stations and stations of the World Wide Standard Seismograph Network, which includes Port Moresby and Rabaul, are used to determine the fault motions of Papua New Guinea earthquakes (Ripper, 1975; 1978).

With a view to reducing serious damage in future earthquakes, the Geophysical Observatory, in conjunction with other government and private bodies, operates a network of accelerographs throughout Papua New Guinea. The accelerograms are available for use by engineers in determining earthquake response of engineering structures and foundations. The Department of Works and Supply has divided Papua New Guinea into two building zones, A and B. Special earthquake resistant building requirements are specified for Zone A, which consists of the previous Territory of New Guinea, plus Kerema in the Gulf Province and southeast Papua east of and including Popondetta. The National Emergency Service and Provincial Headquarters are in a continuous state of readiness for any earthquake emergency and have dealt efficiently with past earthquake disasters.

Future damaging earthquakes must be expected to occur anywhere in the seismic zone of Papua New Guinea at any time. If the most likely sites of large future earthquakes are the places where virtually no high magnitude (7 or 8) earthquakes have occurred for about thirty years, then the Sepik region and New Britain are special candidates for future large earthquakes. Lae and the Huon Peninsula, although continuously shaken by relatively small earthquakes, have escaped the effects of a close high magnitude shock, and also appear to constitute a seismic "gap".

CONCLUSIONS

Large earthquakes have occurred regularly in Papua New Guinea in historical times and will continue to occur regularly in the future. Damage and loss of life will occur both as a result of the actual earthquakes and from the secondary effects such as tsunamis and landslides which often follow large earthquakes.

The Papua New Guinea government is endeavouring to reduce future earthquake effects by the introduction in 1971 of a special Building Code for the seismic zone, and by accumulating accelerograph data for use in future engineering constructions. In addition, Papua New Guinea is participating in the International Pacific Tsunami Warning System and is providing the World Data Centres with earthquake phase information by telex as part of a global program of accurate earthquake location.

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SEISMICITY
 NEW GUINEA REGION
 1964 - 1976
 (15 or more stations)

