# STUDY AND ANALYSIS SITUATION OF EARTHQUAKE IN WESTERN OF THAILAND (THE CASE OF KANCHANABURI) DURING 1982-1985

BY

PUTTIRAT KONCHUAERAT
1

THE FACULTY OF ENVIRONMENT AND RESOURCE STUDIES

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE

(TECHNOLOGY OF ENVIRONMENTAL MANAGEMENT)

IN THE
FACULTY OF GRADUATE STUDIES

OF

MAHIDOL UNIVERSITY

1988

This thesis

entitled

STUDY AND ANALYSIS SITUATION OF EARTHQUAKE IN WESTERN OF THAILAND (THE CASE OF KANCHANABURI) DURING 1982-1985

was submitted to the Faculty of Graduate Studies, Mahidol University for the degree of Master of Soience (Technology of Environmental Management)

on

June 7, 1988

Puttirat Konchuearat

PUTTIRAT KONCHUEARAT

Candidate

Chirasakdi Poonpol

CHIRASAKDI POONPOL, MS. IN E.E

Major Advisor

Kanchit Siripakdi.

KANCHIT SIRIPAKDEE, B.SC.,M.IN GEOLG.

Coadvisor

Sumalee Prachuab

SUMALEE PRACHUAB, B.SC.IN PHSC.

Coadvisor

M. Chulasamaya.

MONTHREE CHULASAMAYA, M.D., Ph.D.

Dean

Faculty of Graduste Studies

Mahidol University

THANAKORN UAN-ON, PH.D.

Dean

Faculty of Environment and Resource Studies

Thesis

entitled

STUDY AND ANALYSIS SITUATION OF EARTHQUAKE IN WESTERN OF THAILAND (THE CASE OF KANCHANABURI) DURING 1982-1985

was submitted to the Faculty of Graduate Studies, Mahidol University for the degree of Master of Science (Technology of Environmental Management)

on

June 7 , 1988

Puttirat Konchuearat

Puttirat Konchuearat

Candidate

Thanakorn Uan-on, Ph.D.

Chairman

Chirasakdi Poonpol,

Chirasakdi Poonpol, Ms. in E.E.

member

Kanchit Siripakdee, B.Sc., M. in Geolg.

member

Sumalee Prachuab

Sumalee Prachuab, B.Sc. in Phsc.

member

M. Chulasamaya

Monthree Chulasamaya, M.D., Ph.D.

member

M. Chulasamaya

Monthree Chulasamaya, M.D., Ph.D.

Dean

Faculty of Graduate Studies

Thanakorn Uan-on, Ph.D.

Dean

Faculty of Environment and Resource Studies

# BIOGRAPHY

Name: PUTTIRAT KONCHUEARAT

Date of birth: November 7, 1948.

Place of birth: Lampang, Thailand.

Institution attended: Bachelor of Science in Tech. Ed., Faculty of Engineering Techonlogy, Institute of Technology and Vocational Education. 1977: B.Sc.

Attended to the Faculty of Graduate Studies, Mahidol University in the Acadamic 1981.

Awarding the degree Master of Science (Technology of Environmental Management) on June , 1988.

DEDICATED

TO MY EXCELLENT PARENTS AND TEACHERS

## ACKNOWLEDGEMENT

I wish to express my gratitude to Mr. Kanchit Siripakdee, my co-advisor and member of the thesis committee, for offering critical comments and helpful reading the manuscript and made useful suggestions. Special thanks go to Mrs. Sumalee Prachuab, my co-advisor and member of this thesis committee, for helpful discussions, suggestions and great assistance in preparing the text of this thesis.

Sincerely gratitudes are extened to Dr. Thanakorn Uan-on, the Dean of the Environment and resoruce Studies and chairman of the thesis committee, for his valuable comments in completing the thesis. Heartful thanks are due to Archan Chirasakdi Poonpol, Deputy Secretary General of Office of National Education Council Committee, my thesis advisor and member of the thesis committee, for useful suggestions and reading the manuscript. My gratitude also goes out to the last member of my thesis committee, Dr.Montree Chulasamaya, the Dean of Faculty of Graduate Studies.

I also wish to express my sincere thanks to;

Mr. Tawatchai Brikshavana, Director of Hydrometeorological Division, and staff members in Study and Research Division, Meteorological Department, for their kindly training how to interpret seismograms.

The government officers of the Water Provide Section, Irrigation Department.

Finally I must express my great extremely appreciation and whole heartful thank to my parents and my teachers for their love, understanding, and knowledges with patience and sacrifice until the successful day has come.

ชื่อ การศึกษาและวิเคราะห์การเกิดแผ่นดินไหวภาคตะวันตกของประเทศไทย (กรณีศึกษาจังหวัดกาญจนบุรี) ระหว่างปี พ.ศ. 2525-2528

ผู้วิจัย นายพุฒิรัตน์ ก้อนเชื้อรัตน์

ปริญญา วิทยาศาสตร์มหาบัณฑิต (เทคโนโลยีการบริหารสิ่งแวดล้อม)

คณะกรรมการควบคุมวิทยานิพนธ์ นายจิระศักดิ์ พูนผล (MS. in E.E)
นายครรชิต ศิริภักดี (M.Sc.)
นางสุมาลี ประจวบ (B.Sc.)

วัน เดือน ปี ที่สำเร็จการศึกษา 7 มิถุนายน 2531

## บทคัดย่อ

การศึกษาการเกิดแผ่นดินไหว ภาคตะวันตกของประเทศไทย แสดงให้เห็นว่า มีการเกิดแผ่นดินไหว 2 บริเวณคือ เขื่อนศรีนครินทร์และเขื่อนเขาแหลม รวมทั้งบริเวณที่เป็นอ่างเก็บน้ำของเขื่อนทั้งสอง ความสั่นทะเทือนเกิดขึ้นภายหลังที่ได้มีการเก็บกักน้ำในอ่างได้ไม่นาน ศูนย์กลางการเกิดแผ่นดินไหวส่วนใหญ่จะเกิดในบริเวณที่เป็นหินปูน ซึ่งเป็นสาเหตุที่เกิดจากน้ำได้ง่าย ผลสรุปของรอยแยกของแผ่นดินไหวที่เขื่อนศรีนครินทร์ ได้พบว่าเป็นแนวแยกแบบผกผันด้วยทิศทางการเลื่อนไปทางซ้าย แผ่นดินไหวที่เขื่อนศรีนครินทร์และเขาแหลม มีความสัมพันธ์กับฟังก์ชั่น $\log N = a - bM$ ค่า b ของแผ่นดินไหวที่เขื่อนศรีนครินทร์มีค่าเท่ากับ 0.87 และแผ่นดินไหวที่เขาแหลมได้ค่า b เท่ากับ 0.89 ค่า b ของความสัมพันธ์ระหว่างความถี่และขนาดมีค่าสูง อัตราส่วนระหว่างขนาดของ aftershock ที่ใหญ่ที่สุดต่อ main shock ก็มีค่าสูง ความแตกต่างในค่า b สำหรับกลุ่มแผ่นดินไหวที่แตกต่างกันในบริเวณที่ใกล้เคียง ให้ความเชื่อมั่นในทางสถิติ รูปแบบของ foreshock-aftershock ตรงตามแบบที่ II ของ Mogi ขณะที่แผ่นดินไหวที่เขื่อนเขาแหลม เป็นแบบ swarm (แบบที่ III) เนื่องจากไม่สามารถที่จะแยกเหตุการณ์ที่เป็น foreshock, mainshock และ

aftershock ของแผ่นดินไหวที่เขื่อนเขาแหลมได้ ดังนั้นจึงไม่สามารถที่จะหาค่า b ของ foreshock และ aftershock, รูปแบบของการเกิด foreshock-aftershock ได้ ความสัมพันธ์ระหว่างระดับน้ำและความถี่ของแผ่นดินไหวทั้งสองแห่งก็ไม่ได้แสดงให้เห็นถึงความสัมพันธ์ที่ดีได้ เนื่องจากระยะเวลาของการตรวจสอบค่อนข้างสั้น

ผลของการศึกษานี้เชื่อว่า อ่างเก็บน้ำทั้งสองนี้สัมพันธ์กับการเกิดความสั่นสะเทือน และคล้ายกับกรณีของต่างประเทศที่ได้มีการคำนวณและตรวจสอบว่าอ่างเก็บน้ำสัมพันธ์กับการเกิดความสั่นสะเทือน อย่างไรก็ตาม ความสั่นสะเทือนที่เกิดทั้งสองบริเวณ อาจจะเกิดจากความคุกรุ่นจากแนวแตกแยกที่พาดผ่านทั้งในและรอบบริเวณพื้นที่เหล่านั้น.

| | |
|---|---|
| Thesis Title | STUDY AND ANALYSIS SITUATION OF OF EARTHQUAKE IN WESTERN OF THAILAND (THE CASE OF KANCHANABURI) DURING 1982-1985 |
| Name | Puttirat Konchuearat |
| Degree | Master of Science (Technology of Environmental Management) |
| Thesis Supervisory Committee | Chirasakdi Poonpol (Ms. in E.E)<br>Kanchit Siripakdee (M.Sc.)<br>Sumalee Prachuab (B.Sc.) |
| Date of Graduation | June 7 , 1988 |


ABSTRACT

The study of the recent earthquake occured in Western Thailand has shown that they occured in 2 areas, Srinakarind and Khao Leam dams and their reservoirs. The tremors were felt not long after the reservoirs impounding. Their epicenters are generally located in the mainly limestones which are easily affected by water. A fault plane solution of the Srinakarind earthquake revealed that is a reverse fault with a small compenent of left lateral motion. The earthquakes of Srinakarind and Khao Leam are related by a function Log N = a - bM, values of b are 0.87 for the Srinakarind earthquake, and 0.89 for Khao Leam earthquake. The b values are also high in the frequency-magnitude relations, the ratio of the largest aftershock magnitude to the main shock magnitude is high. The differences in b values for different earthquake groups in the vinicity area are statistically significant. The foreshock-aftershock

pattern corresponds with Mogi's type II, while the Khao Leam earthquake is swarm type (type III). Due to The Khao Leam earthquake could not been distinguished in form of foreshock, mainshock and aftershock, so some values such as foreshock and aftershock b values, foreshock-aftershock pattern could not been determined. The relations between water level and frequency for both sequences does not show in good correlation, due to the period of examination is rather short.

The result of study is believed that both reservoirs associated with seismic sequences, and were similar to the foreign cases whose have been determined that the reservoir associated seismic activities. However the seismicity of both areas might be caused from active faults running in and around those areas.

TABLE OF CONTENTS Page

CHAPTER page

APPENDICES Page

# LIST OF TABLES

page

TABLE

FIGURE | page

# LIST OF FIGURES

# CHAPTER 1
# INTRODUCTION

## 1.1 Statement.

Earthquakes are the trembling or shaking of ground that result from the sudden movement of parts of the earth`s crust. This is because amounts of stored energy are released in the form of wave. The crust is always under stress and being pushed or pulled, and constantly changing shape or volume. (Coble et. al., 1981, Heeler, 1979). Stress is also causes crustal rocks to tilt, bend, fold or eventually break. If rocks break along the common plane with displacement, a fault is formed. The sudden break or movement along a fault plane is a major cause of a commonly occured earthquake (Prachuab, 1980).

The cause of earthquake may be grouped into two main catagories.

1. Naturally occured.
2. Artificially occured.

Almost all of the earthquakes are naturally occured. They tend to clustered about a fault line or in quite well define distribution. The earthquakes may caused by volcanic eruptions but usually in a well defined area.

The earthquakes along faults are due to friction overiding that occured between the rock against rock along the fault plane. When the crustal stress becomes greater than the friction, the rocks are not longer held in place. Abrupt movement occur up, down sideway or combined. This is accompanied by a great release of potential energy that has built up, sometimes over a very long period of time. This great sudden release of energy causes the vibrations of ground.

The artificial or induced earthquake may be caused by nuclear explosions, construction explosive and reservoir impounding induced. The importance of reservoir induced earthquake has been recently coming to the attention of seismologists. These abnormal earthquakes tend to occur around the dams, their reservoirs and their vinicities. The example cases of earthquakes related to dams and reservoirs are shown in Table 1.1.

Thailand is located outside a known defined seismic belt and may be considered to be situated a low seismicity zone. But on April 22, 1983, a magnitude 5.8 Mb. earthquake occured in western Thailand and continuously occured many times. Their epicenters are in and around the reservoir area of Srinakarind dam in Kanchanaburi province. They also occured in the reseervoir of Khao Leam dam in the same province in 1984. The first event came after the impounding of the reservoir, but the following is vice versa.

Such the cases mentioned above brought the author on interest and pay special attention to investigate further more on western Thailand.

<u>Table</u> 1.1 List of reservoirs for which the earthquakes to associate with water impounding. (After Bazovic, 1974).

| Name of reservoirs -Country | Impoundment Date. month/year | 1 st. Event Date month/year | Magnitude in Richter |
|---|---|---|---|
| Marathon-Greece | 10/1929 | 7/1931 | 5.7 |
| Oued Fodda-Algier | -/1932 | - | - |
| Hoover, Lake Mead-USA | 5/1935 | 9/1936 | 5.0 |
| Boulder-U.S.A. | -/1936 | - | - |
| Pieve di Codor-Italy | -/1949 | - | - |
| Kariba-Rhodesia-Zambia | 12/1958 | 6/1959 | 6.3 |
| Coyote Valley-USA | 1/1959 | 5/1959 | 5.2 |
| Grandval-France | 9/1959 | 12/1961 | Intns.IV |
| Kurobe-Japan | 3/1960 | 8/1961 | 4.9 |
| Camarillas-Spain | 11/1960 | 3/1961 | 4.1 |
| Canelles-Spain | -/1960 | - | - |
| Vajont-Italy | -/1961 | - | - |
| Koyna-India | 6/1961 | 10/1963 | 6.5 |
| Monteynard-France | 4/1962 | 4/1963 | 4.9 |
| Kremasta-Greece | 7/1965 | 8/1965 | 6.3 |
| Piastra-Italy | 6/1965 | 10/1965 | 4.4 |
| Contra-Switzerland | -/1965 | - | - |
| Bajina Basta-Yugoslavia | -/1966 | - | - |
| Grancarevo-Yugoslavia | -/1967 | - | - |
| Kastraki-Greece | -/1968 | - | - |
| Vouglans-France | -/1968 | - | - |
| Almendra-Spain | 4/1971 | 1/1972 | 3.2 |

## 1.2 The Concepts Of The Study.

A preliminary plot of epicenters in and around of The Srinakarind and Khao Leam dams and reservoirs leads the author to speculated that the earthquake occurrences in Kanchanaburi might have been caused by the action of the water impounding. There are some previous studies suggested such thought Cader (1945), Utsu (1966), Gupta et. al. (1969, 1972, 1973), Papazachos (1974) and Scholz (1981).

### 1.2.1 The Study on the relation between the earthquake and regional geology, with additional study on fault plane solution.

Gupta et. al., (1972) did observed that the reservoirs that associated with seismicities are generally located in a region having some geologic heterogeneity. Such the regions are, for instance, the Kariba in Africa, The Kremasta in Greece and the Koyna in India. They are all show evidences of volcanism in the past. Other rocks are suscepted to decompose easily by water.

Other investigators has been observed that there are faults present in the reservoirs of the reservoir-assocated earthquake. Those of fault plane solutions indicate that they are strike-slip displacement. Some examples are The Anderson reservoir in USA. (Bufe, 1976), The Clark Hill reservoir in USA. (Talwani, 1976), The McNauton lake in Canada (Ellis et. al., 1976), The

Nurek reservoir in USSR. (Soboleva et. al., 1976), The Tarbela reservoir in Pakistan (Jacob et. al.,1979), The Koyna reservoir in India (Lee et.al., 1969) and The Hsinfengkiang reservoir in Chaina (Miao-Yuen, 1976).

1.2.2 Study of the relation between the frequency and the magnitude in term of b-value.

Gutenberg and Richter (1944) were among the first to recognize the relationship between frequency and magnitude of the earthquake sequences in California and found that the number of earthquakes decreased logarithmically with the increased magnitude. They introduced an empirical equation describing this relationship,

$$\text{Log } N = a - bM. \text{----------} 1$$

when N is the number of earthquakes which occured of magnitude M in a region per unit time in a particular magnitude interval. The a and b are the constants. The formulation of the frequency-magnitude relation was obtained from a statistical model of rock and crustal deformation which were both done experimented and observed. Furthermore, Mogi (1963) reported that a relationship existed between b value and material properties from a series of laboratory experiments. He monitored the elastic shocks produced by bending rock and resin samples. His conclusion was that b values increased with the degree of heterogeneity of the sample and the degree of spatial variations in the stress distribution. Subsequently, Scholz (1968) improved on Mogi's method using various rock types to show that the b value decleased as stress was increased until fracture occured. According to him, b is the negative value of the slope of cumulative frequency versus distribution, and is believed to be inversely related to the magnitude of the stress at the source.

Utsu (1965) had also proposed the value of the slope coefficient b can be found by maximum likelyhood method, which gives

$$b = \frac{.4343}{\bar{M}-MO} \qquad \text{-------------}2$$

where $$\bar{M} = \frac{\sum Mn}{n}$$

$\bar{M}$ is the mean magnitude of the group of earthquakes, MO is the smallest magnitude considered, and N is the number of events larger than MO.

According to Welkner (1965) the b values were computed using relation 1 and 2 give a good agreement

Gupta et. al. (1973) had observed b value between normal earthquakes and the reservoir-associated earthquakes. He found that the b values for the reservoir-associated earthquake higher than the normal earthquakes. is noted from Table 1.2 that for the reservoir-associated

Table 1.2 The b values for the Koyna, Kariba, and Kremasta regions. (After Gupta et. al., 1972).

| Region | Foreshock b value | Aftershock b value | Aftershock b value of any other earthquake sequence of the region | Regional b value |
|---|---|---|---|---|
| Koyna | 1.87 | 1.28 | 0.51 Godavari Valley earthquake sequence. | 0.47 For Pen--insula, India. |
| Kariba | 1.18 | 1.03 | - | 0.84 |
| Kremasta | 1.41 | 1.12 | 0.07 Average value of 30 aftershock sequence. | 0.82 For - Greece. |

earthquake, the foreshock b values are higher than of the aftershock. However both are higher than of any normal earthquake in the area and the region. Most of the b values for normal earthquakes in any seismic belt are that the foreshock b values are much smaller than of the aftershock. This is inverse to reservoir-associated earthquakes (Table 1.2).

According to McEvilly and Casaday (1967) while studying the California earthquakes, they found that for sequences with low b values (0.4-0.5), the magnitude ratio of the largest aftershock to the main shock (M1/MO) is high (~0.9). Whereas for sequences with a relative high b value (0.6-0.8) this ratio is low (0.6-0.7). Gupta et. al.(1974) also refered Utsu observation on a similar pattern for some earthquakes in Japan. Gupta et. al.(1969) found true the same for the Godavari Valley earthquake sequence (b = 0.5, M1/MO = 0.9) and the Broach earthquake (b = 0.4, M1/MO = 0.8) of Peninsula India. Quite contrary to this, they found a high b value along with a high M1/MO ratio for the Koyna, Kariba, Kremasta, Lake Mead, Monteynard and Mangla (Gupta et. al.,1972). Table 1.3

<u>Table 1.3</u> Magnitude ratios of the largest aftershock to the main shock and b values. (After Gupta et.al., 1972).

| Region | Main shock magnitude MO | Largest after-shock magnitude M1 | M1/MO | b value |
|---|---|---|---|---|
| Lake Mead | 5.0 | 4.4 | 0.88 | 1.40 |
| Monteynard | 4.9 | 4.5 | 0.92 | 0.72 |
| Mangla | 3.5 | 3.3 | 0.94 | 0.96 |
| Koyna | 6.0 | 5.2 | 0.83 | 1.28 |
| Kariba | 6.1 | 6.0 | 0.98 | 1.03 |
| Kremasta | 6.2 | 5.5 | 0.89 | 1.12 |

shows that this ratio is about 0.9 whereas the b value is about one for all the available cases. the second decimal place in b values in not important.

Papazachos (1974) refered Bath's law which Marcus Bath, the Swedish seismologist has observed the difference M0-M1 is equal to 1.2 for the normal earthquake of large earthquakes. Papazachos used homogeneous data of 216 aftershock sequences which occured in the area of Greece and has found that these data fit the law well, for M0 > 5.0 at least. that is;

$$M0-M1 = 1.2 \qquad \text{--------------}1.3$$

He has also observed the average difference M0-M1 of Kremasta, Koyna, Kariba and etc. earthquakes that believed to be the reservoir-associated earthquakes and found that the M0-M1 is equal to 0.5 with a standard deviation equal to 0.3 and concluded that the relation:

$$M0-M1 = 0.5$$

fits these data of the reservoir-associated earthquakes well.

1.2.3 Study of foreshock-aftershock pattern.

Mogi (1963) has classified the forshock-aftershock patterns into three types, as shown in Figure 1.1. In type I model, no foreshock occur which regards to be the type of normal earthquake. In type II, the number of foreshock increses abruptly at the time of the main shock. Type III is a swarm type of activity. The second pattern

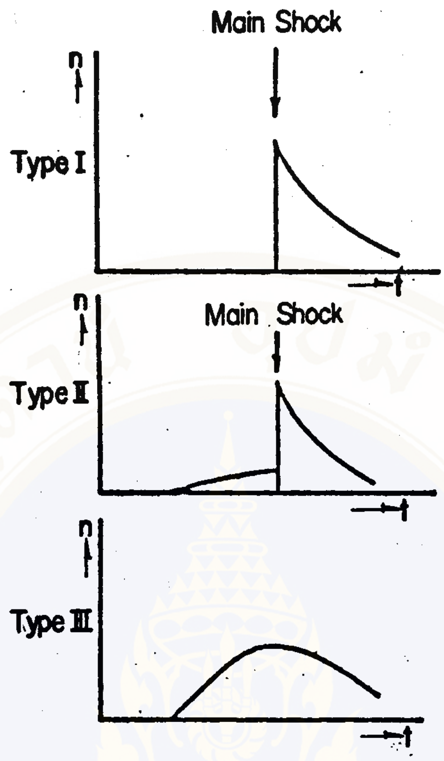



Figure 1.1 Three types of earthquake sequence by Mogi (1963).

is similar to the observations in the Koyna, Kariba and Kremasta regions which are believed to be reservoir-associated earthquakes. Quite a few foreshocks preceded the main earthquake at those regions. It is interesting to note that out of 1,500 earthquakes studied by Mogi in Japan, only 4 per cent fall in type II.

1.2.4 Study of water elevation and frequency of earthquake sequences.

Papazachos (1974) showed that the behavior of earthquakes associated with over a dozen dams, in all cases, the frequency of shocks increased considerable following the reservoir filling and among the factors affecting the tremor frequency are the rate of increase of water level, duration of loading, maximum levels reach, and period for which the high levels are retained.

There are several cases of earthquake swarms for which evidence exists that they are somehow related to artificial lakes such as Marathon Lake in Greece and Vajont Lake in Italy. In these cases no main shock can be distinguished. It is not known whether the time distribution of swarms follows any statistical law.

## 1.3 The Purposes Of The Study.

1.3.1 To study the earthquake occurrences distribution and their frequency in the West of Thailand (the case study of Kanchanaburi).

1.3.2 To study the earthquake occurrence whether they are related to the following factors or not.

1.3.2.1 Study of the relation between the earthquake occurrences and the geology, and additional study of fault plane solution.

1.3.2.2 Study of the relation between the earthquake occurrence and the b values.

1.3.2.3 Study of the relation between magnitude and frequency to compare with the cases of the reservoir-associated earthquake sequences.

1.3.2.4 Study of the foreshock, and aftershock pattern of the sequences.

1.3.2.5 Study of the relation between the earthquake occurrence and the water level of Srinakarind and Khao Leam reservoirs.

## 1.4 Scope Of The Study.

1.4.1 To study the situation of earthquake occurrences in the West of Thailand (the case study of Kanchanaburi).

1.4.2 Compare the data of earthquake sequences of Thailand since the first seismological instruments were installed in 1963 up to December 1985 by using the corrected data from the Meteorological Department.

1.4.3 To study the geological features from the data and informations available through governmental office, The Department of Mineral Resource and/or The Electricity Generating Authority of Thailand (EGAT).

1.4.4 To employ the water elevation data of Srinakarind and Khao Leam dams and reservoirs from the Water Provide Section of the Irrigation Department and/or The Electricity Generating Authority of Thailand from the period of the water started impounding up to December 1985.

## 1.5 The Methods Of The Study.

1.5.1 Study the materials in the subject of geologic and geological structure in the West as follow:

1.5.1.1 Study the general geography and geologic structure for literature revisions through collected papers from texts and/or reports and/or papers of concerned agencies.

1.5.2 Study the derivation of the earthquake sequences in the West of Thailand (the case study of Kanchanaburi).

1.5.2.1 Collect any data concerning the earthquake occurrences such as magnitude, coordinates, frequencies etc. and show them in the term of tables and/or graphs as necessary.

1.5.2.2 Bring the data from 1.5.2.1 and plot on a map to study the distrubution of earthquake occurrences.

1.5.3 Compute b values from the relations between the magnitude and the frequency of the earthquake occurrences by using the relation 1 and 2.

1.5.4 Establish the relationship in forms of graphs and/or tables of 1.5.3.

1.5.5 Plot graphs and/or tabulate the data of the water elevation of Srinakarind and Khao Leam reservoirs by fixing the appropriate time period.

1.5.6 Draw the patterns of foreshocks and aftershocks distributions as classified by Mogi.

1.5.7 Establish graphs of the relations of the magnitude and the frequency as expressed by the relation 1 proposed by Gutenberg and Richter (1944).

1.5.8 Take the result from 1.5.1-1.5.7 to find the solution of the relation of the earthquake occurrences in form of maps and/or graphs and and/or tables as neccessary and describe the materials by the following study:

1.5.8.1 Study of the relation between the earthquake sequences and geology by plotting the epicenters of the occurrences on the geological map and analyze the geologic structure, and study fault plane solution by comparing to any other cases of the reservoir-associated earthquakes mentioned in 1.2.1.

1.5.8.2 Study of the relation between b values and any related values of the earthquake sequences in the West of Thailand from 1.5.3 and b values and any related values of the other associated-reservoir earthquake sequences.

1.5.8.3 Study of the foreshock-aftershock patterns from 1.5.6 and then relating to the other associated-reservoir occurrences pattern.

1.5.8.4 Study of the relation between the water elevation and the frequency of the sequences from 1.5.5.

## 1.6 The Expected Results.

1.6.1 The earthquake distribution regions can be clarified.

1.6.2 After studying of the relations between the earthquake sequences and the several factors such as b values, frequency, magnitude, water elevation, statistics law etc., the future situation of the earthquake occurrence can be expected.

1.6.3 The direction of the faults movement, from the distribution of occurrences and the focal mechanism can be determined.

1.6.4 The results of this study can be used as the guide in the field of geology including analysis in the other parts of geology later.

# CHAPTER 2

# GEOLOGIC STRUCTURE AND EARTHQUAKE

## 2.1 The Earth's Crust.

The solid earth consists of several internal divisions, each with its own special characteristics (Heeler, 1979). These divisions are the thin outer crust shell, the intermediate zone, called mantle and the center core which is divided further into the outer core and the inner core.

The thickness of the crust is only about 5 km. under the ocean, but is as much as 60 km. thick under the continents. According to Coble (1981), the earth's crust are divided into many plates, each plate move freely both up-down and sideway. This phenomena of the crustal movement is governed by the plate tectonic theory which explains all the mechanisms, features and events associated with them.

Each plate is rigid and has its own well define boundary. Since there are movement of these plates, there be a relative movement along each plate boundary. The friction that occured along them caused the stress build up which when release will cause a series of trembling. Thus each plate boundaries are normally defined by the seismic belt around them.

The stress build up along these plate boundaries are also provided enormous pressure distributed through out the rigid plates. This pressure will cause the rock strata to distored and leave its print. When the strain exceed the plasticity limit, the rupture occured as cracks, joints and faults. These folds, cracks, joints or faults are all those geologic structures.

The movement of the earth crust has happened eversince the forming of the earth. Sometimes they are stop and sometimes they are active in a selective area.

## 2.2 Faults.

Faulting (Allison et.al., 1955 and Lepp., 1973) is a type of earth deformation. It is a plane that brake and displace along. In some place one type of rock can be seen builting up against rock of quite another type along a narrow line of contact. In other places, displacements in strata of the same rock may have clearly taken place, either vertically or horizontally.

Whether on land or beneath the oceans, according to Bolt (1978), fault displacements can be divided into the three major types, as shown in Figure 2.1. There are normal fault, reverse fault and strike-slip fault. Both normal and reverse faults produce vertical displacements. They can be seen at the surface as fault scarps, and are commonly called dip-slip faults. By contrast, faulting may cause only horizontal displacements along the strike of the fault, and such faults are described as transcurrent or strike-slip fault. It is agreeable among geologists to have a simple term that tells the direction of displacement slip by relation. If one is standing on one side of the fault and looking across it, then the offset of the other side is determined either to the right or the left of the observer. The terms are left lateral or right lateral movement. Commonly faulting can be a mixture of dip-slip and strike-slip motion.

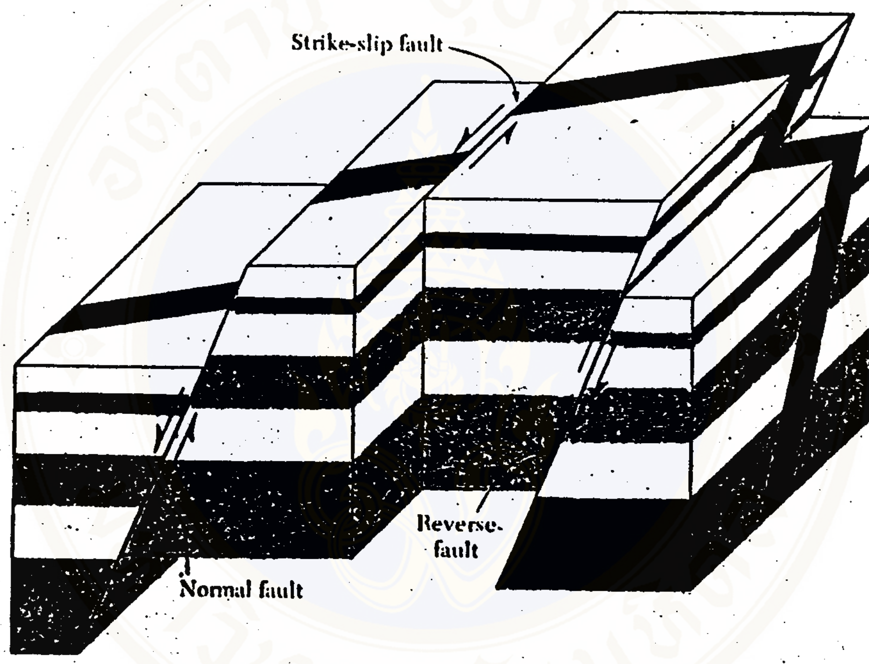



Figure 2.1 Diagram showing the three main types of fault motion. (After Bolt, 1978).

Some faults are deep inside the earth. Other are close to or at the earth's surface. Most faults occur at depths at up to many kilometers (Bolt, 1978). The last displacement to occur along a typical fault may have taken place tens of thousands or even millions of years go.

There is no real agreement on what always constitutes an active fault. However, according to Keeler (1979), many geologists would label a fault active if it can be demonstrated that there has been movement during the last 11,000 years. The Quaternary period is the most recent period of geologic time; most of our landscape has been produced in that time. Therefore, it seems reasonable to classify fault that has moved during the Quaternary as possible active (Table 2.1). Faults that have been inactive for the last three million

Table 2.1 Activity of faults. (After Keeler, 1979).

| Geologic age: Era | Period | Epoch | Years before present | Fault activity |
|---|---|---|---|---|
| Cenozoic | Quaternary | Historic (Calif.) | 200 | Active |
| Cenozoic | Quaternary | Holocene | 11,000 | Active / Potentially active |
| Cenozoic | Quaternary | Pleistocene | 3,000,000 | Potentially active |
| Cenozoic | Tertiary | Pre-Pleistocene | 65,000,000 | Inactive |
| Pre-Cenozoic time | | | | Inactive |
| Age of the earth | | | 4,500,000,000 | |

years are generally classified as inactive (Keeler,1979). However, whereas faults accompanying recorded earthquakes certainly are active, it is often very difficult to prove the activity of a fault unrelated to such easily measured phenomena.

## 2.3 Seismology.

The word seismology, according to Bath (1973), is formed from the Greek seismos (earthquake) and logos (science). Today our knowledges and understanding of earthquakes are much more advanced. However, many questions are still waiting for answers.

Earthquake represents a passage of a series of waves through the rocks of the earth (Allison, 1955). The

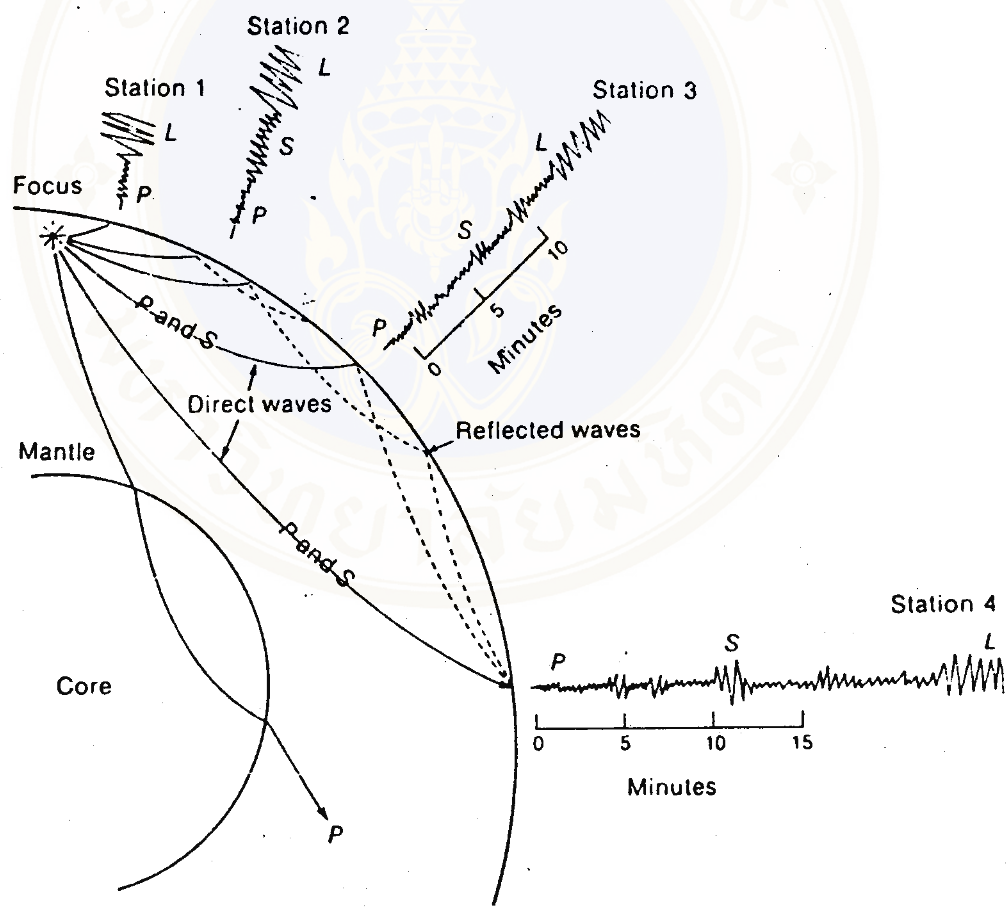



Figure 2.2 A cross section through a portion of the earth, showing the paths of a few of the many earthquake waves and the records they leave on the seismogram at four stations. (After Allison, 1955).

seismic waves originating within the crust radiate outward in all directions from a source or focus (Figure 2.2). Their path are modified by the differences in materials traversed; their persistence is proportional to their initial energy. Some go completedly around or through the earth, whereas other, the weaker one, die out in short distances.

According to Heeler (1979), most earthquases are caused by movement along cracks, or faults. Some earthquakes are caused by the force of magma moving beneath volcanoes; however, the more immediate cause of the earthquakes is the sudden breaking of rock that have been exposed to forces beyond the limit of their strength. Energy is released during this process until all of the energy is used up. The release of the energy causes vibrations and continuously move out into nearby area. This energy called seismic energy and is in the form of waves.

According to Allison et.al. (1955), most major earthquakes occur in three belts of the world, and they are initiated near plate boundaries, (Figure 2.3).

The first belt is the Circum-Pacific belt, extending around Chile, Central America, through a loop in the Caribbiean-Antilles area, California, Japan, the Philippines and Indonesia.

The second belt is the Alpine-Mediterrancan belt, including northern Africa, Spain, Italy, Yugoslavia,

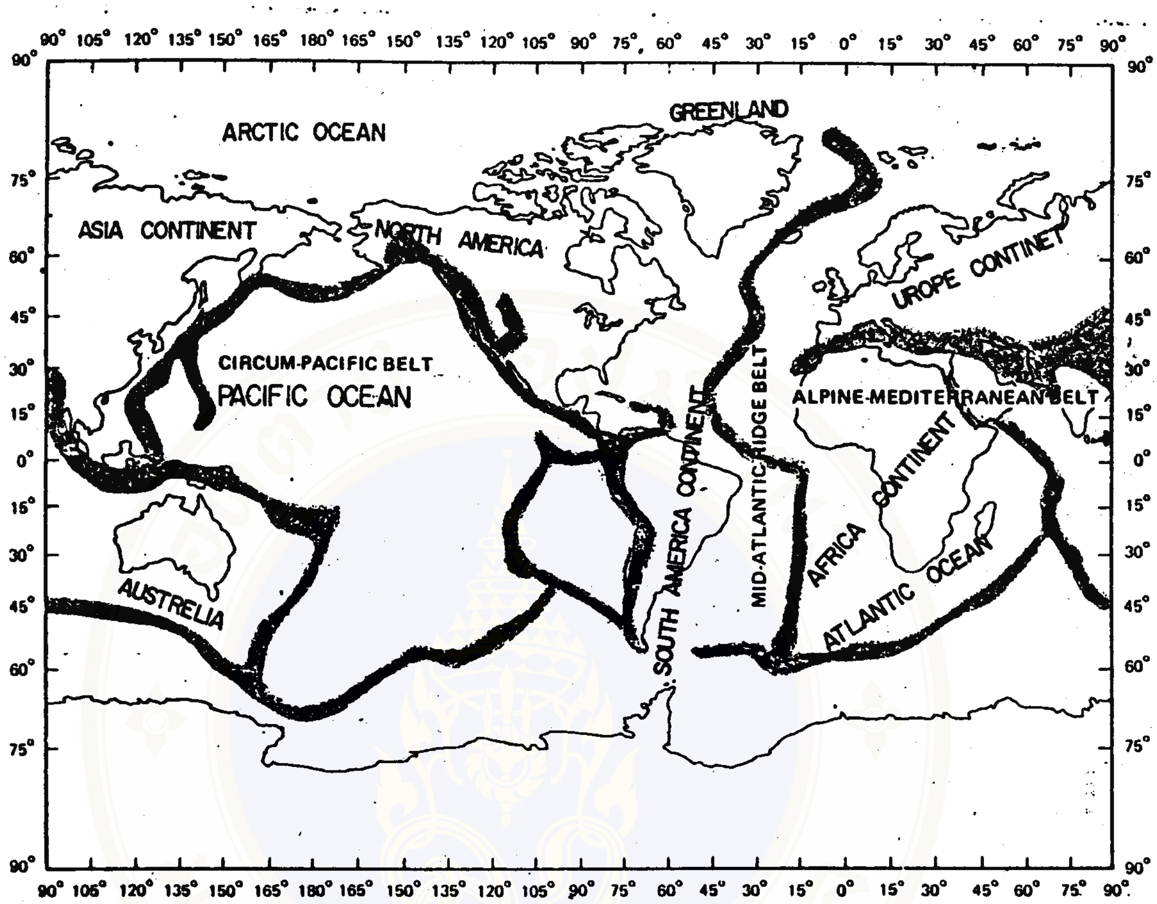



Figure 2.3 Map of the world showing the three major earthquake belts. (After Heeler, 1979.)

Greece, Turkey, Iran, northern India and Burma.

The third belt is the Mid-Atlantic Ridge belt, extending from Iceland, through the middle of the Atlantic Ocean.

The Circum-Pacific belt is the source 80 to 90 per cent of the known global earthquake shocks. Many of the Pacific earthquakes are generated along a deep shear or fault zone that slants down under the continent ocean border. About 5 per cent of earthquakes, all of shallow origin occur along the submarine mountain rise or ridge systems and their associated offseting fracture zones. A few occur in the fault zones of eastern Africa and east-central Siberia.

## 2.4 The Causes Of Earthquake.

According to Keeler (1979), the earth is dynamic, its outer layer of lithosphere is broken into several large and numberous small plates that move relative to one another. From plate tectonic theory, new lithosphere is produced at oceanic ridge systems and older lithosphere either is consumed at subduction zones or else slide past one another. Thus, there are tremendous stress build up in the rocks. When the stress exceeds the strength of the rocks, the rocks fail (produce faulting), and the energy is released in the form of an earthquake.

The association between earthquakes and faulting was explained by the elastic-rebound theory developed by H.F.Reid and others (Allison et. al., 1955), after studying the California earthquake of 1906. According to this theory, the rock beside a fault, in close contact with one another, enable to undergo gradually accumulating strain by changing shape, until their elastic limit is finally reached. They suddenly break, and much of their stored-up elastic energy is released in earthquake waves. The rocks resume their original shapess, but they have been faulted and have different relative positions on either side of the break.

## 2.5 Seismic Waves.

The point beneath the surface where the rocks break and move is called a focus of an earthquake (Coble et. al., 1981). Directly above the focus, on the earth's surface, is the epicenter.

During an earthquake, some rocks move from one place to another. Other rocks vibrate. Earthquakes can cause vibrations in rocks that are at great distances from the focus. These vibrations are called seismic waves. According to seismologists, there are four types of the waves. They are the primary waves or P-waves, the secondary waves or shear waves or S-waves, the Love waves and the Raleight waves as illustrated in Figure 2.4.

The P-waves or primary wave is the fastest traveling waves. P-waves can pass through solid, liquids and gases. They pass through the earth at different speed depending on the density of the media. As they move deeper into the earth, where material is more dense, they speed up. P-waves are like sound waves in that they vibrate in the direction of propagation. They alternately push (compress) and pull (dilate) the rock (Figure 2.4a.).

The S-waves or Secondary waves have the direction of vibration perpendicular to P-wave and their direction of traveling. S-waves can not pass through

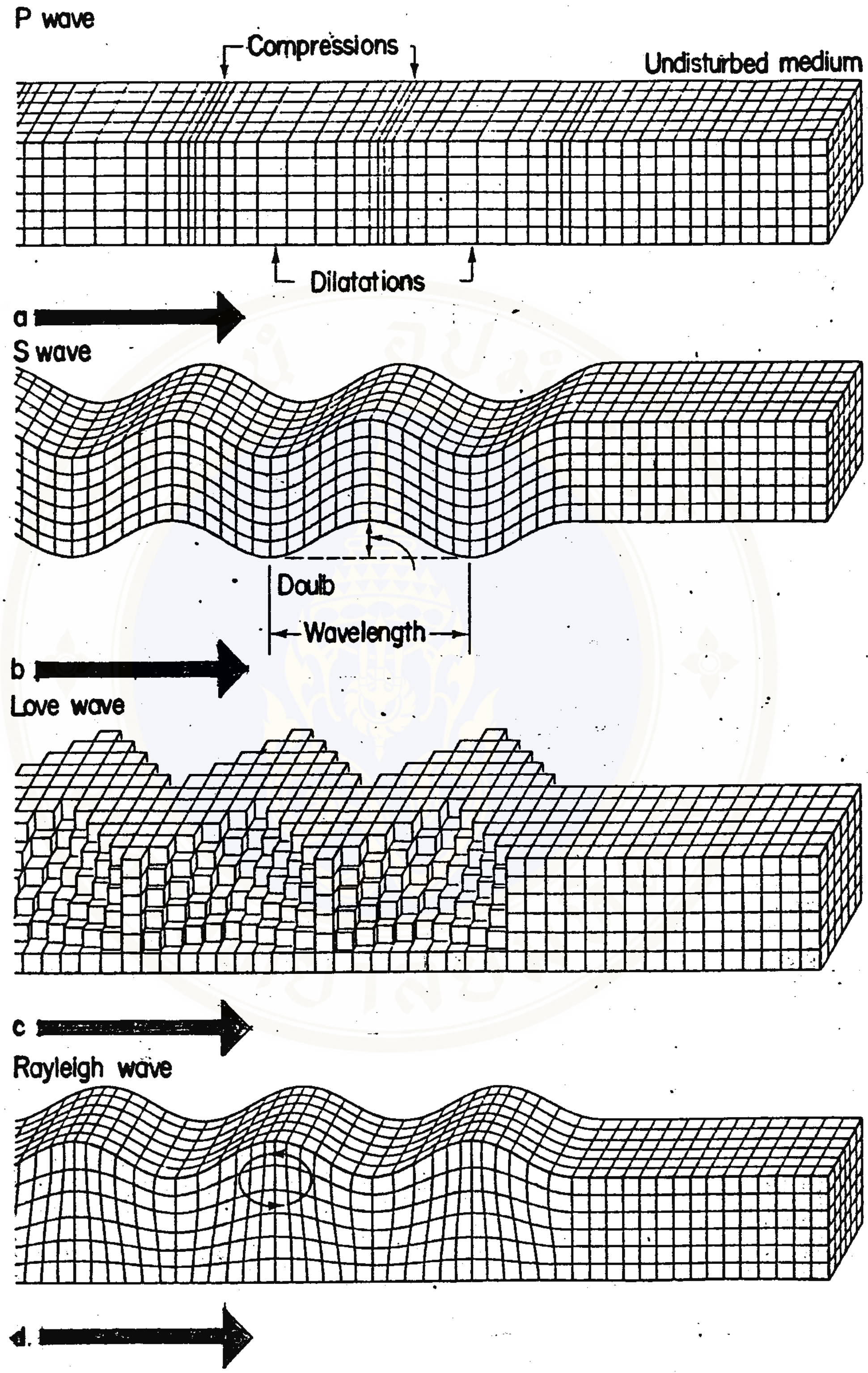



Figure 2.4 Diagram illustrating the forms of ground motion near the ground surface in four types of waves. (After Bolt, 1978).

non-rigid media and their traveling velocity is less than P-waves. S-waves cause rock particles to move from side by side (Figure 2.4b.).

There are seismic waves of the slowest speed. They can be devided into two types. The first is called a Love wave. Its vibvration is horizontally parallel to the earth's surface (Figure 2.4c). The second type of the surface wave is called a Rayleigh wave. It moves both vertically and horizontally circulary (Figure 2.4d).

Seismologists use the differences in traveling time of each wave, especially the P and S-wave, to find a source of origin.

## 2.6 Focus And Epicenter.

According to Coble et.al. (1981), earthquakes are measured and recorded on instruments called a seismograph. All waves that reach seismograph are recorded on a paper called seismogram with reference to time of arrival. The difference in arrival time of waves are used to locate the the epicenter. The geographic location of distant epicenters may be determined by the three-point-positioning method (Allison et.al., 1955). First, the epicental distances from atleast three stations are calculated from the differences between the arrival times of P and S waves at each station. They are converted to distance, then a circle is drawn about each station, with distance radius appropriate to them. The location of the epicenter is indicated at the

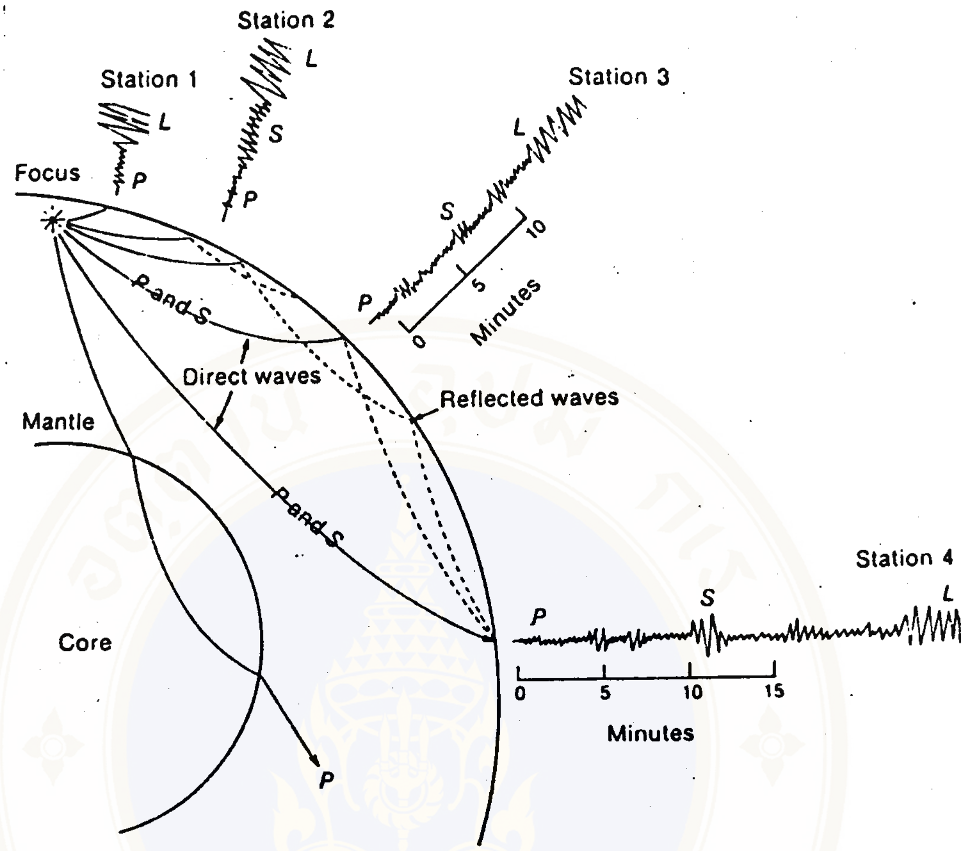



Figure 2.5 Shows the three circle method of location the epicenter of an earthquake from seismograph records at three stations. (After Allison, 1955).

point which the three circles cross each other (Figure 2.5).

Travel-time curves is used to locate earthquake distances. Example is shown in Figure 2.6, Figure 2.6A is seismogram on which the two principal body waves (P and S) have been identified. We can see from the record that the P wave arrived at 8 hours 9.6 minutes and the S wave at 8 hours 18.9 minutes. The difference in arrival time between them is 9.3 minutes. Which this time is plotted on a strip of paper of the same scale as the

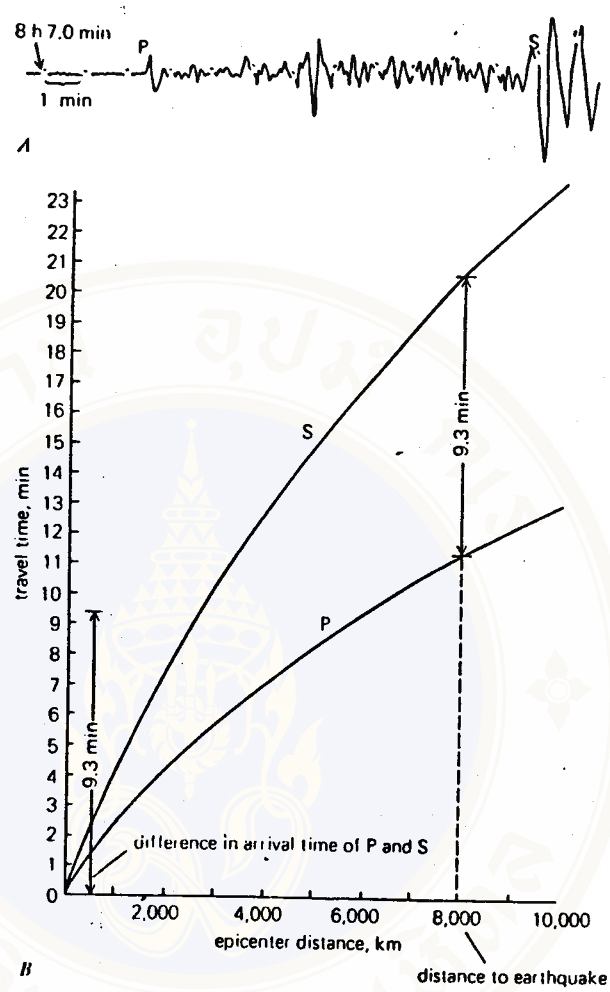



Figure 2.6 (A) Partial seismogram showing arrival of the P and S waves. (B) By plotting the difference in arrival times on a strip of paper we can see from the travel-time curves that this earthquake must have occured 8,000 km. from the recording station. (After Lepp, 1973).

travel-time curve. The distance to the earthquake can be determined as shown in Figure 2.6B. Moreover, by knowing the distance, which in the example is 8,000 kilometers, one can turn to find when the earthquake actually occured. In the example this would be 7 hours 58.4

minutes, which we obtained by subtracting the time required for P to travel 8,000 kilometers from its actual arrival time.

## 2.7 Magnitude And Frequency Of Earthquake.

The actual energy releassed of earthquakes at its source is rated in terms of a standard magnitude scale originated by Richter in 1935 (Allison et.al., 1955) and known as Richter's scale. It is determined from the amplitude of the largest wave recorded on a seismograph. The amplitude is measured on a logarithmic scale, and so it encompasses an extremely wide range of magnitudes. An earthquake of magnitude 3.0 Richter, for example, produces a displacement on the seismograph 10 times larger than does a magnitude of 2.0 Richter. However, the energy released may be 30 to 60 times greater. Thus, between 27,000 and 216,000 shocks of magnitude 5.0 Richter are required to release as much energy as a single earthquake of magnitude 8.0 Richter. The very faint earthquakes are rated little more than 0, whereas, the most severe shocks recorded run to 8.6 Richter.(Keeler, 1979). An explosion equivalent to 1 million tons of TNT generates an earthquake of about 6.0 Richter. The 8.5 Richter of the 1964 Alaskan earthquake was equal to the energy of 320 million tons of TNT.

According to Keeler (1979), there are probably about one million earthquakes a year that can be felt, and on the average, about 15 to 20 large and destructive earthquakes occur in a year shocks associated with volcanic activity. Minor shocks are so numerous that a tremor is taking place somewhere on the earth every few minutes.

**1. Local magnitude ($M_L$). This type of magnitude is measured for short distance earthquake.**

**2. Body magnitude ($M_B$). This type of magnitude is measured for both short and long distance of earthquake.**

**3. Surface magnitude ($M_s$). This type is measured for the large scale in long distance earthquake.**

2.8 Intensity.

According to Allison et. al.(1955) and Bath (1973), intensity is not a source parameter, but it will be convenient to treat this concept in immediate connection with magnitude. The magnitude clearly differs from intensity of an earthquake. The magnitude is calculated from instrumental records, while the intensity is based on direct effects of the shock, such as on buildings, topography, and the changes it produces in rock and soil on the earth's surface. While the magnitude has a certain definite value for each earthquake, the intensity varies with the position of the observation point.

A destruction by an earthquake depends on the geological characteristics of the ground surface and on the size and shape of the man-made structures, including their design, workmanship, and construction materials. Also important are the characteristic of the seismic waves, such as the acceleration, period, velocity and duration.

To measure the severity of an earthquake the Mercalli intensity scale was developed and modified by Wood and Neumann in 1931 (Allison, 1955), and was then called the "Modified Mercalli Scale" or the "MM-Scale" (Bath, 1973). This intensity scale is graded is steps from I to XII in order of increasing severity (Table 2.2).

Table.2.2 Modified Mercalli Scale Of Earthquake Intensities.(After Bath, 1973).

I. Not felt. Marginal and long-period effects of large earthquakes.

II. Felt by persons at rest, on upper floors, or favorably placed.

III. felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.

IV. Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV, wooden walls and frame creak.

V. Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.

VI. Felt by all. Many frightened and run outdoor. persoms walk unsteadily. Windows, dishes, glassware broken. Knickknacks, book etc. off shelves. Pictures off walls, furniture moved or overturned. Weak plaster and masonry D cracked. small bells ring (church, school). Trees, bushes shaken visibly, or heard to rustle.

VII. Difficult to stand. Noticed by drivers. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys brocken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices also unbraced parapets and architectural ornaments. Some cracks in masonry C. Waves on ponds, water turbid with mud. Small slides and caving in along sand or gravel banks, Large bells ring. Concrete irrigation ditches damaged.

VIII. Steering of cars affected. Damage to masonry C; partial collapse. some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.

IX. General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. General damage to foundations. Frame structures, if not bolted, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluviated areas sand and mud ejected, earthquake fountains, sand craters.

X. Most masonry and frame structures destrouyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.

XI. Rails bent greatly. Underground pipelines completely out of service.

XII. Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.

# CHAPTER 3

# REVIEW ON GEOLOGY AND SEISMICITY OF THAILAND

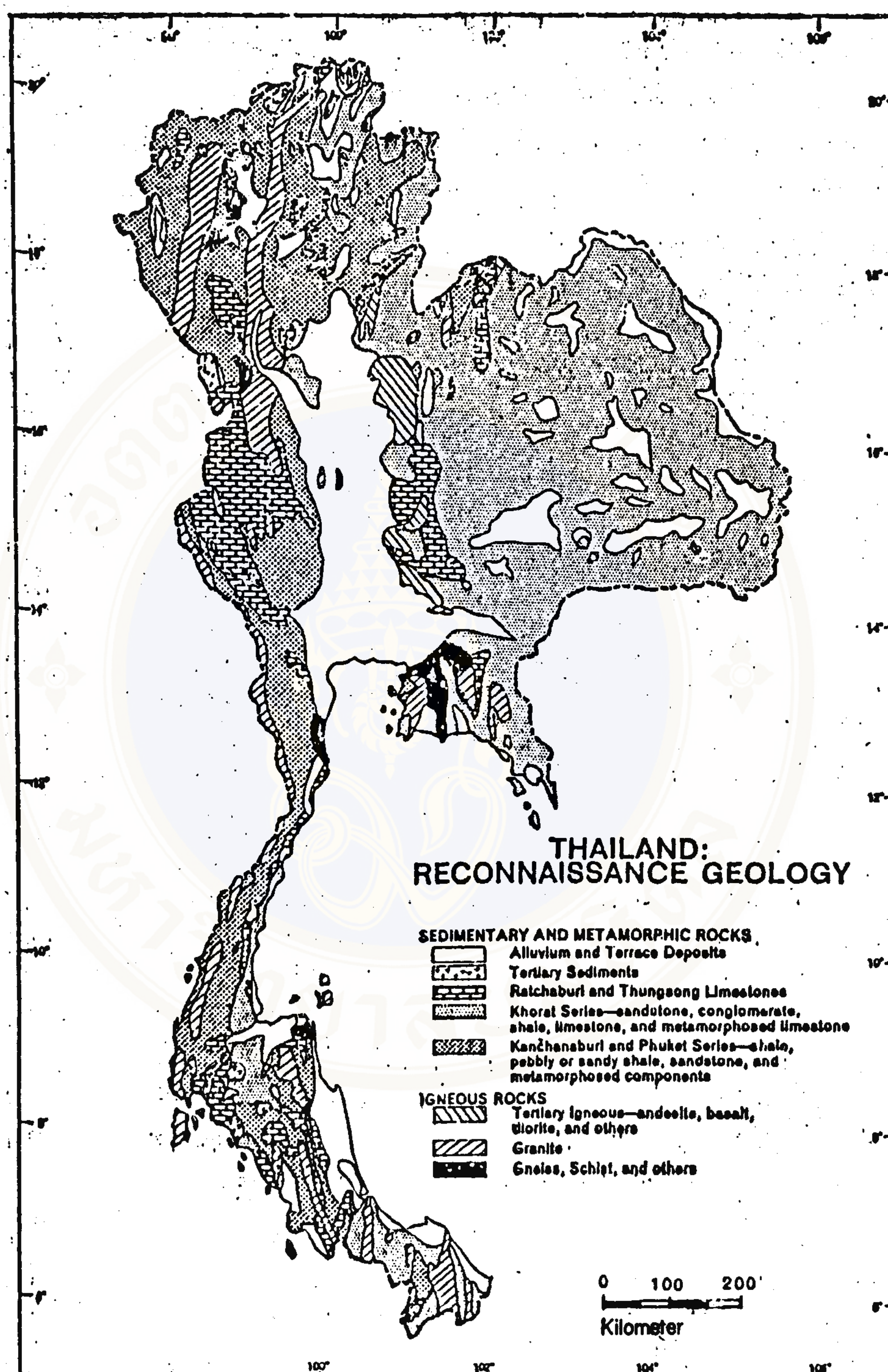
## 3.1 General Geologic Setting Of Thailand.

Thailand occupies a territory of about 518,000 sq.km. in the Southeast Asia Peninsula (Suwannasing,1972), extending from Latitude 5°to 21° north, and longitude 97° to 106° east (Figure 3.1). The country is elongate north- south almost parallel to the known seismicity belt in the Andaman sea. There are two main seismic belts to the west of the country. The outer belt is located in North-South direction almost along the longitude 94 °E. The inner belt is close to the country and qallign north-south about the central plain of Burma. This belt extend into the bay of Mataban with its branch bended toward Thailand (Figure 3.2). According to Nutalaya et. al. (1985), there are many earthquake occured in this belt.

Reconnaissance geological map of Thailand scale 1: 1,000,000 (Figure 3.1) shows trend of rocks in western Thailand run almost NNW-SSE direction. The rocks comprise of mainly sedimentary rocks with some metamorphic belt and granitic intrusion. The age of rocks are mainly Palaeozoic but covered almost the whole range of geologic time.

## 3.2 Geologic Setting Of Western Thailand.

Major rock exposed in western Thailand is limestone of Palaeozoic and Mesozoic era (Figure 3.2). There are




<u>Figure 3.1</u> Map shows reconnaissance geology of Thailand. (After Eiamnoh, 1983).

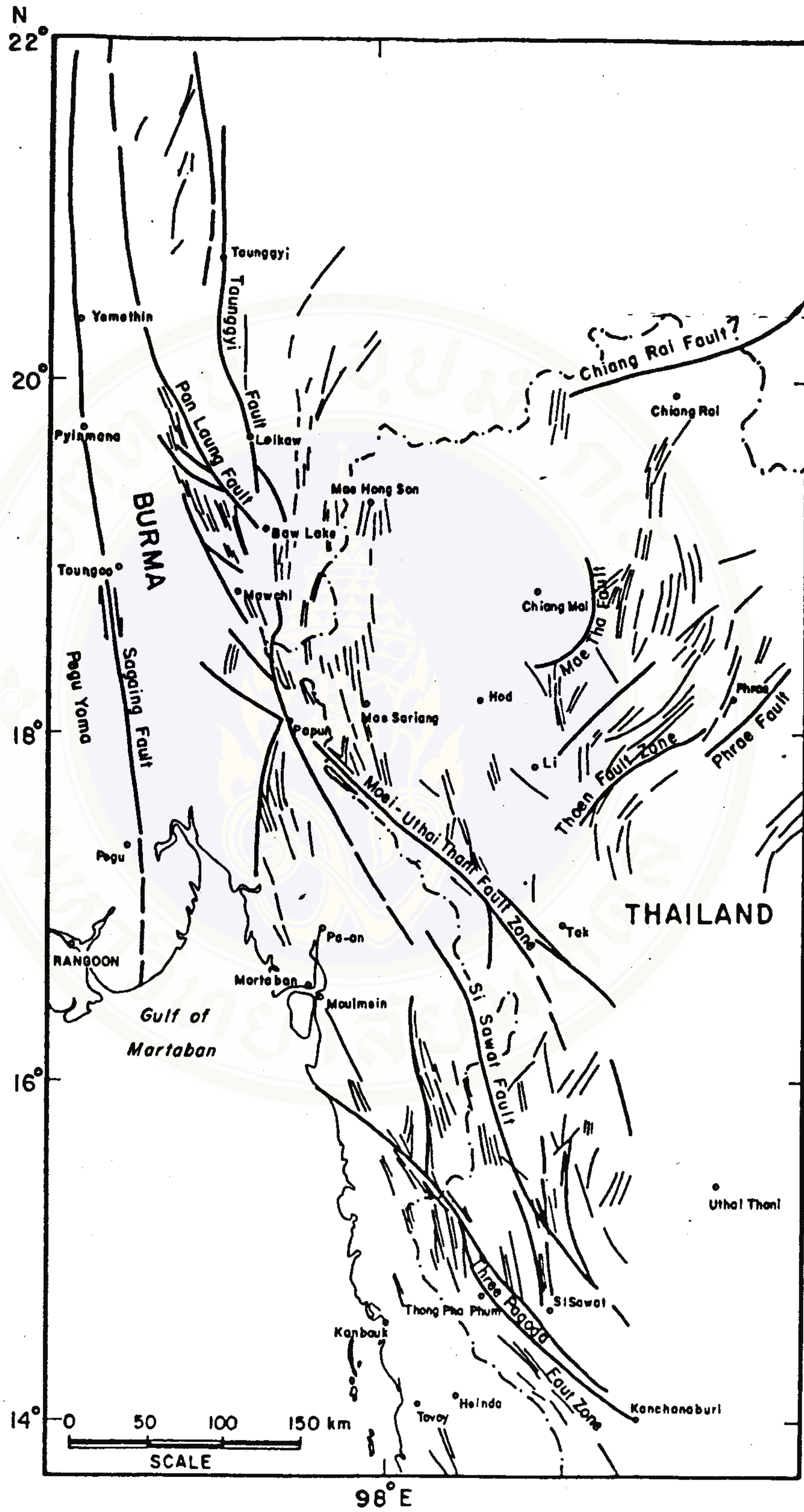



**Figure 3.2** Map shows three major large faults in Thailand. (After Nutalaya et. al., 1985).

some clastic rocks but comparatively in a small amount. The trend of rock runs NW-SE with dipping toward NE. Granite is the only major igneous rock intruded as batholith here and there, and form a high mountain such the one divided Thailand and Burma.

The contact among rock units are commonly a fault. Hence many faults are shown in the geological map. There is one major fault that run through western Thailand extended from Burma through Quae Noi river. This faults have their zones and their branches effect the geology nearby. From the geological map (Figure 3.1), one may see the Tertiary rock and its basin are either bounded by fault line or been faulted through. It is also seen that many creeks or river are running, in a straight line. These are all suggested that these faults or at least the major ones were active later than the time of Tertiary deposition. That means later than tens of million of years and probably active in the last million years ago (Siripakdee, 1980). In other word the area of western Thailand, as suggested by geologic consideration, is potentially active i.e. the crust is still moving.

## 3.3 History Of Seismicity In Thailand.

No one knows when the earthquakes have been occured in Thailand, but the collecting of seismological data base on events in the history from texts, annals, stones incriptions, and astrological documents by Nutalaya et.al. (1985). They have shown a detailed catalog of earthquakes occurring in Thailand dating back 624 BC.

They have identified to total of 45 felt earthquakes which occured in Thailand and Burma. The first possibly collected in Thailand and Burma in 624 BC. at Yonok-Naqabandhu of the 10 of Lunar month with intensity V in MM. scale. And the last earthquake collected occured of such period in 1887 at Bangkok with intensity V in MM. scale. The second collecting period after 1900 from the paper in Thai language at of The Studies and Research Division, Meteolorogical Department of Thailand (1984), found that the first earthquake occured in 1912 felt at Chiengrai, in the morning on May, 24.

In 1975, there was a firm documental record for the first time for earthquake to occur inside Thailand with magnitude 5.6 Richter. It is located in Mae Hongson province. It is the first occurrence that has a magnitude greater than 5.0 Richer but ther was serious damage to building or human life.

The instrumental data of local earthquakes have been compiled for their epicenters. Distribution of earthquakes for the period 1975-1983 is shown in Figure 3.4. Most of these local earthquakes can be classified as microearthquakes which magnitude less than 4.0. However some felt earthquakes always occured in northern Thailand. The epicenter of felt earthquake is shown in Figure 3.5.

The lastest event which effected Thailand was an earthquake on 22 April 1983 at Kanchanaburi province, western Thailand. This earthquake caused slightly damage to a few buildings and more than 100 aftershocks happened within one month. The effect of this event and the aftershock sequence are particular interest because two dams have been built at Quae Yai and Quae Noi (Srinakarind Dam and Khao Leam Dam) about 35 km. from the epicenter. There was no big earthquake which caused severe damage and causalties in this area before.

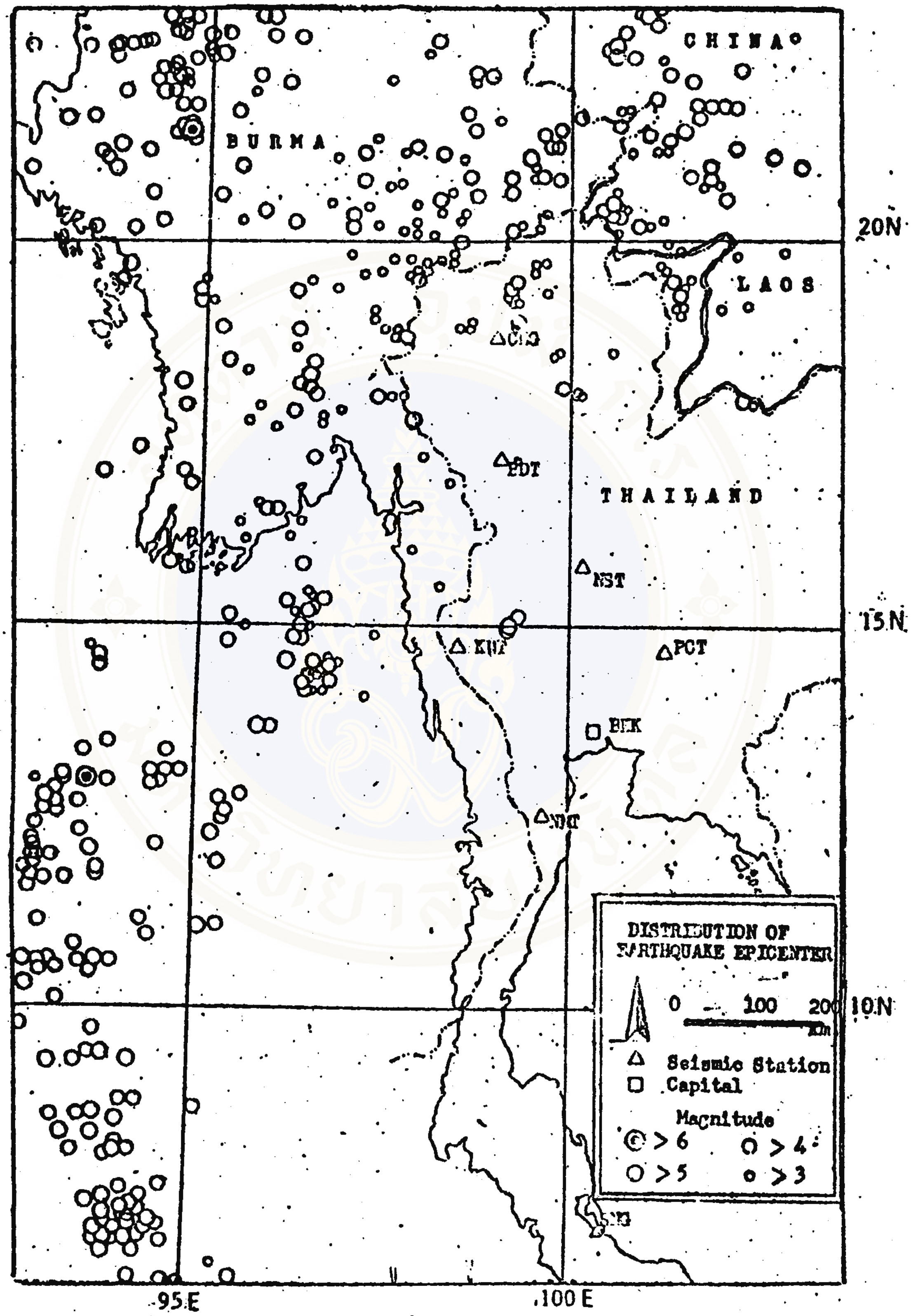



**Figure 3.3** Seismicity of Thailand for the period 1975-1988.(After Prachuab, 1985).

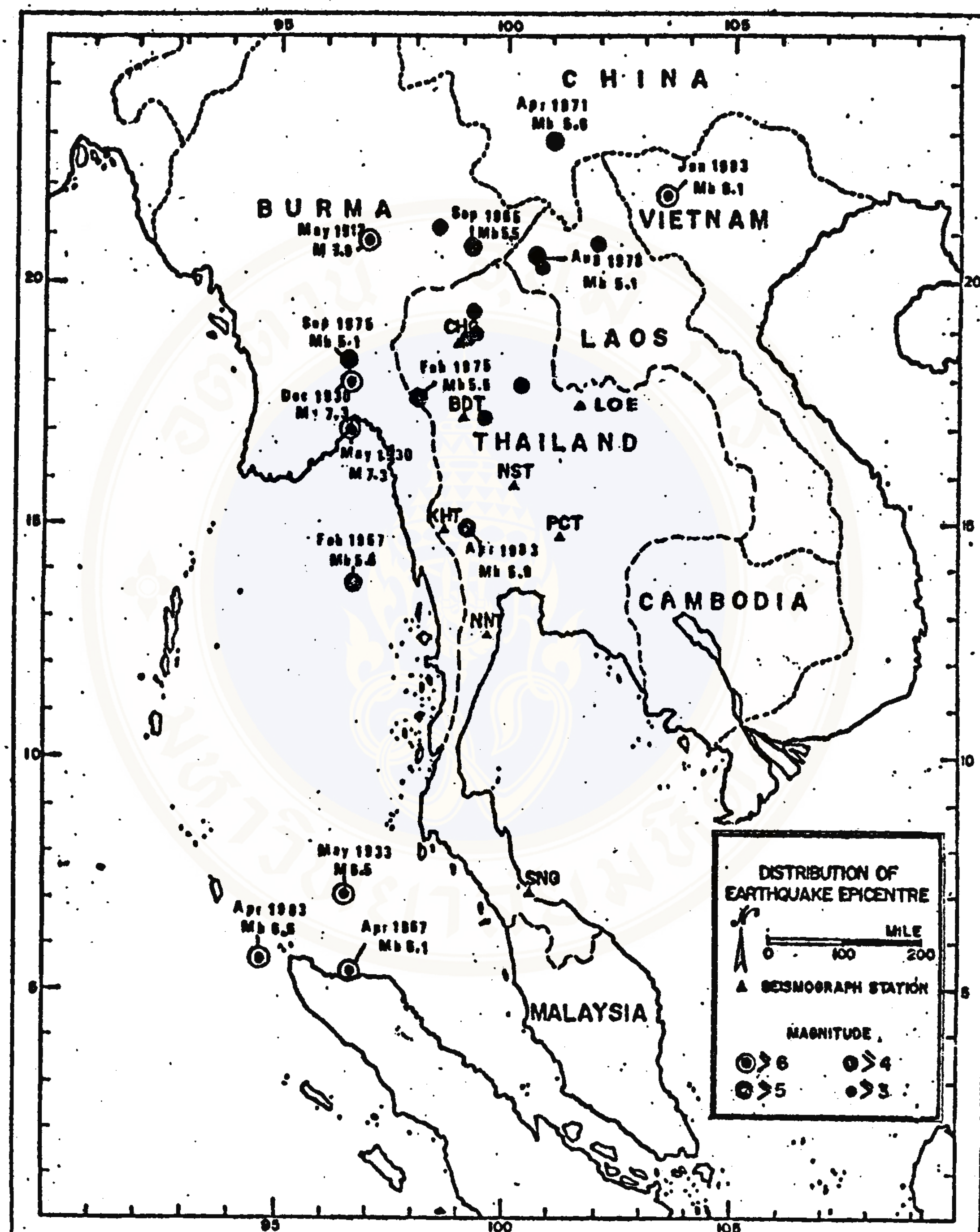



Figure 3.4 Epicenters of felt earthquake in Thailand for the period 1900-1983. (After Prachuab, 1985).

# CHAPTER 4
# STUDY AND ANALYSIS

## 4.1 The Earthquake And Geology.

### 4.1.1 The epicenter area.

The earthquake epicenters were plotted on a geological map scale 1:250,000. They indicate that the earthquakes occured in two main areas one is in the vinicity of Srinakarind reservoir. Such area is bounded by latitude 14.35°N to 15.27°N and longitude 98.73 °E to 99.70 °E. The other is also in the reservoir but of Khao Leam dam and bounded by latitude 14.45°N to 15.02°N and longitude 98.32°E to 98.73°E.

### 4.1.2 The earthquake of Srinakarind.

There are 603 earthquakes occured during the period of Apr.8, 1982 to Dec. 31, 1985 as collected by Met. Dept. (Meteorological Department). Most of them have magnitude less than 2 Richter. The main shock had occured on Apr. 22, 1983 at 00.37 hour (GMT) with the body magnitude of 5.5 Richter. Its epicenter, as calculated from world wide data, is announced at latitude 14.95°N. and longitude 99.20° E. from the focus at less than 10 km. depth (Prachuab, 1985). There were also many foreshocks but the largest one was on Apr. 15, 1983 with the body magnitude of 5.0 richter at 03.30 hour (GMT). Its epicenter was at lat. 14.97°N and long. 99.13°E and its source was indicated at 8.6 km. beneath. The aftershocks were also occured many times with its largest one 5.3 Richter, was on Apr. 22, 1983 at 03.21 hour (GMT) and was located at the depth of 13.8 km. at lat. 14.95°N. and long. 99.15°E.

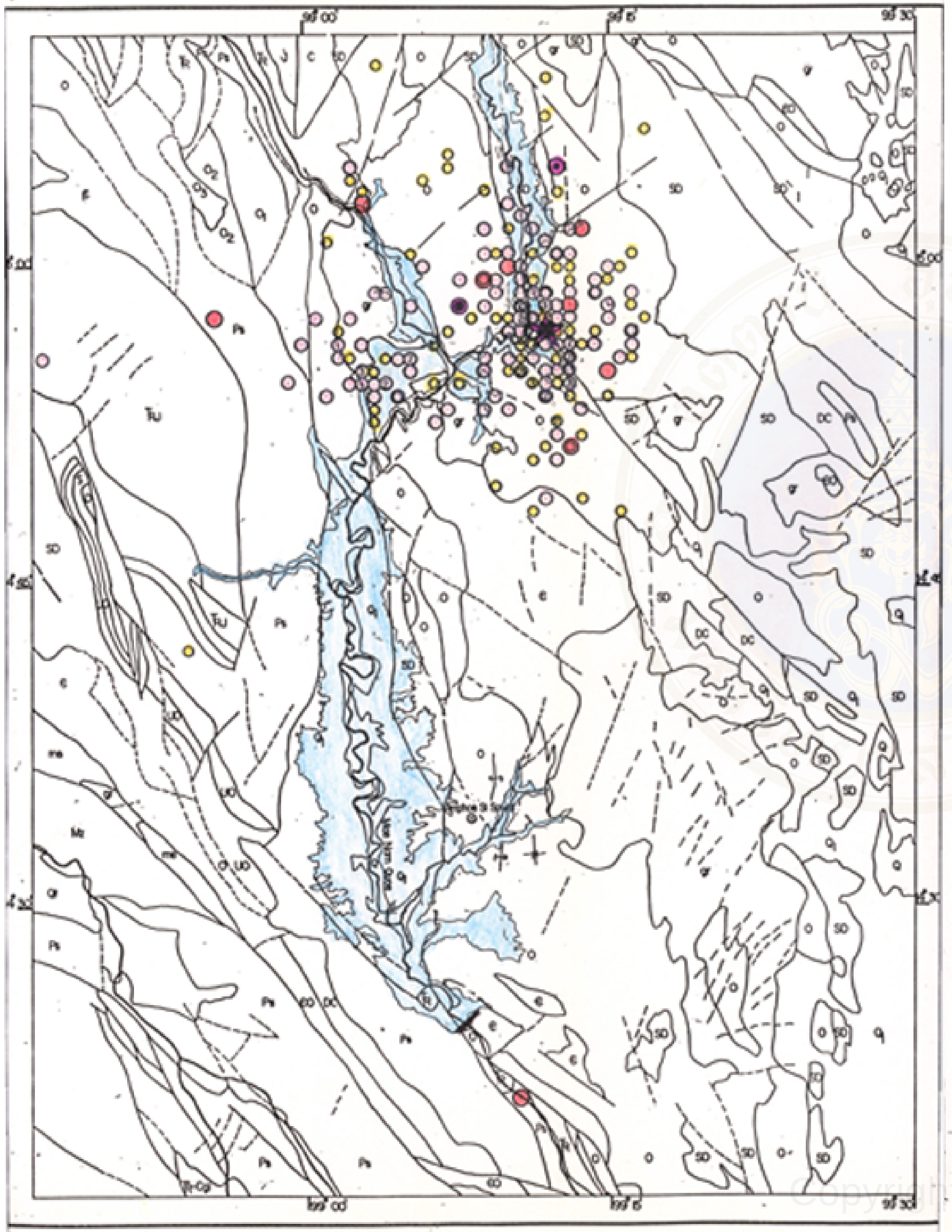
The data of the occurrence at Srinakarind reservoir and its vinicity was reported in April 1985 after impounding in August 1977. Although there are as many as 603 earthquake occured, only 210 out of them are able to be plotted on geologic map. This is because the rest of them are undeterminable due to the lack of sufficient data for the determination of location, magnitude and depth.

The result of plotting shows that the epicenters are clustered in two main groups as shown in the map of Figure 4.1. One group is clouded around the river junction between the Quae Yai and Huai Kha Khaeng. The other group is some what 10 km. east of the first group and seem to show elongate pattern.

4.1.3 Geologic Consideration.

As mention, there are two group of earthquake, thus first group will be designated as group "A" and the second group as group "B".

Group A. epicenters seems to be confined in the granite area as shown in the geologic map Figure 4.1. There is no direct association with any geologic structures such as fault. However there is some general alignment of the epicenters along the geologic boundary between the granite body and the Ordovician limestone.




## EXPLANATION

### SEDIMENTARY AND METAMORPHIC ROCK

| Symbol | Description | Formation | Period | Era |
|---|---|---|---|---|
| Q | Recent flood plain: alluvial sand, silt, back swam deposits and beach sand | | QUATERNARY | CENOZOIC |
| Q1 | Old alluvialfan, colluvial and flood plain deposits of alluvialfan, colluvial and old flood plain deposits sand, silts and laterite | | PLEISTOCENE | CENOZOIC |
| Qt | Terrace gravel, sand, silt, laterite and lateritic soil | | QUATERNARY | CENOZOIC |
| T | Semiconsolidated and consolidated conglomerate, sandstone, shale, limestone, coal beds with fossils | | TERTIARY | CENOZOIC |
| Mz | Sandstone, siltstone, shale and conglomerate of dark red, red, reddish brown or brown, with cross-bedding, ripple mark and micaceous in some parts | | JURASSIC | MESOZOIC |
| J | Sandstone, shale, siltstone and conglomerate | | JURASSIC | MESOZOIC |
| TrJ | Limestone, light grey to dark grey, massive to well bedded, with fossils intercalated with calcareous shale; sandstone, lime-conglomerate, grey to brownish grey | | JURASSIC-TRIASSIC | MESOZOIC |
| Tr | Conglomerate, sandstone intercalate of shale, lime stone with fossils. | CHONG KHAP FORMATION | TRIASSIC | MESOZOIC |
| Tr-Cgl | Limestone conglomerate cemented by red siltstone | | TRIASSIC | MESOZOIC |
| Ps | Massive and bedded limestones containing fusulines brachiopods, pelecypods and bryozoans | SAI YOK LIMESTONE | PERMIAN | PALEOZOIC |
| CP | Pebbly sandstone, sandstone, shale, mudstone, greywacke: greenish grey, brown colours | KAENG KRACHAN FORMATION | PERMIAN | PALEOZOIC |
| DC | Pebbly mudstone, grey sandstone and dark grey shale also red shale | KAENG KRACHAN FORMATION | DEVONIAN-CARBONIFEROUS | PALEOZOIC |
| D | Siltstone and shale | | DEVONIAN | PALEOZOIC |
| C | Sandstone, shale, siltstone | | | PALEOZOIC |
| SD | Quartzite, phyllite, tuffaceous sandstone, limestone-band, brownish shale with Tentaculites, graptolite; and chert beds. | BO PHLOI FORMATION KANCHANABURI FORMATION | DEVONIAN-SILURIAN | PALEOZOIC |
| S | Shale, chert, limestone | | SILURIAN | PALEOZOIC |
| CO | Sandstone, shale, limestone | PHUBON MARBLES | CAMBRO-ORDOVICIAN | PALEOZOIC |
| Є | Massive ortho quartzite, bedded sandstone of-brown to greenish colors, and calcareous shale | CHAO NEN QUARZITE | CAMBRIAN | PALEOZOIC |
| me | Paragneiss, calc-silicate, schist and marble | | CAMBRIAN | PALEOZOIC |
| O | Limestone, light grey, dark grey and bluish grey, massive to thin bedded, recrystallized, with argillaceous-layers, shale: greenish grey, dark grey and quartzite | THUNG SONG GROUP | ORDOVICIAN | PALEOZOIC |
| Є1 | Brown to reddish brown calcareous sandstone and shale | NEARN SAWAN | CAMBRIAN | PALEOZOIC |
| O2 | Banded, argillaceous limestone, argillaceous, quartzite and cephalopods | SONG THO | ORDOVICIAN | PALEOZOIC |
| O3 | Sequence of limestone with or gillaceous band and pinkish shale some graptolite present | KAENG KRAWIA | SILURIAN | PALEOZOIC |
| UO | Limestone with or gillaceous band | | ORDOVICIAN | PALEOZOIC |
| gr | Granite granodiorite, diorite and quartz feldspathic dikes | IGNEOUS ROCK | MESOZOIC | |

### GEOLOGICAL SYMBOLS

Inferred fault — Fault — Strike and dip
Anticline — Syncline — Contact

(NOTE: Number in the circle is the number of occuren) MAGNITUDE > 3, > 4, > 5

MAP SHOWS THE GEOLOGICAL STRUCTURE, RESERVOIR AREA AND EPICETER OF EARTHQUAKES OF SRINAKARIND DAM AND RESERVOIR.

10 5 0 10 Km.

Main shock, Largest Fore shock, Largest After shock

Figure 4.1 Epicenters of felt earthquake of Srinakarind Dam and Reservoir 1982–1985

Anyhow, such geologic feature is only a common igneous-sedimentary rock contact; there is no stress-strain built up to cause any earthquake. In any case, the close correlation may suggest furthur investigation.

Group B earthquake epicenters are somehow scatter but rather confine densely in a small area. They are also show some elongation in N-S direction. There is one geologic structure, the fault, running NNW-SSE through these epicenters. This fault is about 35 km. long as measured the geologic map in Figure 4.1. The fault divide those epicenters into two-half. The epicenter of the main shock is located immediately west close to the fault line. The largest foreshock and aftershock event occured on both side of the fault, west and east respectively.

From the first motion study of the main shock, the fault plane solution indicate that the strike of the fault plane should be in 320° azimuth (NW-SE direction) dipping toward NE (52° azimuth). This fault plane solution is conformed well with the fault line shown in the geologic map. Furthermore, the first motion study also indicate that the slip direction is 155° azimuth which, when considering from the compression and dilation quadrangle, it reveals that the fault is a reverse fault. This is also well correlated to the geology of the area where interrupted.

At this stage, the conclution may be made that the earthquake occurrences in Srinakarind reservoir shown at least one group of the earthquake that is closely related to the fault movement. The fault is align outside the northern edge of the reservoir boundary. Seepage of water in the reservoir may or may not be the adding lubricant to release the fault plane friction. However, since there is no such earthquake or tremor swamp occur previously in the history, the case may be that the lubrication by water seepage into the fault plane have had happened. Thus the earthquakes in this area may caused by the reservoir impounding of Srinakarind Dam.

Fault plane solution of the main shock of Srinakarind earthquake on April 22, 1983 is shown in Figure 4.2.

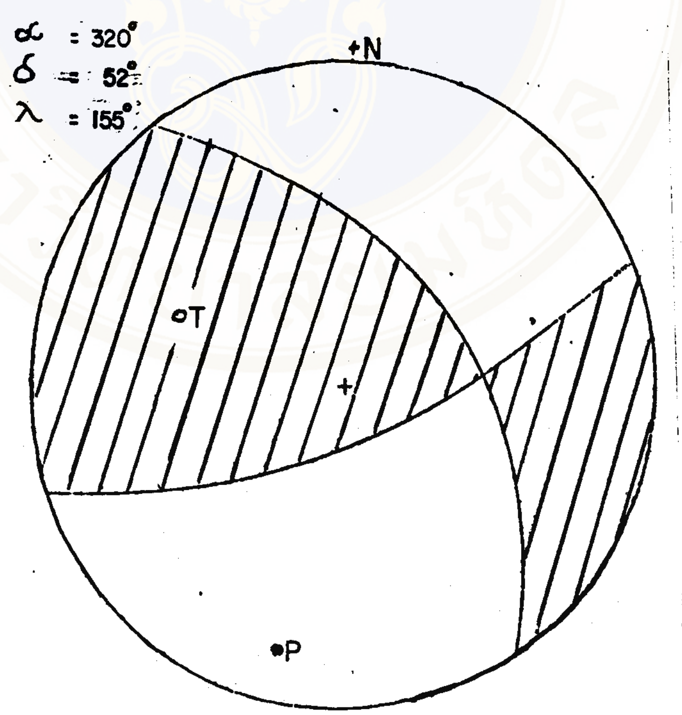



Figure 4.2 Fault plane solution of Srinakarind earthquake of April 22, 1983. (After modified by Fungkhachorn 1984).

It is the only available relult of this kind of study. Fault plane solution indicates reverse faulting with a small component of left lateral movement. The attitude of fault strike is 320° dip is 52° to NE and the slip direction is 155°. According to 1.2.1, most cases of other reservoir-associated earthquakes, the fault plane solutions are strike-slip directions. This is quite contary to the case of Srinskarind earthquake.

4.1.4 The earthquake of Khao Leam.

The earthquake data had been callected by Meorological Department from August 16, 1985 to December 31, 1985. It was found that there are as many as 972 earthquake occured in the reservoir area of the Khao Leam dam. Only 49 occurrences have sufficient data for determining their epicenter locations (Figure 4.3), and with no depth calculation. Most of the earthquake have magnitude less than 2 Richter.

The earthquake in this area are very scattered and has no main shock occured. They may be called or classified as the foreshock earthquake or just only earthquake swarm at a time.

4.1.5 Geologic consideration.

Although there is a major fault pass through the reservoir and the dam, all the earthquake loosely group of earthquake in the west of the reservoir may be possibly associate to some subsurface geology which is not well known now. The geology from the surface exposure reveal no major structure. The rocks and homogeneously distributed. More detail geologic study for the area may be useful before further consideration could be made.

## 4.2 The Relation Between The Frequency And The Magnitude In Term Of B Value Of the Srinakarind And Khao Leam Earthquake.

The study of b values in the frequency-magnitude relation for both sequences are determined by using the method proposed by Utsu (1966). The b values for Srinakarind and Khao Leam earthquakes are found to be 0.87 and 1.03 respectivly. The b values determined for the Srinakarind foreshock and aftershock are 1.32 and 0.89 respectively. However the Khao Leam earthquakes are posibly a swarm type such that the foreshock or aftershock could not been distinguished. According to Gupta et. al. (1973), the observation of himself and others for the earthquakes in California, Japan, India and Broach region, which are natural earthquakes, shows a low b value, The magnitude ratio of largest aftershock to the mainshock (M1/MO) is high, whereas for sequences with relatively high b value, this ratio is low. Quite contrary to this, Gupta et. al. (1969) found a high b value along with a high M1/MO ratio for the Koyna sequence, and also for the Lake Mead, Monteynard, Mangla, Kariba and Kremasta as shown in Table 1.3. They postulated that this may be a typical feature of reservoir-associated seismicity (Gupta et. al., 1972). The case of Srinakarind earthquakes is comparatively the same as the cases mentioned obove, i.e. the author found that the ratio of the largest aftershock to the main shock (M1/M0) is 0.98 as for the b value of 0.87.

Papazachos (1974) showed that there is a statistical relation between the magnitude M1 of the largest aftershock and magnitude M0 of the main shock. He used Bath's law which Markus Bath has observed the difference M0-M1 is equal to 1.2 for the natural earthquakes. He used homogeneous data of 216 aftershock sequences which occured in the area of Greece and found that those data fit this law well, at least for M0 > 5.0 Richter. That is Mo - M1 = 1.2.

The value M0 - M1 for The Koyna, Kremasta and other earthquakes have been calculated but the average difference is equal to 0.5 with a standard deviation equal to 0.3. Hence it has been concluded that the relation M0 - M1 = 0.5 fits the reservoir-associated earthquakes.

For the Srinakarind earthquakes, the difference M0 - M1 is equal to 0.3 which the value fit in the reservoir-associated earthquake cases too.

Gupta et.al.(1972) have also studied b values for the reservoir-associated earthquakes in other aspects as their results have been shown in Table 1.2. It can be noted that the Koyna, Kariba and Kremasta earthquakes, the foreshock b values are higher than the aftershock b values. Gupta et. al.(1973) has shown that the b values for any other natural earthquakes, such as in Japan, Alaska, Greece and Chile, the foreshock b values are much

Table 4.1 The b values for the dam and reservoir regions, the first three are reservoir-associated earthquakes proposed by Gupta et. al. (1972), compare to the cases of Srinakarind and Khao Leam (by the author).

| Region. | Foreshock b value. | Aftershock b value. |
|---|---|---|
| Koyna | 1.80 | 1.28 |
| Kariba | 1.13 | 1.03 |
| Kremasta | 1.41 | 1.12 |
| Srinakarind | 1.32 | 0.89 |
| Khao Leam | * | * |

REMARK : * = b values of foreshock and aftershock for Khao Leam earthquake sequence could not be distinguished.

smaller than the aftershock b values (Table 4.1).

The study of Srinakarind and Khao Leam earthquakes sequence, found that the b values are high also. The b values Srinakarind is found to be 0.89 in the magnitude range 3.0 to 5.8 (Gutenberg and Richter Mb. scale), and the magnitude ratio of the largest aftershock to the main shock (M1/MO; 5.3/5.8) is found to be 0.92 (Table 4.1). For Khao Leam earthquakes, the b value is found to be 1.03 in the magnitude range of 2.1 to 5.1 (Gutenberg and Richter Mb. scale). Due to the type of the events are swarm, so the foreshock, the main shock and the aftershock could not be distinguished, thus the magnitude ratio of largest aftershock to the main shock could not be determined.

To test the statistical significance of the b values of the earthquakes, Gupta et.al.(1973a) have carried out an analysis, using F-distribution. Let $S_F$ (total number of foreshocks), $S_A$ (total number of aftershocks), $b_F$ (b values of foreshock and b (b values of aftershocks) for Koyna, Kariba and Kremasta earthquakes which are reservoir-associated earthquakes. They calculated $b_F/b_A$ and compare it with the F value with $2S_A$ and $2S_F$ degrees of freedom at a particular confidence level. The Srinakarind earthquakes are compared to other known reservoir-associated earthquakes and the results of analysis are given in Table 4.2. The Table 4.2 shows that the differences in the foreshock and aftershock of b values for Koyna, Kariba, Kremasta and also Srinakarind events are significant at 95% confidence level, since the $b_F/b_A$ values are greater than the F values. The foreshock and aftershock sequences of Khao Leam sequences could not be distinguished because the type of those Khao Leam sequence is the swarm type.

Gupta et.al.(1973a) also tested to find out statistical significance of the b value for the aftershock

<u>Table 4.2</u> Statistical significance test for the difference in foreshock and aftershock b values. (For Koyna, Kariba and Kremasta. After Kupta et.al.,1973a), and additional analysis for Srinakarind by the author.

| Name of the earthquake-sequence. | Koyna | Kariba | Kremasta | Srina-karind |
|---|---|---|---|---|
| Total No. of foreshocks $S_F$ | 51 | 451 | 740 | 36 |
| Total No. of aftershocks $S_A$ | 362 | 1,397 | 2,580 | 567 |
| b for foreshocks $b_F$ | 1.87 | 1.13 | 1.41 | 1.32 |
| b for aftershocks $b_A$ | 1.28 | 1.03 | 1.12 | 0.89 |
| Degree of freedom $v_1 = 2S_F$ | 102 | 902 | 1,480 | 72 |
| Degree of freedom $v_2 = 2S_A$ | 724 | 2,794 | 5,160 | 1,134 |
| $b_F/b_A$ | 1.46 | 1.10 | 1.36 | 1.48 |
| F value at 95% confidence-level | 1.30 | 1.09 | 1.07 | 1.36 |

<u>REMARK</u> : Since the F values are smaller than the b value ratios, the difference in the foreshock and aftershock b values are significant at 95% confidence level.

of Koyna to those of the Peninsula India. They found that the differences between the $b_A$ value for the Koyna aftershocks to the Peninsula India is significant at 95% confidence level, the results are summerized in Table 4.3.

Table 4.3 Statistic significance test for the differences in b value of Koyna aftershocks to those of the Peninsula India events. (After Gupta et.al., 1973a).

| | | |
|---|---|---|
| Total No. of Koyna aftershocks | $S_K$ | = 352 |
| Total No. of earthquakes in the Peninsula India- | $S_I$ | = 52 |
| b for Koyna aftershocks | $b_K$ | = 1.28 |
| b for Peninsula India | $b_I$ | = 0.47 |
| degree of freedom $2S_I$ | $v_1$ | = 104 |
| degree of freedom $2S_K$ | $v_2$ | = 724 |
| | $F_{0.05(104,724)}$ | = 1.27 |

REMARK : Since the F value is smaller than the two ratios of the b values, differences between the b value of Koyna aftershock with for the Peninsula India are significant at 95% confidence level.

The author has used the same method as Gupta's for Srinakarind earthquake. The results are the difference between the b values for the Srinakarind aftershocks to those of Thailand and surrounding earthquakes are significanct at 95% too. The result of the analysis are given in Table 4.4.

Table 4.4 Statistical significant test for the differences in b values of Srinakarind with those for Thailand and surrounding area sequences.

| | | | |
|---|---|---|---|
| Total No. of Srinakarind aftershocks | $S_s$ | = | 567 |
| Total No. of Thailand and surrounding area* | $S_T$ | = | 464 |
| b for Srinakarind aftershocks | $b_s$ | = | 0.89 |
| b for Thailand and surrounding area* | $b_T$ | = | 0.76 |
| degree of freedom $2S_T$ | $v_1$ | = | 928 |
| degree of freedom $2S_s$ | $v_2$ | = | 1134 |
| $F_{0.05(928,1134)}$ | | = | 1.00 |

DENOTE : * = Proposed by Prachuab., (1983).

REMARK : Since the F value is smaller than the two ratios of the b values, differences between the b value of Srinakarind aftershock with for Thailand and surrounding area are significant at 95% confidence level.

### 4.3 Study Of The Foreshock-Aftershock Patterns Of Srinakarind And Khao Leam Earthquakes.

According to Moki (1963) studied of the foreshock and aftershock patterns experimentally on models in a laboratory and compared to with the natural earthquake occurrences. The types of shock sequences have a close relation with structural states of materials. The space distributions of successive shock occurrence to the structural state and the space distribution of stress may be applicable to earthquake sequences. Therefore, if an applied stress is assumed to increase gradually, the following results may be deduced (see Figure 1.1).

The type I pattern appears only at regions of homogeneous structure, caused by a uniformly applied stress. This type I model, large main shock and extensive aftershock earthquakes, but no foreshock.

The type II pattern is main shock associated both with foreshock and aftershock series, and it is an intermidiate one between type I and type III. This pattern appears at regions of moderately heterogeneous structure or it may be caused by a stress which is not uniform. The type II, the number of foreshocks increases abruply at the time of the main shock. Type II is similar to the observations in Koyna, Kariba and Kremasta earthquake sequences (Gupta et. al., 1969). It is interesting to note that out of 1,500 earthquake studied by Mogi in Japan, only 4 per cent fall in type II. They are found to be confined in certain localities only.

The type III pattern is earthquake "swarms", with many small shocks increasing in number with time and then subsiding. It appears at regions of heterogeneity or it also may be caused by the concentrated application of stress (for example, by an intrusive stress by verious magma). Type III is considered as a swarm type of activity.

The Srinakarind earthquake sequence have been studied base on main shock on April 22, 1983, and found that the foreshock-aftershock pattern is similar and belong to type II of Mogi's model (Figure 4.4). It is very important that the occurrence of the foreshock is not

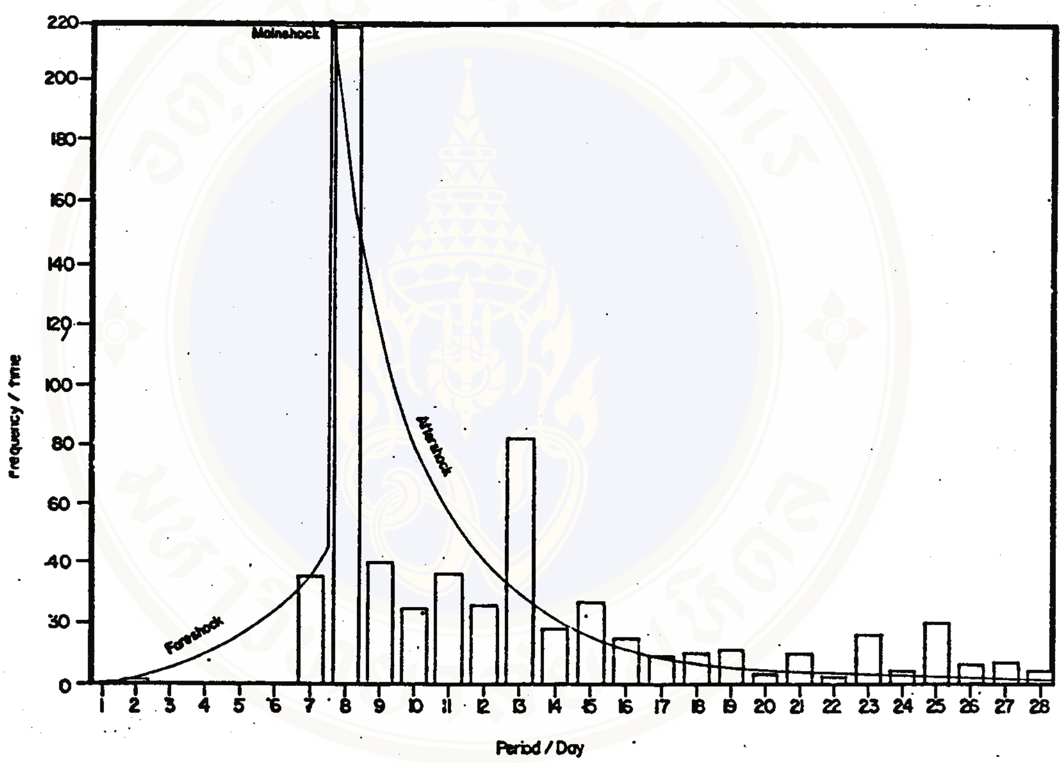



Figure 4.4 The foreshock-aftershock pattern of Srinakarind earthquake.

accidental and has a general tendency to be limited to certain regions attributed to the local mechanical structure. It may be the increasing of stress in the heterogeneous structure of the regions. Its concentration increases highly at many irregular points and the local fractures occur at such weak points. Hense the regions where earthquakes are preceded by foreshocks are deduced to be moderately fractured regions.

For the Khao Leam earthquake sequence, it has been found that the pattern is similar to type III, it is the swarm type because no event has been classified as foreshock, mainshock or aftershock (Figure 4.5).

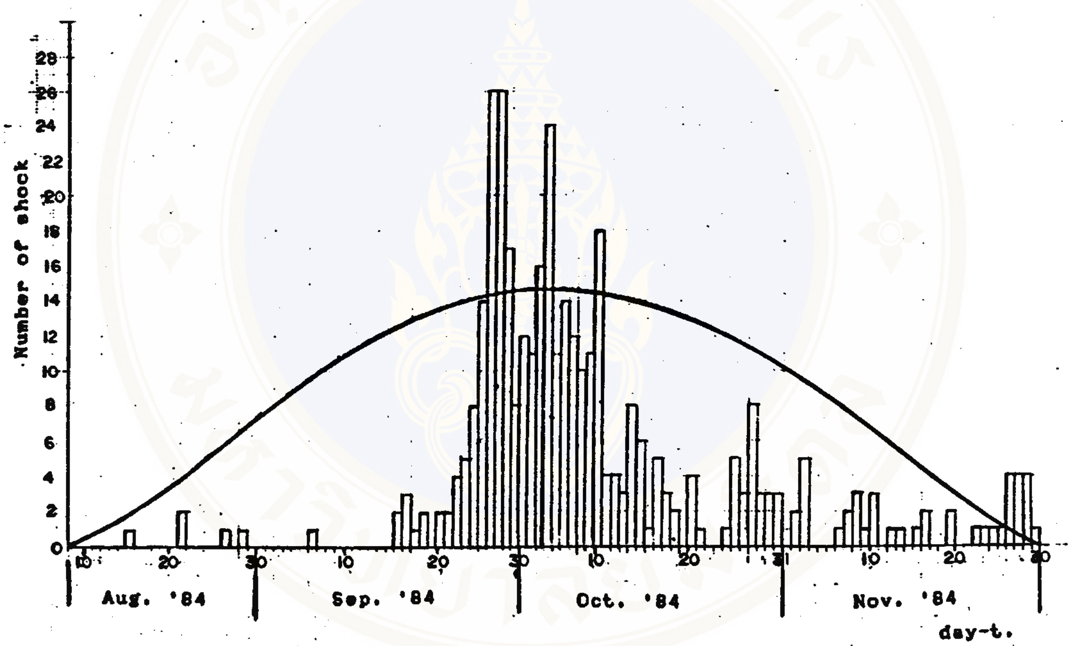



Figure 4.5 The swarm type of Khao Leam earthquake.

4.4 Study Of The Magnitude-Frequency Relation.

Rikitake (1976) has refered Gutenburg and Richter's formula and studied experimentally on the frequency-magnitude relation of global earthquake and found that the number of earthquakes decrease exponentially with increasing magnitude. This relation is usually called magnitude-frequency relation proposed by Gutenberg and Richter (1944), which gives;

$$\text{Log } N = a - bM$$

4.4.1 Study of the magnitude-frequency relation of Srinakarind earthquake. Using the data of Srinakarind sequence during 1983-1985 through the Gutenburg and Richter's formula. The result of the relation gives a = 5.45 and b = 0.87 (Figure 4.6) and the relation is given by

$$\text{Log } N = 5.45 - 0.87 \text{ Mb}$$

It can be seen that the parameter b is found to be 0.87 used by the relation 1 (page 1-6) and is in good agreement with b value which found to be 0.89 from relation 2 (page 1-7) as proposed by Utsu (1966).

4.4.2 Study of the magnitude-frequency relation of Khao Leam earthquake, using the data of Khao Leam earthquake during 1984-1985 through the Gutenberg and Richter's formula. The result of the relation gives a = 4.83 and b = 0.89 (Figure 4.6), and the relation is given by

$$\text{Log N} = 4.83 - 0.89 \text{ Mb.}$$

It can be seen this b value found to be 0.89 is rather good agreement with the b value (b = 1.03) of the same sequence using the relation proposed by Utsu (1966).

Figure 4.6 shows the frequency-magnitude relation Log N = a - bM found for Srinakarind and Khao Leam earthquakes. The data for both regions were combined to determined the values of b for the entire the earthquake regions. As seen in Figure 4.6, the distributions of revised magnitudes are better represented by the straight lines. The slope of both relations are similary steep, i.e. b values of Srinakarind earthquake (right line) is 0.87 and b value of Khao Leam earthquake (left line) is 0.89.

In Scholz's experiments, (1968), attributed variations in the slope b of the Log N versus M curve as due to different stress states, and bases his analysis on the percentage of existing stress within the rock sample relative to the final breaking stress. At low stress levels he attributed microfractures to frictional sliding on pre-existing cracks and to the crushing of pours, a situation similar to the occurrence of shallow volcanic earthquakes where high b values of from 2 to 3 were observed. During the latter phase, the slope b decreases with increasing relative stress from 1 to 0.3. For single component mean stress, values for b are confined between 0 and 1, which is in good agreement with non-vocanic earthquake seimology.

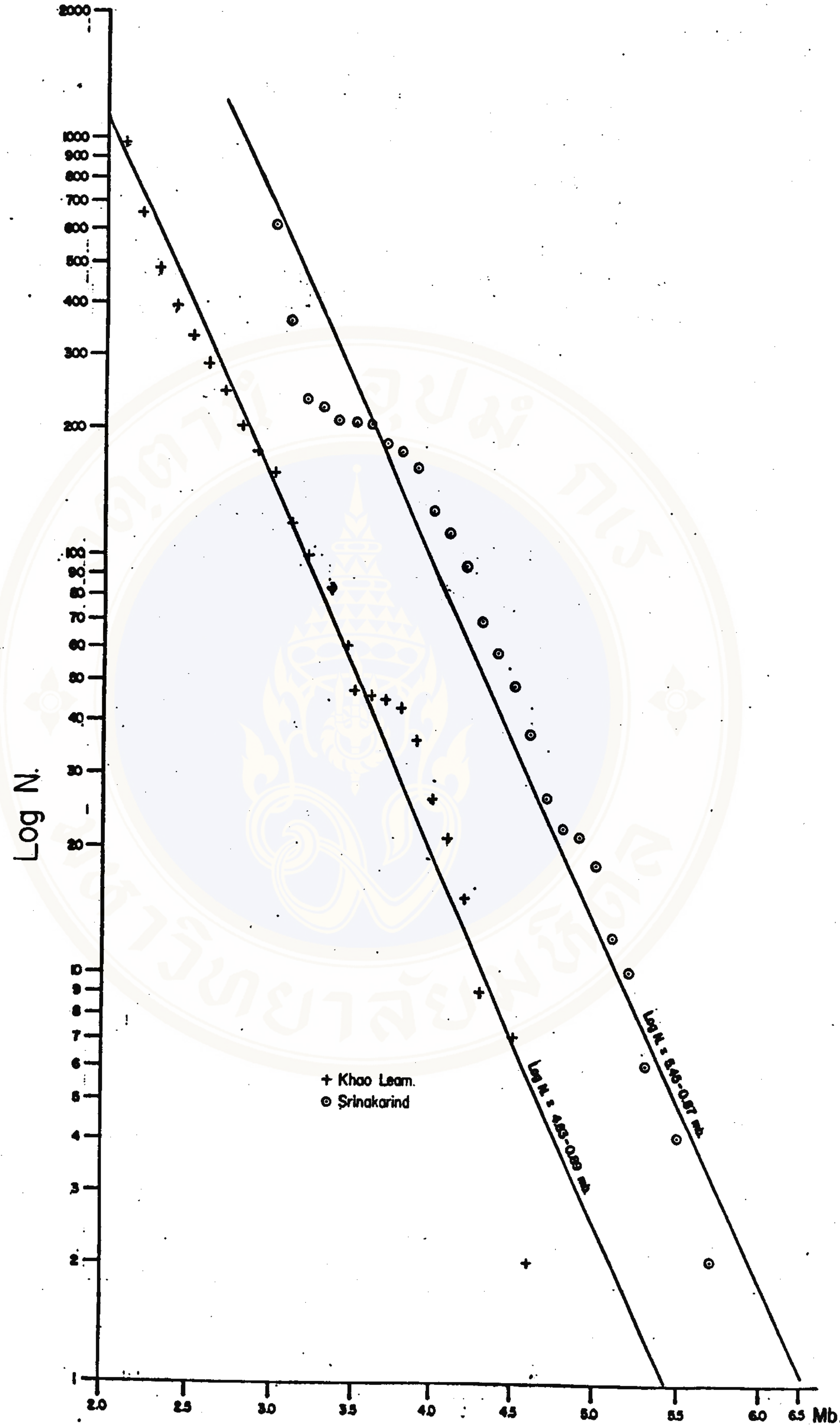



**Figure 4.6** The magnitude-frequency relation of Srinakarind and Khao Leam earthquakes.

The results of the investigation for Srinakarind and Khao Leam earthquakes show the b values of the relation Log N = a - bM are 0.87 and 0.89 respectively.

4.5 Study Of The Relation Between Water Elevation And Frequency Of The Earthquake Events.

The author has studied the behavior of the water level associated with the frequency of Srinakarind and Khao Leam earthquakes. The reservoir water levels are given as the monthly average and the earthquake numbers as total for the same month.

Figure 4.7 and 4.8 show the seismic activities at Srinakarind and Khao Leam dams and reservoirs. The data were especially prepared to check for periodicity and correlation of seismic activity with reservoir water level for the period plotted from January 1983 through December 1985 for Srinakarind dam and from June 1983 through December 1985 for Khao Leam dam; those periods are repeated so that move than one cycle is shown. Because of the reservoirs recharge characteristics, the monthly average of water level in both dams is periodic, and the high level usually occured in November to January and minimum level occured in June to August. The bottom curve is the number of earthquake for a one month period, plotted at the center month; i.e. for Srinakarind earthquake, the first point is plotted above A for August is 83.92m.(MSL), which is no any number of earthquake that occured during the period (Figure 4.7),

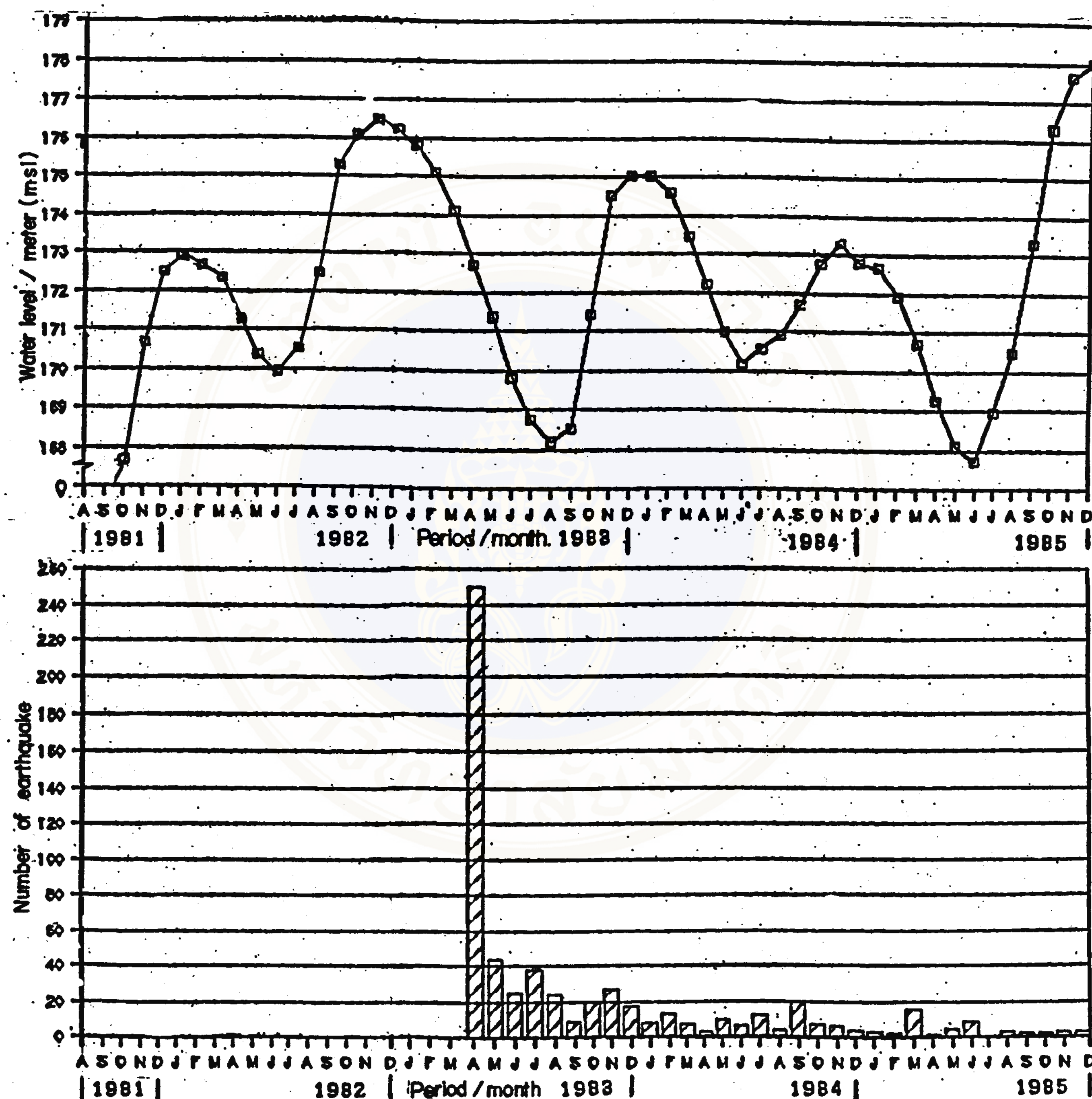
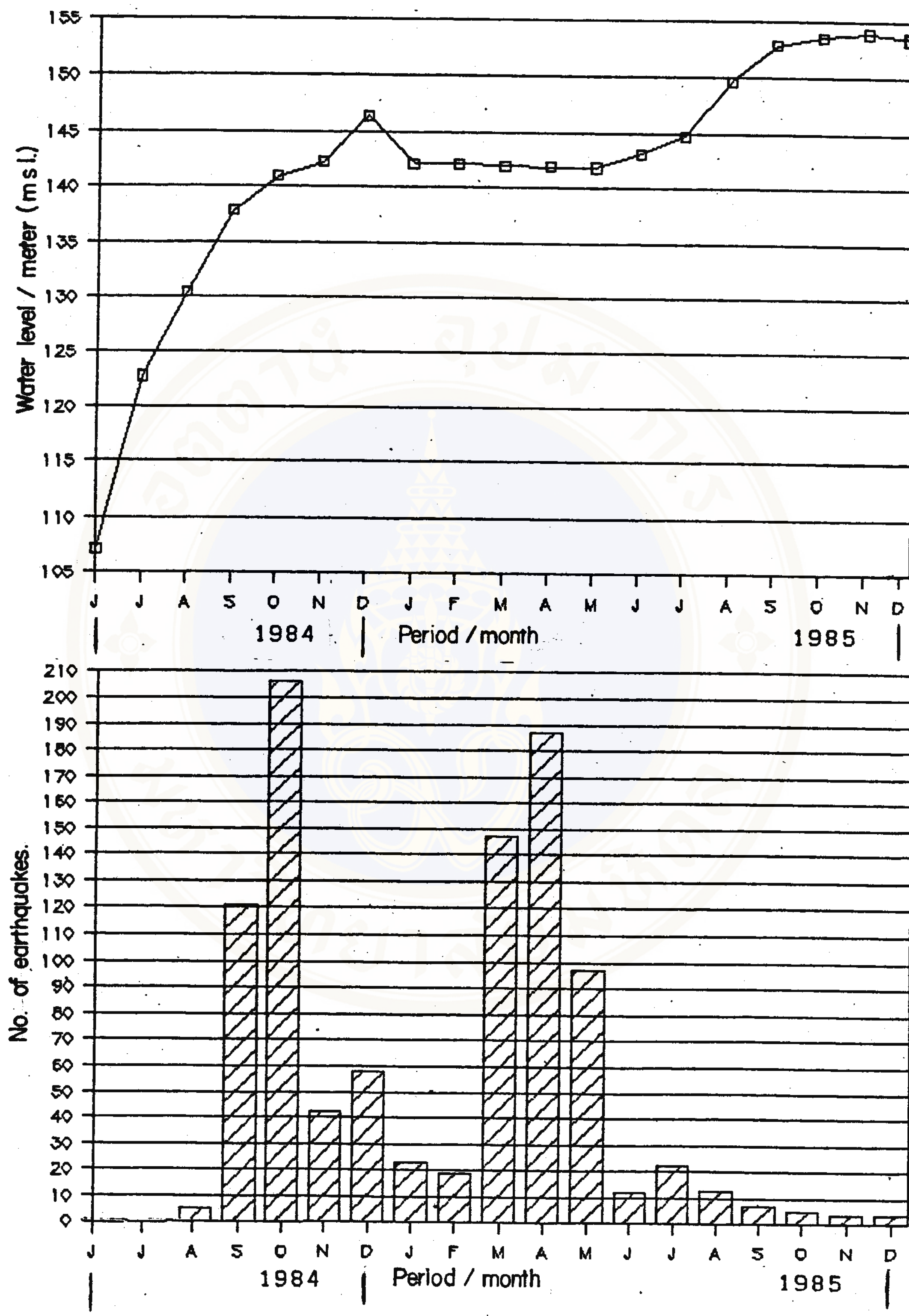



Figure 4.7 The comparision of monthly avarage of water level and total numbers of earthquakes for the same months at Srinakarind earthquake.




<u>Figure 4.8</u> The comparision of monthly avarage of water level and total numbers of earthquakes for the same months at Khao Leam earthquake.

but the maximum number of earthquakes felt in April 1983 while the water level decreased at the corresponding period after that the number of earthquakes gradually decreased although the high water level was high. For Khao Leam earthquake, the first point is plotted above J for January is 107.09 m.(MSL.), which is no any number of earthquake that occured during the period (Figure 4.8), but the maximum number of earthquakes felt for October 1984 while the water level increased at the corresponding period and again for April 1984 the number of earthquakes increased high and gradually decreased after that although the water level increased.

Due to the insufficient period of investigation to examine correlation between water level and number of earthquakes, so the data could not be proved in term of any statistical study.

## CHAPTER 5
## DISCUSSION CONCLUSION AND RECOMMENDATION

### 5.1 Discussion.

It had been examined that the filling of the reservoirs associated with the earthquake all over the world and found that most of those regions had no history of tremors or the regions have noted no seismic activities induced before the dams were built such cases are the Clark Hill (Talwani, 1976), Manic 3 (Leblanc, 1978), Monteynard, Kariba Koyna (Rothe, 1968) Bounder and Lake Mead (Bozavic, 1974), especially the cases of Koyna, Kariba and Kremasta had been interested to examine by many seismologists and geologists. It had been examined the probability of the relation between reservoir filling and earthquake sequences by the relation study of geological structure, water elevation and frequency, frequency and magnitude through statistics law, and given the results as the hypotheses. All of those cases mentioned above were considered to be the typical features of the reservoir-associated seismic earthquakes. For the cases of Srinakarind and Khao Leam earthquakes which have been interested and analyzed by the author, and found that they are the same discrimination characteristics earthquakes from natural earthquakes as the author had studied before, and having mentioned in the previous chapters. If the cases of Koyna, Kariba, Kremasta and the others are the cases of reservoir-associated seismic sequences, then the cases of Srinakarind and Khao Leam earthquakes might be the characteristically cases of reservoir-associated seismic activities, due to the examination results of the available data show to hold good for any other case of reservoir-associated seismicities.

However, the cases of Srinakarind and Khao Leam earthquakes could not be postulated that the reservoir impounding caused the earthquakes, but these cases might be considered to be the similary features of the reservoir-associated seismic activities.

The both activities of Srinakarind and Khao Leam earhtquakes might have been caused by the faults, running through the reservoirs and their vinicity. No one can potulate that whether faults are active or inactive. Specially the Khao Leam reservoir is located on some part of the Tertiary rock and its basin are either bound by fault lines. It is suggested atleast the major ones were potentially active.

Moreover, the study should be investigated in other methods too, such as the study in mechanism of the reservoir impounding, reservoir loading, tectonic state and etc.

## 5.2 Conclusion.

Investigation of seismicity of Srinakarind and Khao Leam earthquakes can be revealed the following common features:

5.2.1 The geological features in and around the Srinakarind and Khao Leam earthquakes are generally situated in regions having some heterogeneity. Specially the Srinakarind region is characterized by presence of partly limestone of Palaeozoic age, which is easily affected by water. The Khao Leam region is situated consist of the mainly Tertiary of Cenozoic and Ordovician of Palaeozoic ages.

5.2.2 Fault plane solution of the Srinakarind earthquake studied by WWSSN found to be reverse fault with a component of left lateral motion, running NW-SE direction, and there is one fault running NNW-SSE through the epicentral area also. At Khao Leam dam and reservoir, although there is a major fault passes through, but being not related to its epicenters.

5.2.3 The foreshock b value of the Srinakarind earthquake is higher than aftershock b value of the same sequence, both being higher than b value of the natural earthquake in and around Thailand.

5.2.4 The foreshock-aftershock pattern of the Srinakarind earthquake corresponds to type II of Mogi's model, where as the Khao Leam earthquake is swarm type (type III of Mogi's model).

5.2.5 The earthquake of Srinakarind is related by a function Log N = a-bM, the value of b being 0.87 and the Khao Leam b value being 0.89. These values hold good for the function proposed by Utsu (1966) which gives b values of the Srinakarind earthquake being 0.89 and the Khao Leam earthquake being 1.03.

5.2.6 The relation between water and earthquake frequency of both occurrences at Srinakarind and Khao Leam reservoirs does not show a good correlation.

The author have studied the cases of reservoir-associated earthquakes from many papers as mentioned in chapter 1 , and show in Table 1.1 page 1-3. Most statistical study in magnitude of those cases did not exceed to the order 6 - 6.5 Richter. Those of have rather occured at the dams, which are higher than 90 meters (EBASCO, 1984). Those cases also occured one main shock and their frequency gradually reduced as the increased period. Hence it might be predicted the shocks of the earthquakes of the Srinakarind and Khao Leam will not be higher than the order 6 - 6.5 Richter, especially the frequency of the Srinakarind earthquake might be reduced until it will not occur anymore soon, due to it reached to be maximum saturated.

The cases of the Srinakarind and Khao Leam may not be the cases of reservoir triggered seismicities, but they are just considered to be the typical features as the reservoir-associated seismicities, they might be caused from the movement of active faults, because no one prove which fault is active or inactive.

## 5.3 Recommendation.

Whether the Srinakarind and Khao Leam earthquakes are postulated to be the cases of reservoir-associated earthquakes or not. The author have some aspects to be recommended as follow:

5.3.1 A large dam should be studied of the seismotectonics of the region around the dam site. The investigations in vinicity of site are required to determine current site seismicity and can assist geological investigation in the mapping of active fault.

5.3.2 A instrumental monitoring station should be installed in proposed areas of the dams and reservoirs at the time the site is proposed to provide a history of seismicity prior to construction.

5.3.3 If the proposed area is seismically active, additional stations should be installed to locate the earthquake hypocenters and determine the frequency of occurrence characteristics and magnitudes.

5.3.4 Close coordinate among the project owners, project geologists, social welfare officers, civil engineers and etc.

5.3.5 One who is interested in this phenomena should carry out theoretical investigations to study the effect of fluid pressure under various patterns of tectonic distribution, in order to apply the results obtained by theoretical investigation to both the Srinakarind and Khao Leam dam areas, taking into consideration geological and tectonic features of the areas and energies released by the earthquakes.

RERERENCES

1. Allison, I. S., R. F. Black, J. M. Dennisson, R. F. Fahnestock and S.M. White (1955). Geology: The Science Of A Changing Earth. Mc.Graw-Hill Book Company. New York. pp.500.

2. Bath, Marcus (1985). The Energy Of Seismic Body Waves And Surface Waves. Printed from "Contributions In Geophysics; In Honor Of Beno Gutenberg". Pergomon Press. London, New York, Paris, Los Angeles. pp.16.

3. Bath, Markus (1973). Introduction To Seismology. Birhauser Verlag Basel And Studgard. Amsterdam, Netherland. pp. 387.

4. Berg, Edward (1968). Relation Between Earthquake Foreshocks, Stress And Main Shock. Nature Vol. 219. September 1968. pp. 1141-1143.

5. Bozovic, A. (1974). Review And Appraisal Of Case History Related To Seismic Effects Of Reservoir Impounding. Engineering Geology. Vol. 8. Elsevier Schientific Publishing Company., Amsterdam. pp. 9-27.

6. Bolt, Bruce. A. (1978). Earthquake. W. H. Freeman, and Company., New York. pp. 245.

7. Bufe, C.G.(1976). The Anderson Reservoir Seismic Gap -induced A Seismicity. Engineering Geology, Vol. 10. Elsevier Schientific Publishing Co., Amsterdam. pp.255-262.

8. Carder, D. S. (1945). Seismic Investigation In The Bounder Dam Area 1940-1944 And The Influence Of Reservoir Loading On Local Earthquake Activity. Bull. Seism. Soc. Am., Vol. 35, pp. 175-192.

9. Carder, Jery P. and E. Berg. (1981). Relation Stress Variations As Determined By B Values From Earthquakes In Circum-Pacific Subduction Zones. Tectonophysics. pp. 71.

10. Coble, Charles R., A. G. Murrey and D. R. Rice. (1981). Earth Science. Prentice-Hall Inc. Engle wood Cliff, New Jersey 0763. pp. 528.

11. Eaimnoh, Apisit. (1983) Geolgy. (in Thai) Thai Watanapanitch. Bangkok. pp. 219.

12. EBASCO (1984). Evaluation Of Seismicity In Kanchanaburi Province. Stage I. Final Report. EBASCO Oversea Corporation, North Corolina, U.S.A. pp. 48.

13. Ellis, R. M., H. Dragert and J. M. Ozard (1976) Seismic Activity In The Mc.Naughton Lake Area, Canada. Engineering Geology Vol. 10. Elsevier Scientific Publishing Co., Amsterdam, The Netherlands. pp. 293-305.

14. Fungkhajorn, Adisorn (1984). Introduction To Mechanism Of Earthquake. (Thai paper), Studies and Research Division, Meteorological Department. Bangkok. pp. 44.

15. Gibowicz, S. J. (1973). Variation Of The Frequency-Magnitude Relation During Earthquake Sequences In New Zealand. Bull. Seism. Soc. Am., Vol. 63, pp. 517-528.

16. Gupta, Harsh K., I. Mohan and H. Narian (1969). The Godavari Valley Earthquake Sequence Of April 1969. Bull. Seism. Soc. Am., Vol. 60, No. 2, pp. 601-615.

17. Gupta, Harsh K., B. K. Rastogi and H. Narian (1972). Some Discrimanatary Characteristics Of Earthquakes Near The Kariba, Kremasta, And Koyna Artificial Lakes. Bull. Am. Soc. Am., Vol. 2, pp. 493-507.

18. Gupta, Harsh K. and B. K. Rastogi (1973). Investigations Of The Behavior Of Reservoir-Associated Earthquakes. Engineering Geology., Vol. 8, pp. 29-38.

19. Gutenberg, B. and C. F. Richter (1944). Frequency Of Earthquakes In California. Bull. Seism. Soc. Am., Vol. 24, pp. 185-188.

20. Heeler, Robert (1979). Challenge To Science, Earth Science. Mc.Graw-Hill. Inc., New York. pp.468

21. Jacob, H. K. (1979). Tabela Reservoir, Pakistan: A Region Of Compressional Tectonics With Reduced Seismicity Upper Initial Reservoir Filling. Bull. Seism. Soc. Am. Vol., 69, pp.1175-1192.

22. Keeler, Edward A. (1979) Environmental Geology. 2' '. Edition., Charles E. Merrill Publishing Company A Bell and Howell Company. Columbus, Ohio. pp. 550.

23. Leblanc, G. and F. Anglin (1978). Induced Seismicity At The Manic 3 Reservoir, Quebec. Bull. seism. Soc. Am., Vol. 68, pp. 1469-1485.

24. Lee, W. K. and C. B. Raleigh (1969). Fault Plane Solution Of The Koyna (India) Earthquake. Nature., Vol. 223, pp. 172.

25. Lepp, Henry. (1973) Dynamic Earth: An Introduction To Earth Science. Mc.graw-Hill Book Co., New York. pp. 485.

26. McEvilly, T. V. and K. B. Casaday (1967). The Earthquake Sequence Of September 1965 Near Antioch, California. Bull. Seism. Soc. Am., Vol. 57, pp. 113-124.

27. Miao-Yueh, Y. Mao-Yuan, H. Yu-Liang, L. Tzu-Chiang, W. C. Yun-Tai, C. Yen and F. Jui (1976). Mechanism Of The Reservoir Impounding Earthquakes At Hsingfengkieng And A Preliminary Endeavour To Discuss Their Cases. Engineering Geology. Vol. 10., Else Scientific Publishing Co., Amsterdam. pp. 331-351

28. Mogi, Kiyoo (1963). Some Discussions On Aftershock, Foreshocks And Earthquake Swarm-The Fracture Of A Semi-Infinite Body Caused By On Inner Stress Origin And Its Relation To The Earthquake Phenomena. (Third paper), Bull. Earthq. Res. Inst., Vol. 41, pp. 615-658.

29. Nutalaya, Prinya. and others (1985). Series On Seismology., Vol. II- Thailand. Southeast Asia Association Of Seismology And Earthquake Engineering., E.P. Arnold, Series Editor and Programme Co-ordinator. pp. 405.

30. Papazachos, B. C. (1974) <u>On The Relation Between Certain Artificial Lakes And The Associated Seismic Sequences.</u> Engineering geology., Vol. 8. Elsevier Scienctific Publishing and Co. Amsterdam, The Netherland. pp. 39-48.

31. Prachuab, Sumalee (1980). <u>Introduction To Seismology (in Thai).</u> Studies and Reserch Division, Meteorological Department. pp. 48.

32. Prachuab, Sumalee (1985). <u>The 22 Apr. 1983 Western Thailand Earthquake And Its Aftershock Seismic Risk And B Value In Thailand And Surrounding Area.</u> Studies and Research Division, Meteorological Department., pp. 22.

33. Rikitake, Tsuneji (1976). <u>Earthquake Prediction.</u> Elsevier Scientific Publishing Company., Amsterdam. Oxford. New York., pp. 357.

34. Rothe, J. P. (1968). <u>Fill A Lake, Start An Earthquake.</u> New Scientist., pp. 75-78.

35. Scholz, C. H. (1968). <u>The Frequency-Magnitude Relation Of Micro Fractureing In Rock And Its Relation To Earthquakes.</u> Bull. Seism. Soc. Am., Vol. 58, pp. 399-415.

36. Scholz, C. H. (1981). <u>The Frequency-Magnitude Relation To Earthquakes.</u> Bull. Seism. Soc. Am. Vol.,58(1), pp. 399-415.

37. Siripakdee, Kanchit (1980). <u>Geology Of Damsite And Reservoir Of Khao Leam Project, Thong Pha Phum, Kanchanaburi.</u> Geological Division, Department Of Mineral Resorces, Ministry Of Industry. June 1980., pp. 36.

38. Sobleva, O. V. and U. A. Mamadaliew (1976). The Influence Of The Nurek Reservoir On Local Earthquake Activity. Engineering Geology., Vol. 10, Elsevier Scientific Publishing Co., Amsterdam., pp. 293-305.

39. Studies And Geophysic Research (1984). Record Of Earthquake Data Felt In Thailand. (in Thai), Studies And Research Division, Meteorological Department., pp. 25.

40. Talwani, P. (1976). Earthquake Associated With The Clark Hill Reservoir South Carolina-A Case Of Induced Seismicity. Engineering Geology, Vol. 10., Elsevier Scientific Publishing Co., Amsterdam., pp.239-243.

41. Utsu, T. (1965). A Method Of Determining The Value Of B In A Formula Log N = a-bM Showing The Magnitude-Frequency Relation For Earthquakes. Geophys. Bull., Hokkaido Univ., Vol. 13, pp. 99-103.

42. Utsu, Tokuji (1966). A Statistical Significance Test Of The Difference In B Value Between Two Earthquake Groups. Journal Of Physics Of The Earth., Vol. 41, No. 2, pp. 34-40.

APPENDIX A.

DATA OF EARTHQUAKE SEQUENCE AT SRINAKARIND DAM AND RESERVOIR.

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1983 | 8 Apr. | 02 20 44.85 | - | - | - | 1.8 | 3.1 |
| | 15 | 09 20 53.94 | - | - | - | 1.8 | 3.1 |
| | | 09 23 54.23 | 14.97 | 99.13 | 8.6 | 5.0 | 5.5 |
| | | 09 31 47.72 | - | - | - | 1.6 | 3.0 |
| | | 09 32 14.13 | - | - | - | 1.6 | 3.0 |
| | | 09 48 17.71 | - | - | - | 1.6 | 3.0 |
| | | 09 49 22.41 | - | - | - | 1.6 | 3.0 |
| | | 09 52 44.87 | - | - | - | 1.6 | 3.0 |
| | | 11 06 48.87 | 14.92 | 99.22 | - | 2.7 | 3.8 |
| | | 11 34 02.84 | 14.35 | 99.18 | 4.6 | 4.4 | 5.0 |
| | | 11 55 18.54 | - | - | - | 1.6 | 3.0 |
| | | 12 06 44.69 | 14.94 | 99.24 | 9.7 | 3.1 | 4.1 |
| | 16 | 14 59 57.92 | 14.90 | 99.22 | 10.7 | 2.5 | 3.6 |
| | 17 | 00 41 22.97 | 14.92 | 99.22 | - | 3.0 | 4.0 |
| | | 02 42 47.25 | - | - | - | 1.7 | 3.0 |
| | | 12 27 50.13 | - | - | - | 1.6 | 3.0 |
| | | 16 13 53.50 | - | - | - | 1.6 | 3.0 |
| | | 16 37 09.75 | - | - | - | 1.6 | 3.0 |
| | | 23 23 50.06 | - | - | - | 1.6 | 3.0 |
| | | 23 47 12.88 | 14.91 | 99.19 | - | 2.9 | 3.9 |
| | 18 | 03 53 27.41 | - | - | - | 1.6 | 3.0 |
| | | 04 41 39.74 | - | - | - | 1.8 | 3.1 |
| | | 06 19 50.96 | - | - | - | 1.7 | 3.0 |
| | | 06 38 12.90 | - | - | - | 1.6 | 3.0 |
| | | 06 40 41.60 | - | - | - | 1.8 | 3.1 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1983 | 18 Apr. | 06 42 04.68 | - | - | - | 1.7 3.0 |
| | | 10 35 17.23 | - | - | - | 1.6 3.0 |
| | | 11 05 37.78 | - | - | - | 1.8 3.1 |
| | | 11 42 05.46 | - | - | - | 1.6 3.0 |
| | | 13 07 10.78 | - | - | - | 1.8 3.1 |
| | | 18 07 12.46 | - | - | - | 1.8 3.1 |
| | 19 | 18 19 56.62 | - | - | - | 1.7 3.0 |
| | 20 | 02 59 52.54 | - | - | - | 1.7 3.0 |
| | | 11 00 04.62 | - | - | - | 1.6 3.0 |
| | | 19 10 44.46 | - | - | - | 1.7 3.0 |
| | 22 | 00 37 34.85 | 14.97 | 99.20 | - | 5.5 5.8 |
| | | 00 47 52.58 | - | - | - | 1.6 3.0 |
| | | 00 50 00.63 | - | - | - | 1.8 3.1 |
| | | 00 50 42.96 | - | - | - | 1.7 3.0 |
| | | 01 07 18.23 | - | - | - | 1.7 3.1 |
| | | 01 13 38.54 | - | - | - | 1.8 3.1 |
| | | 01 14 15.31 | - | - | - | 1.8 3.1 |
| | | 01 20 58.42 | - | - | - | 1.8 3.1 |
| | | 01 28 46.16 | - | - | - | 1.8 3.1 |
| | | 01 34 49.61 | - | - | - | 1.6 3.0 |
| | | 01 36 45.76 | - | - | - | 1.8 3.1 |
| | | 01 38 55.44 | - | - | - | 1.9 3.2 |
| | | 01 41 10.67 | - | - | - | 1.6 3.0 |
| | | 01 45 30.96 | - | - | - | 1.6 3.0 |
| | | 01 45 46.24 | - | - | - | 1.8 3.1 |
| | | 01 54 19.73 | - | - | - | 1.7 3.0 |
| | | 01 56 14.96 | - | - | - | 1.8 3.1 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1983 | 22 Apr. | 02 04 59.24 | - | - | - | 1.8 | 3.1 |
| | | 02 32 23.78 | 14.95 | 99.21 | 9.6 | 2.8 | 3.9 |
| | | 02 38 51.69 | - | - | - | 1.9 | 3.2 |
| | | 02 52 30.41 | - | - | - | 1.8 | 3.1 |
| | | 03 04 59.91 | - | - | - | 2.0 | 3.3 |
| | | 03 21 37.01 | 14.99 | 99.15 | 13.8 | 5.3 | 5.7 |
| | | 03 34 31.50 | - | - | - | 1.6 | 3.0 |
| | | 03 36 17.41 | - | - | - | 1.8 | 3.1 |
| | | 03 57 22.47 | - | - | - | 1.7 | 3.0 |
| | | 04 05 13.76 | - | - | - | 1.7 | 3.0 |
| | | 04 27 13.54 | - | - | - | 1.7 | 3.0 |
| | | 04 39 06.26 | - | - | - | 1.8 | 3.1 |
| | | 04 46 05.07 | - | - | - | 1.8 | 3.1 |
| | | 05 13 54.65 | - | - | - | 1.6 | 3.0 |
| | | 05 26 23.63 | 15.03 | 99.15 | 9.8 | 3.5 | 4.4 |
| | | 06 02 18.56 | 15.10 | 99.17 | 10.3 | 4.2 | 4.9 |
| | | 06 29 37.10 | - | - | - | 1.8 | 3.1 |
| | | 06 50 59.19 | 15.08 | 99.21 | 9.3 | 4.8 | 5.3 |
| | | 07 07 43.06 | - | - | - | 1.7 | 3.0 |
| | | 07 14 51.70 | - | - | - | 1.7 | 3.0 |
| | | 07 16 01.94 | - | - | - | 1.8 | 3.1 |
| | | 07 33 11.50 | - | - | - | 1.8 | 3.1 |
| | | 07 39 53.96 | - | - | - | 1.7 | 3.0 |
| | | 07 54 27.95 | - | - | - | 1.8 | 3.1 |
| | | 08 18 38.80 | - | - | - | 1.8 | 3.1 |
| | | 08 39 41.10 | - | - | - | 1.8 | 3.1 |
| | | 08 40 12.51 | 15.02 | 99.20 | 10.0 | 3.3 | 4.2 |

| YEAR | DY/NO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1983 | 22 Apr. | 08 49 29.80 | - | - | - | 1.6 3.0 |
| | | 08 53 52.17 | - | - | - | 1.8 3.1 |
| | | 09 02 52.76 | - | - | - | 1.6 3.0 |
| | | 09 05 50.96 | - | - | - | 1.8 3.1 |
| | | 09 13 00.96 | - | - | - | 1.6 3.0 |
| | | 09 28 44.73 | 14.98 | 99.16 | 8.2 | 3.2 4.2 |
| | | 09 29 06.72 | 14.94 | 99.22 | - | 3.8 4.6 |
| | | 09 46 55.10 | - | - | - | 1.8 3.1 |
| | | 09 53 02.96 | - | - | - | 1.8 3.1 |
| | | 10 04 39.44 | - | - | - | 1.8 3.1 |
| | | 10 10 40.04 | 15.06 | 99.15 | 11.4 | 2.9 3.9 |
| | | 10 17 24.33 | 15.00 | 99.18 | 10.3 | 3.1 4.1 |
| | | 10 19 32.04 | - | - | - | 1.8 3.1 |
| | | 10 40 47.99 | 14.90 | 99.20 | 8.5 | 3.8 4.6 |
| | | 11 00 17.89 | - | - | - | 2.8 3.1 |
| | | 11 12 22.86 | - | - | - | 1.8 3.1 |
| | | 11 27 48.60 | - | - | - | 1.8 3.1 |
| | | 11 29 37.82 | - | - | - | 1.6 3.0 |
| | | 11 51 24.46 | - | - | - | 1.8 3.1 |
| | | 11 52 46.91 | 14.96 | 99.22 | 14.3 | 3.1 4.1 |
| | | 12 02 28.22 | - | - | - | 1.7 3.0 |
| | | 12 06 04.89 | - | - | - | 1.6 3.0 |
| | | 12 11 09.04 | - | - | - | 1.7 3.0 |
| | | 12 18 06.04 | 14.95 | 99.18 | 8.9 | 4.0 4.7 |
| | | 12 23 11.64 | - | - | - | 1.8 3.1 |
| | | 12 26 36.61 | - | - | - | 1.8 3.1 |
| | | 12 31 43.43 | - | - | - | 1.8 3.1 |

| YEAR | DY/MO | ORIGIN TIME | | | LAT. | LONG. | DEPTH | MAGNT. | |
|---|---|---|---|---|---|---|---|---|---|
| | | H. | M. | S. | (°N) | (°E) | KM. | ML. | MB. |
| 1983 | 22 Apr. | 12 | 35 | 35.36 | - | - | - | 1.7 | 3.0 |
| | | 12 | 51 | 40.13 | 14.97 | 99.20 | 13.1 | 3.1 | 4.1 |
| | | 12 | 54 | 54.74 | 14.93 | 99.15 | 7.9 | 3.8 | 4.6 |
| | | 13 | 16 | 02.58 | - | - | - | 1.7 | 3.0 |
| | | 13 | 26 | 27.54 | - | - | - | 1.6 | 3.0 |
| | | 13 | 38 | 32.20 | 14.86 | 99.20 | 4.0 | 2.7 | 3.8 |
| | | 14 | 02 | 49.06 | - | - | - | 1.6 | 3.0 |
| | | 14 | 11 | 55.13 | - | - | - | 1.7 | 3.0 |
| | | 14 | 17 | 06.08 | 14.98 | 99.20 | 12.4 | 2.8 | 3.9 |
| | | 14 | 19 | 43.95 | - | - | - | 1.8 | 3.1 |
| | | 14 | 20 | 29.56 | 14.95 | 99.17 | 12.3 | 3.8 | 4.6 |
| | | 14 | 27 | 23.95 | - | - | - | 1.6 | 3.0 |
| | | 14 | 27 | 46.24 | - | - | - | 1.6 | 3.0 |
| | | 14 | 32 | 03.25 | - | - | - | 1.8 | 3.1 |
| | | 14 | 37 | 14.33 | - | - | - | 1.8 | 3.1 |
| | | 14 | 39 | 46.79 | 14.94 | 99.20 | 9.6 | 3.8 | 4.6 |
| | | 14 | 51 | 49.60 | - | - | - | 1.7 | 3.0 |
| | | 14 | 56 | 01.94 | 14.89 | 99.23 | 8.7 | 3.0 | 4.0 |
| | | 15 | 15 | 03.60 | - | - | - | 1.7 | 3.0 |
| | | 15 | 44 | 37.05 | - | - | - | 1.6 | 3.0 |
| | | 15 | 45 | 47.00 | 14.87 | 99.21 | 7.3 | 3.0 | 4.0 |
| | | 15 | 48 | 53.07 | - | - | - | 1.7 | 3.0 |
| | | 16 | 08 | 00.17 | - | - | - | 1.7 | 3.0 |
| | | 16 | 12 | 56.57 | 14.54 | 99.19 | 8.6 | 3.8 | 4.6 |
| | | 16 | 16 | 46.11 | - | - | - | 1.7 | 3.0 |
| | | 16 | 21 | 26.05 | - | - | - | 1.7 | 3.0 |
| | | 16 | 25 | 47.96 | - | - | - | 1.7 | 3.0 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1983 | 22 Apr. | 16 43 11.60 | - | - | - | 1.8 3.1 |
| | | 16 43 38.85 | - | - | - | 1.8 3.1 |
| | | 16 51 25.76 | - | - | - | 1.6 3.0 |
| | | 17 03 38.62 | 14.96 | 99.16 | 9.2 | 4.0 4.7 |
| | | 17 17 39.58 | - | - | - | 1.8 3.1 |
| | | 17 22 31.75 | - | - | - | 1.7 3.0 |
| | | 17 44 11.44 | - | - | - | 1.7 3.0 |
| | | 17 50 47.96 | - | - | - | 1.6 3.0 |
| | | 17 59 48.34 | 14.90 | 99.25 | - | 2.8 3.9 |
| | | 18 01 04.36 | 14.85 | 99.21 | - | 3.4 4.3 |
| | | 18 22 35.32 | 14.88 | 99.21 | 8.9 | 2.6 3.7 |
| | | 19 18 02.76 | - | - | - | 2.0 3.3 |
| | | 19 25 40.51 | - | - | - | 1.6 3.0 |
| | | 19 31 21.53 | - | - | - | 1.7 3.0 |
| | | 19 32 52.04 | - | - | - | 1.6 3.0 |
| | | 19 33 19.44 | - | - | - | 1.6 3.0 |
| | | 19 40 18.90 | - | - | - | 1.6 3.0 |
| | | 19 45 49.80 | - | - | - | 1.6 3.0 |
| | | 19 53 30.48 | - | - | - | 1.8 3.1 |
| | | 20 02 01.64 | 14.91 | 99.21 | 12.7 | 2.7 3.8 |
| | | 20 05 15.76 | 14.96 | 99.19 | 27.1 | 2.9 3.9 |
| | | 20 10 19.40 | - | - | - | 1.6 3.0 |
| | | 20 11 27.16 | - | - | - | 1.6 3.0 |
| | | 20 13 54.96 | - | - | - | 1.6 3.0 |
| | | 20 54 54.99 | - | - | - | 1.8 3.1 |
| | | 21 19 29.07 | - | - | - | 1.7 3.0 |
| | | 21 23 54.58 | - | - | - | 1.7 3.0 |

| YEAR | DY/MO | ORIGIN TIME H. | M. | S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|---|---|
| 1983 | 22 Apr | 21 | 34 | 23.77 | - | - | - | 1.7 | 3.0 |
| | | 22 | 07 | 39.01 | 14.99 | 99.22 | 17.2 | 2.7 | 3.8 |
| | | 22 | 14 | 27.30 | - | - | - | 1.7 | 3.0 |
| | | 22 | 53 | 22.06 | - | - | - | 1.6 | 3.0 |
| | | 22 | 56 | 49.07 | - | - | - | 1.8 | 3.1 |
| | | 23 | 17 | 02.81 | - | - | - | 1.8 | 3.1 |
| | | 23 | 41 | 48.61 | - | - | - | 1.7 | 3.0 |
| | 23 | 00 | 01 | 31.03 | - | - | - | 1.8 | 3.1 |
| | | 00 | 45 | 50.52 | - | - | - | 1.7 | 3.0 |
| | | 01 | 26 | 59.27 | - | - | - | 1.6 | 3.0 |
| | | 01 | 47 | 50.77 | - | - | - | 1.6 | 3.0 |
| | | 02 | 21 | 04.06 | - | - | - | 1.6 | 3.0 |
| | | 02 | 25 | 14.08 | 14.94 | 99.21 | 9.8 | 3.6 | 4.5 |
| | | 03 | 16 | 59.61 | - | - | - | 1.7 | 3.0 |
| | | 03 | 21 | 19.12 | - | - | - | 1.6 | 3.0 |
| | | 03 | 59 | 27.40 | - | - | - | 1.8 | 3.1 |
| | | 04 | 12 | 56.05 | 14.99 | 99.22 | 10.7 | 2.9 | 3.9 |
| | | 04 | 42 | 31.19 | - | - | - | 1.6 | 3.0 |
| | | 04 | 45 | 59.58 | - | - | - | 1.8 | 3.1 |
| | | 04 | 50 | 43.44 | - | - | - | 1.7 | 3.0 |
| | | 05 | 24 | 19.92 | 15.01 | 99.21 | 6.5 | 3.4 | 4.3 |
| | | 05 | 53 | 51.12 | - | - | - | 1.8 | 3.1 |
| | | 06 | 00 | 42.40 | - | - | - | 1.6 | 3.0 |
| | | 07 | 13 | 38.68 | - | - | - | 1.6 | 3.0 |
| | | 07 | 21 | 24.51 | - | - | - | 1.7 | 3.0 |
| | | 08 | 44 | 06.26 | - | - | - | 1.8 | 3.1 |
| | | 09 | 31 | 17.74 | 14.97 | 99.22 | 9.6 | 4.8 | 5.3 |

| YEAR | DY/MO | ORIGIN TIME H. | M. | S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|---|---|
| 1983 | 23 Apr. | 09 | 51 | 10.03 | - | - | - | 1.8 | 3.1 |
| | | 10 | 50 | 02.09 | 14.93 | 99.22 | 13.5 | 3.3 | 4.2 |
| | | 13 | 44 | 33.40 | 14.91 | 99.07 | 7.7 | 3.4 | 4.3 |
| | | 13 | 48 | 59.26 | 15.00 | 99.17 | 6.6 | 4.4 | 5.2 |
| | | 14 | 14 | 26.71 | 14.91 | 99.05 | 20.8 | 3.3 | 4.2 |
| | | 16 | 19 | 21.44 | 14.93 | 99.08 | 10.5 | 3.0 | 4.0 |
| | | 19 | 23 | 24.84 | 14.91 | 99.04 | 9.4 | 3.5 | 4.4 |
| | | 20 | 11 | 23.80 | 14.91 | 99.11 | 14.0 | 2.7 | 3.8 |
| | | 22 | 10 | 34.02 | 14.92 | 99.06 | 11.8 | 2.9 | 3.9 |
| | | 22 | 47 | 19.09 | 14.92 | 99.09 | 12.3 | 3.2 | 4.2 |
| | | 22 | 54 | 32.81 | 14.91 | 98.99 | 9.7 | 3.5 | 4.4 |
| | | 23 | 07 | 33.47 | 14.90 | 99.06 | 9.4 | 3.5 | 4.4 |
| | | 23 | 11 | 22.15 | 14.93 | 98.83 | 29.7 | 3.5 | 4.4 |
| | 24 | 00 | 35 | 18.03 | 14.91 | 99.06 | 15.7 | 3.0 | 4.0 |
| | | 01 | 40 | 34.88 | 14.89 | 99.12 | 13.8 | 3.1 | 4.1 |
| | | 03 | 03 | 06.33 | 14.93 | 99.04 | 11.5 | 2.7 | 3.8 |
| | | 04 | 19 | 13.96 | 14.98 | 99.06 | 7.9 | 3.8 | 4.6 |
| | | 06 | 04 | 34.18 | 14.94 | 99.05 | 10.4 | 3.2 | 4.2 |
| | | 07 | 14 | 05.26 | 14.90 | 99.02 | 9.1 | 3.2 | 4.2 |
| | | 15 | 43 | 19.59 | 14.94 | 99.00 | 9.5 | 3.8 | 4.6 |
| | | 17 | 07 | 25.18 | 14.94 | 99.03 | 13.3 | 3.1 | 4.1 |
| | | 22 | 10 | 00.50 | 14.91 | 99.07 | 10.6 | 3.2 | 4.2 |
| | | 22 | 19 | 56.97 | 14.93 | 99.07 | 14.0 | 2.8 | 3.9 |
| | 25 Apr. | 19 | 14 | 55.06 | 14.92 | 99.05 | 11.5 | 3.1 | 4.1 |
| | | 19 | 39 | 40.73 | 14.93 | 99.03 | 9.2 | 3.5 | 4.4 |
| | | 21 | 50 | 20.06 | 14.90 | 99.08 | 11.9 | 3.0 | 4.0 |
| | | 22 | 22 | 22.60 | 14.92 | 99.05 | 12.6 | 3.3 | 4.2 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. ( °N) | LONG. ( °E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1983 | 26 Apr. | 05 44 01.51 | 14.90 | 99.08 | 18.5 | 2.9 | 3.9 |
| | | 08 15 46.94 | 15.13 | 99.23 | 13.4 | 4.6 | 5.2 |
| | | 09 05 40.02 | 14.89 | 99.06 | - | 2.8 | 3.9 |
| | | 10 07 27.41 | 14.88 | 99.06 | 11.8 | 2.8 | 3.9 |
| | | 14 35 37.11 | 14.96 | 99.04 | 7.4 | 3.7 | 4.5 |
| | | 15 11 21.40 | 14.92 | 99.05 | 6.3 | 3.3 | 4.2 |
| | | 19 16 56.57 | 14.93 | 99.09 | 6.9 | 3.3 | 4.2 |
| | 27 | 08 35 43.72 | 14.96 | 99.01 | 11.2 | 3.8 | 4.6 |
| | | 11 59 54.34 | 14.97 | 99.09 | 12.2 | 3.4 | 4.3 |
| | | 17 15 59.89 | 14.96 | 98.93 | 13.0 | 4.7 | 5.2 |
| | | 20 27 48.17 | 14.98 | 99.07 | 8.2 | 3.7 | 4.5 |
| | 28 | 11 01 06.01 | - | - | - | 1.6 | 3.0 |
| | | 11 55 52.27 | - | - | - | 1.8 | 3.1 |
| | | 13 07 01.05 | - | - | - | 1.6 | 3.0 |
| | | 14 21 17.80 | - | - | - | 1.8 | 3.1 |
| | | 14 25 13.22 | - | - | - | 1.7 | 3.0 |
| | | 14 33 49.96 | - | - | - | 1.6 | 3.0 |
| | | 19 52 30.64 | 14.98 | 99.19 | 8.1 | 3.1 | 4.1 |
| | | 19 57 31.96 | - | - | - | 1.8 | 3.1 |
| | | 21 07 24.23 | - | - | - | 1.7 | 3.0 |
| | | 23 01 40.06 | - | - | - | 1.8 | 3.1 |
| | | 23 13 18.03 | 15.00 | 99.22 | 9.7 | 2.9 | 3.9 |
| | 29 | 00 45 47.96 | - | - | - | 1.6 | 3.0 |
| | | 02 39 12.11 | 15.01 | 99.19 | 12.8 | 2.7 | 3.8 |
| | | 05 05 56.96 | - | - | - | 1.8 | 3.1 |
| | | 11 27 04.03 | 14.97 | 99.18 | 10.0 | 2.9 | 3.9 |
| | | 11 28 39.50 | - | - | - | 2.0 | 3.3 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1983 | 29 Apr. | 14 38 17.11 | 14.96 | 99.17 | 10.6 | 2.9 | 3.9 |
| | | 17 54 57.01 | 15.01 | 99.16 | 11.3 | 2.9 | 3.9 |
| | | 20 05 21.24 | - | - | - | 1.8 | 3.1 |
| | 30 | 01 12 49.42 | 15.01 | 99.15 | 8.8 | 4.3 | 5.0 |
| | | 03 18 06.72 | 15.01 | 99.21 | 11.9 | 2.8 | 3.9 |
| | | 05 46 44.13 | 14.99 | 99.13 | 12.3 | 3.5 | 4.4 |
| | | 06 04 20.38 | 15.03 | 99.17 | 10.7 | 2.8 | 3.6 |
| | | 07 30 14.94 | 15.04 | 99.18 | 11.5 | 3.6 | 4.5 |
| | | 08 25 03.66 | 15.05 | 99.17 | 10.4 | 3.6 | 4.5 |
| | 1 May | 05 07 38.96 | - | - | - | 1.8 | 3.1 |
| | | 05 55 37.31 | 15.00 | 99.18 | 6.8 | 3.5 | 4.4 |
| | | 06 07 05.14 | 15.01 | 99.17 | 9.0 | 4.2 | 4.9 |
| | | 14 45 07.96 | - | - | - | 1.8 | 3.1 |
| | 2 | 05 51 21.66 | 15.01 | 99.21 | 8.6 | 3.1 | 4.1 |
| | | 17 30 45.87 | 15.03 | 99.22 | 7.9 | 3.1 | 4.1 |
| | 3 | 06 10 16.25 | 15.03 | 99.19 | 10.8 | 3.3 | 4.2 |
| | | 17 40 02.06 | 14.99 | 99.18 | 8.3 | 3.6 | 4.5 |
| | 4 | 02 02 37.01 | - | - | - | 1.8 | 3.1 |
| | | 13 51 26.21 | - | - | - | 1.8 | 3.1 |
| | | 20 13 01.82 | - | - | - | 2.7 | 3.1 |
| | | 22 39 39.60 | - | - | - | 1.9 | 3.2 |
| | 5 | 18 14 00.92 | 14.97 | 99.20 | 10.6 | 3.4 | 4.3 |
| | 6 | 19 14 23.35 | 14.97 | 99.21 | 9.7 | 3.5 | 4.4 |
| | 7 | 02 48 21.38 | - | - | - | 1.8 | 3.1 |
| | 8 | 11 29 30.98 | - | - | - | 1.8 | 3.1 |
| | 9 | 09 58 31.74 | 14.96 | 99.21 | 8.7 | 3.1 | 4.1 |
| | 10 | 08 05 31.49 | 14.94 | 99.22 | 7.3 | 3.1 | 4.1 |

| YEAR | DY/MO | ORIGIN TIME H. | M. | S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|---|---|
| 1983 | 11 May | 21 | 54 | 40.80 | - | - | - | 1.8 | 3.1 |
| | 12 | 05 | 03 | 23.10 | - | - | - | 1.8 | 3.1 |
| | 13 | 21 | 54 | 43.70 | 14.93 | 99.26 | 6.5 | 3.4 | 4.3 |
| | 15 | 09 | 58 | 08.96 | - | - | - | 1.8 | 3.1 |
| | | 14 | 21 | 46.23 | - | - | - | 1.8 | 3.1 |
| | 16 | 08 | 05 | 49.92 | 14.93 | 99.09 | 12.8 | 3.4 | 4.3 |
| | 17 | 13 | 16 | 11.12 | - | - | - | 1.8 | 3.1 |
| | 18 | 08 | 31 | 15.61 | 14.96 | 99.20 | 9.0 | 3.4 | 4.3 |
| | | 12 | 57 | 33.26 | - | - | - | 2.0 | 3.3 |
| | 20 | 11 | 40 | 29.50 | 14.97 | 99.20 | 12.5 | 3.5 | 4.4 |
| | 21 | 00 | 29 | 00.09 | - | - | - | 1.8 | 3.1 |
| | | 15 | 25 | 25.43 | 14.97 | 99.22 | 10.5 | 3.2 | 4.2 |
| | 22 | 22 | 26 | 57.96 | - | - | - | 1.8 | 3.1 |
| | 23 | 13 | 04 | 23.59 | - | - | - | 1.8 | 3.1 |
| | | 14 | 45 | 11.96 | - | - | - | 1.8 | 3.1 |
| | | 16 | 24 | 05.59 | - | - | - | 1.8 | 3.1 |
| | 24 | 10 | 14 | 25.96 | - | - | - | 1.8 | 3.1 |
| | | 16 | 42 | 55.37 | - | - | - | 1.8 | 3.1 |
| | 25 | 10 | 44 | 59.49 | - | - | - | 1.9 | 3.2 |
| | | 12 | 20 | 27.09 | - | - | - | 1.8 | 3.1 |
| | | 13 | 14 | 12.23 | - | - | - | 1.9 | 3.2 |
| | 27 | 21 | 03 | 18.96 | - | - | - | 1.8 | 3.1 |
| | 28 | 11 | 30 | 14.23 | - | - | - | 1.8 | 3.1 |
| | | 18 | 52 | 49.56 | 15.01 | 99.21 | 7.9 | 3.4 | 4.3 |
| | 29 | 07 | 25 | 13.88 | 14.98 | 99.22 | 10.6 | 3.0 | 4.0 |
| | | 16 | 14 | 42.23 | - | - | - | 1.9 | 3.2 |
| | 1 Jun. | 13 | 58 | 45.40 | - | - | - | 1.6 | 3.0 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1983 | 4 Jun. | 20 41 18.10 | - | - | - | 1.8 3.1 |
| | 5 | 01 58 46.57 | 14.98 | 99.18 | 8.9 | 3.2 4.2 |
| | | 08 35 13.21 | 14.98 | 99.20 | 9.7 | 3.4 4.3 |
| | | 22 47 08.54 | 14.97 | 99.18 | 10.2 | 3.2 4.2 |
| | 8 | 02 44 22.82 | - | - | - | 1.7 3.0 |
| | | 07 37 34.96 | - | - | - | 1.6 3.0 |
| | 10 | 09 45 46.34 | 14.99 | 99.24 | 14.0 | 3.2 4.2 |
| | 11 | 08 09 47.23 | - | - | - | 1.6 3.0 |
| | 12 | 08 03 08.96 | - | - | - | 1.6 3.0 |
| | 13 | 07 37 42.23 | - | - | - | 2.0 3.3 |
| | | 19 37 06.87 | - | - | - | 2.0 3.3 |
| | 14 | 22 16 28.43 | 14.96 | 99.18 | 6.4 | 4.4 5.0 |
| | | 22 31 33.04 | - | - | - | 1.8 3.1 |
| | 15 | 11 26 31.60 | - | - | - | 1.8 3.1 |
| | 17 | 19 25 15.69 | 14.97 | 99.15 | 6.4 | 4.4 5.0 |
| | 19 | 13 12 19.74 | 14.98 | 99.19 | 7.3 | 3.6 4.5 |
| | | 21 46 37.17 | 14.99 | 99.16 | 8.3 | 3.2 4.2 |
| | 20 | 21 04 50.23 | - | - | - | 1.8 3.1 |
| | | 22 57 35.46 | - | - | - | 1.7 3.0 |
| | 22 | 20 52 49.59 | - | - | - | 1.7 3.0 |
| | 24 | 10 59 23.23 | - | - | - | 1.8 3.1 |
| | 25 | 05 41 32.46 | - | - | - | 1.8 3.1 |
| | 26 | 17 32 07.60 | - | - | - | 1.8 3.1 |
| | 27 | 06 47 57.96 | - | - | - | 1.8 3.1 |
| | 1 Jul. | 05 00 55.23 | - | - | - | 1.8 3.1 |
| | 4 | 21 43 20.05 | - | - | - | 1.7 3.0 |
| | | 22 22 18.84 | 14.93 | 99.17 | 15.0 | 2.3 3.5 |

| YEAR | DY/MO | ORIGIN TIME H. | M. | S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|---|---|
| 1983 | 5 Jul. | 14 | 23 | 42.13 | 14.81 | 99.26 | 3.3 | 2.0 | 3.3 |
| | 6 | 04 | 58 | 17.55 | 14.96 | 99.19 | 8.2 | 4.2 | 4.9 |
| | 7 | 11 | 34 | 47.93 | 14.92 | 99.20 | 8.2 | 3.1 | 4.1 |
| | | 11 | 35 | 01.18 | - | - | - | 1.6 | 3.0 |
| | 9 | 20 | 30 | 42.02 | 14.94 | 99.23 | 16.9 | 2.5 | 3.6 |
| | 10 | 04 | 19 | 24.81 | 14.95 | 99.19 | 15.9 | 3.2 | 4.2 |
| | | 20 | 46 | 56.62 | 14.95 | 99.24 | 9.2 | 2.0 | 3.3 |
| | 11 | 12 | 59 | 18.96 | - | - | - | 1.7 | 3.0 |
| | | 19 | 57 | 53.10 | - | - | - | 1.8 | 3.1 |
| | 12 | 12 | 59 | 19.12 | 14.85 | 99.19 | 4.7 | 2.2 | 3.4 |
| | | 19 | 57 | 54.45 | 14.81 | 99.19 | 10.0 | 2.9 | 3.9 |
| | 13 | 15 | 38 | 11.07 | 14.86 | 99.16 | - | 2.0 | 3.3 |
| | | 15 | 43 | 25.88 | 15.27 | 98.78 | 63.5 | 2.4 | 3.6 |
| | 14 | 21 | 55 | 08.81 | 14.98 | 99.20 | 10.0 | 4.3 | 5.0 |
| | | 22 | 43 | 54.45 | 14.70 | 98.91 | 33.0 | 2.0 | 3.3 |
| | 15 | 00 | 42 | 25.99 | 14.90 | 99.20 | 9.3 | 4.0 | 4.7 |
| | | 03 | 31 | 02.17 | 14.93 | 99.19 | 15.3 | 3.3 | 4.2 |
| | | 13 | 23 | 16.60 | - | - | - | 1.8 | 3.1 |
| | 17 | 16 | 45 | 21.86 | 14.95 | 99.19 | 12.2 | 4.5 | 5.1 |
| | | 17 | 48 | 01.37 | 14.86 | 99.22 | 12.4 | 5.0 | 5.5 |
| | | 19 | 44 | 19.56 | 14.95 | 99.20 | 7.5 | 3.6 | 4.5 |
| | 18 | 20 | 27 | 33.62 | 14.92 | 99.18 | 11.3 | 2.8 | 3.9 |
| | 22 | 23 | 16 | 53.10 | - | - | - | 1.6 | 3.0 |
| | 23 | 16 | 22 | 21.60 | - | - | - | 1.7 | 3.0 |
| | 24 | 10 | 35 | 53.56 | 14.87 | 99.23 | 11.1 | 2.7 | 3.8 |
| | | 12 | 47 | 44.69 | - | - | - | 1.6 | 3.0 |
| | 25 | 09 | 43 | 07.10 | - | - | - | 1.6 | 3.0 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1983 | 27 Jul. | 06 34 21.10 | - | - | - | 1.8 3.1 |
| | 29 | 18 51 20.10 | - | - | - | 1.7 3.0 |
| | | 19 28 41.10 | - | - | - | 1.8 3.1 |
| | 30 | 04 26 59.60 | - | - | - | 1.8 3.1 |
| | | 08 59 04.60 | - | - | - | 1.6 3.0 |
| | | 09 27 10.10 | - | - | - | 1.8 3.1 |
| | 31 | 05 41 00.98 | 14.96 | 99.20 | 10.4 | 3.2 4.2 |
| | | 18 56 19.60 | - | - | - | 1.8 3.1 |
| | 2 Aug. | 15 44 49.49 | 14.89 | 99.15 | 8.0 | 3.2 4.2 |
| | 3 | 06 45 41.64 | - | - | - | 1.8 3.1 |
| | 5 | 04 21 17.89 | 14.91 | 99.19 | 11.1 | 2.8 3.9 |
| | | 15 51 14.25 | - | - | - | 1.8 3.1 |
| | 7 | 05 27 16.87 | - | - | - | 1.7 3.0 |
| | | 16 01 28.97 | - | - | - | 1.7 3.0 |
| | 8 | 05 02 48.44 | - | - | - | 1.8 3.1 |
| | 10 | 13 56 21.23 | 14.91 | 99.20 | 10.3 | 3.1 4.1 |
| | 13 | 02 31 55.99 | - | - | - | 1.7 3.0 |
| | 14 | 00 50 19.23 | - | - | - | 1.8 3.1 |
| | | 04 39 12.79 | - | - | - | 1.6 3.0 |
| | | 10 23 55.10 | - | - | - | 1.6 3.0 |
| | | 20 52 15.29 | - | - | - | 1.7 3.0 |
| | 20 | 21 53 19.42 | - | - | - | 1.8 3.1 |
| | 23 | 01 49 12.88 | - | - | - | 1.8 3.1 |
| | 26 | 15 49 46.61 | 14.91 | 99.22 | - | 3.0 4.0 |
| | | 18 46 12.24 | - | - | - | 1.6 3.0 |
| | 27 | 10 11 50.57 | - | - | - | 1.8 3.1 |
| | 28 | 16 24 01.43 | 14.93 | 99.18 | - | 2.7 3.8 |

| YEAR | DY/MO | ORIGIN TIME H. | M. | S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|---|---|
| 1983 | 28 Aug. | 16 | 25 | 58.76 | 14.88 | 99.21 | 10.0 | 2.4 | 3.6 |
| | 29 | 15 | 58 | 59.89 | 14.94 | 99.27 | 11.9 | 3.2 | 4.2 |
| | | 22 | 09 | 52.59 | 14.92 | 99.25 | 11.5 | 4.6 | 5.2 |
| | | 22 | 41 | 25.61 | - | - | - | 1.8 | 3.1 |
| | | 22 | 55 | 12.37 | 14.90 | 99.25 | 20.7 | 2.7 | 3.8 |
| | 3 Sep. | 19 | 37 | 25.20 | 14.95 | 99.22 | 33.8 | 2.6 | 3.7 |
| | 12 | 19 | 32 | 11.03 | 14.92 | 99.17 | 13.2 | 2.8 | 3.9 |
| | 14 | 00 | 23 | 38.18 | 14.86 | 99.22 | 11.5 | 2.4 | 3.6 |
| | 17 | 08 | 05 | 37.23 | - | - | - | 1.8 | 3.1 |
| | 24 | 18 | 39 | 08.10 | - | - | - | 1.7 | 3.0 |
| | 28 | 05 | 07 | 39.60 | - | - | - | 1.8 | 3.1 |
| | | 11 | 46 | 35.60 | - | - | - | 1.6 | 3.0 |
| | | 22 | 23 | 03.10 | - | - | - | 1.6 | 3.0 |
| | 30 | 14 | 22 | 09.60 | - | - | - | 1.6 | 3.0 |
| | 2 Oct. | 16 | 42 | 50.10 | - | - | - | 1.8 | 3.1 |
| | 4 | 02 | 28 | 20.00 | - | - | - | 1.8 | 3.1 |
| | | 22 | 01 | 13.60 | 14.82 | 99.23 | 16.0 | 2.5 | 3.6 |
| | 11 | 16 | 42 | 22.60 | - | - | - | 1.6 | 3.0 |
| | 14 | 06 | 41 | 57.07 | 15.00 | 99.21 | 17.1 | 2.6 | 3.7 |
| | 23 | 06 | 33 | 30.60 | - | - | - | 1.7 | 3.0 |
| | | 23 | 10 | 16.09 | 15.01 | 99.22 | 11.3 | 3.1 | 4.1 |
| | 24 | 02 | 38 | 08.83 | 14.96 | 99.22 | 9.9 | 3.2 | 4.2 |
| | | 06 | 27 | 52.83 | 14.97 | 99.24 | 9.6 | 2.8 | 3.9 |
| | 25 | 06 | 24 | 20.10 | - | - | - | 1.7 | 3.0 |
| | | 08 | 03 | 57.90 | 14.96 | 99.23 | 9.2 | 3.0 | 4.0 |
| | | 11 | 36 | 50.34 | - | - | - | 1.6 | 3.0 |
| | | 15 | 24 | 05.10 | - | - | - | 1.6 | 3.0 |

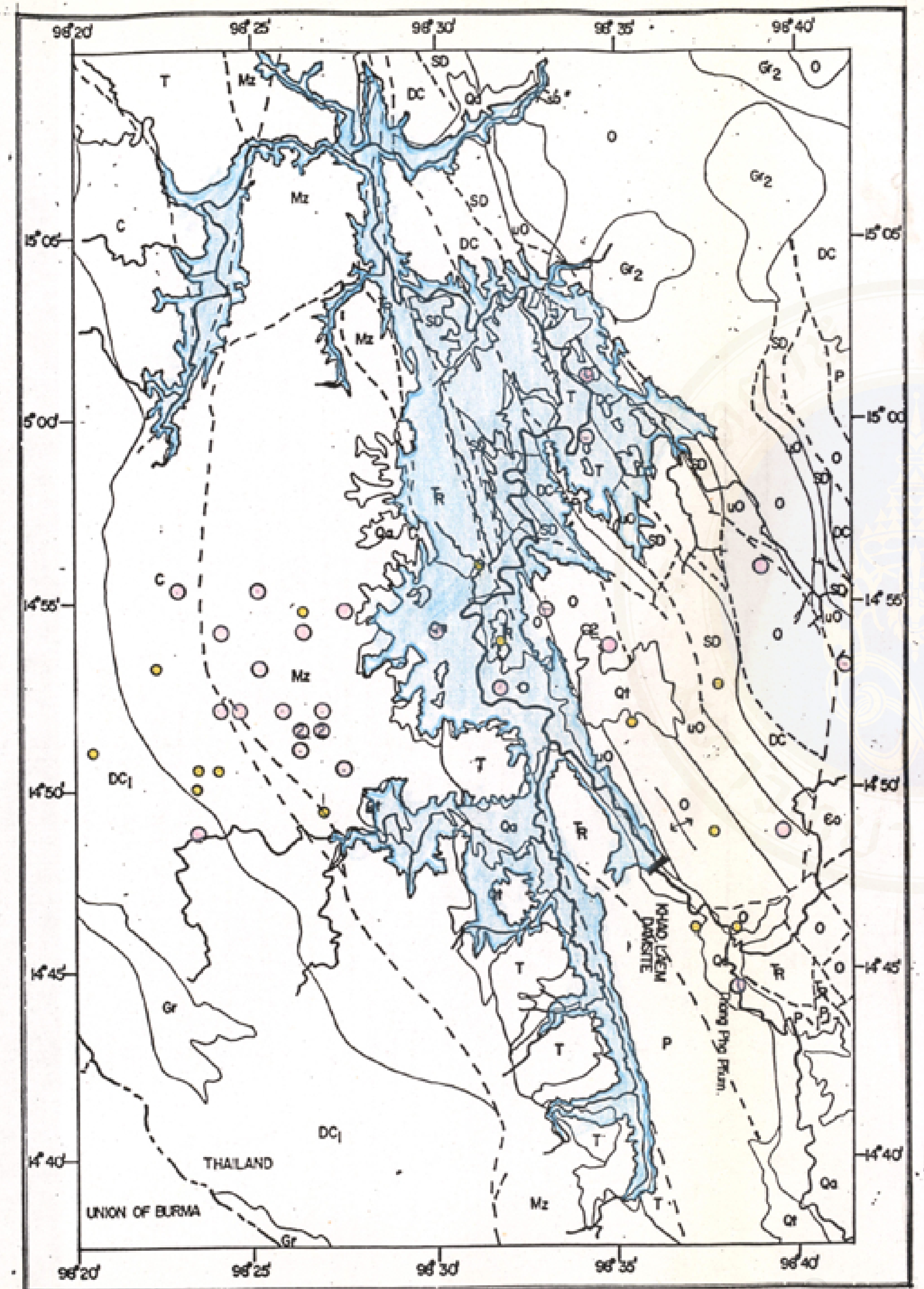
| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1983 | 26 Aug. | 11 16 58.10 | - | - | - | 1.7 3.0 |
| | | 21 46 00.10 | - | - | - | 1.6 3.0 |
| | 27 | 13 27 12.10 | - | - | - | 1.6 3.0 |
| | | 16 35 22.10 | - | - | - | 1.6 3.0 |
| | 30 | 03 02 19.60 | - | - | - | 1.6 3.0 |
| | | 11 33 47.10 | - | - | - | 1.6 3.0 |
| | 31 | 16 25 01.60 | - | - | - | 1.6 3.0 |
| | 1 Nov. | 03 07 14.60 | - | - | - | 1.8 3.1 |
| | 5 | 10 48 58.10 | - | - | - | 1.6 3.0 |
| | 7 | 06 24 14.70 | 15.03 | 99.20 | 14.7 | 3.1 4.1 |
| | 9 | 01 28 10.78 | - | - | - | 1.6 3.0 |
| | 12 | 05 49 50.10 | - | - | - | 1.7 3.0 |
| | 13 | 19 46 58.26 | 15.06 | 99.21 | 9.9 | 2.8 3.9 |
| | 15 | 20 38 56.10 | - | - | - | 1.8 3.1 |
| | 16 | 03 46 47.10 | - | - | - | 1.6 3.0 |
| | 18 | 00 11 55.38 | - | - | - | 1.8 3.1 |
| | | 00 15 15.60 | - | - | - | 1.7 3.0 |
| | | 05 09 04.10 | - | - | - | 1.6 3.0 |
| | | 09 16 47.10 | - | - | - | 1.7 3.0 |
| | | 14 26 57.60 | - | - | - | 1.6 3.0 |
| | | 14 33 46.10 | - | - | - | 1.6 3.0 |
| | 19 | 18 13 19.44 | 15.16 | 99.06 | 10.0 | 2.4 3.6 |
| | 22 | 12 43 11.60 | - | - | - | 1.6 3.0 |
| | | 16 27 29.10 | - | - | - | 1.6 3.0 |
| | | 22 04 17.10 | - | - | - | 1.6 3.0 |
| | | 22 23 36.10 | - | - | - | 1.6 3.0 |
| | 23 | 16 17 01.32 | - | - | - | 1.6 3.0 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1983 | 25 Nov. | 12 49 51.60 | - | - | - | 1.7 3.0 |
| | 26 | 12 50 55.10 | - | - | - | 1.7 3.0 |
| | | 16 06 59.60 | - | - | - | 1.6 3.0 |
| | 27 | 17 02 57.10 | - | - | - | 1.6 3.0 |
| | 28 | 13 02 47.46 | - | - | - | 1.6 3.0 |
| | | 20 49 03 73 | - | - | - | 1.8 3.1 |
| | 29 | 03 16 15.10 | - | - | - | 1.8 3.1 |
| | 1 Dec. | 22 36 14.76 | - | - | - | 1.6 3.0 |
| | 2 | 03 28 43.24 | - | - | - | 1.8 3.1 |
| | 5 | 17 31 32.24 | - | - | - | 1.7 3.0 |
| | 6 | 09 24 27.90 | 15.08 | 99.12 | 11.4 | 2.4 3.6 |
| | | 19 25 46.78 | 15.09 | 99.12 | 12.3 | 2.4 3.6 |
| | 7 | 04 10 26.10 | - | - | - | 1.7 3.0 |
| | 8 | 21 18 51.69 | 15.15 | 99.20 | - | 2.0 3.3 |
| | | 23 06 55.60 | 14.91 | 99.19 | 60.3 | 2.2 3.4 |
| | 12 | 20 25 21.54 | 15.12 | 99.26 | 6.7 | 1.8 3.1 |
| | | 20 28 03.19 | 15.12 | 99.28 | 7.1 | 2.1 3.3 |
| | 14 | 13 26 38.46 | - | - | - | 1.6 3.0 |
| | 15 | 08 23 11.24 | - | - | - | 1.8 3.1 |
| | 17 | 19 47 37.60 | - | - | - | 1.6 3.0 |
| | | 22 15 14.10 | - | - | - | 1.7 3.0 |
| | 26 | 00 30 10.72 | 14.90 | 99.20 | - | 2.5 3.6 |
| | | 18 36 01.46 | - | - | - | 1.7 3.0 |
| | 31 | 05 23 32.76 | 14.94 | 99.18 | 15.8 | 2.4 3.6 |
| 1984 | 1 Jan. | 09 10 24.10 | - | - | - | 1.8 3.1 |
| | 2 | 20 31 56.10 | - | - | - | 1.6 3.0 |
| | 4 | 04 45 06.10 | - | - | - | 1.7 3.0 |

| YEAR | DY/MO | ORIGIN TIME H. | M. | S. | LAT. ( °N) | LONG. ( °E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|---|---|
| 1984 | 4 Jan. | 19 | 14 | 58.10 | - | - | - | 1.6 | 3.0 |
| | 10 | 16 | 57 | 24.49 | 14.93 | 99.22 | 6.1 | 2.6 | 3.7 |
| | 14 | 05 | 47 | 30.80 | 14.96 | 99.25 | - | 3.0 | 4.0 |
| | 15 | 12 | 04 | 12.91 | - | - | - | 2.3 | 3.5 |
| | 20 | 12 | 58 | 25.35 | - | - | - | 1.9 | 3.2 |
| | 3 Feb. | 21 | 07 | 20.10 | - | - | - | 1.6 | 3.0 |
| | 4 | 19 | 36 | 36.60 | - | - | - | 1.6 | 3.0 |
| | 5 | 13 | 12 | 15.60 | - | - | - | 1.6 | 3.0 |
| | 6 | 05 | 18 | 03.10 | - | - | - | 1.7 | 3.0 |
| | 8 | 02 | 40 | 07.70 | 14.98 | 99.24 | - | 3.3 | 4.2 |
| | 15 | 17 | 05 | 06.10 | - | - | - | 1.6 | 3.0 |
| | 22 | 07 | 06 | 16.73 | - | - | - | 2.0 | 3.3 |
| | 23 | 07 | 05 | 54.50 | 14.88 | 99.11 | - | 3.4 | 4.3 |
| | 24 | 23 | 37 | 21.73 | - | - | - | 1.6 | 3.0 |
| | 26 | 20 | 39 | 53.10 | 14.92 | 99.21 | - | 3.0 | 4.0 |
| | | 22 | 44 | 50.10 | 14.93 | 99.21 | - | 2.8 | 3.9 |
| | 28 | 17 | 05 | 20.10 | - | - | - | 1.6 | 3.0 |
| | | 23 | 05 | 08.00 | - | - | - | 1.6 | 3.0 |
| | 8 Mar. | 15 | 15 | 52.96 | - | - | - | 1.7 | 3.0 |
| | 13 | 04 | 46 | 13.96 | - | - | - | 1.7 | 3.0 |
| | 17 | 15 | 51 | 42.23 | - | - | - | 1.8 | 3.1 |
| | 19 | 13 | 57 | 08.86 | 14.97 | 99.18 | 10.0 | 2.8 | 3.9 |
| | 23 | 20 | 57 | 19.14 | 15.07 | 99.10 | - | 2.5 | 3.6 |
| | 27 | 11 | 36 | 43.23 | - | - | - | 1.6 | 3.0 |
| | 28 | 11 | 21 | 55.35 | - | - | - | 2.2 | 3.4 |
| | 1 Apr. | 03 | 11 | 06.40 | 14.93 | 99.18 | - | 2.4 | 3.6 |
| | 2 | 06 | 01 | 25.11 | 14.89 | 99.17 | - | 3.3 | 4.2 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1984 | 25 Apr. | 01 43 08.23 | - | - | - | 1.8 | 3.1 |
| | 1 May | 12 49 37.40 | - | - | - | 1.6 | 3.0 |
| | 4 | 04 50 26.54 | - | - | - | 1.6 | 3.0 |
| | 5 | 04 55 20.72 | - | - | - | 1.8 | 3.1 |
| | 11 | 09 18 08.52 | - | - | - | 1.7 | 3.0 |
| | 12 | 10 53 28.07 | - | - | - | 1.6 | 3.0 |
| | 15 | 04 51 28.84 | - | - | - | 1.6 | 3.0 |
| | 22 | 08 14 54.48 | - | - | - | 1.8 | 3.1 |
| | | 20 58 30.12 | - | - | - | 1.7 | 3.0 |
| | 26 | 20 26 12.51 | 14.91 | 99.13 | - | 2.8 | 3.9 |
| | 27 | 18 12 31.45 | 15.03 | 99.02 | 4.8 | 2.5 | 3.6 |
| | 25 Jun. | 02 30 05.38 | 14.83 | 99.20 | - | 3.1 | 4.1 |
| | 29 | 22 45 00.10 | - | - | - | 1.8 | 3.1 |
| | 30 | 04 50 15.13 | - | - | - | 1.6 | 3.0 |
| | | 11 56 05.21 | 14.99 | 99.15 | - | 2.5 | 3.6 |
| | | 11 58 53.24 | 14.92 | 99.18 | - | 3.8 | 4.6 |
| | | 14 33 05.10 | - | - | - | 1.8 | 3.1 |
| | 1 Jul. | 12 26 21.55 | - | - | - | 1.8 | 3.1 |
| | 2 | 12 39 44.96 | - | - | - | 1.6 | 3.0 |
| | 3 | 14 31 08.70 | 15.00 | 99.10 | - | 3.8 | 4.6 |
| | | 14 36 55.90 | 15.04 | 99.70 | 13.1 | 2.9 | 3.9 |
| | | 14 40 23.60 | 14.90 | 99.16 | - | 3.6 | 4.5 |
| | 5 | 15 04 41.55 | - | - | - | 1.7 | 3.0 |
| | | 17 44 44.06 | - | - | - | 1.7 | 3.0 |
| | | 20 21 47.32 | - | - | - | 1.7 | 3.0 |
| | 7 | 23 49 06.05 | - | - | - | 1.7 | 3.0 |
| | 8 | 18 19 08.85 | - | - | - | 1.6 | 3.0 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1984 | 16 Jul. | 03 56 40.68 | - | - | - | 1.6 3.0 |
| | 25 | 14 33 56.00 | 14.98 | 99.27 | - | 3.0 4.0 |
| | 6 Aug. | 05 32 55.20 | - | - | - | 1.9 3.2 |
| | 10 | 15 44 11.00 | 15.00 | 99.25 | - | 3.6 4.5 |
| | | 15 53 05 04 | - | - | - | 1.6 3.0 |
| | 13 | 09 06 21.23 | - | - | - | 1.8 3.1 |
| | 2 Sep. | 19 02 37.20 | - | - | - | 1.6 3.0 |
| | | 19 04 10.00 | - | - | - | 1.7 3.0 |
| | 3 | 16 02 56.80 | 15.05 | 99.05 | - | 4.5 5.1 |
| | | 17 42 23.40 | 15.08 | 99.04 | - | 3.1 4.1 |
| | 5 | 05 56 13.72 | - | - | - | 1.6 3.0 |
| | | 21 19 14.10 | - | - | - | 1.6 3.0 |
| | | 22 03 01.98 | - | - | - | 1.6 3.0 |
| | | 22 46 22.54 | - | - | - | 1.7 3.0 |
| | 7 | 08 06 58.41 | - | - | - | 1.6 3.0 |
| | | 22 26 07.60 | - | - | - | 1.6 3.0 |
| | | 23 52 02.40 | - | - | - | 1.6 3.0 |
| | 10 | 20 53 38.80 | 14.92 | 99.15 | - | 3.1 4.1 |
| | 11 | 05 50 38.16 | - | - | - | 1.7 3.0 |
| | | 17 22 25.88 | - | - | - | 1.7 3.0 |
| | | 22 30 02.40 | 14.83 | 99.16 | - | 2.7 3.8 |
| | 12 | 22 16 26.89 | - | - | - | 1.6 3.0 |
| | 16 | 11 04 44.80 | 15.06 | 99.39 | - | 2.9 3.9 |
| | | 16 33 50.46 | - | - | - | 1.6 3.0 |
| | | 16 34 53.13 | - | - | - | 1.6 3.0 |
| | 23 | 19 45 06.10 | - | - | - | 1.6 3.0 |
| | 2 Oct. | 12 58 10.10 | - | - | - | 1.7 3.0 |




## EXPLANATION

### SEDIMENTARY AND METAMORPHIC ROCK

| Symbol | Description | Formation | Period | Era |
|---|---|---|---|---|
| Q | Recent flood plain: aluvial sand, silt, back swam deposits and beach sand | | QUATERNARY | CENOZOIC |
| Qa | Quaternary alluvium deposits and recent sediments, loose to semiconsolidated sand, silt, clay and gravel | | QUATERNARY | CENOZOIC |
| Qt | Terrace gravel, sand, silt laterite and lateritic soil | | QUATERNARY | CENOZOIC |
| T | Semiconsolidated and consolidated conglomerate, s sandstone, shale, limestone, coal beds with fossils | | TERTIARY | CENOZOIC |
| Mz | Sandstone, siltstone, shale and conglomerate of dark red, red, reddish brown, with cross-bedding, ripple mark and micaceous in some parts | | JURASSIC | MESOZOIC |
| TR | Conglomerate, sandstone intercalate of shale, limestone with fossils | CHONG KHAP FORMATON | TRIASSIC | MESOZOIC |
| Ps | Massive and bedded limestone containing fusulines brachiopods, pelecypods and bryozoans | SAI YOK LIMESTONE | PERMIAN | PALEOZOIC |
| CP | Pebbly sandstone, sandstone, shale, mudstone, graywacke: greenish grey, brown colours. | KHAENG KRACHAN FORMATION | PERMIAN | PALEOZOIC |
| P | Mainly massive bedded grey limestone and reef limestone with abundant micro-fossils. Chert nodules are not common White sandstone are present in some upper stratigraphic unit. | | PERMIAN | PALEOZOIC |
| C | Sandstone, shale, siltstone | | | PALEOZOIC |
| DC | Pebbly mudstone, grey sandstone and dark grey shale also red shale | KHAENG KRACHAN FORMATION | DEVONIAN | PALEOZOIC |
| SD | Quartzite, phylite, tuffaceous sandstone, limestone-bands, brownish shale with Tentaculite and chert beds | BO PHLOI FORMATION<br>KANCHANABURI FORMATION | DEVONIAN-SILURIAN | PALEOZOIC |
| Є | Massive ortho-quartzite, bedded sandstone of brown to greenish colours and calcareous shale | CHAO NEN QUARZITE | CAMBRIAN | PALEOZOIC |
| me | Paragneiss, calc-silicate, schist and marble. | | CAMBRIAN | PALEOZOIC |
| $Gr_2$ | Medium to fine grained biotite granite of Triassic | | | |
| uO | Limestone with argillaceous band | KRENG KRAWIA | ORDOVICIAN | PALEOZOIC |
| O | Limestone, light grey, dark grey and bluish grey massive to thin bedded, recrystallized, with argillaceous-layers, shale: greenish grey, dark grey and quartzite | THUNG SONG GROUP | ORDOVICIAN | PALEOZOIC |
| Gr | Granite granodiorite, diorite and quartz feldspathic dikes | IGNEOUS ROCKS | MESOZOIC | |

### GEOLOGICAL SYMBOLS

Inferred fault
Syncline
Anticline
Strike and dip
Fault
Contact

(NOTE : Number in the circle is the number of occurence)

MAGNITUDE. ○ > 2, ○ > 3

5 0 5 10
Kilometers.

MAP SHOWS THE GEOLOGICAL STRUCTURE, RESERVOIR AREA AND EPICENTER OF EARTHQUAKES OF KHAO LAEM DAM AND RESERVOIR

Figure 4.3 Epicenters of felt earthquake of Khoa Laem Dam and Reservoir 1984—1985

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1984 | 3 Oct. | 03 26 24.06 | - | - | - | 1.6 | 3.0 |
| | 10 | 19 51 47.90 | 14.93 | 99.22 | - | 2.7 | 3.8 |
| | 12 | 21 50 20.68 | - | - | - | 1.7 | 3.0 |
| | 20 | 02 24 28.48 | - | - | - | 1.6 | 3.0 |
| | | 22 08 10.33 | - | - | - | 2.2 | 3.4 |
| | 30 | 19 19 16.41 | - | - | - | 1.8 | 3.1 |
| | 2 Nov. | 22 36 00.00 | 14.88 | 98.73 | - | 2.8 | 3.9 |
| | 18 | 21 07 54.10 | 14.95 | 99.03 | - | 2.5 | 3.6 |
| | 20 | 14 39 51.21 | - | - | - | 1.6 | 3.0 |
| | 23 | 08 16 12.78 | - | - | - | 1.7 | 3.0 |
| | 25 | 02 01 09.80 | 14.95 | 99.12 | - | 2.4 | 3.6 |
| | | 11 26 49.10 | - | - | - | 1.6 | 3.0 |
| | 2 Dec. | 04 51 27.19 | - | - | - | 1.6 | 3.0 |
| | 8 | 02 40 53.27 | 14.99 | 99.19 | - | 2.6 | 3.7 |
| | 11 | 19 47 23.25 | - | - | - | 1.7 | 3.0 |
| | | 21 19 26.40 | - | - | - | 1.6 | 3.0 |
| 1985 | 14 Jan. | 12 37 05.09 | - | - | - | 1.6 | 3.0 |
| | 18 | 21 07 04.59 | - | - | - | 1.6 | 3.0 |
| | 31 | 23 23 11.26 | 14.94 | 99.11 | 8.1 | 3.6 | 4.5 |
| | 16 Feb. | 14 24 41.75 | - | - | - | 1.7 | 3.0 |
| | 28 | 10 09 32.05 | 14.96 | 99.14 | - | 2.6 | 3.7 |
| | 1 Mar. | 16 05 23.51 | - | - | - | 1.7 | 3.0 |
| | 3 | 01 46 35.83 | 14.99 | 99.25 | - | 2.7 | 3.8 |
| | | 04 45 01.19 | - | - | - | 1.6 | 3.0 |
| | | 15 00 03.09 | - | - | - | 1.6 | 3.0 |
| | 8 | 04 56 53.57 | 15.07 | 99.04 | - | 2.4 | 3.6 |
| | | 07 45 00.71 | 15.06 | 99.05 | - | 2.3 | 3.5 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1985 | 10 Mar. | 05 34 33.61 | 14.96 | 99.18 | - | 4.4 5.0 |
| | | 09 36 14.52 | 14.95 | 99.27 | - | 4.1 4.8 |
| | | 10 31 46.97 | 14.97 | 99.25 | - | 4.0 4.7 |
| | | 10 34 35.00 | - | - | - | 1.8 3.1 |
| | | 12 59 51.93 | 14.98 | 99.24 | - | 2.8 3.9 |
| | | 13 13 39.64 | 14.97 | 99.27 | - | 2.7 3.8 |
| | 11 | 21 36 28.67 | 14.96 | 99.28 | - | 2.6 3.7 |
| | 12 | 10 25 29.00 | 14.95 | 99.27 | - | 2.8 3.9 |
| | 13 | 00 43 11.80 | - | - | - | 1.6 3.0 |
| | 23 | 12 28 57.14 | 15.00 | 99.26 | - | 2.8 3.9 |
| | 23 Apr. | 16 19 40.40 | - | - | - | 1.7 3.0 |
| | 1 May | 23 05 33.00 | - | - | - | 1.6 3.0 |
| | 4 | 19 43 37.75 | - | - | - | 1.6 3.0 |
| | 5 | 13 01 18.00 | - | - | - | 1.8 3.1 |
| | 20 | 00 25 52.09 | - | - | - | 1.6 3.0 |
| | 25 | 18 13 10.75 | - | - | - | 1.6 3.0 |
| | 1 Jun. | 16 30 57.68 | 14.93 | 99.27 | - | 2.7 3.8 |
| | 3 | 00 53 14.25 | - | - | - | 1.6 3.0 |
| | 4 | 11 39 36.05 | - | - | - | 1.6 3.0 |
| | 9 | 18 23 49.24 | - | - | - | 1.7 3.0 |
| | 10 | 00 44 17.78 | - | - | - | 1.6 3.0 |
| | 12 | 15 38 11.55 | - | - | - | 1.6 3.0 |
| | 17 | 15 07 13.15 | - | - | - | 1.7 3.0 |
| | 25 | 01 01 30.32 | - | - | - | 1.6 3.0 |
| | 26 | 11 41 55.85 | - | - | - | 1.6 3.0 |
| | 2 Aug. | 19 56 05.90 | - | - | - | 1.6 3.0 |
| | 14 | 07 59 29.54 | - | - | - | 1.6 3.0 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1985 | 31 Aug. | 14 58 41.35 | - | - | - | 1.7 | 3.0 |
| | 19 Sep. | 18 42 58.00 | - | - | - | 1.6 | 3.0 |
| | 29 | 03 11 51.97 | - | - | - | 1.6 | 3.0 |
| | 15 Oct. | 12 34 45.71 | - | - | - | 1.6 | 3.0 |
| | 20 | 10 43 15.91 | 14.91 | 99.27 | 3.6 | 3.0 | 4.0 |
| | 4 Nov. | 07 51 04.30 | - | - | - | 1.7 | 3.0 |
| | | 22 44 13.35 | - | - | - | 1.7 | 3.0 |
| | 24 | 15 21 40.00 | - | - | - | 1.7 | 3.0 |
| | 8 Dec. | 19 06 27.51 | 15.01 | 99.21 | 5.0 | 2.8 | 3.9 |
| | 13 | 02 38 36.32 | - | - | - | 1.7 | 3.0 |
| | | 19 13 11.37 | 15.01 | 99.09 | 5.1 | 2.4 | 3.6 |

**REMARK.: The coordinates of some sequences have not been shown the latitudes, longitudes and depths due to the data were complex because of long distance, the seismogram of some stations was out of order, too low magnitude to interpret and ect.

## APPENDIX B.

DATA OF EARTHQUAKE SEQUENCES AT KHAO LEAM DAM AND RESERVOIR.

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1984 | 16 Aug. | 16 58 36.84 | - | - | - | 2.0 | 3.3 |
| | 22 | 02 49 01.84 | - | - | - | 1.5 | 2.9 |
| | | 16 18 40.84 | - | - | - | 1.6 | 3.0 |
| | 27 | 19 03 59.29 | - | - | - | 0.5 | 2.1 |
| | 29 | 09 33 52.18 | - | - | - | 0.5 | 2.1 |
| | 6 Sep. | 00 46 52.68 | - | - | - | 0.5 | 2.1 |
| | 16 | 08 22 28.78 | - | - | - | 0.5 | 2.1 |
| | | 15 26 56.78 | - | - | - | 0.5 | 2.1 |
| | 17 | 19 40 48.28 | - | - | - | 0.5 | 2.1 |
| | | 22 07 25.28 | - | - | - | 0.6 | 2.2 |
| | | 22 08 06.48 | - | - | - | 0.6 | 2.2 |
| | 18 | 23 01 59.99 | - | - | - | 0.5 | 2.1 |
| | 19 | 01 37 06.28 | - | - | - | 0.5 | 2.1 |
| | | 22 40 09.58 | - | - | - | 0.5 | 2.1 |
| | 21 | 04 44 42.28 | - | - | - | 0.5 | 2.1 |
| | | 15 40 27.68 | - | - | - | 0.6 | 2.2 |
| | 22 | 01 54 01.78 | - | - | - | 0.5 | 2.1 |
| | | 22 15 10.68 | - | - | - | 0.5 | 2.1 |
| | 23 | 00 18 41.48 | - | - | - | 0.5 | 2.1 |
| | | 01 48 42.78 | - | - | - | 0.5 | 2.1 |
| | | 07 06 01.78 | - | - | - | 0.5 | 2.1 |
| | | 09 38 46.53 | - | - | - | 0.5 | 2.1 |
| | 24 | 04 51 26.78 | - | - | - | 0.5 | 2.1 |
| | | 06 40 18.78 | - | - | - | 0.5 | 2.1 |
| | | 08 53 50.28 | - | - | - | 0.5 | 2.1 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1984 | 24 Sep. | 09 18 35.28 | - | - | - | 0.5 2.1 |
| | | 21 29 46.88 | - | - | - | 0.5 2.1 |
| | 25 | 00 01 48.28 | - | - | - | 0.5 2.1 |
| | | 02 39 41.78 | - | - | - | 0.5 2.1 |
| | | 04 14 21.28 | - | - | - | 0.5 2.1 |
| | | 05 38 21.28 | - | - | - | 0.5 2.1 |
| | | 12 56 09.78 | - | - | - | 0.5 2.1 |
| | | 13 28 13.28 | - | - | - | 0.5 2.1 |
| | | 13 47 42.28 | - | - | - | 0.6 2.2 |
| | | 14 56 11.78 | - | - | - | 0.5 2.1 |
| | 26 | 04 35 35.38 | - | - | - | 0.6 2.2 |
| | | 04 39 08.28 | - | - | - | 0.5 2.1 |
| | | 05 35 37.78 | - | - | - | 0.5 2.1 |
| | | 05 38 11.28 | - | - | - | 0.5 2.1 |
| | | 05 47 22.28 | - | - | - | 0.5 2.1 |
| | | 06 16 22.28 | - | - | - | 0.5 2.1 |
| | | 10 18 47.18 | - | - | - | 0.5 2.1 |
| | | 12 31 41.28 | - | - | - | 0.5 2.1 |
| | | 16 44 44.28 | - | - | - | 0.5 2.1 |
| | | 18 30 21.78 | - | - | - | 0.5 2.1 |
| | | 18 31 30.23 | - | - | - | 0.6 2.2 |
| | | 20 33 51.28 | - | - | - | 0.5 2.1 |
| | | 22 51 04.90 | 14.80 | 98.63 | - | 2.8 3.9 |
| | | 22 52 46.78 | - | - | - | 0.5 2.1 |
| | 27 | 02 45 28.40 | 14.80 | 98.39 | - | 3.6 4.5 |
| | | 02 55 06.28 | - | - | - | 0.5 2.1 |
| | | 03 07 45.28 | - | - | - | 0.5 2.1 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1984 | 27 Sep. | 03 22 23.78 | - | - | - | 0.5 2.1 |
| | | 03 29 59.28 | - | - | - | 0.5 2.1 |
| | | 03 34 00.78 | - | - | - | 0.6 2.2 |
| | | 04 10 50.28 | - | - | - | 0.5 2.1 |
| | | 04 18 36.28 | - | - | - | 0.5 2.1 |
| | | 04 19 26.28 | - | - | - | 0.5 2.1 |
| | | 04 48 46.78 | - | - | - | 0.6 2.2 |
| | | 04 48 57.28 | - | - | - | 0.5 2.1 |
| | | 04 50 40.28 | - | - | - | 0.5 2.1 |
| | | 05 34 41.78 | - | - | - | 0.5 2.1 |
| | | 06 07 42.78 | - | - | - | 0.5 2.1 |
| | | 08 21 48.28 | - | - | - | 0.5 2.1 |
| | | 10 29 07.28 | - | - | - | 0.5 2.1 |
| | | 12 06 18.98 | - | - | - | 0.5 2.1 |
| | | 12 41 38.78 | - | - | - | 0.5 2.1 |
| | | 13 27 06.78 | - | - | - | 0.6 2.2 |
| | | 13 37 47.28 | - | - | - | 0.5 2.1 |
| | | 13 48 47.78 | - | - | - | 0.5 2.1 |
| | | 14 31 43.78 | - | - | - | 0.5 2.1 |
| | | 15 12 43.28 | - | - | - | 0.5 2.1 |
| | | 18 04 31.78 | - | - | - | 0.5 2.1 |
| | | 19 41 42.78 | - | - | - | 0.5 2.1 |
| | | 22 59 04.78 | - | - | - | 0.5 2.1 |
| | 28 | 00 39 36.78 | - | - | - | 0.5 2.1 |
| | | 00 40 39.78 | - | - | - | 0.6 2.2 |
| | | 02 10 54.28 | - | - | - | 0.5 2.1 |
| | | 02 35 00.28 | - | - | - | 0.5 2.1 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1984 | 28 Sep. | 03 07 53.80 | 14.86 | 98.45 | - | 3.6 4.5 |
| | | 03 35 03.08 | - | - | - | 0.5 2.1 |
| | | 03 43 53.18 | - | - | - | 0.5 2.1 |
| | | 04 08 52.78 | - | - | - | 0.5 2.1 |
| | | 04 16 22.78 | - | - | - | 0.5 2.1 |
| | | 05 00 54.78 | - | - | - | 0.6 2.2 |
| | | 05 13 34.28 | - | - | - | 0.5 2.1 |
| | | 07 36 07.78 | - | - | - | 0.5 2.1 |
| | | 07 52 42.48 | - | - | - | 0.5 2.1 |
| | | 08 02 13.98 | - | - | - | 0.5 2.1 |
| | | 08 18 44.28 | - | - | - | 0.5 2.1 |
| | | 08 43 27.58 | - | - | - | 0.5 2.1 |
| | | 10 57 06.78 | - | - | - | 0.5 2.1 |
| | | 11 59 22.08 | - | - | - | 0.5 2.1 |
| | | 13 56 32.79 | - | - | - | 0.5 2.1 |
| | | 14 08 15.28 | - | - | - | 0.5 2.1 |
| | | 15 44 47.28 | - | - | - | 0.5 2.1 |
| | | 16 37 32.28 | - | - | - | 0.5 2.1 |
| | | 21 51 24.98 | - | - | - | 0.5 2.1 |
| | | 22 20 23.78 | - | - | - | 0.6 2.2 |
| | | 22 23 29.28 | - | - | - | 0.5 2.1 |
| | | 23 19 29.08 | - | - | - | 0.5 2.1 |
| | 29 | 01 16 55.70 | 14.87 | 98.53 | - | 3.1 4.1 |
| | | 01 23 19.28 | - | - | - | 0.5 2.1 |
| | | 01 24 03.28 | - | - | - | 0.5 2.1 |
| | | 01 28 38.37 | - | - | - | 0.5 2.1 |
| | | 02 36 11.38 | - | - | - | 0.6 2.2 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1984 | 29 Sep. | 03 35 33.28 | - | - | - | 0.5 | 2.1 |
| | | 03 45 37.28 | - | - | - | 0.5 | 2.1 |
| | | 04 04 10.28 | - | - | - | 0.5 | 2.1 |
| | | 04 54 11.78 | - | - | - | 0.5 | 2.1 |
| | | 05 43 06.28 | - | - | - | 0.5 | 2.1 |
| | | 07 09 32.28 | - | - | - | 0.6 | 2.2 |
| | | 07 45 07.28 | - | - | - | 0.5 | 2.1 |
| | | 08 56 08.28 | - | - | - | 0.5 | 2.1 |
| | | 12 44 30.28 | - | - | - | 0.6 | 2.2 |
| | | 14 01 19.28 | - | - | - | 0.6 | 2.2 |
| | | 17 46 17.28 | - | - | - | 0.6 | 2.2 |
| | | 23 09 19.28 | - | - | - | 0.6 | 2.2 |
| | 30 | 03 33 28.78 | - | - | - | 0.6 | 2.2 |
| | | 09 25 36.98 | - | - | - | 0.5 | 2.1 |
| | | 11 54 49.78 | - | - | - | 0.5 | 2.1 |
| | | 20 00 01.28 | - | - | - | 0.6 | 2.2 |
| | | 22 19 24.28 | - | - | - | 0.5 | 2.1 |
| | | 22 45 56.28 | - | - | - | 0.5 | 2.1 |
| | | 23 54 57.78 | - | - | - | 0.5 | 2.1 |
| | | 23 55 37.28 | - | - | - | 0.5 | 2.1 |
| | 1 Oct. | 00 12 04.28 | - | - | - | 0.6 | 2.2 |
| | | 00 14 41.28 | - | - | - | 0.6 | 2.2 |
| | | 04 20 37.28 | - | - | - | 0.6 | 2.2 |
| | | 06 05 32.28 | - | - | - | 0.6 | 2.2 |
| | | 06 14 11.28 | - | - | - | 0.6 | 2.2 |
| | | 06 25 55.28 | - | - | - | 0.5 | 2.1 |
| | | 10 19 26.78 | - | - | - | 0.6 | 2.2 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1984 | 1 Oct. | 12 33 35.53 | - | - | - | 0.5 2.1 |
| | | 20 03 52.28 | - | - | - | 0.5 2.1 |
| | | 21 16 03.28 | - | - | - | 0.5 2.1 |
| | | 22 43 09.28 | - | - | - | 0.6 2.2 |
| | | 23 14 26.48 | - | - | - | 0.6 2.2 |
| | 2 | 02 59 38.38 | - | - | - | 0.5 2.1 |
| | | 05 09 13.78 | - | - | - | 0.5 2.1 |
| | | 05 23 47.28 | - | - | - | 0.5 2.1 |
| | | 09 59 52.78 | - | - | - | 0.5 2.1 |
| | | 13 02 30.38 | - | - | - | 0.5 2.1 |
| | | 18 12 32.38 | - | - | - | 0.5 2.1 |
| | | 18 27 48.03 | - | - | - | 0.6 2.2 |
| | | 19 53 21.98 | - | - | - | 0.5 2.1 |
| | | 20 03 54.88 | - | - | - | 0.5 2.1 |
| | | 21 27 08.28 | - | - | - | 0.5 2.1 |
| | | 23 45 49.28 | - | - | - | 0.5 2.1 |
| | 3 | 02 14 30.18 | - | - | - | 0.5 2.1 |
| | | 04 37 44.28 | - | - | - | 0.5 2.1 |
| | | 06 26 29.98 | - | - | - | 0.5 2.1 |
| | | 09 03 01.28 | - | - | - | 0.5 2.1 |
| | | 09 11 53.28 | - | - | - | 0.5 2.1 |
| | | 10 04 44.28 | - | - | - | 0.5 2.1 |
| | | 10 32 09.38 | - | - | - | 0.6 2.2 |
| | | 10 48 39.28 | - | - | - | 0.6 2.2 |
| | | 11 07 26.28 | - | - | - | 0.5 2.1 |
| | | 13 57 26.48 | - | - | - | 0.6 2.2 |
| | | 15 44 50.28 | - | - | - | 0.5 2.1 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1984 | 3 Oct. | 15 54 46.78 | - | - | - | 0.6 2.2 |
| | | 20 13 37.48 | - | - | - | 0.6 2.2 |
| | | 20 54 46.78 | - | - | - | 0.6 2.2 |
| | | 23 46 25.28 | - | - | - | 0.5 2.1 |
| | | 23 54 20.08 | - | - | - | 0.5 2.1 |
| | 4 | 00 40 20.28 | - | - | - | 0.5 2.1 |
| | | 01 54 10.28 | - | - | - | 0.5 2.1 |
| | | 02 41 37.28 | - | - | - | 0.5 2.1 |
| | | 03 16 41.38 | - | - | - | 0.5 2.1 |
| | | 03 50 48.78 | - | - | - | 0.5 2.1 |
| | | 03 52 05.68 | - | - | - | 0.5 2.1 |
| | | 03 58 32.28 | - | - | - | 0.5 2.1 |
| | | 04 00 16.28 | - | - | - | 0.5 2.1 |
| | | 04 01 15.48 | - | - | - | 0.5 2.1 |
| | | 04 22 20.78 | - | - | - | 0.5 2.1 |
| | | 04 29 32.28 | - | - | - | 0.6 2.2 |
| | | 06 51 17.28 | - | - | - | 0.6 2.2 |
| | | 08 14 21.68 | - | - | - | 0.5 2.1 |
| | | 09 52 19.78 | - | - | - | 0.5 2.1 |
| | | 14 23 08.80 | 14.90 | 98.44 | - | 3.2 4.2 |
| | | 15 19 24.18 | - | - | - | 0.5 2.1 |
| | | 15 35 38.28 | - | - | - | 0.5 2.1 |
| | | 15 41 47.78 | - | - | - | 0.5 2.1 |
| | | 16 32 48.28 | - | - | - | 0.5 2.1 |
| | | 16 48 10.28 | - | - | - | 0.5 2.1 |
| | | 17 29 22.28 | - | - | - | 0.6 2.2 |
| | | 18 39 23.28 | - | - | - | 0.5 2.1 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1984 | 4 Oct. | 20 51 10 28 | - | - | - | 0.5 2.1 |
| | | 22 54 38.78 | - | - | - | 0.6 2.2 |
| | 5 | 02 44 20.28 | - | - | - | 0.5 2.1 |
| | | 03 14 02.08 | - | - | - | 0.5 2.1 |
| | | 03 41 51.28 | - | - | - | 0.5 2.1 |
| | | 07 06 13.28 | - | - | - | 0.5 2.1 |
| | | 11 32 59.68 | - | - | - | 0.5 2.1 |
| | | 14 08 50.28 | - | - | - | 0.5 2.1 |
| | | 17 02 10.78 | - | - | - | 0.5 2.1 |
| | | 18 53 49.28 | - | - | - | 0.5 2.1 |
| | | 19 56 48.43 | - | - | - | 0.5 2.1 |
| | | 20 49 16.18 | - | - | - | 0.5 2.1 |
| | | 22 41 13.78 | - | - | - | 0.5 2.1 |
| | 6 | 01 27 05.28 | - | - | - | 0.5 2.1 |
| | | 03 34 01.28 | - | - | - | 0.5 2.1 |
| | | 03 39 29.78 | - | - | - | 0.5 2.1 |
| | | 03 57 38.48 | - | - | - | 0.5 2.1 |
| | | 07 12 29.28 | - | - | - | 0.5 2.1 |
| | | 07 43 02.28 | - | - | - | 0.5 2.1 |
| | | 08 12 38.28 | - | - | - | 0.5 2.1 |
| | | 09 34 14.28 | - | - | - | 0.5 2.1 |
| | | 13 34 40.28 | - | - | - | 0.5 2.1 |
| | | 15 16 26.78 | - | - | - | 0.5 2.1 |
| | | 16 20 40.78 | - | - | - | 0.5 2.1 |
| | | 20 45 10.78 | - | - | - | 0.5 2.1 |
| | | 22 28 36.28 | - | - | - | 0.5 2.1 |
| | | 23 59 23.98 | - | - | - | 0.5 2.1 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. ( °N) | LONG. ( °E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1984 | 7 Oct. | 02 01 56.78 | - | - | - | 0.5 2.1 |
| | | 03 34 01.28 | - | - | - | 0.5 2.1 |
| | | 03 39 29.78 | - | - | - | 0.5 2.1 |
| | | 03 57 38.48 | - | - | - | 0.5 2.1 |
| | | 07 12 27.28 | - | - | - | 0.5 2.1 |
| | | 07 43 02.28 | - | - | - | 0.5 2.1 |
| | | 08 12 38.28 | - | - | - | 0.5 2.1 |
| | | 09 34 14.28 | - | - | - | 0.5 2.1 |
| | | 13 34 40.28 | - | - | - | 0.5 2.1 |
| | | 15 03 26.78 | - | - | - | 0.5 2.1 |
| | | 16 20 40.78 | - | - | - | 0.5 2.1 |
| | | 20 45 10.78 | - | - | - | 0.5 2.1 |
| | 8 | 05 02 31.58 | - | - | - | 0.6 2.2 |
| | | 11 40 49.28 | - | - | - | 0.6 2.2 |
| | | 13 35 38.48 | - | - | - | 0.5 2.1 |
| | | 13 37 57.28 | - | - | - | 0.5 2.1 |
| | | 16 40 42.28 | - | - | - | 0.5 2.1 |
| | | 20 30 49.43 | - | - | - | 0.5 2.1 |
| | | 21 50 54.43 | - | - | - | 0.5 2.1 |
| | | 22 16 43.28 | - | - | - | 0.5 2.1 |
| | | 22 54 22.58 | - | - | - | 0.5 2.1 |
| | | 23 44 07.28 | - | - | - | 0.5 2.1 |
| | 9 | 02 34 26.13 | - | - | - | 0.5 2.1 |
| | | 02 46 42.28 | - | - | - | 0.6 2.2 |
| | | 06 12 11.28 | - | - | - | 0.6 2.2 |
| | | 06 41 08.34 | - | - | - | 0.6 2.2 |
| | | 07 11 52.28 | - | - | - | 0.6 2.2 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1984 | 9 Oct. | 11 10 22.93 | - | - | - | 0.5 2.1 |
| | | 12 01 56.13 | - | - | - | 0.5 2.1 |
| | | 19 26 15.78 | - | - | - | 0.5 2.1 |
| | | 20 12 06.03 | - | - | - | 0.5 2.1 |
| | | 20 55 54.50 | - | - | - | 0.5 2.1 |
| | | 23 44 07.28 | - | - | - | 0.5 2.1 |
| | 10 | 02 45 14.43 | - | - | - | 0.5 2.1 |
| | | 02 46 27.73 | - | - | - | 0.6 2.2 |
| | | 04 07 27.53 | - | - | - | 0.6 2.2 |
| | | 04 17 06.23 | - | - | - | 0.6 2.2 |
| | | 06 42 18.53 | - | - | - | 0.5 2.1 |
| | | 06 48 23.43 | - | - | - | 0.6 2.2 |
| | | 08 22 17.13 | - | - | - | 0.5 2.1 |
| | | 08 33 49.68 | - | - | - | 0.6 2.2 |
| | | 08 35 17.73 | - | - | - | 0.5 2.1 |
| | | 09 39 57.37 | - | - | - | 0.5 2.1 |
| | | 09 48 12.13 | - | - | - | 0.5 2.1 |
| | | 10 21 38.28 | - | - | - | 0.5 2.1 |
| | | 11 37 52.78 | - | - | - | 0.6 2.2 |
| | | 12 34 51.18 | 14.90 | 98.57 | - | 2.9 3.9 |
| | | 12 46 45.03 | - | - | - | 0.5 2.1 |
| | | 14 05 01.63 | - | - | - | 0.6 2.2 |
| | | 14 07 05.43 | - | - | - | 0.5 2.1 |
| | | 18 42 08.03 | - | - | - | 0.5 2.1 |
| | 11 | 11 29 19.08 | - | - | - | 0.6 2.2 |
| | | 14 35 59.29 | - | - | - | 0.5 2.1 |
| | | 16 27 00.53 | - | - | - | 0.5 2.1 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1984 | 11 Oct. | 21 13 58.28 | - | - | - | 0.5 | 2.1 |
| | 12 | 11 34 03.18 | - | - | - | 0.6 | 2.2 |
| | | 16 55 05.43 | - | - | - | 0.5 | 2.1 |
| | | 17 39 54.78 | - | - | - | 0.5 | 2.1 |
| | | 18 27 26.23 | - | - | - | 0.5 | 2.1 |
| | 13 | 04 07 33.28 | - | - | - | 0.6 | 2.2 |
| | | 05 13 10.28 | - | - | - | 0.6 | 2.2 |
| | | 07 44 09.28 | - | - | - | 0.5 | 2.1 |
| | 14 | 02 58 03.94 | 14.86 | 98.40 | - | 3.0 | 4.0 |
| | | 03 37 04.16 | 14.83 | 98.40 | - | 2.7 | 3.8 |
| | | 04 05 14.49 | 14.83 | 98.39 | - | 2.7 | 3.8 |
| | | 04 47 05.00 | 14.85 | 98.44 | - | 3.1 | 4.1 |
| | | 05 18 01.88 | - | - | - | 0.5 | 2.1 |
| | | 07 42 57.83 | - | - | - | 0.5 | 2.1 |
| | | 12 18 41.18 | - | - | - | 0.5 | 2.1 |
| | | 14 18 39.93 | - | - | - | 0.6 | 2.2 |
| | 15 | 01 38 26.23 | - | - | - | 0.5 | 2.1 |
| | | 01 39 59.93 | - | - | - | 0.5 | 2.1 |
| | | 11 03 06.73 | - | - | - | 0.5 | 2.1 |
| | | 20 21 31.03 | - | - | - | 0.6 | 2.2 |
| | | 21 24 49.73 | - | - | - | 0.5 | 2.1 |
| | | 23 31 41.23 | - | - | - | 0.6 | 2.2 |
| | 16 | 07 53 43.23 | - | - | - | 0.5 | 2.1 |
| | 17 | 00 04 20.33 | - | - | - | 0.5 | 2.1 |
| | | 00 38 42.88 | - | - | - | 0.6 | 2.2 |
| | | 08 09 39.19 | - | - | - | 0.5 | 2.1 |
| | | 08 14 40.38 | - | - | - | 0.5 | 2.1 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1984 | 17 Oct. | 13 21 08.23 | - | - | - | 0.6 2.2 |
| | 18 | 04 16 43.28 | - | - | - | 0.5 2.1 |
| | | 14 21 39.28 | - | - | - | 0.5 2.1 |
| | | 23 52 28.28 | - | - | - | 0.5 2.1 |
| | 19 | 16 51 56.53 | - | - | - | 0.5 2.1 |
| | | 17 04 39.33 | - | - | - | 0.5 2.1 |
| | 21 | 00 52 22.78 | - | - | - | 0.5 2.1 |
| | | 06 19 27.08 | - | - | - | 0.5 2.1 |
| | | 06 49 56.95 | - | - | - | 0.5 2.1 |
| | | 08 00 30.23 | - | - | - | 0.5 2.1 |
| | 22 | 11 01 58.53 | - | - | - | 0.5 2.1 |
| | 25 | 04 38 58.93 | - | - | - | 0.8 2.3 |
| | 26 | 06 45 21.23 | - | - | - | 0.6 2.2 |
| | | 12 19 34.98 | - | - | - | 1.0 2.5 |
| | | 20 25 31.00 | 14.86 | 98.43 | - | 3.0 4.0 |
| | | 20 32 09.23 | - | - | - | 0.5 2.1 |
| | | 23 20 05.13 | - | - | - | 0.7 2.3 |
| | 27 | 05 42 17.03 | - | - | - | 0.9 2.4 |
| | | 23 28 43.28 | - | - | - | 1.6 3.0 |
| | | 23 31 15.48 | - | - | - | 1.9 3.2 |
| | 28 | 00 27 02.23 | - | - | - | 0.7 2.3 |
| | | 04 25 21.98 | - | - | - | 0.7 2.3 |
| | | 06 09 54.60 | 14.83 | 98.46 | - | 3.7 4.5 |
| | | 06 18 01.28 | - | - | - | 0.5 2.1 |
| | | 07 40 31.28 | - | - | - | 1.4 2.8 |
| | | 09 32 07.78 | - | - | - | 0.9 2.4 |
| | | 12 48 00.78 | - | - | - | 0.7 2.3 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | | | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|---|---|
| 1984 | 28 Oct. | 20 | 34 | 32.88 | - | - | - | 0.6 | 2.2 |
| | 29 | 09 | 17 | 33.28 | - | - | - | 1.6 | 3.0 |
| | | 20 | 46 | 58.28 | - | - | - | 1.2 | 2.7 |
| | | 20 | 47 | 46.68 | - | - | - | 1.6 | 3.0 |
| | 30 | 02 | 35 | 27.53 | - | - | - | 0.7 | 2.3 |
| | | 06 | 59 | 57.78 | - | - | - | 0.9 | 2.4 |
| | | 11 | 54 | 38.13 | - | - | - | 0.6 | 2.2 |
| | 31 | 03 | 15 | 38.33 | - | - | - | 1.8 | 3.1 |
| | | 13 | 55 | 24.43 | - | - | - | 0.7 | 2.3 |
| | | 18 | 46 | 19.23 | - | - | - | 0.7 | 2.3 |
| | 1 Nov. | 08 | 32 | 01.03 | - | - | - | 0.6 | 2.2 |
| | 2 | 01 | 03 | 54.13 | - | - | - | 0.9 | 2.4 |
| | | 22 | 36 | 00.00 | 14.88 | 98.73 | - | 2.8 | 3.9 |
| | 3 | 00 | 01 | 21.53 | - | - | - | 1.3 | 2.7 |
| | | 00 | 36 | 50.28 | - | - | - | 1.4 | 2.8 |
| | | 00 | 05 | 03.28 | - | - | - | 1.0 | 2.5 |
| | | 17 | 14 | 29.29 | - | - | - | 0.7 | 2.3 |
| | | 20 | 45 | 33.78 | - | - | - | 0.7 | 2.3 |
| | 7 | 05 | 28 | 23.20 | 14.77 | 98.64 | 2.2 | 2.4 | 3.6 |
| | 8 | 17 | 39 | 03.78 | - | - | - | 0.6 | 2.2 |
| | | 18 | 25 | 32.23 | - | - | - | 0.5 | 2.1 |
| | 9 | 06 | 10 | 07.28 | - | - | - | 0.5 | 2.1 |
| | | 07 | 10 | 01.03 | - | - | - | 0.5 | 2.1 |
| | | 07 | 21 | 57.28 | - | - | - | 0.5 | 2.1 |
| | 10 | 23 | 29 | 11.28 | - | - | - | 0.9 | 2.4 |
| | 11 | 08 | 06 | 57.28 | - | - | - | 0.5 | 2.1 |
| | | 08 | 21 | 35.28 | - | - | - | 0.7 | 2.3 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1984 | 11 Nov. | 20 27 27.48 | - | - | - | 0.6 2.2 |
| | 13 | 20 16 40.78 | - | - | - | 0.6 2.2 |
| | 14 | 19 12 13.03 | - | - | - | 0.7 2.3 |
| | 16 | 09 57 18.68 | - | - | - | 0.5 2.1 |
| | 17 | 06 52 54.28 | - | - | - | 0.9 2.4 |
| | | 07 33 03.88 | - | - | - | 0.7 2.3 |
| | 20 | 08 20 49.38 | - | - | - | 0.6 2.2 |
| | | 10 43 35.38 | - | - | - | 0.7 2.3 |
| | 23 | 17 25 10.28 | - | - | - | 0.9 2.4 |
| | 24 | 00 29 28.28 | - | - | - | 0.6 2.2 |
| | 25 | 09 28 50.53 | - | - | - | 1.4 2.8 |
| | 26 | 12 57 02.78 | - | - | - | 0.9 2.4 |
| | 27 | 14 25 18.15 | - | - | - | 0.7 2.3 |
| | | 15 51 57.53 | - | - | - | 0.7 2.3 |
| | | 22 11 13.08 | - | - | - | 1.2 2.7 |
| | | 22 51 32.58 | - | - | - | 0.9 2.4 |
| | 28 | 12 11 26.58 | - | - | - | 0.7 2.3 |
| | | 16 57 17.78 | - | - | - | 0.6 2.2 |
| | | 19 26 22.18 | - | - | - | 0.9 2.4 |
| | | 23 59 17.48 | - | - | - | 0.7 2.3 |
| | 29 | 08 10 01.63 | - | - | - | 1.6 3.0 |
| | | 12 34 08.28 | - | - | - | 1.8 3.1 |
| | | 16 47 21.78 | - | - | - | 0.9 2.4 |
| | | 18 10 18.13 | - | - | - | 1.6 3.0 |
| | 30 | 22 29 02.58 | - | - | - | 0.5 2.1 |
| | 1 Dec. | 05 01 16.38 | - | - | - | 0.7 2.3 |
| | | 05 52 07.48 | - | - | - | 0.6 2.2 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1984 | 2 Dec. | 01 36 50.28 | - | - | - | 0.9 | 2.4 |
| | | 01 59 01.28 | - | - | - | 0.7 | 2.3 |
| | | 05 28 51.78 | - | - | - | 0.6 | 2.2 |
| | | 13 47 12.28 | - | - | - | 0.7 | 2.3 |
| | 3 | 13 52 37.60 | 14.90 | 98.50 | - | 3.1 | 4.1 |
| | | 15 11 10.88 | - | - | - | 1.0 | 2.5 |
| | | 19 54 40.98 | - | - | - | 0.9 | 2.4 |
| | 4 | 03 10 31.28 | - | - | - | 0.9 | 2.4 |
| | | 08 35 59.78 | - | - | - | 0.7 | 2.3 |
| | | 12 22 58.28 | - | - | - | 0.7 | 2.3 |
| | | 13 31 14.10 | 14.99 | 98.57 | - | 3.3 | 4.2 |
| | 6 | 10 14 10.58 | - | - | - | 0.6 | 2.2 |
| | 7 | 01 38 50.28 | - | - | - | 1.4 | 2.8 |
| | | 11 56 04.53 | - | - | - | 1.2 | 2.7 |
| | | 22 51 31.28 | - | - | - | 1.4 | 2.8 |
| | 8 | 03 40 27.28 | - | - | - | 0.9 | 2.4 |
| | | 20 36 48.63 | - | - | - | 0.7 | 2.3 |
| | | 21 37 10.23 | - | - | - | 0.9 | 2.4 |
| | 9 | 13 36 01.03 | - | - | - | 0.7 | 2.3 |
| | | 17 30 07.28 | - | - | - | 0.7 | 2.3 |
| | 10 | 00 58 22.28 | - | - | - | 0.9 | 2.4 |
| | | 11 47 15.43 | - | - | - | 0.7 | 2.3 |
| | | 12 31 05.28 | - | - | - | 0.7 | 2.3 |
| | | 12 34 51.18 | 14.90 | 98.57 | - | 2.9 | 3.9 |
| | | 12 39 30.23 | - | - | - | 0.9 | 2.4 |
| | | 12 51 01.28 | - | - | - | 0.7 | 2.3 |
| | | 23 44 21.53 | - | - | - | 1.6 | 3.0 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1984 | 11 Dec. | 05 10 59.28 | - | - | - | 0.9 2.4 |
| | | 20 05 32.28 | - | - | - | 0.7 2.3 |
| | 12 | 20 03 24.53 | - | - | - | 1.2 2.7 |
| | 14 | 02 58 03.94 | 14.86 | 98.41 | - | 3.0 4.0 |
| | | 03 36 45.78 | - | - | - | 0.7 2.3 |
| | | 03 37 04.16 | 14.83 | 98.40 | - | 2.7 3.8 |
| | | 04 05 14.49 | 14.82 | 98.39 | - | 2.7 3.8 |
| | | 04 47 05.00 | 14.85 | 98.44 | - | 3.1 4.1 |
| | | 09 06 20.28 | - | - | - | 0.7 2.3 |
| | | 09 58 56.88 | - | - | - | 0.8 2.4 |
| | | 14 29 15.98 | - | - | - | 0.6 2.2 |
| | | 21 10 24.50 | 14.91 | 98.55 | - | 3.1 4.1 |
| | | 21 20 11.78 | - | - | - | 0.7 2.3 |
| | 15 | 01 05 25.20 | 14.85 | 98.45 | - | 2.7 3.8 |
| | | 02 55 30.48 | - | - | - | 1.0 2.5 |
| | | 04 31 17.38 | - | - | - | 1.1 2.6 |
| | | 13 51 47.80 | 14.84 | 98.44 | - | 3.8 4.6 |
| | | 17 38 27.68 | - | - | - | 0.9 2.4 |
| | | 18 29 31.18 | - | - | - | 0.7 2.3 |
| | | 22 48 19.38 | - | - | - | 0.7 2.3 |
| | 16 | 10 42 10.68 | - | - | - | 0.6 2.2 |
| | | 20 10 18.28 | - | - | - | 0.9 2.4 |
| | | 20 12 41.48 | - | - | - | 0.9 2.4 |
| | | 20 21 18.28 | - | - | - | 0.7 2.3 |
| | | 21 52 48.13 | - | - | - | 0.9 2.4 |
| | 21 | 08 00 23.20 | 14.81 | 98.45 | - | 2.6 3.7 |
| | 22 | 22 50 30.41 | - | - | - | 2.2 3.4 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1984 | 28 Dec. | 14 23 42.80 | 14.45 | 98.45 | - | 3.6 4.5 |
| | 30 | 05 31 25.30 | 14.85 | 98.45 | - | 3.5 4.4 |
| 1985 | 8 Jan. | 13 31 30.87 | - | - | - | 0.5 2.1 |
| | | 21 08 50.12 | - | - | - | 0.6 2.2 |
| | | 22 14 30.70 | - | - | - | 0.5 2.1 |
| | | 22 44 57.78 | - | - | - | 0.5 2.1 |
| | 9 | 05 01 55.42 | - | - | - | 0.5 2.1 |
| | | 06 22 06.92 | - | - | - | 0.5 2.1 |
| | | 17 17 52.98 | 14.91 | 98.46 | - | 3.3 4.2 |
| | 10 | 00 30 31.68 | - | - | - | 0.5 2.1 |
| | | 12 34 46.18 | - | - | - | 0.7 2.3 |
| | | 18 21 44.28 | - | - | - | 0.9 2.4 |
| | | 18 36 27.28 | - | - | - | 0.7 2.3 |
| | 12 | 04 28 33.43 | - | - | - | 0.6 2.2 |
| | | 10 42 25.83 | - | - | - | 0.5 2.1 |
| | 13 | 14 43 20.93 | - | - | - | 0.6 2.2 |
| | | 23 10 04.63 | - | - | - | 0.5 2.1 |
| | 18 | 12 46 25.70 | 14.77 | 98.62 | 8.6 | 2.9 3.9 |
| | 22 | 22 50 42.50 | 44.93 | 98.65 | - | 3.3 4.2 |
| | 23 | 12 21 54.76 | 14.90 | 98.40 | - | 4.5 5.1 |
| | | 17 38 39.40 | 14.91 | 98.44 | - | 2.9 3.9 |
| | | 19 49 20.10 | 14.92 | 98.38 | - | 3.3 4.2 |
| | 24 | 23 32 33.80 | 14.92 | 98.42 | - | 3.2 4.2 |
| | 26 | 11 13 08.40 | 14.84 | 98.34 | - | 2.9 3.9 |
| | 30 | 23 13 12.20 | 14.88 | 98.37 | - | 2.8 3.9 |
| | 1 Feb. | 08 54 06.33 | - | - | - | 0.5 2.1 |
| | | 14 47 09.83 | - | - | - | 0.5 2.1 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. ( °N) | LONG. ( °E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1985 | 3 Feb. | 00 56 56.10 | 14.88 | 98.42 | - | 3.0 | 4.0 |
| | 5 | 05 33 43.11 | - | - | - | 0.5 | 2.1 |
| | 13 | 06 55 40.73 | - | - | - | 0.5 | 2.1 |
| | 14 | 00 23 36.93 | - | - | - | 0.5 | 2.1 |
| | 16 | 06 06 56.11 | - | - | - | 0.5 | 2.1 |
| | | 19 12 48.79 | - | - | - | 0.5 | 2.1 |
| | 19 | 16 58 35.98 | - | - | - | 0.5 | 2.1 |
| | 21 | 01 33 44.28 | - | - | - | 0.5 | 2.1 |
| | | 05 48 35.60 | 14.89 | 98.58 | - | 3.0 | 4.0 |
| | | 05 50 51.78 | - | - | - | 0.5 | 2.1 |
| | | 06 12 03.28 | - | - | - | 0.5 | 2.1 |
| | | 06 52 16.38 | - | - | - | 0.5 | 2.1 |
| | 22 | 10 03 57.78 | - | - | - | 0.5 | 2.1 |
| | | 13 59 25.98 | - | - | - | 0.5 | 2.1 |
| | | 15 29 44.78 | - | - | - | 0.5 | 2.1 |
| | 24 | 17 06 11.23 | - | - | - | 0.5 | 2.1 |
| | 26 | 19 03 32.93 | - | - | - | 0.5 | 2.1 |
| | 1 Mar. | 06 42 54.43 | - | - | - | 1.0 | 2.5 |
| | | 20 55 27.21 | - | - | - | 1.1 | 2.6 |
| | | 21 10 53.08 | - | - | - | 1.0 | 2.5 |
| | | 21 55 03.08 | - | - | - | 0.7 | 2.3 |
| | | 22 36 03.83 | - | - | - | 2.0 | 3.3 |
| | | 22 44 17.98 | - | - | - | 0.6 | 2.2 |
| | 2 | 20 28 22.11 | - | - | - | 1.1 | 2.6 |
| | 3 | 23 39 54.28 | - | - | - | 0.7 | 2.3 |
| | 4 | 08 20 20.11 | - | - | - | 0.6 | 2.2 |
| | | 09 01 01.53 | - | - | - | 1.0 | 2.5 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1985 | 5 Mar. | 00 57 00.78 | - | - | - | 0.9 2.4 |
| | | 13 41 40.13 | - | - | - | 1.1 2.6 |
| | 6 | 12 22 05.13 | - | - | - | 1.0 2.5 |
| | 7 | 16 22 33.71 | - | - | - | 0.6 2.2 |
| | 8 | 00 17 17.78 | - | - | - | 1.8 3.1 |
| | | 04 17 21.33 | - | - | - | 0.9 2.4 |
| | | 06 35 47.93 | - | - | - | 0.6 2.2 |
| | | 19 37 44.93 | - | - | - | 1.5 2.9 |
| | 9 | 02 01 22.93 | - | - | - | 1.4 2.8 |
| | | 11 27 50.11 | - | - | - | 1.0 2.5 |
| | | 13 45 34.43 | - | - | - | 1.6 3.0 |
| | | 15 23 31.93 | - | - | - | 2.0 3.3 |
| | 11 | 07 06 13.83 | - | - | - | 1.5 2.9 |
| | | 07 32 51.43 | - | - | - | 1.4 2.8 |
| | | 08 56 42.93 | - | - | - | 1.2 2.7 |
| | | 10 15 32.93 | - | - | - | 1.1 2.6 |
| | | 21 54 28.93 | - | - | - | 1.1 2.6 |
| | 12 | 09 19 03.68 | - | - | - | 1.6 3.0 |
| | | 15 11 46.28 | - | - | - | 0.8 2.3 |
| | | 16 31 12.18 | - | - | - | 1.2 2.7 |
| | | 20 42 48.51 | - | - | - | 1.2 2.7 |
| | 13 | 14 11 18.89 | - | - | - | 0.9 2.4 |
| | | 16 20 20.28 | - | - | - | 0.7 2.3 |
| | | 22 42 04.48 | - | - | - | 1.5 2.9 |
| | 14 | 00 46 26.88 | - | - | - | 0.6 2.2 |
| | | 00 47 44.93 | - | - | - | 1.0 2.5 |
| | | 01 16 06.58 | - | - | - | 1.3 2.7 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1985 | 14 Mar. | 05 36 34.43 | - | - | - | 0.9 | 2.4 |
| | | 08 13 15.13 | - | - | - | 1.2 | 2.7 |
| | | 11 23 06.91 | - | - | - | 0.7 | 2.3 |
| | | 17 04 19.58 | - | - | - | 1.1 | 2.6 |
| | | 18 00 48.38 | - | - | - | 1.6 | 3.0 |
| | 15 | 06 53 19.69 | - | - | - | 1.4 | 2.8 |
| | | 11 01 23.70 | 14.88 | 98.32 | - | 2.8 | 3.9 |
| | | 14 35 27.28 | - | - | - | 0.7 | 2.3 |
| | | 17 40 18.91 | - | - | - | 0.9 | 2.4 |
| | | 21 12 46.18 | - | - | - | 1.2 | 2.7 |
| | | 21 28 28.58 | - | - | - | 0.7 | 2.3 |
| | | 21 38 19.08 | - | - | - | 0.7 | 2.3 |
| | 16 | 01 57 34.93 | - | - | - | 1.5 | 2.9 |
| | | 06 37 10.63 | - | - | - | 0.6 | 2.2 |
| | | 06 48 29.28 | - | - | - | 1.9 | 3.2 |
| | | 09 13 38.93 | - | - | - | 2.0 | 3.3 |
| | | 10 44 28.61 | - | - | - | 0.7 | 2.3 |
| | | 11 34 22.48 | - | - | - | 1.1 | 2.6 |
| | | 12 52 28.28 | - | - | - | 0.6 | 2.2 |
| | | 12 53 39.43 | - | - | - | 1.8 | 3.1 |
| | | 12 54 58.43 | - | - | - | 1.0 | 2.5 |
| | | 16 16 49.93 | - | - | - | 1.6 | 3.0 |
| | | 20 06 11.63 | - | - | - | 0.8 | 2.3 |
| | 17 | 06 21 23.43 | - | - | - | 1.8 | 3.1 |
| | | 06 46 22.28 | - | - | - | 1.4 | 2.8 |
| | | 11 01 30.53 | - | - | - | 2.2 | 3.4 |
| | | 11 40 41.91 | - | - | - | 1.6 | 2.6 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1985 | 17 Mar. | 12 42 45.04 | 14.93 | 98.52 | - | 2.8 | 3.9 |
| | | 18 03 41.48 | - | - | - | 1.2 | 2.7 |
| | | 18 06 48.11 | - | - | - | 1.9 | 3.2 |
| | | 18 12 46.11 | - | - | - | 1.2 | 2.7 |
| | | 18 43 30.68 | - | - | - | 1.0 | 2.5 |
| | | 21 20 20.11 | - | - | - | 0.7 | 2.3 |
| | 19 | 02 14 10.18 | - | - | - | 0.9 | 2.4 |
| | | 05 51 21.28 | - | - | - | 1.0 | 2.5 |
| | | 18 14 41.98 | - | - | - | 1.5 | 2.9 |
| | | 18 18 33.98 | - | - | - | 0.7 | 2.3 |
| | 20 | 07 58 58.48 | - | - | - | 1.1 | 2.6 |
| | | 09 02 21.78 | - | - | - | 0.8 | 2.3 |
| | | 14 51 11.28 | - | - | - | 1.4 | 2.8 |
| | | 17 27 55.78 | - | - | - | 0.9 | 2.4 |
| | | 17 46 09.23 | - | - | - | 0.7 | 2.3 |
| | 21 | 10 34 45.33 | - | - | - | 1.5 | 2.9 |
| | | 11 32 03.53 | - | - | - | 0.9 | 2.4 |
| | | 11 41 44.13 | - | - | - | 0.6 | 2.2 |
| | | 20 08 26.71 | - | - | - | 2.0 | 3.3 |
| | | 20 28 22.36 | - | - | - | 1.6 | 3.0 |
| | | 22 11 01.18 | - | - | - | 0.7 | 2.3 |
| | 22 | 14 08 48.13 | - | - | - | 1.2 | 2.7 |
| | | 23 06 02.78 | - | - | - | 0.6 | 2.2 |
| | | 23 50 24.28 | - | - | - | 1.4 | 2.8 |
| | 23 | 03 15 32.68 | - | - | - | 2.2 | 3.4 |
| | | 05 13 42.43 | - | - | - | 1.0 | 2.5 |
| | | 07 17 35.48 | - | - | - | 1.9 | 3.2 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1985 | 23 Mar. | 09 44 16.46 | - | - | - | 1.1 2.6 |
| | | 09 46 24.58 | - | - | - | 2.0 3.3 |
| | | 09 47 47.08 | - | - | - | 1.2 2.7 |
| | 24 | 01 35 01.53 | - | - | - | 1.6 3.0 |
| | | 09 49 29.48 | - | - | - | 0.9 2.4 |
| | | 13 33 53.88 | - | - | - | 0.8 2.3 |
| | | 15 15 18.88 | - | - | - | 0.6 2.2 |
| | 25 | 02 36 13.88 | - | - | - | 0.6 2.2 |
| | | 03 44 11.21 | - | - | - | 0.6 2.2 |
| | | 08 03 33.68 | - | - | - | 1.8 3.1 |
| | | 08 04 53.28 | - | - | - | 0.6 2.2 |
| | | 10 06 29.18 | - | - | - | 0.6 2.2 |
| | | 11 56 30.50 | 14.88 | 98.69 | 4.6 | 3.5 4.4 |
| | | 12 22 10.38 | - | - | - | 0.6 2.2 |
| | | 12 24 12.08 | - | - | - | 0.6 2.2 |
| | | 12 29 03.58 | - | - | - | 0.6 2.2 |
| | | 13 15 08.68 | - | - | - | 0.6 2.2 |
| | | 15 28 55.33 | - | - | - | 0.6 2.2 |
| | | 18 16 14.23 | - | - | - | 1.0 2.5 |
| | | 20 23 12.48 | - | - | - | 0.6 2.2 |
| | | 20 39 10.91 | - | - | - | 0.6 2.2 |
| | | 21 07 43.88 | - | - | - | 0.6 2.2 |
| | | 21 10 03.11 | - | - | - | 1.5 2.9 |
| | | 22 17 39.23 | - | - | - | 1.1 2.6 |
| | 26 | 14 00 55.91 | - | - | - | 1.0 2.5 |
| | | 17 06 14.73 | - | - | - | 1.9 3.2 |
| | 27 | 08 57 33.78 | - | - | - | 1.6 3.0 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1985 | 27 Mar. | 20 06 30.83 | - | - | - | 1.2 | 2.7 |
| | 28 | 01 21 11.68 | - | - | - | 0.8 | 2.3 |
| | | 07 00 10.58 | - | - | - | 0.9 | 2.4 |
| | | 09 07 45.51 | - | - | - | 1.8 | 3.1 |
| | | 10 22 16.93 | - | - | - | 1.9 | 3.2 |
| | | 21 19 01.43 | - | - | - | 2.0 | 3.3 |
| | | 23 28 55.73 | - | - | - | 1.6 | 3.0 |
| | 29 | 04 10 24.73 | - | - | - | 1.9 | 3.2 |
| | | 04 26 02.13 | - | - | - | 2.0 | 3.3 |
| | | 12 02 17.31 | - | - | - | 1.2 | 2.7 |
| | | 14 16 17.48 | - | - | - | 1.1 | 2.6 |
| | | 15 23 06.81 | - | - | - | 1.2 | 2.7 |
| | | 15 33 57.61 | - | - | - | 1.1 | 2.6 |
| | | 22 08 53.53 | - | - | - | 2.0 | 3.3 |
| | 30 | 03 56 50.13 | - | - | - | 2.0 | 3.3 |
| | 31 | 02 42 12.33 | - | - | - | 2.2 | 3.4 |
| | | 02 48 06.58 | - | - | - | 0.8 | 2.3 |
| | | 03 49 41.73 | - | - | - | 1.6 | 3.0 |
| | | 06 39 44.31 | - | - | - | 1.8 | 3.1 |
| | | 07 46 52.11 | - | - | - | 1.4 | 2.8 |
| | | 09 53 24.23 | - | - | - | 2.1 | 3.3 |
| | | 09 55 14.23 | - | - | - | 2.1 | 3.3 |
| | | 10 45 07.98 | - | - | - | 2.2 | 2.4 |
| | | 12 23 40.78 | - | - | - | 1.5 | 2.9 |
| | | 13 58 22.78 | - | - | - | 1.1 | 2.6 |
| | | 21 02 40.93 | - | - | - | 1.2 | 2.7 |
| | | 21 44 17.93 | - | - | - | 2.0 | 3.3 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1985 | 31 Mar. | 22 06 08.27 | - | - | - | 0.6 2.2 |
| | | 23 22 05.28 | - | - | - | 0.9 2.4 |
| | 1 Apr. | 08 36 17.93 | - | - | - | 1.0 2.5 |
| | | 11 25 34.83 | - | - | - | 2.0 3.3 |
| | | 14 05 47.93 | - | - | - | 2.2 3.4 |
| | | 23 11 29.11 | - | - | - | 0.9 2.4 |
| | 2 | 01 09 20.58 | - | - | - | 1.0 2.5 |
| | | 02 54 21.98 | - | - | - | 1.4 2.8 |
| | | 15 31 41.78 | - | - | - | 1.1 2.6 |
| | | 17 21 15.28 | - | - | - | 0.9 2.4 |
| | | 19 41 17.93 | - | - | - | 2.0 3.3 |
| | | 19 49 12.28 | - | - | - | 0.7 2.3 |
| | | 19 59 08.80 | - | - | - | 2.2 3.4 |
| | | 20 10 22.28 | - | - | - | 1.1 2.6 |
| | | 20 14 57.78 | - | - | - | 1.0 2.5 |
| | 3 | 04 08 00.98 | - | - | - | 0.9 2.4 |
| | | 18 55 25.78 | - | - | - | 0.9 2.4 |
| | 4 | 02 06 45.58 | - | - | - | 1.2 2.7 |
| | | 02 24 34.11 | - | - | - | 1.6 3.0 |
| | | 06 51 48.43 | - | - | - | 2.0 3.3 |
| | | 10 36 33.28 | - | - | - | 0.7 2.3 |
| | | 17 11 27.13 | - | - | - | 2.0 3.3 |
| | | 21 43 42.28 | - | - | - | 1.1 2.6 |
| | 5 | 14 44 46.16 | - | - | - | 1.2 2.7 |
| | | 15 21 24.28 | - | - | - | 0.9 2.4 |
| | 6 | 13 33 12.28 | - | - | - | 1.5 2.9 |
| | | 15 08 18.28 | - | - | - | 1.4 2.8 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1985 | 6 Apr. | 15 15 22.28 | - | - | - | 0.6 | 2.2 |
| | | 22 40 13.06 | - | - | - | 1.9 | 3.2 |
| | 8 | 21 22 33.78 | - | - | - | 1.0 | 2.5 |
| | 9 | 18 22 33.61 | - | - | - | 1.1 | 2.6 |
| | | 21 54 01.50 | - | - | - | 1.0 | 2.5 |
| | | 21 54 09.98 | - | - | - | 0.7 | 2.3 |
| | 10 | 06 55 21.88 | - | - | - | 1.6 | 3.0 |
| | | 22 30 27.68 | - | - | - | 1.2 | 2.7 |
| | 11 | 20 12 25.61 | - | - | - | 1.4 | 2.8 |
| | 12 | 07 21 53.28 | - | - | - | 1.1 | 2.6 |
| | | 09 58 51.11 | - | - | - | 1.2 | 2.7 |
| | | 11 57 50.73 | - | - | - | 1.5 | 2.9 |
| | | 13 49 30.98 | - | - | - | 1.1 | 2.6 |
| | | 19 59 48.08 | - | - | - | 1.4 | 2.8 |
| | | 23 15 12.28 | - | - | - | 1.0 | 2.5 |
| | | 23 41 45.08 | - | - | - | 1.2 | 2.7 |
| | 13 | 10 44 33.63 | - | - | - | 2.1 | 3.3 |
| | | 10 50 30.08 | - | - | - | 2.2 | 2.4 |
| | | 15 47 29.28 | - | - | - | 0.8 | 2.3 |
| | 14 | 00 12 35.93 | - | - | - | 1.9 | 3.2 |
| | | 01 39 45.61 | - | - | - | 1.5 | 2.9 |
| | | 03 29 43.08 | - | - | - | 0.6 | 2.2 |
| | | 03 43 33.68 | - | - | - | 0.6 | 2.2 |
| | | 04 38 38.18 | - | - | - | 2.1 | 3.0 |
| | | 04 39 19.91 | - | - | - | 0.9 | 2.4 |
| | | 12 14 25.98 | - | - | - | 1.2 | 2.7 |
| | | 15 09 29.28 | - | - | - | 0.7 | 2.3 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1985 | 14 Apr. | 15 13 35.28 | - | - | - | 0.6 2.2 |
| | | 22 24 59.28 | - | - | - | 1.4 2.8 |
| | 15 | 00 31 21.28 | - | - | - | 1.0 2.5 |
| | | 09 14 48.90 | - | - | - | 1.1 2.6 |
| | | 11 53 43.11 | - | - | - | 1.5 2.9 |
| | | 17 13 49.61 | - | - | - | 1.4 2.8 |
| | | 19 49 43.73 | - | - | - | 1.6 3.0 |
| | 16 | 03 10 26.11 | - | - | - | 0.9 2.4 |
| | 17 | 12 26 03.06 | - | - | - | 1.8 3.1 |
| | | 22 06 40.98 | - | - | - | 1.0 2.5 |
| | 18 | 04 51 27.28 | - | - | - | 1.9 3.2 |
| | | 10 44 12.38 | - | - | - | 0.7 2.3 |
| | | 13 10 34.08 | - | - | - | 1.6 3.0 |
| | | 18 35 54.08 | - | - | - | 1.1 2.6 |
| | 19 | 05 44 31.50 | - | - | - | 0.9 2.4 |
| | | 10 00 06.78 | - | - | - | 1.5 2.9 |
| | | 13 32 31.28 | - | - | - | 1.0 2.5 |
| | | 15 03 44.61 | - | - | - | 0.8 2.3 |
| | 20 | 08 04 03.78 | - | - | - | 1.0 2.5 |
| | 21 | 07 04 12.68 | - | - | - | 0.6 2.2 |
| | | 20 31 29.93 | - | - | - | 2.2 3.4 |
| | | 21 03 36.78 | - | - | - | 1.1 2.6 |
| | | 21 23 46.28 | - | - | - | 1.0 2.5 |
| | | 22 49 18.64 | 14.87 | 98.54 | 8.5 | 2.7 3.8 |
| | | 22 49 21.93 | - | - | - | 1.6 3.0 |
| | | 22 51 18.28 | - | - | - | 1.0 2.5 |
| | | 22 53 30.28 | - | - | - | 0.8 2.3 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1985 | 21 Apr. | 22 55 09.48 | - | - | - | 1.8 3.1 |
| | | 23 06 07.78 | - | - | - | 1.0 2.5 |
| | | 23 37 41.88 | - | - | - | 0.6 2.2 |
| | | 23 58 52.28 | - | - | - | 1.6 3.0 |
| | 22 | 00 50 29.28 | - | - | - | 1.3 2.7 |
| | | 00 52 32.08 | - | - | - | 1.0 2.5 |
| | | 00 54 09.08 | - | - | - | 1.9 3.2 |
| | | 01 20 36.28 | - | - | - | 1.0 2.5 |
| | | 01 30 22.28 | - | - | - | 1.2 2.7 |
| | | 03 08 14.61 | - | - | - | 1.2 2.7 |
| | | 03 21 25.31 | - | - | - | 1.6 3.0 |
| | | 03 42 05.68 | - | - | - | 1.1 2.6 |
| | | 03 44 27.28 | - | - | - | 0.9 2.4 |
| | | 03 50 14.08 | - | - | - | 0.6 2.2 |
| | | 04 27 25.28 | - | - | - | 1.1 2.6 |
| | | 04 28 52.28 | - | - | - | 0.6 2.2 |
| | | 04 30 38.78 | - | - | - | 1.0 2.5 |
| | | 04 59 12.78 | - | - | - | 1.2 2.7 |
| | | 05 15 29.08 | - | - | - | 1.1 2.6 |
| | | 05 24 40.28 | - | - | - | 1.6 3.0 |
| | | 05 44 44.43 | - | - | - | 2.2 3.4 |
| | | 05 55 11.28 | - | - | - | 0.5 2.1 |
| | | 06 28 08.38 | - | - | - | 0.9 2.4 |
| | | 07 23 04.08 | - | - | - | 1.8 3.1 |
| | | 08 06 42.28 | - | - | - | 1.2 2.7 |
| | | 09 50 52.28 | - | - | - | 0.6 2.2 |
| | | 10 39 31.28 | - | - | - | 1.0 2.5 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1985 | 22 Apr. | 10 47 42.28 | - | - | - | 1.1 2.6 |
| | | 11 18 08.48 | - | - | - | 0.7 2.3 |
| | | 11 24 00.61 | - | - | - | 2.0 3.3 |
| | | 14 01 41.28 | - | - | - | 0.7 2.3 |
| | | 14 20 19.36 | - | - | - | 1.8 3.1 |
| | | 15 58 13.08 | - | - | - | 0.9 2.4 |
| | | 16 13 14.78 | - | - | - | 0.9 2.4 |
| | | 17 20 23.78 | - | - | - | 1.1 2.6 |
| | | 17 35 34.28 | - | - | - | 0.6 2.2 |
| | | 19 02 26.28 | - | - | - | 0.7 2.3 |
| | | 19 34 02.98 | - | - | - | 0.6 2.2 |
| | | 20 33 42.93 | - | - | - | 1.4 2.8 |
| | | 21 58 55.28 | - | - | - | 0.6 2.2 |
| | | 22 07 42.28 | - | - | - | 0.9 2.4 |
| | | 22 36 48.28 | - | - | - | 1.2 2.7 |
| | | 23 26 06.08 | - | - | - | 0.7 2.3 |
| | 23 | 00 42 51.48 | - | - | - | 1.9 3.2 |
| | | 01 07 19.28 | - | - | - | 1.2 2.7 |
| | | 05 32 07.23 | - | - | - | 1.9 3.2 |
| | | 05 38 07.28 | - | - | - | 0.6 2.2 |
| | | 06 41 55.78 | - | - | - | 0.7 2.3 |
| | | 09 55 37.51 | - | - | - | 2.0 3.3 |
| | | 14 37 02.78 | - | - | - | 0.6 2.2 |
| | | 15 28 08.88 | - | - | - | 0.8 2.3 |
| | | 15 55 04.78 | - | - | - | 0.6 2.2 |
| | | 17 13 08.38 | - | - | - | 0.7 2.3 |
| | | 20 31 11.13 | - | - | - | 1.5 2.9 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1985 | 23 Apr. | 21 14 32.93 | - | - | - | 1.6 3.0 |
| | | 21 19 49.93 | - | - | - | 1.0 2.5 |
| | | 22 09 09.78 | - | - | - | 0.9 2.4 |
| | | 22 51 36.28 | - | - | - | 0.6 2.2 |
| | | 22 53 26.28 | - | - | - | 0.7 2.3 |
| | | 23 54 42.28 | - | - | - | 0.6 2.2 |
| | 24 | 00 03 09.28 | - | - | - | 0.7 2.3 |
| | | 00 30 33.28 | - | - | - | 0.6 2.2 |
| | | 00 22 00.93 | - | - | - | 0.7 2.3 |
| | | 00 36 52.28 | - | - | - | 1.2 2.7 |
| | | 06 39 31.93 | - | - | - | 1.4 2.8 |
| | | 06 43 19.28 | - | - | - | 1.1 2.6 |
| | | 07 11 53.28 | - | - | - | 1.1 2.6 |
| | | 08 28 58.48 | - | - | - | 1.0 2.5 |
| | | 09 10 06.33 | - | - | - | 1.8 3.1 |
| | | 09 27 48.47 | - | - | - | 0.9 2.4 |
| | | 11 18 18.28 | - | - | - | 0.7 2.3 |
| | | 12 09 52.28 | - | - | - | 1.5 2.9 |
| | | 18 03 31.78 | - | - | - | 1.4 2.8 |
| | | 20 16 31.11 | - | - | - | 0.7 2.3 |
| | | 23 53 36.93 | - | - | - | 1.2 3.0 |
| | 25 | 05 57 42.11 | - | - | - | 0.9 2.4 |
| | | 08 23 34.28 | - | - | - | 0.6 2.2 |
| | | 12 01 39.93 | - | - | - | 2.0 3.3 |
| | | 17 34 30.78 | - | - | - | 0.7 2.3 |
| | | 17 57 02.21 | - | - | - | 1.4 2.8 |
| | | 18 30 38.28 | - | - | - | 0.6 2.2 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1985 | 23 Apr. | 18 40 58.58 | - | - | - | 0.7 2.3 |
| | | 21 33 04.11 | - | - | - | 0.6 2.2 |
| | | 22 35 07.01 | - | - | - | 1.2 2.7 |
| | 26 | 05 45 02.98 | - | - | - | 1.1 2.6 |
| | | 08 30 34.38 | - | - | - | 0.9 2.4 |
| | | 14 32 30.28 | - | - | - | 2.2 3.4 |
| | | 15 06 03.08 | - | - | - | 1.5 2.9 |
| | | 16 56 45.78 | - | - | - | 1.0 2.5 |
| | | 19 38 25.28 | - | - | - | 0.7 2.3 |
| | 27 | 01 33 17.38 | - | - | - | 2.2 3.4 |
| | | 09 43 58.28 | - | - | - | 1.2 2.7 |
| | | 13 46 42.78 | - | - | - | 1.1 2.6 |
| | | 19 10 18.08 | - | - | - | 0.6 2.2 |
| | | 19 55 56.28 | - | - | - | 0.6 2.2 |
| | 28 | 07 48 55.28 | - | - | - | 1.2 2.7 |
| | | 08 02 12.58 | - | - | - | 1.8 3.1 |
| | | 08 12 27.88 | - | - | - | 1.0 2.5 |
| | | 13 09 13.28 | - | - | - | 0.6 2.2 |
| | | 15 25 09.28 | - | - | - | 1.4 2.8 |
| | | 20 18 57.78 | - | - | - | 0.7 2.3 |
| | | 22 19 33.28 | - | - | - | 0.6 2.2 |
| | 29 | 06 12 02.98 | - | - | - | 0.7 2.3 |
| | | 08 13 45.59 | - | - | - | 1.6 3.0 |
| | | 15 44 01.08 | - | - | - | 0.6 2.2 |
| | | 16 14 51.28 | - | - | - | 0.6 2.2 |
| | | 18 27 42.28 | - | - | - | 1.8 3.1 |
| | | 19 06 51.78 | - | - | - | 1.6 3.0 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|
| 1985 | 1 May | 01 24 05.78 | - | - | - | 1.6 | 2.2 |
| | | 01 54 36.28 | - | - | - | 0.7 | 2.3 |
| | | 02 27 19.28 | - | - | - | 0.6 | 2.2 |
| | 2 | 18 50 31.18 | - | - | - | 0.6 | 2.2 |
| | 3 | 04 29 19.28 | - | - | - | 0.7 | 2.3 |
| | | 12 20 18.78 | - | - | - | 1.2 | 2.7 |
| | | 14 55 23.28 | - | - | - | 1.9 | 3.2 |
| | | 17 50 19.28 | - | - | - | 2.2 | 3.4 |
| | | 18 12 27.78 | - | - | - | 1.0 | 2.5 |
| | | 18 13 11.28 | - | - | - | 1.9 | 3.2 |
| | | 18 27 14.88 | - | - | - | 1.2 | 2.7 |
| | | 18 30 41.48 | - | - | - | 0.7 | 2.3 |
| | | 19 50 19.72 | 14.80 | 98.66 | 0.1 | 3.1 | 4.1 |
| | | 21 08 48.28 | - | - | - | 0.6 | 2.2 |
| | | 22 54 34.78 | - | - | - | 0.7 | 2.3 |
| | 4 | 08 59 37.56 | - | - | - | 1.5 | 2.9 |
| | | 09 43 01.78 | - | - | - | 2.2 | 3.4 |
| | | 10 01 38.93 | - | - | - | 1.6 | 3.0 |
| | | 10 59 39.93 | - | - | - | 2.2 | 3.4 |
| | | 11 01 51.73 | - | - | - | 1.4 | 2.8 |
| | | 11 02 18.78 | - | - | - | 1.1 | 2.6 |
| | | 11 02 51.28 | - | - | - | 0.9 | 2.4 |
| | | 11 04 26.28 | - | - | - | 1.0 | 2.5 |
| | | 12 08 53.28 | - | - | - | 0.6 | 2.2 |
| | | 12 21 05.28 | - | - | - | 0.7 | 2.3 |
| | | 12 26 16.93 | - | - | - | 1.8 | 3.1 |
| | | 13 02 46.28 | - | - | - | 0.9 | 2.2 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1985 | 4 May | 15 51 59.28 | - | - | - | 1.0 2.5 |
| | | 21 39 07.78 | - | - | - | 1.1 2.6 |
| | 5 | 00 17 24.28 | - | - | - | 0.6 2.2 |
| | | 00 45 35.28 | - | - | - | 1.5 2.9 |
| | | 01 21 53.28 | - | - | - | 1.4 2.8 |
| | | 01 35 15.08 | - | - | - | 1.3 2.7 |
| | | 02 05 18.28 | - | - | - | 1.1 2.6 |
| | | 05 32 37.48 | - | - | - | 0.6 2.2 |
| | | 05 50 27.28 | - | - | - | 0.6 2.2 |
| | | 11 28 21.11 | - | - | - | 1.8 3.1 |
| | | 13 04 33.28 | - | - | - | 1.6 3.0 |
| | | 19 52 31.28 | - | - | - | 0.6 2.2 |
| | | 22 31 10.28 | - | - | - | 2.0 3.3 |
| | 6 | 02 32 24.18 | - | - | - | 0.7 2.3 |
| | | 04 46 18.78 | - | - | - | 1.5 2.9 |
| | | 05 42 12.58 | - | - | - | 1.8 3.1 |
| | | 12 27 18.18 | - | - | - | 1.0 2.5 |
| | | 12 49 25.38 | - | - | - | 0.6 2.2 |
| | | 12 56 58.28 | - | - | - | 0.6 2.2 |
| | | 15 18 19.31 | - | - | - | 0.9 2.4 |
| | | 17 14 50.11 | - | - | - | 1.6 3.0 |
| | | 21 26 08.18 | - | - | - | 1.0 2.5 |
| | 7 | 02 13 11.18 | - | - | - | 1.1 2.6 |
| | | 12 03 36.28 | - | - | - | 0.9 2.4 |
| | 8 | 10 59 01.08 | - | - | - | 0.6 2.2 |
| | | 12 18 40.58 | - | - | - | 1.4 2.8 |
| | | 14 05 04.18 | - | - | - | 1.3 2.7 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1985 | 8 May | 18 46 22.18 | - | - | - | 0.6 2.2 |
| | 9 | 03 15 23.28 | - | - | - | 0.7 2.3 |
| | 10 | 03 49 22.88 | - | - | - | 1.6 3.0 |
| | | 04 22 57.93 | - | - | - | 1.0 2.5 |
| | | 04 23 55.78 | - | - | - | 0.6 2.2 |
| | 11 | 10 08 05.73 | - | - | - | 1.9 3.2 |
| | | 10 11 34.78 | - | - | - | 0.7 2.3 |
| | | 14 15 02.51 | - | - | - | 0.7 2.3 |
| | | 14 28 06.93 | - | - | - | 1.6 3.0 |
| | | 14 49 39.28 | - | - | - | 1.2 2.7 |
| | | 19 20 12.78 | - | - | - | 0.6 2.2 |
| | | 19 22 46.28 | - | - | - | 0.5 2.1 |
| | | 19 52 35.28 | - | - | - | 0.6 2.2 |
| | | 20 24 18.28 | - | - | - | 0.7 2.3 |
| | | 20 34 51.78 | - | - | - | 0.6 2.2 |
| | 12 | 07 36 16.13 | - | - | - | 2.2 3.4 |
| | | 17 36 01.72 | - | - | - | 1.8 3.1 |
| | | 17 57 56.63 | - | - | - | 1.2 2.7 |
| | | 21 32 12.88 | - | - | - | 0.6 2.2 |
| | 14 | 09 45 08.48 | - | - | - | 1.1 2.6 |
| | | 13 46 21.98 | - | - | - | 0.9 2.4 |
| | | 19 05 29.08 | - | - | - | 0.8 2.3 |
| | 15 | 03 34 12.03 | - | - | - | 1.8 3.1 |
| | | 04 40 10.78 | - | - | - | 1.1 2.6 |
| | | 05 26 26.28 | - | - | - | 1.2 2.7 |
| | | 07 08 58.33 | - | - | - | 1.6 3.0 |
| | | 09 47 23.58 | - | - | - | 1.2 2.7 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1985 | 15 May | 20 17 13.18 | - | - | - | 1.0 2.5 |
| | | 22 06 20.43 | - | - | - | 0.9 2.4 |
| | | 22 22 32.76 | - | - | - | 1.5 2.9 |
| | | 22 23 36.76 | - | - | - | 1.6 3.0 |
| | | 22 25 40.28 | - | - | - | 1.4 2.8 |
| | | 23 19 22.06 | - | - | - | 0.9 2.4 |
| | 16 | 01 30 31.98 | - | - | - | 0.5 2.1 |
| | | 05 54 30.48 | - | - | - | 0.5 2.1 |
| | 17 | 10 49 07.62 | - | - | - | 0.6 2.2 |
| | 19 | 16 20 07.78 | - | - | - | 0.5 2.1 |
| | 21 | 10 12 37.13 | - | - | - | 0.5 2.1 |
| | | 11 22 55.93 | - | - | - | 0.6 2.2 |
| | 24 | 16 51 50.53 | - | - | - | 0.5 2.1 |
| | | 18 04 49.43 | - | - | - | 0.5 2.1 |
| | 26 | 10 58 55.58 | - | - | - | 0.5 2.1 |
| | | 12 04 51.83 | - | - | - | 0.5 2.1 |
| | 2 Jun. | 09 05 50.05 | 14.85 | 98.59 | - | 2.7 3.8 |
| | | 23 54 38.93 | - | - | - | 0.5 2.1 |
| | 3 | 00 13 16.83 | - | - | - | 0.5 2.1 |
| | | 08 47 26.11 | - | - | - | 0.5 2.1 |
| | 4 | 00 16 16.08 | - | - | - | 0.5 2.1 |
| | 6 | 18 56 15.93 | - | - | - | 0.6 2.2 |
| | 7 | 05 37 10.31 | - | - | - | 0.5 2.1 |
| | 11 | 18 22 34.98 | - | - | - | 0.5 2.1 |
| | 18 | 03 32 12.63 | - | - | - | 0.6 2.2 |
| | | 10 35 29.73 | - | - | - | 0.6 2.2 |
| | | 10 45 00.53 | - | - | - | 0.5 2.1 |

| YEAR | DY/MO | ORIGIN TIME H. | M. | S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. | MB. |
|---|---|---|---|---|---|---|---|---|---|
| 1985 | 22 Jun. | 02 | 59 | 19.13 | - | - | - | 0.6 | 2.2 |
| | 2 Jul. | 16 | 06 | 06.13 | - | - | - | 0.6 | 2.2 |
| | 10 | 23 | 54 | 19.09 | 15.02 | 98.57 | 5.2 | 3.7 | 4.5 |
| | 11 | 08 | 26 | 28.03 | - | - | - | 0.5 | 2.1 |
| | | 19 | 41 | 44.65 | - | - | - | 2.0 | 3.3 |
| | 13 | 06 | 42 | 41.93 | - | - | - | 0.5 | 2.1 |
| | 20 | 04 | 17 | 48.29 | 14.88 | 98.63 | 4.1 | 2.6 | 3.7 |
| | | 06 | 45 | 30.88 | - | - | - | 0.5 | 2.1 |
| | | 10 | 14 | 13.68 | - | - | - | 0.5 | 2.1 |
| | | 17 | 10 | 57.08 | - | - | - | 0.6 | 2.2 |
| | | 17 | 43 | 10.78 | - | - | - | 0.5 | 2.1 |
| | 21 | 00 | 25 | 11.38 | - | - | - | 0.5 | 2.1 |
| | | 21 | 51 | 17.93 | - | - | - | 0.6 | 2.2 |
| | 22 | 01 | 15 | 02.07 | - | - | - | 0.5 | 2.1 |
| | | 01 | 54 | 08.47 | - | - | - | 0.5 | 2.1 |
| | | 12 | 01 | 06.43 | - | - | - | 0.5 | 2.1 |
| | 24 | 03 | 46 | 46.53 | - | - | - | 0.6 | 2.2 |
| | | 05 | 52 | 33.93 | - | - | - | 0.6 | 2.2 |
| | | 06 | 28 | 00.77 | - | - | - | 0.5 | 2.1 |
| | | 13 | 49 | 37.93 | - | - | - | 0.5 | 2.1 |
| | 28 | 01 | 28 | 01.83 | - | - | - | 0.5 | 2.1 |
| | | 06 | 41 | 19.33 | - | - | - | 0.5 | 2.1 |
| | 30 | 11 | 20 | 04.83 | - | - | - | 0.6 | 2.2 |
| | 3 Aug. | 15 | 18 | 03.31 | - | - | - | 0.5 | 2.1 |
| | 4 | 09 | 40 | 51.38 | - | - | - | 0.5 | 2.1 |
| | | 20 | 26 | 31.85 | 14.90 | 98.53 | - | 2.1 | 3.5 |
| | | 20 | 36 | 30.48 | - | - | - | 0.5 | 2.1 |

| YEAR | DY/MO | ORIGIN TIME H. M. S. | LAT. (°N) | LONG. (°E) | DEPTH KM. | MAGNT. ML. MB. |
|---|---|---|---|---|---|---|
| 1985 | 5 Aug. | 03 50 02.53 | - | - | - | 0.6 2.2 |
| | 6 | 11 23 32.98 | - | - | - | 0.5 2.1 |
| | 8 | 10 35 42.98 | - | - | - | 0.5 2.1 |
| | 9 | 01 13 29.73 | - | - | - | 0.6 2.2 |
| | 11 | 03 05 10.41 | - | - | - | 0.5 2.1 |
| | 13 | 23 58 06.08 | - | - | - | 0.5 2.1 |
| | 15 | 19 55 47.98 | - | - | - | 0.5 2.1 |
| | 19 | 12 44 44.18 | - | - | - | 0.5 2.1 |
| | 21 | 13 18 24.73 | - | - | - | 0.6 2.2 |
| | 7 Feb. | 15 05 15.08 | - | - | - | 0.5 2.1 |
| | | 17 16 48.43 | - | - | - | 0.7 2.2 |
| | | 17 25 00.78 | - | - | - | 0.5 2.1 |
| | 9 | 04 24 38.88 | - | - | - | 0.5 2.1 |
| | 16 | 02 39 29.17 | - | - | - | 0.6 2.2 |
| | 18 | 18 31 01.92 | - | - | - | 0.6 2.2 |
| | 22 | 20 35 32.00 | - | - | - | 0.5 2.1 |
| | 4 Oct. | 09 47 30.88 | - | - | - | 0.5 2.1 |
| | 5 | 14 50 01.29 | - | - | - | 0.6 2.2 |
| | | 15 06 03.06 | - | - | - | 0.6 2.2 |
| | 9 | 01 19 55.28 | - | - | - | 0.5 2.1 |
| | 31 | 13 11 50.21 | - | - | - | 0.5 2.1 |
| | 10 Nov. | 17 03 23.08 | - | - | - | 0.5 2.1 |
| | 28 | 20 25 53.98 | - | - | - | 0.5 2.1 |
| | 29 | 16 14 23.78 | - | - | - | 0.5 2.1 |
| | 30 | 11 05 44.71 | - | - | - | 0.5 2.1 |
| | 3 Dec. | 09 01 59.34 | - | - | - | 0.5 2.1 |
| | 11 | 06 55 49.08 | - | - | - | 0.5 2.1 |

| YEAR | DY/MO | ORIGIN TIME | LAT. | LONG. | DEPTH | MAGNT. |
|---|---|---|---|---|---|---|
| | | H. M. S. | ( °N) | ( °E) | KM. | ML. MB. |
| 1985 | 14 Dec. | 12 02 21.78 | - | - | - | 0.5 2.1 |
| | 29 | 12 42 20.30 | - | - | - | 0.6 2.2 |

** REMARK : The coordinates of some sequences have not been shown the latitudes, longitudes and depths due to the data were complex because of long distance, the seismogram of some stations was out of order, too long magnitude to interpret and ect.

## APPENDIX C.

**BODY MAGNITUDE WITH THEIR CORRESPONDING B VALUE OF SRIANKARIND DAM AND RESERVOIR EARTHQUAKE SEQUENCES FROM 1982-1985.**

| Mb | n | N=Σn | Mn | ΣMn | $\overline{M}$ | MO | $\overline{M}$-MO | b= .4343 / $\overline{M}$-MO |
|---|---|---|---|---|---|---|---|---|
| 3.0 | 241 | 603 | 723.0 | 2071.1 | 3.44 | 2.95 | .49 | 0.8863 |
| 3.1 | 131 | 362 | 406.1 | 1348.1 | 3.72 | 3.05 | .67 | 0.6482 |
| 3.2 | 9 | 231 | 28.8 | 942.0 | 4.07 | 3.15 | .92 | 0.4721 |
| 3.3 | 13 | 222 | 42.9 | 913.2 | 4.11 | 3.25 | .86 | 0.5050 |
| 3.4 | 4 | 209 | 13.6 | 870.3 | 4.16 | 3.35 | .81 | 0.5362 |
| 3.5 | 3 | 205 | 10.5 | 856.7 | 4.18 | 3.45 | .73 | 0.5949 |
| 3.6 | 20 | 202 | 72.0 | 846.2 | 4.19 | 3.55 | .64 | 0.6786 |
| 3.7 | 7 | 182 | 25.9 | 774.2 | 4.25 | 3.65 | .60 | 0.7238 |
| 3.8 | 15 | 175 | 57.0 | 748.3 | 4.28 | 3.75 | .53 | 0.8194 |
| 3.9 | 34 | 160 | 132.6 | 691.3 | 4.32 | 3.85 | .47 | 0.9240 |
| 4.0 | 13 | 126 | 52.0 | 558.7 | 4.43 | 3.95 | .48 | 0.9048 |
| 4.1 | 19 | 113 | 77.9 | 506.7 | 4.48 | 4.05 | .43 | 1.0100 |
| 4.2 | 25 | 94 | 105.0 | 428.8 | 4.56 | 4.15 | .41 | 1.0593 |
| 4.3 | 11 | 69 | 47.3 | 323.8 | 4.69 | 4.25 | .44 | 0.9871 |
| 4.4 | 10 | 58 | 44.0 | 276.5 | 4.77 | 4.35 | .42 | 1.0341 |
| 4.5 | 11 | 48 | 49.5 | 232.5 | 4.84 | 4.45 | .39 | 1.1136 |
| 4.6 | 11 | 37 | 50.6 | 183.0 | 4.95 | 4.55 | .40 | 1.0858 |
| 4.7 | 4 | 26 | 18.8 | 132.4 | 5.09 | 4.65 | .44 | 0.9871 |
| 4.8 | 1 | 22 | 4.8 | 113.6 | 5.16 | 4.75 | .41 | 1.0593 |
| 4.9 | 3 | 21 | 14.7 | 108.8 | 5.18 | 4.85 | .33 | 1.3161 |
| 5.0 | 6 | 18 | 30.0 | 94.1 | 5.23 | 4.95 | .28 | 1.5511 |
| 5.1 | 2 | 12 | 10.2 | 64.1 | 5.34 | 5.05 | .29 | 1.4976 |
| 5.2 | 4 | 10 | 20.8 | 53.9 | 5.39 | 5.15 | .24 | 1.8096 |

(To be continued on page A-62)

| Mb | n | N=$\Sigma$n | Mn | $\Sigma$Mn | $\overline{M}$ | MO | $\overline{M}$-MO | b=$\frac{.4343}{\overline{M}-MO}$ |
|---|---|---|---|---|---|---|---|---|
| 5.3 | 2 | 6 | 10.6 | 33.1 | 5.52 | 5.25 | .27 | 1.6082 |
| 5.5 | 2 | 4 | 11.0 | 22.5 | 5.63 | 5.45 | .18 | 2.4128 |
| 5.7 | 1 | 2 | 5.7 | 11.5 | 5.75 | 5.65 | .10 | 4.3430 |
| 5.8 | 1 | 1 | 5.8 | 5.8 | 5.80 | 5.75 | .05 | 8.6860 |

## APPENDIX D.

FORESHOCK B VALUE OF SRINAKARIND DAM AND RESERVOIR EARTHQUAKE SEQUENCES FROM 1982-1985.

| Mb | n | $N=\Sigma n$ | Mn | $\Sigma Mn$ | $\bar{M}$ | MO | $\bar{M}$-MO | $b=\frac{.4343}{\bar{M}-MO}$ |
|---|---|---|---|---|---|---|---|---|
| 3.0 | 20 | 35 | 60.0 | 114.9 | 3.28 | 2.95 | .33 | 1.3161 |
| 3.1 | 7 | 15 | 21.7 | 54.9 | 3.66 | 3.05 | .61 | 0.7120 |
| 3.3 | 1 | 8 | 3.3 | 33.2 | 4.15 | 3.25 | .90 | 0.4826 |
| 3.6 | 1 | 7 | 3.6 | 29.9 | 4.27 | 3.55 | .72 | 0.6032 |
| 3.8 | 1 | 6 | 3.8 | 26.3 | 4.38 | 3.75 | .63 | 0.6894 |
| 3.9 | 1 | 5 | 3.9 | 22.5 | 4.50 | 3.85 | .65 | 0.6682 |
| 4.0 | 1 | 4 | 4.0 | 18.6 | 4.65 | 3.95 | .70 | 0.6204 |
| 4.1 | 1 | 3 | 4.1 | 14.6 | 4.87 | 4.05 | .79 | 0.5498 |
| 5.0 | 1 | 2 | 5.0 | 10.5 | 5.25 | 4.95 | .30 | 1.4477 |
| 5.5 | 1 | 1 | 5.5 | 5.5 | 5.50 | 5.45 | .05 | 8.6860 |

## APPENDIX E.

AFTERSHOCK B VALUE OF SRINAKARIND DAM AND RESERVOIR EARTHQUAKE SEQUENCES FROM 1982-1985.

| Mb | n | N=Σn | Mn | ΣMn | $\overline{M}$ | MO | $\overline{M}$-MO | b=$\frac{.4343}{\overline{M}-MO}$ |
|---|---|---|---|---|---|---|---|---|
| 3.0 | 221 | 567 | 663.0 | 1950.4 | 3.44 | 2.95 | .49 | 0.8863 |
| 3.1 | 124 | 346 | 384.4 | 1287.4 | 3.72 | 3.05 | .67 | 0.6482 |
| 3.2 | 9 | 222 | 28.8 | 903.0 | 4.07 | 3.15 | .92 | 0.4721 |
| 3.3 | 12 | 213 | 39.6 | 874.2 | 4.10 | 3.25 | .85 | 0.5109 |
| 3.4 | 4 | 201 | 13.6 | 834.6 | 4.15 | 3.35 | .80 | 0.5429 |
| 3.5 | 3 | 197 | 10.5 | 821.0 | 4.17 | 3.45 | .72 | 0.6032 |
| 3.6 | 19 | 194 | 68.4 | 810.5 | 4.18 | 3.55 | .63 | 0.6894 |
| 3.7 | 7 | 175 | 25.9 | 742.1 | 4.24 | 3.65 | .59 | 0.7361 |
| 3.8 | 14 | 168 | 53.2 | 716.2 | 4.26 | 3.75 | .51 | 0.8516 |
| 3.9 | 33 | 154 | 128.7 | 663.0 | 4.31 | 3.85 | .46 | 0.9441 |
| 4.0 | 12 | 121 | 48.0 | 534.3 | 4.42 | 3.95 | .47 | 0.9240 |
| 4.1 | 18 | 109 | 73.8 | 486.3 | 4.46 | 4.05 | .41 | 1.0593 |
| 4.2 | 25 | 91 | 105.0 | 412.5 | 4.53 | 4.15 | .38 | 1.1429 |
| 4.3 | 11 | 66 | 47.3 | 307.5 | 4.66 | 4.25 | .41 | 1.0593 |
| 4.4 | 10 | 55 | 44.0 | 260.2 | 4.73 | 4.35 | .38 | 1.1429 |
| 4.5 | 11 | 45 | 49.5 | 216.2 | 4.80 | 3.45 | .35 | 1.2409 |
| 4.6 | 11 | 34 | 50.6 | 166.7 | 4.90 | 4.55 | .35 | 1.2409 |
| 4.7 | 4 | 23 | 18.8 | 116.1 | 5.05 | 4.65 | .40 | 1.0858 |
| 4.8 | 1 | 19 | 4.8 | 97.3 | 5.12 | 4.75 | .37 | 1.1738 |
| 4.9 | 3 | 18 | 14.7 | 92.5 | 5.14 | 4.85 | .29 | 1.4976 |
| 5.0 | 5 | 15 | 25.0 | 77.8 | 5.19 | 4.95 | .24 | 1.8096 |
| 5.1 | 2 | 10 | 10.2 | 52.8 | 5.28 | 5.05 | .23 | 1.8883 |
| 5.2 | 4 | 8 | 20.8 | 42.6 | 5.33 | 5.15 | .18 | 2.4128 |
| 5.3 | 2 | 4 | 10.6 | 21.8 | 5.45 | 5.25 | .20 | 2.1715 |

(To be continued on page A-65)

| Mb | n | N=Σn | Mn | ΣMn | $\overline{M}$ | MO | $\overline{M}$-MO | b=$\frac{.4343}{\overline{M}-MO}$ |
|---|---|---|---|---|---|---|---|---|
| 5.5 | 1 | 2 | 5.5 | 11.2 | 5.60 | 5.45 | .15 | 2.8953 |
| 5.7 | 1 | 1 | 5.7 | 5.7 | 5.70 | 5.65 | .05 | 8.6860 |

## APPENDIX F.

BODY MAGNITUDE WITH THEIR CORRESPONDING B VALUE OF KHAO LEAM DAM AND RESERVOIR FROM 1984-1985.

| Mb | n | N=Σn | Mn | ΣMn | $\bar{M}$ | MO | $\bar{M}$-MO | $b=\frac{.4343}{\bar{M}-MO}$ |
|---|---|---|---|---|---|---|---|---|
| 2.1 | 320 | 972 | 672.0 | 2401.9 | 2.47 | 2.05 | .42 | 1.0341 |
| 2.2 | 168 | 652 | 369.6 | 1729.9 | 2.65 | 2.15 | .50 | 0.8686 |
| 2.3 | 92 | 484 | 211.6 | 1360.3 | 2.81 | 2.25 | .56 | 0.7755 |
| 2.4 | 61 | 392 | 146.4 | 1148.7 | 2.93 | 2.35 | .58 | 0.7488 |
| 2.5 | 44 | 331 | 110.0 | 1002.3 | 3.03 | 2.45 | .58 | 0.7488 |
| 2.6 | 39 | 287 | 101.4 | 892.3 | 3.11 | 2.55 | .56 | 0.7755 |
| 2.7 | 44 | 248 | 118.8 | 790.9 | 3.19 | 2.65 | .54 | 0.8043 |
| 2.8 | 27 | 204 | 75.6 | 672.1 | 3.30 | 2.75 | .55 | 0.7896 |
| 2.9 | 21 | 177 | 60.9 | 596.5 | 3.37 | 2.85 | .52 | 0.8352 |
| 3.0 | 36 | 156 | 108.0 | 535.6 | 3.43 | 2.95 | .48 | 0.9048 |
| 3.1 | 20 | 120 | 62.0 | 427.6 | 3.56 | 3.05 | .51 | 0.8516 |
| 3.2 | 16 | 100 | 51.2 | 365.6 | 3.66 | 3.15 | .51 | 0.8516 |
| 3.3 | 23 | 84 | 75.9 | 314.4 | 3.74 | 3.25 | .49 | 0.8863 |
| 3.4 | 14 | 61 | 47.6 | 238.5 | 3.91 | 3.35 | .56 | 0.7755 |
| 3.5 | 1 | 47 | 3.5 | 190.9 | 4.06 | 3.45 | .61 | 0.7120 |
| 3.6 | 1 | 46 | 3.6 | 187.4 | 4.06 | 3.55 | .51 | 0.8516 |
| 3.7 | 2 | 45 | 7.4 | 183.8 | 4.08 | 3.65 | .43 | 1.0100 |
| 3.8 | 7 | 43 | 26.6 | 176.4 | 4.10 | 3.75 | .35 | 1.2409 |
| 3.9 | 10 | 36 | 39.0 | 149.8 | 4.16 | 3.85 | .31 | 1.4010 |
| 4.0 | 5 | 26 | 20.0 | 110.8 | 4.26 | 3.95 | .31 | 1.4010 |
| 4.1 | 6 | 21 | 24.6 | 90.8 | 4.32 | 4.05 | .27 | 1.6085 |
| 4.2 | 6 | 15 | 25.2 | 66.2 | 4.41 | 4.15 | .26 | 1.6704 |
| 4.4 | 2 | 9 | 8.8 | 41.0 | 4.56 | 4.35 | .21 | 2.0681 |
| 4.5 | 5 | 7 | 22.5 | 32.2 | 4.60 | 4.45 | .15 | 2.8953 |
| 4.6 | 1 | 2 | 4.6 | 9.7 | 4.85 | 4.55 | .30 | 1.4477 |
| 5.1 | 1 | 1 | 5.1 | 5.1 | 5.10 | 5.05 | .05 | 8.6860 |

## APPENDIX G.

MONTHLY AVERAGE WATER LEVEL OF SRINAKARIND DAM AND RESERVOIR.

| YEAR | DY RANGE | MO. | WATR. LEV./M. | YEAR | DY RANGE | MO. | WATR LEV./M. |
|---|---|---|---|---|---|---|---|
| 1977 | 1-31 | Aug. | 83.92 | 1979 | 1-31 | Aug. | 142.34 |
| | 1-30 | Sep. | 96.68 | | 1-30 | Sep. | 145.40 |
| | 1-31 | Oct. | 103.88 | | 1-31 | Oct. | 148.37 |
| | 1-30 | Nov. | 106.29 | | 1-30 | Nov. | 149.12 |
| | 1-31 | Dec. | 107.42 | | 1-31 | Dec. | 149.26 |
| 1978 | 1-31 | Jan. | 108.19 | 1980 | 1-31 | Jan. | 149.50 |
| | 1-28 | Feb. | 108.68 | | 1-29 | Feb. | 149.59 |
| | 1-31 | Mar. | 108.72 | | 1-31 | Mar. | 149.28 |
| | 1-30 | Apr. | 107.98 | | 1-30 | Apr. | 148.80 |
| | 1-31 | May | 107.26 | | 1-31 | May | 148.44 |
| | 1-30 | Jun. | 107.91 | | 1-30 | Jun. | 148.87 |
| | 1-31 | Jul. | 110.13 | | 1-31 | Jul. | 149.68 |
| | 1-31 | Aug. | 116.50 | | 1-31 | Aug. | 150.67 |
| | 1-30 | Sep. | 125.93 | | 1-30 | Sep. | 152.91 |
| | 1-31 | Oct. | 134.89 | | 1-31 | Oct. | 155.76 |
| | 1-30 | Nov. | 137.69 | | 1-30 | Nov. | 157.33 |
| | 1-31 | Dec. | 138.59 | | 1-31 | Dec. | 157.81 |
| 1979 | 1-31 | Jan. | 135.83 | 1981 | 1-31 | Jan. | 157.95 |
| | 1-28 | Feb. | 138.88 | | 1-28 | Feb. | 157.77 |
| | 1-31 | Mar. | 138.77 | | 1-31 | Mar. | 157.23 |
| | 1-30 | Apr. | 138.07 | | 1-30 | Apr. | 156.54 |
| | 1-31 | May | 137.65 | | 1-31 | May | 155.90 |
| | 1-30 | Jun. | 137.65 | | 1-30 | Jun. | 156.24 |
| | 1-31 | Jul. | 139.58 | | 1-31 | Jul. | 157.77 |

(To be continued on page A-68)

| YEAR | DY RANGE | MO. | WATR. LEV./M. | YEAR | DY RANGE | MO. | WATR LEV./M. |
|---|---|---|---|---|---|---|---|
| 1981 | 1-31 | Aug. | 160.88 | 1983 | 1-30 | Nov. | 174.52 |
| | 1-30 | Sep. | 164.69 | | 1-31 | Dec. | 175.04 |
| | 1-31 | Oct. | 167.77 | 1984 | 1-31 | Jan. | 175.04 |
| | 1-30 | Nov. | 170.68 | | 1-29 | Feb. | 174.59 |
| | 1-31 | Dec. | 172.58 | | 1-31 | Mar. | 173.46 |
| 1982 | 1-31 | Jan. | 172.96 | | 1-30 | Apr. | 172.20 |
| | 1-28 | Feb. | 172.76 | | 1-31 | May | 170.99 |
| | 1-31 | Mar. | 172.41 | | 1-30 | Jun. | 170.18 |
| | 1-30 | Apr. | 171.22 | | 1-31 | Jul. | 170.57 |
| | 1-31 | May | 170.44 | | 1-31 | Aug. | 170.91 |
| | 1-30 | Jun. | 169.99 | | 1-30 | Sep. | 171.71 |
| | 1-31 | Jul. | 170.66 | | 1-31 | Oct. | 172.75 |
| | 1-31 | Aug. | 172.59 | | 1-30 | Nov. | 173.31 |
| | 1-30 | Sep. | 175.37 | | 1-31 | Dec. | 172.80 |
| | 1-31 | Oct. | 176.18 | 1985 | 1-31 | Jan. | 172.67 |
| | 1-30 | Nov. | 176.57 | | 1-28 | Feb. | 171.95 |
| | 1-31 | Dec. | 176.32 | | 1-31 | Mar. | 170.73 |
| 1983 | 1-31 | Jan. | 175.83 | | 1-30 | Apr. | 169.28 |
| | 1-28 | Feb. | 175.12 | | 1-31 | May | 168.11 |
| | 1-31 | Mar. | 174.13 | | 1-30 | Jun. | 167.73 |
| | 1-30 | Apr. | 172.73 | | 1-31 | Jul. | 168.97 |
| | 1-31 | May | 171.37 | | 1-31 | Aug. | 170.47 |
| | 1-30 | Jun. | 169.81 | | 1-30 | Sep. | 173.32 |
| | 1-31 | Jul. | 168.76 | | 1-31 | Oct. | 176.31 |
| | 1-31 | Aug. | 168.19 | | 1-30 | Nov. | 177.66 |
| | 1-30 | Sep. | 168.54 | | 1-31 | Dec. | 178.01 |
| | 1-31 | Oct. | 171.42 | | | | |

## APPENDIX H.

MONTHLY AVERAGE WATER LEVEL OF KHAO LEAM DAM AND RESERVOIR.

| YEAR | DY RANGE | MO. | WATR. LEV./M. | YEAR | DY RANGE | MO. | WATR LEV./M. |
|---|---|---|---|---|---|---|---|
| 1984 | 1-30 | Jun. | 107.09 | 1984 | 1-31 | Jul. | 122.72 |
| | 1-31 | Aug. | 130.43 | | 1-30 | Sep. | 137.82 |
| | 1-31 | Oct. | 140.90 | | 1-30 | Nov. | 142.26 |
| | 1-31 | Dec. | 146.40 | 1985 | 1-31 | Jan. | 142.12 |
| 1985 | 1-28 | Feb. | 142.13 | | 1-31 | Mar. | 141.97 |
| | 1-30 | Apr. | 141.88 | | 1-31 | May | 141.86 |
| | 1-30 | Jun. | 143.10 | | 1-31 | Jul. | 144.71 |
| | 1-31 | Aug. | 149.62 | | 1-30 | Sep. | 152.85 |
| | 1-31 | Oct. | 153.53 | | 1-30 | Nov. | 153.93 |
| | 1-31 | Dec. | 153.47 | | | | |

## APPENDIX I.

### THE FEATURES OF SRINAKARIND DAM AND RESERVOIR

| | |
|---|---|
| Catchment Area. | 10,800 sq.km. |
| Reservoir. | |
| -Normal high water level | 180 m. |
| -Reservoir surface area at-<br>high water level. | 404.65 sq.km. |
| -Total storage capacity. | 17,200x$10^{6}$ cu.m. |
| -Effective storage capacity. | 4,350x$10^{6}$ cu.m. |
| -Reservoir area | 404.65 sq.km. |
| -Length of reservoir | 110.0 km. |
| Dam. | |
| -Type. | Rockfill with imprevious core. |
| -Height. | 140 m.(MSL) |
| -Crest length. | 615 m.(MSL) |
| -Volume. | 13,000x$10^{3}$ cu.m. |

## APPENDIX J.

### THE FEATURES OF KHAO LEAM DAM AND RESERVOIR

Catchment Area. 3,720 sq.km.

Reservoir.

- -Normal high water level 155.0 m.
- -Total storage capacity. $9,500 \times 10^{6}$ cu.m.
- -Effective storage capacity. $7,450 \times 10^{6}$ cu.m.
- -Reservoir area 356.0 sq.km.

Dam

- -Type. Rockfill dam with reinforce-concrete face.
- -Height. 164 m.(MSL)
- -Crest length. 980 m.(MSL)
- -Volume. $8,000 \times 10^{3}$ cu.m.

## APPENDIX K.

**THE RELATIONS IN $M_L$, $M_B$ AND $M_S$ SCALE. (After Bath, 1958).**

A unified magnitude $m$ with the following relations to $M_L$, $M_B$ and $M_S$ defined by Gutenberg and Richter:

$$m = 1.7 + 0.8\,M_L - 0.01\,M_L^2$$

$$m' = M_B$$

$$m = M_S - 0.37\,(M_S - 6.76)$$