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Papua New Guinea Earthquake Strong Motion Recordings.

by

B.A. Gaull

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PAPUA NEW GUINEA EARTHQUAKE STRONG MOTION RECORDINGS

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Bureau of Mineral Resources

Port Moresby Geophysical Observatory

INTRODUCTION

Instruments which are specifically designed to record strong ground motion associated with earthquakes are known as accelerographs. They trigger at a preset acceleration level and record triaxial acceleration/time histories on either photographic film or magnetic tape. By the end of 1973, 21 accelerographs had been installed throughout Papua New Guinea.

AIMS

The information obtained from the accelerograph network in Papua New Guinea is used in the assessment of earthquake risk, firstly to establish relations between the earthquake magnitude, source mechanism, hypocentral distance, and the ground motion recorded, and secondly to establish the effects of geology on ground motion. Using these data in conjunction with a known earthquake frequency/magnitude relation (e.g. Brooks, 1965), return periods for particular levels of acceleration or velocity may be estimated for given sites in Papua New Guinea. These results enable the structural engineer to compute the forces to which his structure would be subjected and, if necessary, to reinforce it accordingly. The strong-motion data will also assist in the preparation of building codes and regulations.

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It has been recommended by the Papua New Guinea Advisory Committee on Seismology and Earthquake Engineering that the building regulations for Papua New Guinea be modified to require compulsory installation of three accelerographs in every building of eight or more storeys. This should lead to a better understanding of how structures respond to ground motion.

INSTRUMENTION

Sites, models, and owners of the 21 accelerographs in Papua New Guinea in 1973 are listed below:

Site	No & Type of Instrument	Owner
Frieda River	2 Skinner-Duflou M02	Carpentaria Exploration Co
Lae	3 " " "	Bureau of Mineral Resources (BMR)
Lae	1 " " "	Public Works Department (PWD)
Lae	2 " " "	University of Technology
Lae	1 Kinemetrics SMA-1	University of Technology
Musa Damsite	2 " "	PWD
Panguna	2 Skinner-Dublou M02	Bougainville Copper Pty Ltd
Port Moresby	1 " " "	BMR
Rabaul	2 " " "	BMR and PWD
Ramu Damsite	2 " " "	PWD
Star Mountains	2 " " "	Kennecott Pacific Pty Ltd
Wewak	1 " " "	PWD

Apart from the accelerographs belonging to Bougainville Copper Pty Ltd and the University of Technology, the instruments are maintained by the Port Moresby Geophysical Observatory in conjunction

with their owners.

RESULTS

A strong-motion data centre for all Papua New Guinea and Australian accelerograms has been established by BMR in Canberra (Denham & Small, 1971). At this centre, the original accelerograms, which are recorded on either 35-mm (MO2 type) of 70-mm (SMA-1 type) film, are copied, enlarged, and digitized. The information is stored in Canberra and distributed to all participating institutions as well as to any interested party who may request it.

Since the first installation during 1967, accelerographs have been triggered 64 times up to the end of October 1973; the maximum ground acceleration recorded (about 300 cm/sec^2) was at Panguna on 30 October 1972. All except one of these activations took place on the soft-rock sites at Yonki, Lae, Panguna, and Rabaul. The one exception was at the Musa River Damsite on 16 September 1972, when a local earthquake triggered accelerographs sited on both hard and soft rock.

Musa River accelerograms

The peak ground accelerations recorded by the instruments at the crest and base of the Musa River Gorge were 196 and 42 cm/sec^2 respectively. The corresponding mean periods of the ground motion at the time of maximum acceleration at the two sites were about 0.23 and 0.04 seconds respectively.

The author considers that the large differences between the ground motions - the one recorded on the sediments at the higher accelerograph site, the other on the ultramafic rock outcrop at the lower site - can be explained by the differences in geological and topographic factors between the two sites.

Yonki and Panguna accelerograms

Using the 20 accelerograms recorded by the accelerograph at the Upper Ramu Damsite up to the end of 1972, Denham, Small and Everingham (1973) computed the following relation for that site:

$$\log_{10} Y_a = 2.26 + (0.40 \pm 0.20)\ ML - (1.41 \pm 0.87) \log R$$

$$\log_{10} Y_v = -1.16 + (0.29 \pm 0.16)\ ML - (0.09 \pm 0.12) \log R$$

where ML is the Richter magnitude

R is the hypocentral distance in kilometres

Y_a is the maximum acceleration in cm/s^2

Y_v is the maximum velocity in cm/s

Although the data from accelerograms obtained at Panguna were inadequate for the establishment of an empirical relation between ground motion, magnitude, and distance for that site alone, they were combined with the Yonki data and the following results were obtained:

$$\log Y_a = 2.91 + (0.32 \pm 0.11)\ ML - (1.45 \pm 0.57) \log R$$

$$\log Y_v = 0.55 + (0.22 \pm 0.08)\ ML - (0.14 \pm 0.12) \log R$$

The validity of combining the two sets of data may be questioned because of the difference between the geological foundations at the two sites, but the method seems justified since the errors of the coefficients have been reduced.

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