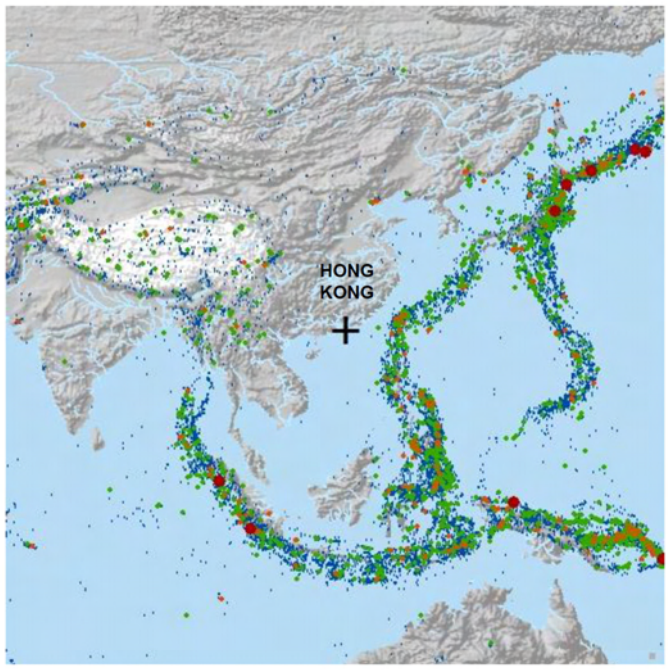
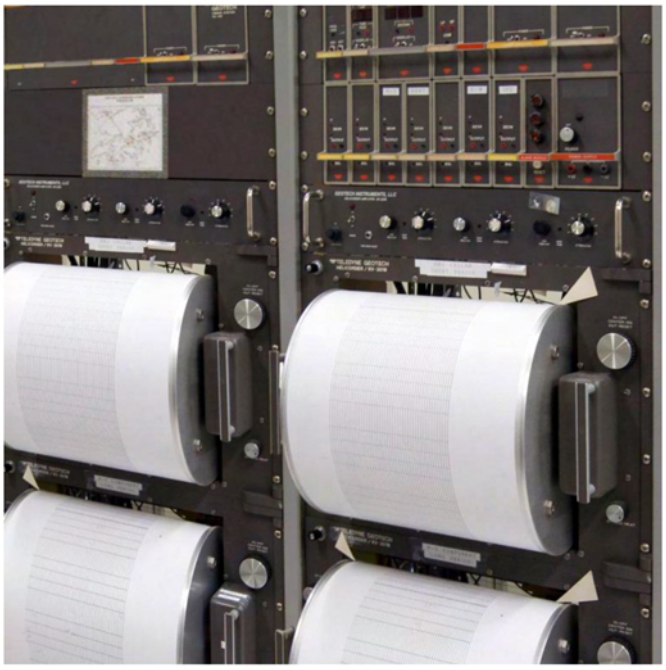
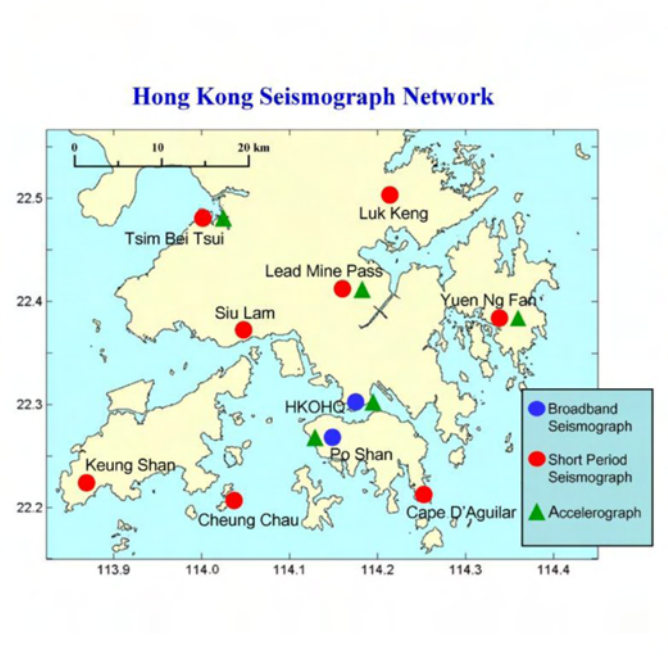
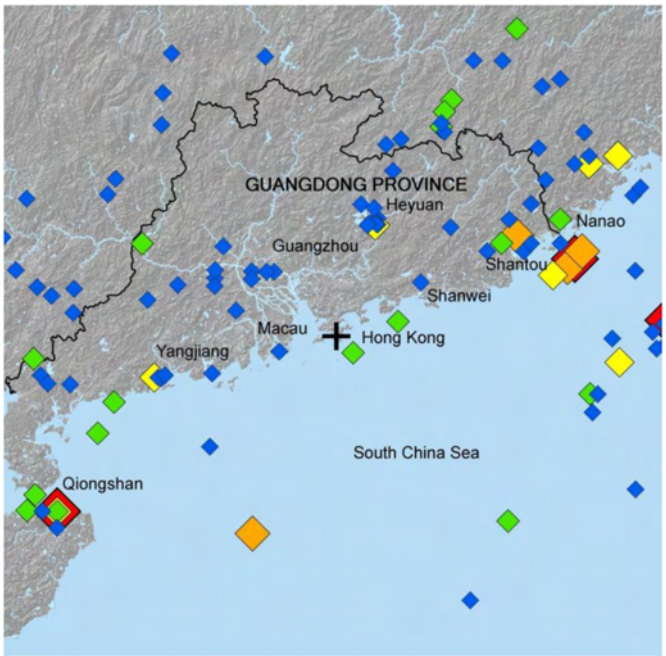
GEO Publication No. 1/2012

Review of Earthquake Data for the Hong Kong Region









Geotechnical Engineering Office
Civil Engineering and Development Department
The Government of the Hong Kong
Special Administrative Region

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Review of Earthquake Data for the Hong Kong Region

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Captions of Figures on the Front Cover:

Top Left	Seismicity Map Centred at Hong Kong (Earthquakes from 1973 to 2011 of Magnitude $M > 5$; Data Obtained from the Website of the United States Geological Survey)
Top Right	Seismograph of Monitoring Instrument in the Hong Kong Observatory (Courtesy of the Hong Kong Observatory)
Bottom Left	The Hong Kong Seismograph Network (Courtesy of the Hong Kong Observatory)
Bottom Right	Regional Seismicity Map Centred at Hong Kong (Extracted from Figure 3.1)

Foreword

This Publication presents available information on historical and recent earthquakes which have occurred within 500 km of Hong Kong, up to September 2011.

The Publication on "Review of Earthquake Data for the Hong Kong Region" was published in 1991 (Geotechnical Control Office Publication No. 1/91). This covered a region within approximately 350 km of Hong Kong and presented earthquake information up to the 1980s. Since then, more earthquake data within the region have been obtained by various earthquake monitoring agencies. These data are generally more accurate, as they have been recorded by advanced monitoring instruments. The GEO considers that it is timely and prudent to review the available earthquake data with a view to producing a more complete earthquake catalogue, and facilitating seismic studies in the region.

Data provided from various earthquake monitoring agencies, including Hong Kong Observatory (HKO), Earthquake Administration of Guangdong Province (EAGP), United States Geological Survey (USGS) and International Seismological Centre (ISC), have been collated and documented in the present Publication. As part of the study, intensities of earthquakes experienced in Hong Kong have been re-assessed using supplementary information obtained from local newspapers dating back to 1874.

This Publication was prepared by a team led by Dr J.W. Pappin of Arup, in collaboration with EAGP. The team members are Dr H. Jiang, Mr Y.B. Yu, Dr P.L. Chen, Ms M.M.L. So and Ms I.P.H. Yim. This work was overseen by Mr K.K.S. Ho and Mr Y.K. Shiu, and coordinated by Dr J.S.H. Kwan and Mr R.C.H. Koo. Colleagues of HKO, Mr H.Y. Mok and Mr W.C. Woo, provided valuable input to this Publication. Draft versions of the Publication were circulated to relevant Government departments and local academics for comment. The contributions of all parties are gratefully acknowledged.

Y.C. Chan
Head, Geotechnical Engineering Office
September 2012

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1 Introduction

1.1 Background

Prior to about 1970, there was a scarcity of earthquake data for the Hong Kong region. Previous studies had been carried out by the Hong Kong Observatory (HKO) (the then Royal Observatory, Hong Kong) to collect earthquake data for a region within 320 km of Hong Kong and evaluate the local seismicity of Hong Kong (Lau, 1972; Lam, 1980). The data given by Lau (1972) covered only a short period of 38 years from 1931 to 1968. Some major historical earthquakes, which were taken directly from earlier Chinese publications, were reported by Lam (1980).

There has been increasing public expression of interest in the seismicity of Hong Kong. A review of earthquake data in the Hong Kong region was presented in Geotechnical Control Office Publication No. 1/91 (GCO, 1991). Available information on earthquakes with epicentres located in the Hong Kong region, bounded by longitudes 111°0' E and 117°0' E, and latitudes 19°30' N and 25°30' N, covering a region within about 350 km of Hong Kong was documented in the Publication.

Since the issue of the above Publication, there has been continuous development in this subject and acquisition of additional earthquake data. For example, the Hong Kong Seismograph Network, established by HKO in 1979 to monitor earthquakes in the vicinity of Hong Kong, was expanded from four stations to nine stations in 1997 (Tam et al, 1997). The quantity and quality of earthquake data collected have been greatly improved since then.

This document is an update of GCO Publication No. 1/91 and provides reliable earthquake data for seismic studies of the Hong Kong region.

1.2 Objectives

The objectives of this document are:

(a) to update the earthquake catalogue given in GCO Publication No. 1/91 by incorporating relevant earthquake data from the following sources:

  (i) The Hong Kong Observatory (HKO);

  (ii) The Earthquake Administration of Guangdong Province (EAGP);

  (iii) The United States Geological Survey (USGS);

  (iv) The International Seismological Centre (ISC);

(b) to expand area of coverage of the earthquake catalogue to 500 km within Hong Kong for earthquake magnitude $M \geq 5.0$ and within 150 km of Hong Kong for earthquake magnitude $M \geq 2.1$;

(c) to document information of earthquakes felt in Hong Kong; and

(d) to assess the intensities of historical earthquakes experienced in Hong Kong that were reported in local newspapers.

2 Sources of Earthquake Records

2.1 General

A review of all known available earthquake records has been carried out in updating the earthquake catalogue. The earthquake records include historical and instrumental data.

Historical data means the earthquake records prior to instruments for seismic monitoring being invented. The earthquake magnitude was estimated based on descriptive records. In China, ancient records on earthquakes date back to about 4,000 years ago. In Guangdong Province, the first documented earthquake occurred in 288 A.D. Earthquake information for Guangdong is documented in some early western publications (e.g. Biot, 1841; MacGowan, 1887). Chinese publications, however, are considered to be more complete and reliable. Descriptions of the background and development of the relevant Chinese publications are given in Section 2.2.

Instrumental earthquake data are available since the beginning of the 20th Century. Initially, there were very few instruments around the world for recording earthquakes, one of which was a set of long-period seismographs set up by HKO in 1921. During the mid 1960s, the distribution and reliability of the world seismograph network had been greatly enhanced. International agencies including ISC and USGS provided access to their earthquake records. By 1970, the Chinese seismograph network was also becoming well established. EAGP have provided the earthquake data, which are monitored by the Department of Monitoring and Prediction of the China Earthquake Administration, since 1970. Their instruments are located in various parts of Guangdong Province to record the earthquakes of Local Magnitude (M_L) greater than about 2. EAGP carried out updating of an earthquake catalogue for the Guangdong region regularly. Relevant data in their latest catalogue have been included in this Publication.

HKO established a seismograph network to monitor earthquakes in the vicinity of Hong Kong in 1979, then expanded and upgraded it in 1997 (Tam et al, 1997). Interpreted data of earthquake ground motions measured by the HKO network were available since 2000. Details of the instrumental records are discussed in Section 2.3.

2.2 Historical Data

Within intraplate regions such as southeast China, the instrumental data of earthquakes cover a relatively short time span of about 100 years compared with the geological time scale involved in the recurrence of earthquakes. In order to extend the period of coverage, historical records of earthquakes are also included in this Publication. By collating the "observed" or "felt" effects of earthquakes, which are referred to as macroseismic data, the corresponding earthquake size and location are estimated.

The sources of historical data provided by EAGP are largely extracted from the following Chinese publications:

(a) "Directory of Historical Strong Earthquakes in China (23rd Century B.C. to 1911 A.D.)" by the Department of

Earthquake Disaster Prevention, China Earthquake Administration (DEDP, 1995);

(b) "Directory of Recent Earthquakes in China (1912 A.D. to 1990 A.D.)" by the Department of Earthquake Disaster Prevention, China Earthquake Administration (DEDP, 1999); and

(c) "Directory of Strong Earthquakes in China (23rd Century B.C. to 2005 A.D.) for earthquakes after 1990 A.D." by the Department of Monitoring and Prediction, China Earthquake Administration (DMP, 2005).

The first two directories consolidated earthquake data reported in earlier documents including the first formal publication of the earthquake data in China entitled "Chronological Tables of Earthquake Data of China", published in 1956 (Academia Sinica, 1956), and "Catalogue of Earthquakes in China" by Gu et al (1983).

In addition to the catalogues published by Academia Sinica and Gu et al (op cit), seismological authorities in a number of provinces in the Mainland China also published their own catalogues to include local earthquakes of smaller magnitudes. In the late 1970s, a committee was set up in the Mainland China to review and consolidate available documents on earthquake records. This resulted in a five-volume set of catalogues entitled "Compilation of Historical Materials on Chinese Earthquakes", published between 1983 and 1986 by the Editorial Committee on Historical Materials on Chinese Earthquakes (ECHMCE, 1983-1986). In 1988, the report entitled "Summary of Chinese Earthquake Catalogue (780 B.C. - 1986 A.D.)" (CEA, 1988) was published.

In addition to the above three directories, earthquake hazard assessment reports for feasibility study on construction of major infrastructure in the Guangdong region contain historical earthquake data. EAGP had reviewed those reports and consolidated the earthquake data to supplement their database (see Appendix A).

Notwithstanding, the above historical data are incomplete and their reliability varies for different time periods and different locations. Clearly most earthquakes occurring within the South China Sea prior to the installation of seismological instruments in Hong Kong and other places might not be felt on land. Even on land, the reliability of the information depends on the quality of the written records. Generally, the data reliability deteriorates as it gets older but there could be exceptions with some periods of history being more properly retained than the others.

2.3 Instrumental Data

Earthquakes can be recorded instrumentally by seismometers or accelerometers set up in seismic stations. Those seismic stations are connected to form a seismograph network. The recorded data can be analysed for estimation of epicentral locations and earthquake magnitudes.

2.3.1 Worldwide Instrumental Data

Seismological instruments first began to be deployed in the beginning of the 20th Century and their worldwide detection capabilities have improved with time. The reliability of the data greatly improved in the mid 1960s due to the deployment of a sensitive and geographically uniform instrumental network. The Global Seismographic Network (GSN) and the co-operation of a variety of seismic reporting networks worldwide were systematically developed at about that time. The GSN is a permanent digital network of state-of-the-art seismological and geophysical sensors connected by a telecommunication network. There are over 150 modern seismic stations distributed globally for worldwide monitoring.

The ISC collects seismogram readings from station networks throughout the world in co-operation with other seismological data centres and seismological organisations, so that the focal location and magnitude of each earthquake event can be determined. The ISC website contains an earthquake catalogue of events since 1900. Their ISC catalogue indicates recommended magnitude for events that have different magnitudes determined by different parties.

The USGS provides earthquake information including automatically detecting, locating and characterising earthquake events by using the data of the GSN. The USGS gathers the data to determine the location and magnitude of earthquakes worldwide and publishes the results as an earthquake bulletin regularly. The USGS website provides an earthquake catalogue of events since 1973. Generally, events with a magnitude greater than about 4 are included in the catalogue.

2.3.2 Chinese Instrumental Data

Since 1970, the Department of Monitoring and Prediction of the China Earthquake Administration has maintained a database of local instrumentally recorded earthquakes with local earthquake magnitudes $M_L \geq 2.1$. This information has been provided by EAGP and compiled in this Publication. The locations of the instruments are spaced at about 40 km to 50 km apart across Guangdong Province.

2.3.3 Hong Kong Instrumental Data

In 1921, a set of 3-component long-period seismographs, using smoke papers for recording, was established by HKO. An underground cellar (HKO Cellar) was constructed in 1923 inside the 1883 building of their Headquarters in Tsim Sha Tsui to accommodate the instruments.

In 1979, HKO acquired electronic recording equipment for the long-period seismometers with pen-and-ink type recorders that replaced photographic recording. In the same year, a short-period seismograph network comprising four seismological stations, located at HKO Cellar, Tsim Bei Tsui, Yuen Ng Fan and Cheung Chau, was established. The network was expanded in 1997 with the addition of five seismological stations at Cape D'Aguilar, Keung Shan, Lead Mine Pass, Luk Keng and Siu Lam. The equipment was

upgraded to support digitisation of waveform data at stations at the same time. The stations are spread over the territory in order to achieve long baselines for better computation of epicentral positions. A review of instrumental earthquake data in the vicinity of Hong Kong had been carried out by Chan & Zhao (1996) and Chan et al (1997).

A new seismograph station, the Po Shan Seismograph Station (HKPS), started operation in February 2010. It is located inside a drainage tunnel on Po Shan Road, Mid-Levels, Hong Kong Island, about 300 m deep in the mountain. The station is equipped with a high-quality broadband seismometer and a strong motion accelerometer together with a 26-bit digitizer (Woo & Wong, 2010).

In 2011, accelerometers were installed and commissioned in the seismological stations at Tsim Bei Tsui, Lead Mine Pas, Yuen Ng Fan and HKO Cellar. Together with the existing accelerometer in HKPS, these five accelerometers record and provide real-time data on ground motion.

3 Earthquake Catalogues

3.1 General

This Publication contains the following two earthquake catalogues:

(a) Regional Earthquake Catalogue; and

(b) Local Earthquake Catalogue.

3.2 Regional Earthquake Catalogue

This catalogue lists all known earthquake events with moment magnitude (M_W) of at least 5 that occurred within 500 km of Hong Kong based on available records up to September 2011. It is considered that seismic effects of earthquakes located beyond the cut-off distance of 500 km from Hong Kong will become less significant for the evaluation of seismic hazard. Both historical and instrumental data are included in the catalogue. The earthquake events are presented in Figure 3.1 and the catalogue is contained in Appendix C. This catalogue has been compiled after reviewing the information provided by the following sources:

(a) EAGP;

(b) USGS;

(c) ISC; and

(d) GCO Publication No. 1/91.

The information provided by EAGP has been used as a basis for assessing the earthquake magnitudes and locations in compiling the catalogue. The moment magnitude in the catalogue is converted from the macroseismic or instrumental magnitudes provided by EAGP. Where appropriate the magnitude and depth from the records of the ISC, the USGS, and GCO Publication No. 1/91 are included. The distance of the earthquake from Hong Kong is calculated based on the location of HKO Compound at Tsim Sha Tsui (114° 10’ E, 22° 18’ N). Explanatory notes for the catalogue are presented in Appendix B.

3.3 Local Earthquake Catalogue

This catalogue contains all known instrumental earthquake records for events with M_L of at least 2.1 that occurred within 150 km of Hong Kong from the beginning of 1970 to September 2011. It is considered that seismic effects of earthquake magnitude less than 5 and distance greater than 150 km from Hong Kong will become less significant in the evaluation of seismic hazard. Figure 3.2 shows the earthquake data provided by HKO for those reported events within the territory of Hong Kong and the earthquake data outside Hong Kong provided by EAGP. The earthquake data provided by HKO and EAGP are listed in Appendix D. It should be noted that foreshocks and aftershocks are included (see Appendix B for detailed explanatory notes).

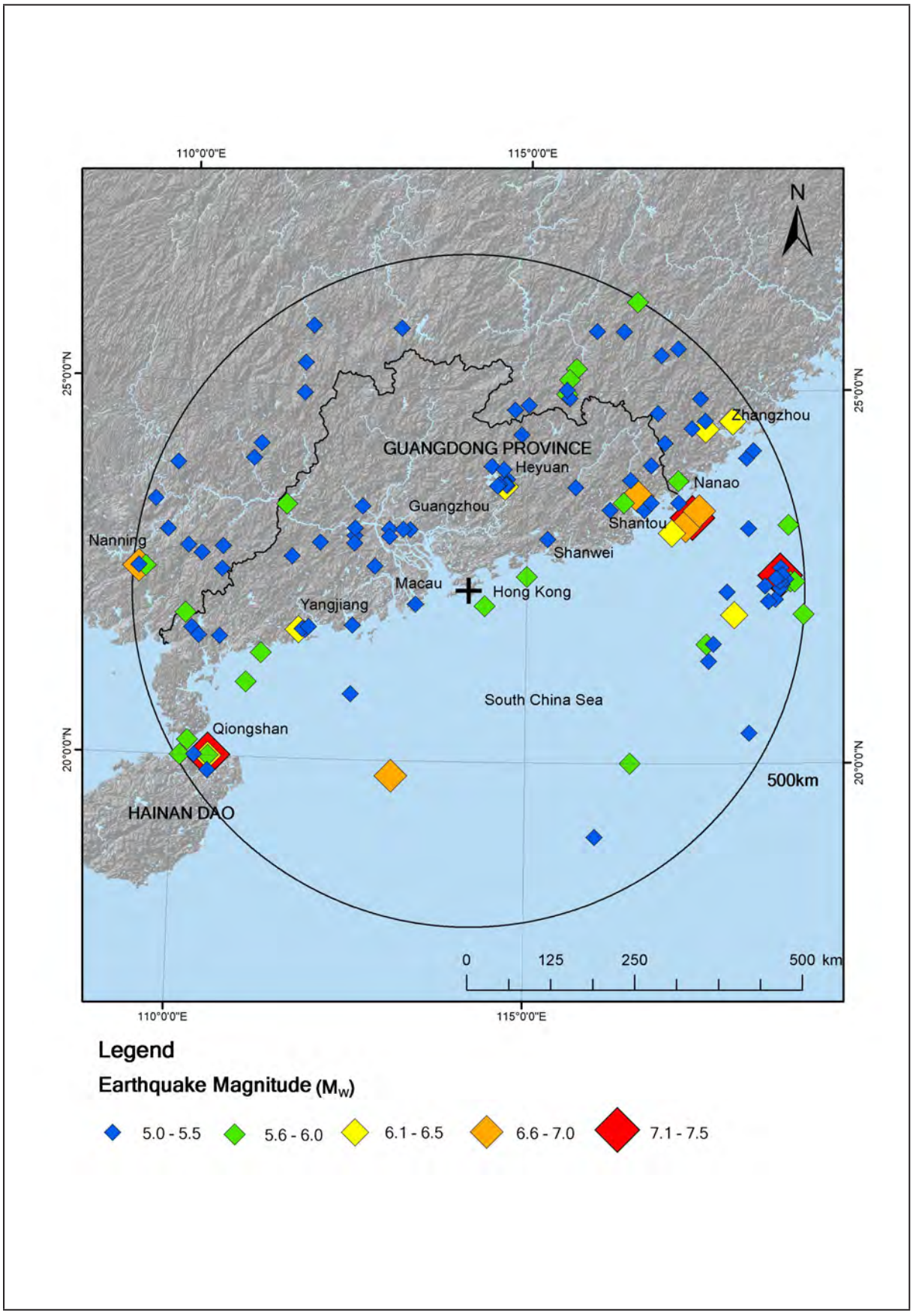


Figure 3.1 Earthquake Events in the Regional Earthquake Catalogue

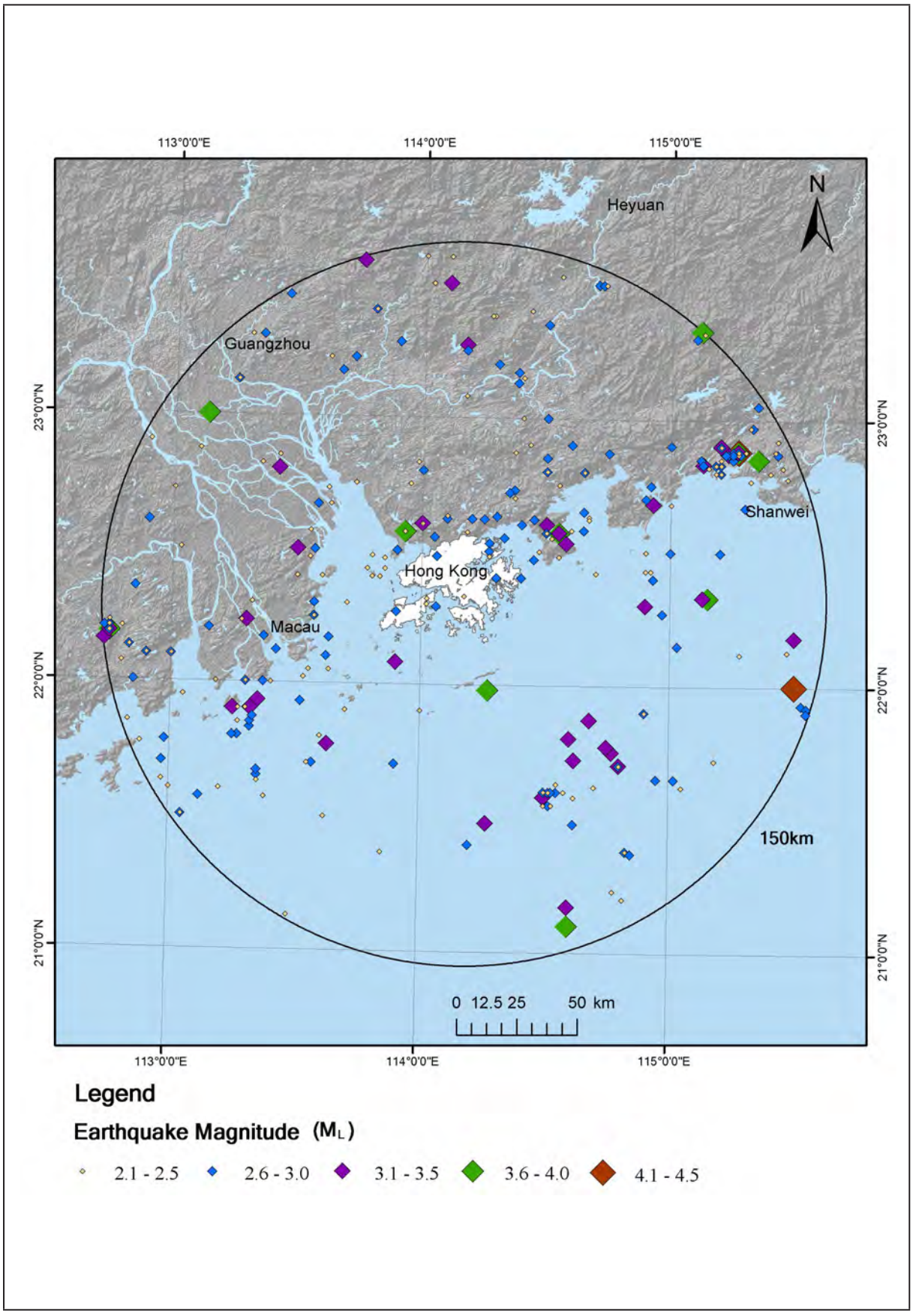


Figure 3.2 Earthquake Events in the Local Earthquake Catalogue

4 Earthquake Magnitude and Intensity

4.1 General

One of the seismic parameters given in the earthquake catalogues in Appendices C and D is earthquake magnitude, which is a measure of earthquake size. The magnitude scales used in the various sources of information are different, namely Richter or local magnitude (M_L), body wave magnitude (m_b), surface wave magnitude (M_S) and moment magnitude (M_W). Macroseismic magnitude was recorded for historical earthquakes that were not monitored by any instrument. For seismic hazard assessment, it is necessary to unify the magnitude of earthquakes to the same scale. In recent years, moment magnitude is considered to be the most appropriate scale. It is directly related to the energy released by earthquakes and it does not suffer from the limitation of tending to saturate at large magnitudes.

4.2 Macroseismic Magnitude

For historical earthquakes, no instrumental data are available and the earthquake magnitude has to be estimated from empirical correlations. Relationships between magnitude (often the surface-wave magnitude) and epicentral intensity (detailed descriptions of the intensity scale are presented in Appendix G) are usually used. The estimated magnitude is known as macroseismic magnitude.

The correlation between the macroseismic magnitude and the intensity adopted in various Chinese earthquake directories, referenced by EAGP, is as follows:

$$M_{SC} = 0.579\, I_0 + 1.403 \quad \text{..... (4.1)}$$

where M_{SC} = macroseismic surface-wave magnitude
I_0 = epicentral earthquake intensity.

It should be noted that the calculated M_{SC} values presented in Chinese earthquake directories have been rounded off to the nearest ¼ unit. The epicentral earthquake intensity (I_0) of the events included in the Chinese earthquake directories was determined based on the Chinese Seismic Intensity (CSI) scale developed by Hsieh (1957). Table G1 of Appendix G provides a summary of this intensity scale and compares this scale with the modified Modified Mercalli Intensity (MMI) scale used by USGS (2009). The CSI scale was subsequently modified to become the intensity scale presented in GB/T 17742-2008 (2008). However, the definitions of the two intensity scales are generally similar.

When earthquakes did not cause any damage on buildings, or where the epicentres were located in remote areas, I_0 of the earthquakes cannot be assessed, and hence M_{SC}. In such cases, M_{SC} has been determined empirically based on the equivalent radius of Intensity IV isoseismal as shown in Equation 4.2.

$$M_{SC} = 1.60 \log R_{IV} + 2.12 \quad \text{..... (4.2)}$$

where M_{SC} = macroseismic surface-wave magnitude
R_{IV} = equivalent radius of Intensity IV isoseismal (in km).

4.3 Instrumental Magnitude

Modern seismographs record ground motions as a function of time. The estimation of an earthquake's size or magnitude can be estimated based on the distance from a seismograph to the earthquake and the maximum signal amplitude recorded. There are several different methods to determine an earthquake size.

(a) Local Magnitude (M_L)

M_L measures the local earthquakes (at distances up to about 600 km from the recording station) and was the first widely used instrumental magnitude scale in the United States (Richter, 1935). It is defined as follows:

$$M_L = \log (a) - \log (a_0) \quad \text{..... (4.3)}$$

where a is the maximum trace amplitude recorded by a standard instrument (the Wood Anderson Torsion seismometer) and a_0 is amplitude of background noise at the same distance. A problem with this method is that earthquakes having magnitude greater than 6.5 exhibit similar amplitude readings. This problem is referred to as "saturation".

(b) Surface Wave Magnitude (M_S)

The surface-wave magnitude scale was developed to solve the "saturation" problem of Richter magnitude above M_L of 6.5. M_S measures the surface waves (Rayleigh waves) that travel primarily at teleseismic distances (Gutenberg, 1945) along the uppermost layers of the earth and is defined as follows:

$$M_S = \log (A/T) + s \quad \text{..... (4.4)}$$

where A is the maximum displacement (in μm), T is the period of seismic displacement (in s), and s is a correction term for distance of the seismic station and depth of the earthquake.

However, the surface-wave magnitude scale also has a "saturation" problem for events larger than an M_S of about 8.

(c) Body Wave Magnitude (m_b)

The body-wave magnitude (m_b) is commonly used in tectonically stable regions (e.g. eastern parts of North America and Canada). m_b measures earthquakes using the body wave (P-wave). The definition is the same as for M_S

but with a different correction term (s). According to Kanamori (1983), this magnitude scale also suffers from the "saturation" problem.

Determination of magnitude requires a different range of frequencies in the seismogram. M_S and m_b are the extension of M_L and can give magnitude estimates at greater distances. However, these three scales are based on the maximum amplitude of seismogram recordings which could be "saturated" for large magnitude events. This means that the amplitude of waves recorded may not be able to reflect the real size of large earthquakes. The moment magnitude scale was proposed by Kanamori (1977) and Hanks & Kanamori (1979), and is fundamentally different from the above scales as discussed below.

(d) Moment Magnitude (M_W)

M_W is the latest concept in magnitude determination based on seismic moment (M_0). M_0 measures the size of an earthquake by fault geometry and slip, and can be used to measure local or distant earthquakes. M_0 is defined as follows:

$$M_0 = D\,A\,\mu \quad \text{..... (4.5)}$$

where D is average displacement over the entire fault surface (in cm), A is area of fault surface (in cm^2), and μ is average shear rigidity of the faulted rocks (in dyn/cm^2). The value of D is estimated from observed surface displacements or from displacements on the fault plane reconstructed from instrumental or geodetic modelling.

M_W is related to M_0 by the following correlation (Kanamori, 1977):

$$M_W = 2/3 \log (M_0) - 10.7 \quad \text{..... (4.6)}$$

where the unit of M_0 is dyne centimetres (or 10^{-7} Nm).

4.4 Magnitude Conversion

The earthquake data in the catalogues presented in Appendices C and D have been compiled from different international and local sources. Different magnitude scales (e.g. M_L, M_S, m_b and M_W) are reported in those earthquake data sources. For small earthquakes, the measured values of those different magnitude scales are similar. To facilitate consistent comparisons, the magnitude scale for large earthquake event can be converted into M_W by empirical relationships as described below:

(a) for converting local magnitude (M_L) to moment magnitude (M_W), the following relationship proposed by Free (1996) is used:

$$M_W = 0.84 + 0.79\, M_L \quad \text{..... (4.7)}$$

(b) for other magnitude scales (m_b and M_S), the following conversion relationships developed by Johnston (1996a and 1996b) have been used to determine seismic moment (M_0) :

$$\log (M_0) = 18.75 + 0.496\, (m_b) + 0.094\, (m_b)^2 \quad \text{..... (4.8)}$$

$$\log (M_0) = 24.67 - 1.077\, (M_S) + 0.190\, (M_S)^2 \quad \text{..... (4.9)}$$

The calculated M_0 can then be converted to moment magnitude (M_W) using Equation 4.6.

M_W values in the Regional Earthquake Catalogue have been calculated based on EAGP's data using the above equations.

4.5 Other Seismic Parameters for Magnitude Determination

The available seismic parameters to determine the magnitude of some of the earthquakes between 1905 and 1964 have been extracted from GCO Publication No. 1/91 and reproduced in Appendix E. After 1964, the ISC collected earthquake information (including seismic parameters) worldwide. Updated and detailed information of seismic parameters can be found in the ISC (2011) website (http://www.isc.ac.uk).

5 Earthquakes Felt in Hong Kong

Earthquakes are occasionally felt in Hong Kong. Data and information from these earthquakes could be useful for the assessment of seismic hazard.

HKO maintains a record of locally felt earth tremors since 1979 when their seismographs went into operation. Seismicity data of the earlier earthquakes which could be felt in Hong Kong can be extracted from the directories of historical strong earthquakes, and EAGP's internal reports. EAGP collected various pieces of available information and advised that 17 notable historical earthquakes could have been felt in Hong Kong before 1979. Detailed information of the earthquakes is presented in Table 5.1 and the corresponding epicentres are shown in Figure 5.1. A search of Hong Kong newspaper records of these events has been carried out with an aim to collecting more factual information for assessing the earthquake intensity experienced in Hong Kong. Appendix H presents direct quotes of the newspaper records and brief assessments of the earthquake intensity.

HKO publishes a list of the earthquake events experienced in Hong Kong since 1979 on their website (http://www.hko.hk). Table 5.2 presents the data listed by HKO for intensity III or above, which are considered as noticeable earthquakes in general, to September 2011. The epicentres of these events are shown in Figure 5.2.

Table 5.1 Earthquakes before 1979 Likely to Have Been Felt in Hong Kong

No.	Hong Kong Time				Universal Time#				Location	Lat.	Long.	M_S	M_W	Intensity Felt at HK	Distance (km)
	Year	Month	Day	Time	Year	Month	Day	Time							
1*	1067	11	12						Chaozhou	23.6	116.6	6¾	6.7		270
2*	1185	6	15						Zhangzhou	24.6	118.0	6½	6.4		440
3	1372	9	25						Guangzhou	23.1	113.3	4¾	5.2	< V	120
4*	1600	9	29						Nanao	23.2	117.3	7	6.9	≤ V	340
5*	1604	12	29						Zhangzhou	24.7	119.0	8	8.1		540
6*	1605	7	13						Qiongshan	20.0	110.5	7½	7.5		430
7*	1664	9	30						Taishan	21.8	112.5	5	5.3	< V	200
8*	1824	8	14						Guangzhou	23.0	113.0	5	5.3	< V	150
9*^	1874	6	23	09:23	1874	6	23	01:23	Dangan Island	22.1	114.4	5¾	5.8	< VII	32
10*^	1892	4	22	09:40	1892	4	22	01:40	Taiwan	22.7	120.2	6	6.0		660
11*^	1895	8	30	17:45	1895	8	30	09:45	Jieyang	23.5	116.4	6	6.0		250
12*^	1905	8	12	20:25	1905	8	12	12:25	Macau	22.1	113.4	5	5.3	IV - V	100
13*^	1911	5	15	00:41	1911	5	14	16:41	Haifeng	22.5	115.0	6	6.0	< VI	80
14*^	1918	2	13	14:07	1918	2	13	06:07	Nanao	23.3	117.4	7.3	7.3	V - VI	350
15*^	1931	9	21	18:27	1931	9	21	10:27	South China Sea	19.8	113.1	6¾	6.7	IV - V	170
16*^+	1962	3	19	05:18	1962	3	18	20:18	NW Heyuan	23.71	114.67	6.1	6.1	< V	80
17*^+	1969	7	26	07:49	1969	7	25	22:49	Yangjiang	21.73	111.73	6.4	6.3		290

Notes:
- * indicates that isoseismal map of the event is provided in Appendix F.
- ^ indicates that newspaper records of the events are available and the records are given in Appendix H.
- # Universal Time is given where the time information is available.
- + Summer Time used in Hong Kong (see explanatory note in Appendix B.2.1).

Table 5.2 Events Felt in Hong Kong from 1979 to 2011 as Listed by HKO (Sheet 1 of 3)

No.	Hong Kong Time				Universal Time				Location	Lat.	Long.	Magnitude^	Distance (km)	Number of Reports
	Year	Month	Day	Time	Year	Month	Day	Time						
1	1981	4	9	09:04	1981	4	9	01:04	Haifeng, Guangdong	23.0	115.4	4.2	150	A few
2*	1982	2	25	08:39	1982	2	25	00:39	Southern Longnam, Jiangxi	24.7	114.8	4.4	270	9
3	1982	8	30	04:23	1982	8	29	20:23	East of Lantau Island	22.3	114.0	2.5	18	12
4	1982	10	7	22:13	1982	10	7	14:13	East of Lantau Island	22.3	113.9	2.6	18	12
5	1983	6	24	15:18	1983	6	24	07:18	Northwestern Vietnam	21.7	103.3	6.6	1120	24
6	1983	12	6	22:26	1983	12	6	14:26	Mai Po, Hong Kong	22.5	114.0	2.8	28	12
7	1985	4	24	00:15	1985	4	23	16:15	Central Luzon	15.3	120.6	6.3	1030	5
8*	1986	1	28	07:14	1986	1	27	23:14	Yangjiang, Guangdong	22.0	111.5	4.1	280	9
9*	1987	2	25	22:28	1987	2	25	14:28	Yangjiang, Guangdong	21.7	111.6	4.1	270	20
10*	1987	8	2	17:08	1987	8	2	09:08	Xunwu, Jiangxi	24.9	115.6	4.9	330	28
11	1989	11	26	00:14	1989	11	25	16:14	Heyuan, Guangdong	23.7	114.6	5.1	160	18

Table 5.2 Events Felt in Hong Kong from 1979 to 2011 as Listed by HKO (Sheet 2 of 3)

No.	Hong Kong Time				Universal Time				Location	Lat.	Long.	Magnitude^	Distance (km)	Number of Reports
	Year	Month	Day	Time	Year	Month	Day	Time						
12	1991	9	21	23:37	1991	9	21	15:37	Heyuan, Guangdong	23.9	114.5	4.2	170	18
13	1992	9	14	21:16	1992	9	14	13:16	Dongsha Dao	21.4	117.8	5.4	380	18
14	1994	9	16	14:20	1994	9	16	06:20	Southern Taiwan Strait	22.5	118.7	7.3	470	105
15	1994	12	31	10:57	1994	12	31	02:57	Beibu Wan	20.5	109.3	5.7	540	6
16	1995	1	10	18:10	1995	1	10	10:10	Beibu Wan	20.2	109.2	5.5	570	10
17	1995	2	25	11:15	1995	2	25	03:15	East of Xiamen, Fujian	24.3	118.7	4.9	510	4
18	1995	3	26	11:24	1995	3	26	03:24	South of Xiachuan Dao	21.0	112.4	4.2	230	5
19	1995	5	11	09:59	1995	5	11	01:59	East of Lantau Island	22.3	114.1	3.1	12	47
20	1996	3	5	22:52	1996	3	5	14:52	East of Taiwan	24.1	122.2	6.4	840	2
21	1999	3	25	06:10	1999	3	24	22:10	Heyuan, Guangdong	23.7	114.6	4.4	160	30
22	1999	8	20	01:15	1999	8	19	17:15	Heyuan, Guangdong	23.7	114.6	4.5	160	29
23	1999	9	21	01:47	1999	9	20	17:47	Central Taiwan	23.8	121.0	7.7	710	47
24	1999	9	26	07:53	1999	9	25	23:53	Central Taiwan	23.7	121.2	6.5	730	8

Table 5.2 Events Felt in Hong Kong from 1979 to 2011 as Listed by HKO (Sheet 3 of 3)

No.	Hong Kong Time				Universal Time				Location	Lat.	Long.	Magnitude^	Distance (km)	Number of Reports
	Year	Month	Day	Time	Year	Month	Day	Time						
25	1999	9	30	13:24	1999	9	30	05:24	Dapeng Peninsula, Guangdong	22.5	114.5	3.8	40	19
26	1999	10	22	10:19	1999	10	22	02:19	Central Taiwan	23.4	120.5	5.9	660	16
27	1999	10	22	11:10	1999	10	22	03:10	Central Taiwan	23.4	120.5	5.6	660	18
28	1999	12	12	02:04	1999	12	11	18:04	Western Luzon	15.8	119.7	7.3	930	15
29	2000	6	11	02:24	2000	6	10	18:24	Central Taiwan	23.8	121.2	6.4	740	5
30	2002	3	31	14:53	2002	3	31	06:53	East of Taiwan	24.3	122.2	7.4	850	15
31	2003	12	10	12:38	2003	12	10	04:38	Southeast of Taiwan	23.0	121.4	6.8	740	13
32	2006	9	14	19:53	2006	9	14	11:53	Near Dangan Island	22.0	114.3	3.5	36	200+
33	2006	12	26	20:26	2006	12	26	12:26	Near Southern Taiwan	21.8	120.6	7.2	660	300+
34	2010	11	19	14:42	2010	11	19	06:42	Deep Bay in Shenzhen	22.5	114.0	3.7	31	100+
35	2011	3	20	16:26	2011	3	20	08:26	Southern part of the Luzon Strait	19.1	121.1	6.0	800	10

Notes: * indicates that isoseismal map of the event is provided in Appendix F.
^ no information on the scale of magnitude is provided by HKO.

Remark: Earthquake parameters in this table were determined by preliminary analyses at the time of issuance of the corresponding earthquake press releases.

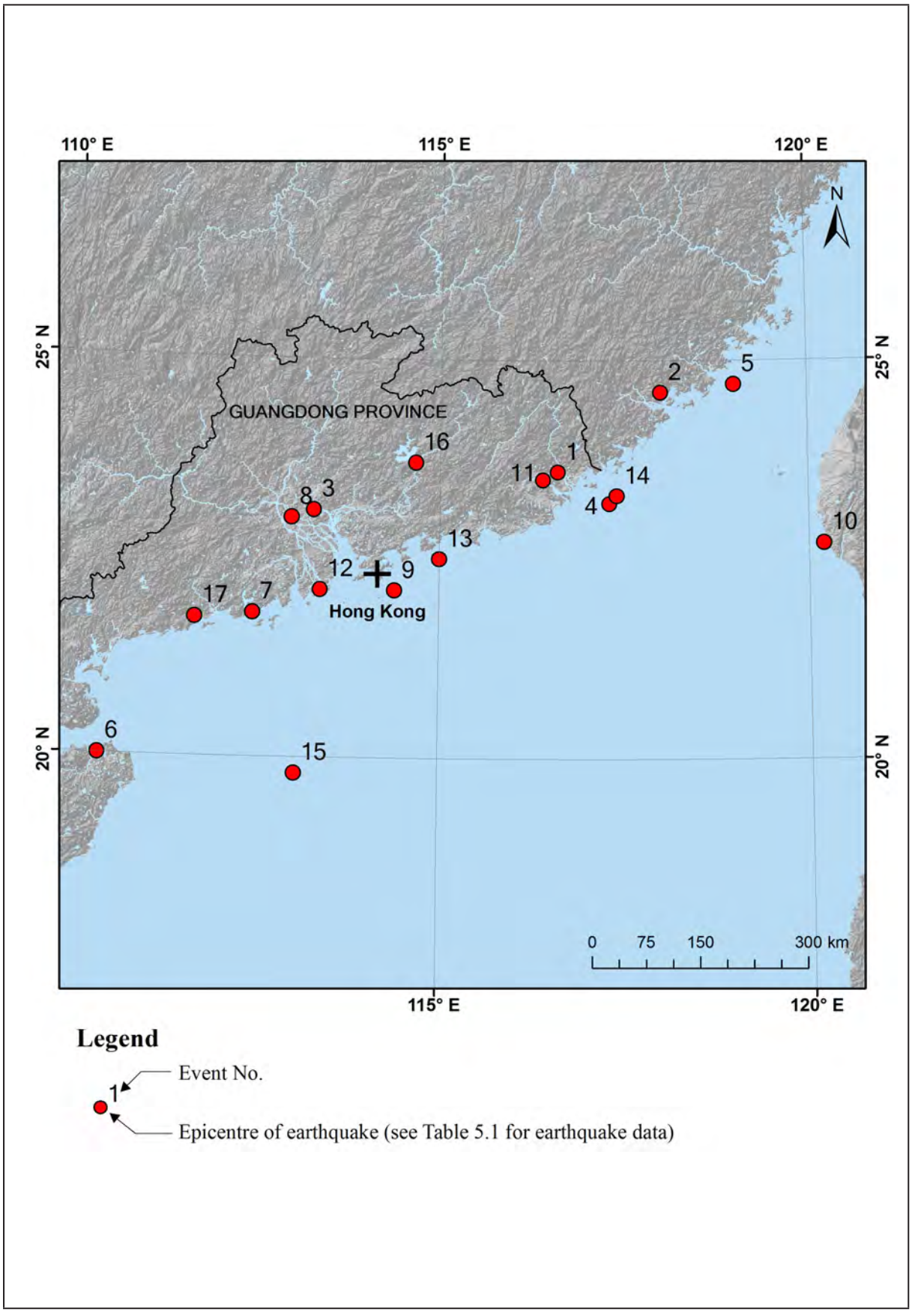
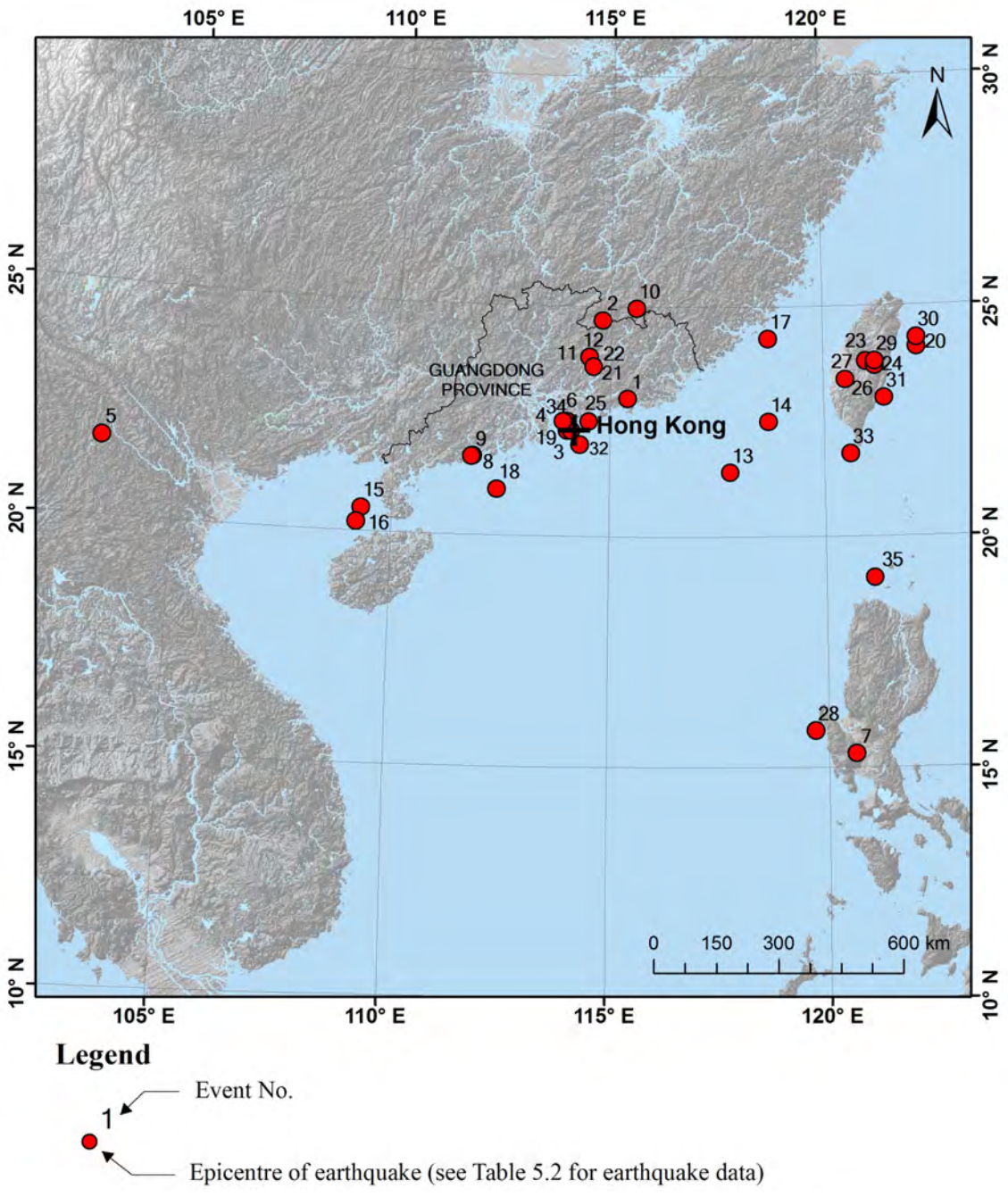


Figure 5.1 Earthquakes before 1979 Likely to Have Been Felt in Hong Kong



Note: Earthquakes presented in this figure have intensity III or above.

Figure 5.2 Earthquakes Felt in Hong Kong from 1979 to 2011 (as Listed by HKO)

6 Summary

Earthquake information within 500 km of Hong Kong has been collated to compile the Regional Earthquake Catalogue and the Local Earthquake Catalogue. These two earthquake catalogues are presented in Appendices C and D respectively of this Publication. The Regional Earthquake Catalogue contains all known earthquake events having $M_W \geq 5.0$ within 500 km of Hong Kong up to September 2011. The Local Earthquake Catalogue includes all instrumentally recorded events in the time period between January 1970 and September 2011 having $M_L \geq 2.1$ within 150 km of Hong Kong.

Events which are likely to have been felt in Hong Kong before 1979 and events which were felt in Hong Kong from 1979 to 2011 are listed in Tables 5.1 and 5.2 respectively. Available isoseismal maps of those events are provided in Appendix F.

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Appendix A

Summary of the Data Sources

Contents

A.1 General

This appendix gives background information on the sources used for compiling the earthquake catalogues.

A.2 Earthquake Administration of Guangdong Province (EAGP)

According to EAGP, their earthquake data are derived based on the following references:

(a) "Directory of Historical Strong Earthquake (23rd Century B.C. to 1911 A.D.)" by the Department of Earthquake Disaster Prevention, China Earthquake Administration (DEDP, 1995);

(b) "Directory of Recent Earthquakes in China (1912 A.D. to 1990 A.D.)" by the Department of Earthquake Disaster Prevention, China Earthquake Administration (DEDP, 1999);

(c) "Directory of Strong Earthquakes in China (23rd Century B.C. to 2005 A.D.) for earthquakes after 1990 A.D." by the Department of Monitoring and Prediction, China Earthquake Administration (DMP, 2005);

(d) instrumental data of the Guangdong Seismograph Network;

(e) earthquake catalogue of Fujian by the China Earthquake Administration; and

(f) feasibility study reports on construction of major infrastructures in Guangdong region by EAGP.

Data of aftershocks and earthquakes induced by the Xinfengjiang Reservoir at Heyuan are included.

A.3 Hong Kong Observatory (HKO)

HKO monitors earthquakes using the Hong Kong Seismograph Network and analyses the seismic data to determine parameters for earthquakes of local magnitude (M_L) 1.5 or above, within 200 km of the HKO Headquarters (latitude 22° 18' N, longitude 114° 10' E). The parameters are provided to various organisations, including Civil Engineering and Development Department (CEDD), China Earthquake Administration, EAGP, ISC and the Hong Kong University (HKU) on monthly or quarterly basis for reference. HKO maintains a database of the seismic data, and provides the parameters and data to interested organisations upon request.

A.4 United States Geological Survey (USGS) - National Earthquake Information Centre (NEIC)

The National Earthquake Information Centre (NEIC) in USGS collects data from a variety of seismic reporting networks worldwide. The data are used to determine the location and magnitude of significant earthquakes. The results are published in their Earthquake Bulletins and catalogues. The USGS data set contains information of earthquakes, since 1973 generally with magnitudes $M > 4$.

A.5 International Seismological Centre (ISC)

The main task of ISC is to re-determine earthquake location making use of all available worldwide earthquake information, and search for earthquakes, previously unidentified by individual parties. The relevant seismic parameters to determine earthquake magnitude can be found in the ISC website (ISC, 2011). The ISC earthquake catalogue includes events that have occurred since 1900.

A.6 Review of Earthquake Data for the Hong Kong Region (GCO Publication No. 1/91)

GCO Publication No. 1/91 (GCO, 1991) consolidated and reviewed all available literature known to GCO at the time of publication specifically for the Hong Kong region. The report contains a summary of known earthquakes within the Guangdong region with macroseismic magnitude ≥ 4¾ and instrumental magnitude ≥ 4.0 up to 1989. This information was largely compiled on the basis of information given by the Editorial Committee on Historical Materials on Chinese Earthquakes (ECHMCE, 1983 - 1986). Other sources used to augment the catalogue are as follows:

(a) earthquake database of the ISC;

(b) Lee et al (1976); and

(c) Ding et al (1984).

A.7 References

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Appendix B

Explanatory Notes of Earthquake Catalogues

Contents

B.1 General

Explanatory notes on the information given in the Regional Earthquake Catalogue in Appendix C and the Local Earthquake Catalogue in Appendix D are presented below.

B.2 Regional Earthquake Catalogue

B.2.1 Date and Time of Occurrence

Universal date and time are given, where the chronological information is available, by converting from Beijing local time recorded in EAGP's data.

Only the year, month and day are recorded for most of the historical earthquakes. Chronological data for some of these events are incomplete, for example, time of occurrence of some events is not available. However, it is noted that the time of occurrence for historical earthquake events on 23 June 1874, 30 August 1895 and 12 August 1905 was reported in local newspaper records. The reported time is included in the catalogue. It should be noted that Hong Kong used Summer Time for various periods of the year from 1941 until 1979. The Summer Time has been considered for the earthquake events in 1962 and 1969 and it is nine hours ahead of Universal Time, as described in Appendix H.

B.2.2 Epicentre Location

The latitude and longitude of the epicentres based on the information provided by EAGP are listed in the catalogue. The locations are given to precision of 0.1 degrees before 1970, except for those events with post-earthquake field investigation. After 1970, the locations are given with a precision up to 0.01 degrees.

B.2.3 Magnitude and Intensity

For earthquakes without instrumental records, the macroseismic magnitude, indicated with "I_1", "I_2" or "N" in the column, was calculated from the recorded intensity by EAGP. "I_1" means the magnitude is estimated from epicentral intensity. "I_2" means the magnitude is derived from the correlation of Intensity IV isoseismal and equivalent radius. "N" means the magnitude assessment method from intensity is not known. Details of each derivation method are explained in Section 4.2. The instrumental magnitude is given when there was an instrumental record and they are indicated as "M".

The magnitude provided by EAGP was used as a basis to convert into M_W. The magnitudes in different magnitude scales given in USGS, ISC and GCO (1991) are also provided in the catalogue for comparison purposes.

Epicentral intensities were assessed according to the Chinese Seismic Intensity (CSI) scale (Hsieh, 1957) when the record is available in the Directories of Earthquakes in China (DEDP, 1995 & 1999; DMP, 2005). The available epicentral intensity is included in Appendix C.

B.3 Local Earthquake Catalogue

B.3.1 Date and Time of Occurrence

Universal date and time are given by converting from the reported Beijing local time. The time is given in hours and minutes.

B.3.2 Epicentre Location

The location is given to a precision of 0.01 degrees.

B.3.3 Magnitude

The instrumental magnitude provided by EAGP is the local magnitude scale M_L.

B.4 References

DEDP (1995). *Directory of Historical Strong Earthquakes in China (23rd Century B.C. - 1911 A.D.)*. Department of Earthquake Disaster Prevention, China Earthquake Administration, Seismological Press, China. *中國歷史強震目錄 (公元前23世紀 - 公元1911年)*, 震害防禦司, 中國地震局, 地震出版社, 514 p (in Chinese).

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Appendix C

Regional Earthquake Catalogue

Contents

List of Tables

C.1 General

This appendix presents the Regional Earthquake Catalogue. The catalogue contains all known events having a $M_W \geq 5$ that have occurred within 500 km of Hong Kong up to September 2011.

C.2 Events in GCO Publication No. 1/91 not Included in the Regional Earthquake Catalogue

The earthquake catalogue provided by EAGP, which consolidates data of different sources (see Appendix A), is considered to be the most complete for historical earthquake events. The events listed in GCO (1991) have been checked against the EAGP's catalogue. The events with the same date and time and similar location have been regarded as the same event. Some events listed in GCO (1991) are not included, as explained in Table C1.

C.3 References

GCO (1991). *Review of Earthquake Data for the Hong Kong Region*. GCO Publication No. 1/91, Geotechnical Control Office, Civil Engineering Services Department, Hong Kong, 109 p.

Hsieh, Y.S. (1957). A new scale of seismic intensity adapted to the conditions in Chinese Territories. *Acta Geophysica Sinica*. 中國地震烈度新標準, *地球物理學報*, vol. 6, pp 35-47 (in Chinese).

Table C1 Events in GCO Publication No. 1/91 which are not Included in the Regional Earthquake Catalogue

Universal Date and Time		Reason for not being Included in the Catalogue
Date	Time	
1520 May	/	These events cannot be identified in the latest available data set provided by EAGP.
1571 Jun 05	/	
1791 Mar	/	
1895 Feb	/	
1922 May 20	/	
1936 Apr 23	/	
1962 Jul 19	09:30	The moment magnitudes M_W of these events are less than 5.
1977 May 11	20:31	
1980 Jul 24	09:00	
1981 May 04	11:05	
1985 Sep 03	23:58	

Table C2 Regional Earthquake Catalogue (Sheet 1 of 7)

No.	Universal Date and Time						EAGP Location		EAGP Data					USGS Data				ISC Data			GCO 1/91 Data			Location
	Year	Month	Day	Hour	Min.	Sec.	Lat.	Long.	M_S	Calculated M_W	Depth (km)	Epicentral Intensity	Deriving Method	m_b	M_L	M_w	Depth (km)	M_S	m_b	Depth (km)	M_S	m_b	Depth (km)	
1#	1067	11	12				23.6	116.6	6¾	6.7		IX	I_1								6¾			Near Chaozhou, Guangdong
2*	1067	11	16				24.6	117.6	5¼	5.5		VII	N											Zhangzhou, Fujian
3#^	1185	6	15				24.6	118.0	6½	6.4		VIII	N											Near Zhangzhou, Fujian
4	1372	6	1				24.2	111.1	4¾	5.2			I_2											West Hexian, Guangxi
5	1372	9	25				23.1	113.3	4¾	5.2		VI	I_1								4¾			Northwest Guangzhou, Guangdong
6	1445	12	21				24.5	117.6	6¼	6.2		VIII	I_1											Zhangzhou, Fujian
7	1445						23.4	112.6	4¾	5.2		VI	I_1								4¾			Sihui, Guangdong
8	1507	3	14				22.8	110.6	5	5.3			I_2											Northeast Yulin, Guangxi
9	1508	11					23.7	115.7	5	5.3			I_2											Northwest Jieyang, Guangdong
10	1509	10	1				21.6	110.6	4¾	5.2			I_2											Wuchuan, Huazhou, Guangdong
11	1519	9					23.5	117.2	5	5.3			I_2											North east of Chaoyang, Guangdong
12	1520	7	21				24.0	111.0	4¾	5.2			I_2											Wuzhou, Pingdong, Guangxi
13	1535	5					25.8	116.4	4¾	5.2		VI	I_1											Changting, Fujian
14	1538	3					23.8	116.5	4¾	5.2			I_2											Northwest Chaozhou, Guangdong
15	1549	11	11				24.5	117.4	5	5.3			I_2											West Zhangzhou, Fujian
16	1558	6					23.4	111.5	5½	5.6		VII	I_1								5¼			Fengchuan, Fengkai, Guangdong
17	1562						25.8	116.0	4¾	5.2		VI	I_1											Ruijin, Jiangxi
18	1577	2	27				24.8	115.0	4¾	5.2		VI	I_1											Dingnan, Jiangxi
19	1584	7	8				23.0	112.5	5	5.3			I_2											Near Zhaoqing, Guangdong
20	1584	8	6				22.9	112.5	5	5.3			I_2											Near Zhaoqing, Guangdong

Table C2 Regional Earthquake Catalogue (Sheet 2 of 7)

No.	Universal Date and Time						EAGP Location		EAGP Data					USGS Data				ISC Data			GCO 1/91 Data			Location
	Year	Month	Day	Hour	Min.	Sec.	Lat.	Long.	M_S	Calculated M_W	Depth (km)	Epicentral Intensity	Deriving Method	m_b	M_L	M_w	Depth (km)	M_S	m_b	Depth (km)	M_S	m_b	Depth (km)	
21	1599	1	24				25.3	111.7	5	5.3			I_2											South Dao County, Hunan
22	1599	1	25				21.0	111.0	5½	5.6			I_2											Near Wuchuan, Guangdong
23^	1600	3	26				23.8	117.2	5½	5.6		VII	I_1											Zhaoan, Fujian
24^#	1600	9	29				23.2	117.3	7	6.9		IX	I_1								7			Nanao, Guangdong
25#	1605	7	13				20.0	110.5	7½	7.5		X	I_1											Qiongshan, Hainan
26^	1605	7	19				20.0	110.5	6½	6.4			I_2											Qiongshan, Hainan
27^	1605	8	17				20.0	110.5	6	6.0			I_2											Qiongshan, Hainan
28^	1605	10	7				20.0	110.5	6	6.0			I_2											Qiongshan, Hainan
29^	1605	12	15				20.0	110.5	6½	6.4			I_2											Qiongshan, Hainan
30	1606	2	20				20.0	110.5	5½	5.6			I_2											Qiongshan, Hainan
31	1611	9	9				21.4	111.2	6	6.0			N								5			Dianbai, Hainan
32	1618						20.0	110.1	5½	5.6		VII	I_1											Chengmai, Hainan
33	1640						25.8	113.1	4¾	5.2		VI	I_2											Chenzhou, Hunan
34^	1641	11	26				23.5	116.4	5¾	5.8		VII	I_1								5¾			East Jieyang, Guangdong
35	1651	1	17				26.2	116.6	5½	5.6		VI+	I_1											Ninghua, Fujian
36	1653	9	11				21.7	110.2	4¾	5.2		VI	I_1											Lianjiang, Guangdong
37	1656	3					22.6	112.8	4¾	5.2		VI	I_1								4¾			Heshan, Guangdong
38#	1664	9	30				21.8	112.5	5	5.3			I_2											Taishan, Guangdong
39	1665	9	19				22.7	111.6	5	5.3		VI	I_1											Luoding, Guangdong
40	1683	10	10				23.1	113.0	5	5.3		VI	I_1								5			Nanhai, Guangdong
41	1686	1	1				22.8	110.1	5¼	5.5			I_2											Hepu (Yulin)
42	1693	4	25				23.0	115.3	4¾	5.2		VI	I_1								5			Haifeng, Guangdong
43	1731	10	22				24.1	118.2	5	5.3			I_2											Near Zhangzhou, Fujian
44	1749	2	28				22.9	112.0	5	5.3		VI	I_1											Yunfu, Guangdong
45	1759	10	25				23.9	109.9	4¾	5.2			I_2											Southeast Xiangzhou, Guangxi
46	1778	10	29				22.5	110.6	5¼	5.5			I_2											Yulin (Wuchuan)

Table C2 Regional Earthquake Catalogue (Sheet 3 of 7)

No.	Universal Date and Time						EAGP Location		EAGP Data					USGS Data				ISC Data			GCO 1/91 Data			Location
	Year	Month	Day	Hour	Min.	Sec.	Lat.	Long.	M_S	Calculated M_W	Depth (km)	Epicentral Intensity	Deriving Method	m_b	M_L	M_w	Depth (km)	M_S	m_b	Depth (km)	M_S	m_b	Depth (km)	
47	1782	4	30				25.8	111.8	5	5.3		VI	I_1											Yongzhou, Ningyuan, Hunan
48	1791	4	8				23.8	117.5	≥ 5½	≥ 5.6		≥VII	I_1											Near Dongshan, Fujian
49	1804						24.9	115.6	5¼	5.5		VII-	I_1											Xunwu, Jiangxi
50	1806	1	11				25.3	115.7	6	6.0		VIII	I_1								6			South Huichang, Jiangxi
51#	1824	8	14				23.0	113.0	5	5.3			I_2											Southwest Guangzhou, Guangdong
52	1832	1					24.3	117.0	5	5.3		VI	I_1											West Pinghe, Fujian
53	1849						23.4	116.2	4¾	5.2		VI	I_1											Hungyang, Puning, Guangdong
54	1853	2	8				24.9	111.7	4¾	5.2		VI	I_1											East Jianghua Ridge, Hunan
55	1857	1	29				22.7	110.3	4¾	5.2		VI	I_1											Beiliu, Guangxi
56	1860	1	25				22.5	109.4	5¼	5.5			I_2											Lingshan (Yulin)
57	1871	6	26				20.2	110.2	5½	5.6			I_2											Qiongzhou Strait
58#	1874	6	23	1	23		22.1	114.4	5¾	5.8			I_2								5¾			Dangan Island, Guangdong
59	1874	7					23.0	115.3	4¾	5.2		VI	I_1								5			Haifeng, Guangdong
60	1878	11	23				23.5	118	≥ 6	≥ 6			I_2											Nanhai
61	1886	1	13				23.4	116.7	4¾	5.2		VI	I_1								5			Shantou, Guangdong
62	1887	4	8				24.0	116.8	5	5.3		VI	I_1								5			Sanrao, Raoping, Guangdong
63	1890	8	30				21.9	110.1	5¾	5.8			I_2											Luchuan, Guangxi-Lianjiang, Guangdong
64	1892	7	28				19.8	110.5	5	5.3		VI	I_1											Haikou, Hainan
65#	1895	8	30	9	45		23.5	116.4	6	6.0		VIII	I_1								6¼			Jieyang, Guangdong
66	1899	11	28				23.4	109.6	5	5.3		VI	I_1											Wuxuan, Guangxi
67#w	1905	8	12	12	25		22.1	113.4	5	5.3		VI	N								5½			Macau, Guangdong

Table C2 Regional Earthquake Catalogue (Sheet 4 of 7)

No.	Universal Date and Time						EAGP Location		EAGP Data					USGS Data				ISC Data			GCO 1/91 Data			Location
	Year	Month	Day	Hour	Min.	Sec.	Lat.	Long.	M_S	Calculated M_W	Depth (km)	Epicentral Intensity	Deriving Method	m_b	M_L	M_w	Depth (km)	M_S	m_b	Depth (km)	M_S	m_b	Depth (km)	
68	1906	8	19	10	1	16	24.2	118.3	5¼	5.5			I_2											Near Xiamen, Fujian
69	1909	8	11				23.1	112.5	4¾	5.2		VI	I_1											Zhaoqing, Guangdong
70	1911	2	5				23.0	109.8	5¼	5.5			N											Northeast Lingshan, Guangxi
71#	1911	5	14	16	41		22.5	115.0	6	6.0			N											Near Haifeng, Guangdong
72	1913	9	26				20.0	110.3	5	5.3		VI	I_1											Haikou, Hainan
73	1915						23.1	113.2	4¾	5.2		VI	I_1											Guangzhou, Guangdong
74^#w	1918	2	13	6	7	11	23.3	117.4	7.3	7.3		X	M					7.3			7.4	7.2	60	Nanao, Guangdong
75	1918	2	13	20	25	19	23.4	117.5	6¾	6.7			M											Nanao, Guangdong
76^w	1921	3	19	8	19	45	23.1	117.1	6½	6.4	10		M					No magnitude record			6.4			Nanao, Guangdong
77	1925	1	27				24.4	114.9	5	5.3		VI	I_1											Heping, Guangdong
78w	1926	6	13	2	3	0	20.0	116.5	5½	5.6			N					No magnitude record			5¼			Near Dongsha Islands
79	1929	10	24	6	34	13	22.0	118.0	6½	6.4			M					6.5						East Dongsha Islands
80#w	1931	9	21	10	27	20	19.8	113.1	6¾	6.7			M					6.8			6.7			North Xisha Islands
81*	1933						21.6	110.3	4¾	5.2			M											Lianjiang, Guangdong
82	1936	4	1				22.5	109.4	6¾	6.7		IX	I_1											Northeast Lingshan, Guangxi
83*	1940	3	2				24.7	116.9	5¼	5.5			M											Southeast Yongding, Fujian
84w	1941	9	21	6	19	45	25.2	115.6	5¾	5.8		VII	M								6			Xunwu, Jiangxi
85	1943	11	7	8	25	45	22.0	119.0	6	6.0			M					No magnitude record						Southwest Kaohsiung, Taiwan
86	1953	1	1				23.8	114.7	4¾	5.2		VI	M											Heyuan, Guangdong
87	1954	9	6	14	6	32	22.2	118.6	5¼	5.5			M											Southwest of Kaohsiung, Taiwan
88	1955	3	27	13	59		19.0	116.0	5¼	5.5			M											South Dongsha Islands

Table C2 Regional Earthquake Catalogue (Sheet 5 of 7)

No.	Universal Date and Time						EAGP Location		EAGP Data					USGS Data				ISC Data			GCO 1/91 Data			Location
	Year	Month	Day	Hour	Min.	Sec.	Lat.	Long.	M_S	Calculated M_W	Depth (km)	Epicentral Intensity	Deriving Method	m_b	M_L	M_w	Depth (km)	M_S	m_b	Depth (km)	M_S	m_b	Depth (km)	
89	1955	3	30	13	55		22.4	118.7	4.8	5.2	40		*M*											Northeast Zhongsha Islands
90	1958	9	25	1	5	36	22.5	109.5	5¾	5.8	5	VII	*M*											Lingshan, Guangxi
91#w	1962	3	18	20	18	53	23.71	114.67	6.1	6.1	5	VIII	*M*					6.0			5.8		22	Northwest Heyuan, Guangdong
92w	1962	4	5	13	10	17	23.97	114.47	4.9	5.3	6		*M*					4.5			4.9			Northwest Heyuan, Guangdong
93	1962	4	23	22	10	10	23.5	116.8	4¾	5.2			*M*											Near Chenghai, Guangdong
94w	1962	7	29	8	57	41	23.78	114.65	5.3	5.5	8		*M*					4.8			4.7			Northwest Heyuan, Guangdong
95w	1962	8	30	13	43	54	23.72	114.70	4¾	5.2	6		*M*								4.8			Northwest Heyuan, Guangdong
96w	1962	11	6	9	14	35	23.93	114.65	4.8	5.2	8		*M*								4.8			Northwest Heyuan, Guangdong
97	1964	9	23	0	4	39	23.73	114.68	5.1	5.4	4	VI	*M*						4.8	33	5.1		5	Northwest Heyuan, Guangdong
98	1966	9	26	4	22	57	22.3	117.9	5.3	5.5	51		*M*						4.9	51				Northeast Dongsha Islands
99	1967	12	30	5	24	3	20.4	118.2	5.0	5.3	33		*M*						5.1	/				East Dongsha Islands
100^	1968	4	1	9	5	5	24.9	117.53	5.2	5.4		VI+	*M*						4.9	59				Huaan, Fujian
101#	1969	7	25	22	49	43	21.73	111.73	6.4	6.3	5	VIII+	*M*						5.5	18	6.2	5.5	11	Yangjiang
102^	1972	4	5	17	53	1	23.20	118.80	5.5	5.6			*M*						4.9	33				Southwest of Southern Taiwan
103#^	1982	2	25	0	39	11	24.73	114.80	4.9	5.3	23	VI	*M*	4.5			8	3.9	4.4	5	4.1	4.4		Longnan, Jiangxi
104^	1985	11	6	8	38	49	22.03	118.17	4.3	5.0	14		*M*	4.7			25		4.6	41				Taiwan Region
105#^	1986	1	27	23	13	52	21.72	111.82	4.8	5.2	7	VI	*M*	4.1			33		4.5	0	5.0	4.5		Yangjiang
106	1986	10	22	14	35	46	22.44	118.76	5.4	5.6	13		*M*	5.0			14	4.3	5.2	11				Northeast of Donsha Islands
107#	1987	2	25	14	28	4	21.73	111.78	4.7	5.2			*M*	4.1			33		4.1	33	4.7	4.1		Yangjiang, Guangdong
108#	1987	8	2	9	7	33	24.96	115.56	5.4	5.6	12	VII	*M*	4.9			10	4.8	5.0	8	4.9	4.9		Xunwu, Jiangxi
109	1987	8	2	23	19	11	25.01	115.56	4.7	5.2	9		*M*	4.7			10	4.0	4.9	10				Xunwu, Jiangxi
110	1987	9	5	20	46	12	22.47	118.70	5.5	5.6	11		*M*	5.1			11	4.7	5.1	15				East Donsha Islands

Table C2 Regional Earthquake Catalogue (Sheet 6 of 7)

No.	Universal Date and Time						EAGP Location		EAGP Data					USGS Data				ISC Data			GCO 1/91 Data			Location
	Year	Month	Day	Hour	Min.	Sec.	Lat.	Long.	M_S	Calculated M_W	Depth (km)	Epicentral Intensity	Deriving Method	m_b	M_L	M_w	Depth (km)	M_S	m_b	Depth (km)	M_S	m_b	Depth (km)	
111^	1987	9	15	2	4	32	23.73	114.58	4.7	5.2	13	VI	*M*	4.7			33		4.7	15	4.7	4.7		Heyuan, Guangdong
112^	1989	11	25	16	13	48	23.71	114.56	4.7	5.2	32	VI	*M*		5.1		33		5.0	15				Heyuan, Guangdong
113^	1992	9	14	13	16	29	21.60	117.60	5.9	5.9	17		*M*			5.5	16	5.5	5.3	17				Northeast Donsha Islands
114	1992	9	18	16	46	35	21.60	117.70	5.1	5.2			*M*		4.8		21	4.7	4.5	21				Northeast Donsha Islands
115	1992	11	26	10	47	55	25.48	116.95	4.7	5.2			*M*	4.1			33			14				Longyan, Fujian
116^	1994	9	16	6	20	18	22.52	118.67	7.2	7.1	23		*M*			6.8	13	6.9	6.4	19				TaiwanStrait
117^	1994	9	16	7	36	19	22.35	118.67	4.7	5.2	9		*M*	4.8			10		4.7	2				TaiwanStrait
118^	1994	9	20	11	21	7	22.62	118.68	5.0	5.3	9		*M*	4.8			10	4.6	4.8	10				TaiwanStrait
119^	1994	10	19	17	55	24	22.47	118.75	5.2	5.4	15		*M*			5.0	15	5.0	4.9	39				TaiwanStrait
120^	1994	11	10	7	7	42	22.44	118.82	5.4	5.6	12		*M*			5.1	33	4.9	5.0	26				TaiwanStrait
121	1994	11	13	16	50	18	22.17	118.50	4.7	5.2	33		*M*	4.8			10	4.5	4.7	10				TaiwanStrait
122^	1994	11	16	0	0	0	22.44	118.88	5.6	5.7	13		*M*	5.2			13	5.0	5.1	7				TaiwanStrait
123^	1994	12	21	11	22	12	22.44	118.67	5.3	5.5	14		*M*			5.1	15	4.7	5.1	10				TaiwanStrait
124^	1994	12	22	4	11	3	22.53	118.70	5.2	5.4	32		*M*	4.8			33	4.5	4.7	13				TaiwanStrait
125^	1995	2	17	20	26	6	23.15	118.22	5.0	5.3	10		*M*	4.7			10	4.7	4.6	10				TaiwanStrait
126	1995	3	26	3	23	51	20.88	112.50	4.8	5.2			*M*	4.2			10		4.1	10				80 km from Xiachuandao
127^	1997	5	31	6	51	2	25.57	117.20	5.1	5.4	10	VI	*M*	Not recorded				4.3	4.1	16				Yongan, Fujian
128^	1999	6	5	17	15	12	21.37	117.63	5.0	5.3			*M*	4.4			18	4.3	4.2	19				Near Nanhai
129^	1999	12	26	19	2	58	22.38	118.45	4.8	5.2			*M*	4.4			33	4.3	4.3	4				TaiwanStrait
130	2004	9	16	18	31	21	21.76	111.87	4.8	5.2	12	VI	*M*	4.4			10	3.9	4.1	10				Yangjiang
131^	2005	4	3	16	25	20	22.48	118.61	4.6	5.1	19		*M*	4.5			10	3.8	4.3	15				TaiwanStrait

Table C2 Regional Earthquake Catalogue (Sheet 7 of 7)

Notes:
(1) Earthquake data in the time period from 1067 to Sept 2011 deemed to be reliable as advised by EAGP.
(2) Other published earthquake sources are provided for comparison purposes:
  (a) United States Geological Survey (USGS), National Earthquake Information Centre, World Data Centre for Seismology (Record period: 1973 to Oct 2011).
  (b) International Seismological Centre (ISC) (Record period: 1900 to Oct 2011).
  (c) GCO Publication No. 1/91, Review of Earthquake Data for the Hong Kong Region (GCO, 1991) (Record period: 1067 to 1989).
(3) The epicentral earthquake intensity of the events was determined based on the Chinese Seismic Intensity (CSI) scale developed by Hsieh (1957).

Symbols:
* Additional earthquake events provided by EAGP, based on the latest earthquake catalogue review in Mainland China.
^ Coordinates of earthquake are modified by EAGP, from the original sources based on latest earthquake catalogue review in Mainland China.
# Isoseimal maps are provided in Appendix E of this report.
w Details of seismic parameters are provided in Appendix E of this report.

Remarks regarding the determination of the EAGP earthquake magnitudes based on the scale of intensity:
(i) I_1 indicates that the magnitude is estimated from the empirical correlation given by Equation 4.1.
(ii) I_2 indicates that the magnitude is estimated from the empirical correlation given by Equation 4.2.
(iii) *N* indicates that the magnitude assessment method from intensity is not known.
(iv) *M* indicates that the magnitude is obtained from instrumental records.

Appendix D

Local Earthquake Catalogue

Contents

List of Tables

D.1 General

This appendix presents the Local Earthquake Catalogue provided by HKO and EAGP. The catalogue contains all known instrumentally recorded events having a $M_L \geq 2.1$ that have occurred within 150 km of Hong Kong from the beginning of 1970 up to September 2011. HKO reports locally felt earthquakes since 1980 and records earthquakes outside Hong Kong since 2000 using their expanded seismograph network.

Table D1 Local Earthquake Catalogue (Sheet 1 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
1	1970	1	3	12	21	22.67	113.58		2.9				
2	1970	1	4	14	2	21.70	114.80		3.1				
3	1970	1	4	18	58	21.70	114.80		2.6				
4	1970	1	5	14	14	22.72	113.00		2.5				
5	1970	1	7	19	41	21.70	114.80		2.6				
6	1970	1	8	12	35	21.70	114.80		2.5				
7	1970	7	1	7	58	22.18	112.75		2.6				
8	1970	7	1	8	8	22.18	112.75		2.4				
9	1970	7	1	22	17	22.18	112.75		3.5				
10	1970	7	2	1	8	22.18	112.75		2.3				
11	1970	7	2	5	56	22.18	112.75		2.1				
12	1970	7	2	10	25	22.18	112.75		3.1				
13	1970	7	2	19	17	22.18	112.75		2.6				
14	1970	7	2	19	18	22.18	112.75		2.7				
15	1970	7	2	19	25	22.18	112.75		2.1				
16	1970	7	2	19	28	22.18	112.75		2.7				
17	1970	7	2	19	30	22.18	112.75		2.7				
18	1970	7	2	19	53	22.18	112.75		2.1				
19	1970	7	2	19	53	22.18	112.75		2.1				
20	1970	7	2	22	1	22.18	112.75		2.6				
21	1970	7	2	22	27	22.18	112.75		2.1				
22	1970	7	3	1	44	22.18	112.75		2.6				
23	1970	7	3	1	44	22.18	112.75		2.6				
24	1970	7	3	2	23	22.18	112.75		2.1				
25	1970	7	3	3	5	22.18	112.75		2.8				
26	1970	7	3	3	48	22.18	112.75		2.1				
27	1970	7	3	3	51	22.18	112.75		2.7				
28	1970	7	3	6	15	22.18	112.75		2.7				

Table D1 Local Earthquake Catalogue (Sheet 2 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
29	1970	7	3	6	40	22.18	112.75		2.7				
30	1970	7	3	6	46	22.18	112.75		2.7				
31	1970	7	3	6	57	22.18	112.75		2.8				
32	1970	7	3	7	7	22.18	112.75		2.7				
33	1970	7	3	7	24	22.18	112.75		2.8				
34	1970	7	3	9	42	22.18	112.75		2.1				
35	1970	7	3	10	19	22.18	112.75		2.9				
36	1970	7	3	10	41	22.18	112.75		2.1				
37	1970	7	3	18	35	22.18	112.75		2.6				
38	1970	7	3	20	31	22.18	112.75		2.4				
39	1970	7	3	20	32	22.18	112.75		2.2				
40	1970	7	3	20	34	22.18	112.75		2.4				
41	1970	7	3	20	34	22.18	112.75		4.0				
42	1970	7	3	20	35	22.18	112.75		2.1				
43	1970	7	3	20	41	22.18	112.75		2.5				
44	1970	7	3	20	57	22.18	112.75		2.4				
45	1970	7	3	21	3	22.18	112.75		2.5				
46	1970	7	3	21	12	22.18	112.75		2.2				
47	1970	7	3	21	32	22.18	112.75		2.2				
48	1970	7	3	21	40	22.18	112.75		2.3				
49	1970	7	3	21	49	22.18	112.75		2.1				
50	1970	7	3	22	2	22.18	112.75		2.1				
51	1970	7	3	22	15	22.18	112.75		2.1				
52	1970	7	3	22	22	22.18	112.75		2.5				
53	1970	7	3	23	13	22.18	112.75		2.6				
54	1970	7	3	23	44	22.18	112.75		2.5				
55	1970	7	4	19	51	22.18	112.75		2.7				
56	1970	7	4	19	52	22.18	112.75		2.8				

Table D1 Local Earthquake Catalogue (Sheet 3 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
57	1970	7	4	20	36	22.18	112.75		2.3				
58	1970	7	4	21	57	22.18	112.75		2.1				
59	1970	7	4	23	48	22.18	112.75		2.6				
60	1970	7	4	23	49	22.18	112.75		2.2				
61	1970	7	5	0	57	22.18	112.75		2.6				
62	1970	7	5	12	0	22.18	112.75		2.6				
63	1970	7	5	13	13	22.18	112.75		2.1				
64	1970	7	5	17	43	22.18	112.75		3.1				
65	1970	7	5	18	0	22.18	112.75		2.1				
66	1970	7	5	18	31	22.18	112.75		2.6				
67	1970	7	5	18	40	22.18	112.75		2.4				
68	1970	7	5	18	45	22.18	112.75		2.2				
69	1970	7	5	18	50	22.18	112.75		2.3				
70	1970	7	5	18	51	22.18	112.75		2.6				
71	1970	7	5	20	55	22.18	112.75		2.2				
72	1970	7	6	2	19	22.18	112.75		2.4				
73	1970	7	6	2	25	22.18	112.75		2.4				
74	1970	7	6	7	14	22.18	112.75		2.2				
75	1970	7	6	14	58	22.18	112.75		2.4				
76	1970	7	6	15	30	22.18	112.75		2.3				
77	1970	7	6	18	36	22.18	112.75		2.1				
78	1970	7	6	23	39	22.18	112.75		2.1				
79	1970	7	6	23	50	22.18	112.75		3.2				
80	1970	7	7	20	13	22.18	112.75		2.4				
81	1970	7	7	21	33	22.18	112.75		2.6				
82	1970	7	8	11	8	22.18	112.75		2.4				
83	1970	7	9	7	59	22.18	112.75		3.0				
84	1970	7	9	7	59	22.18	112.75		2.7				

Table D1 Local Earthquake Catalogue (Sheet 4 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
85	1970	7	9	9	27	22.18	112.75		2.5				
86	1970	7	10	2	3	22.18	112.75		2.2				
87	1970	7	12	12	27	22.18	112.75		3.3				
88	1970	7	12	12	29	22.18	112.75		2.9				
89	1970	7	12	12	30	22.18	112.75		2.7				
90	1970	7	12	12	30	22.18	112.75		2.3				
91	1970	7	12	12	30	22.18	112.75		2.8				
92	1970	7	12	12	32	22.18	112.75		2.7				
93	1970	7	12	12	33	22.18	112.75		2.4				
94	1970	7	12	12	34	22.18	112.75		2.3				
95	1970	7	12	12	35	22.18	112.75		2.5				
96	1970	7	12	12	35	22.18	112.75		2.6				
97	1970	7	12	13	25	22.18	112.75		2.1				
98	1970	7	12	15	22	22.18	112.75		2.1				
99	1970	7	13	16	57	22.18	112.75		3.1				
100	1970	7	13	21	36	22.18	112.75		2.1				
101	1970	7	15	15	19	22.18	112.75		3.1				
102	1970	7	15	15	22	22.18	112.75		2.4				
103	1970	7	15	15	22	22.18	112.75		2.5				
104	1970	7	18	3	24	22.18	112.75		3.1				
105	1970	8	6	4	41	22.18	112.75		2.4				
106	1970	8	6	16	13	22.18	112.75		2.8				
107	1970	8	8	15	2	22.18	112.75		3.1				
108	1970	8	12	6	59	22.18	112.75		2.8				
109	1970	8	13	22	18	22.18	112.75		2.1				
110	1970	9	17	21	46	22.18	112.75		3.1				
111	1970	9	24	6	54	22.18	112.75		2.4				
112	1971	1	1	12	18	22.20	112.75		2.2				

Table D1 Local Earthquake Catalogue (Sheet 5 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
113	1971	1	12	13	23	22.33	114.17		2.3				
114	1971	1	30	4	58	22.13	112.83		2.7				
115	1971	2	2	6	45	22.13	112.83		2.3				
116	1971	2	14	3	55	22.20	112.75		2.4				
117	1971	2	15	20	7	22.50	114.47		2.3				
118	1971	2	18	4	29	22.20	112.75		2.5				
119	1971	2	27	20	42	22.90	115.20		2.6				
120	1971	3	9	6	58	22.42	114.70		2.3				
121	1971	4	17	14	11	22.20	112.75		2.3				
122	1971	4	19	6	58	21.90	113.70		2.3				
123	1971	4	19	7	51	21.80	113.60		2.4				
124	1971	4	24	9	43	22.90	115.20		3.4				
125	1971	4	24	9	57	22.90	115.20		2.2				
126	1971	4	24	16	4	22.90	115.20		2.2				
127	1971	4	25	13	50	22.90	115.20		2.1				
128	1971	4	26	17	21	22.90	115.20		2.1				
129	1971	4	26	17	28	22.90	115.20		2.5				
130	1971	4	26	19	24	22.90	115.20		2.1				
131	1971	4	26	20	13	22.90	115.20		2.2				
132	1971	4	27	8	9	21.90	114.90		2.3				
133	1971	4	30	9	4	21.90	114.90		2.6				
134	1971	5	3	7	13	22.50	115.00		2.6				
135	1971	5	11	6	58	22.20	112.75		2.8				
136	1971	6	3	7	38	22.90	115.20		3.1				
137	1971	6	30	1	20	22.17	113.63		2.6				
138	1971	6	30	1	21	22.17	113.63		2.8				
139	1971	7	10	13	18	22.90	115.20		2.6				
140	1971	8	10	7	43	22.90	115.20		2.3				

Table D1 Local Earthquake Catalogue (Sheet 6 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
141	1971	8	28	3	55	21.60	113.00		2.1				
142	1971	8	28	4	37	21.60	113.00		2.1				
143	1971	8	28	5	17	21.60	113.00		2.1				
144	1971	8	28	5	36	21.60	113.00		2.2				
145	1971	8	28	11	49	22.90	115.20		2.3				
146	1971	8	30	22	57	22.90	115.20		2.4				
147	1971	9	6	13	45	22.90	115.20		2.5				
148	1971	9	16	11	9	22.90	115.20		2.6				
149	1971	9	28	21	24	22.90	115.20		2.2				
150	1971	10	22	11	28	22.90	115.20		2.1				
151	1971	10	22	12	26	22.90	115.20		2.3				
152	1971	10	22	14	4	22.90	115.20		2.1				
153	1971	10	22	14	15	22.90	115.20		2.3				
154	1971	10	30	4	8	22.90	115.20		2.5				
155	1971	12	20	8	35	22.80	114.65		2.6				
156	1971	12	24	11	49	22.80	114.65		2.1				
157	1971	12	25	11	20	22.80	114.65		2.3				
158	1971	12	28	10	10	22.80	114.65		2.1				
159	1971	12	28	13	5	22.80	114.65		2.3				
160	1971	12	28	14	2	22.80	114.65		2.1				
161	1972	2	14	15	15	22.50	115.20		2.7				
162	1972	2	20	5	6	22.80	114.50		2.7				
163	1972	2	20	13	32	22.80	114.50		2.6				
164	1972	4	5	11	31	22.90	114.60		2.9				
165	1972	4	5	11	53	22.90	114.60		2.9				
166	1972	4	24	15	36	21.60	113.20		2.3				
167	1972	4	28	22	4	22.75	114.55		2.3				
168	1972	7	24	3	29	21.50	113.05		2.8				

Table D1 Local Earthquake Catalogue (Sheet 7 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
169	1972	7	24	5	41	21.50	113.05		2.4				
170	1972	7	24	6	2	21.50	113.05		2.8				
171	1972	7	24	11	59	21.50	113.05		2.9				
172	1972	7	24	11	59	21.50	113.05		2.7				
173	1972	7	24	12	9	21.50	113.05		2.4				
174	1972	12	16	22	16	22.87	113.10		2.4				
175	1972	12	31	3	16	22.08	113.90		3.3				
176	1973	3	21	5	45	23.60	114.10		2.1				
177	1973	4	20	5	46	22.50	113.50		3.1				
178	1973	6	2	20	34	22.30	114.90		3.2				
179	1973	7	5	5	50	23.00	114.50		2.6				
180	1973	11	7	20	48	23.40	113.80		2.1				
181	1973	11	7	20	50	23.40	113.80		2.5				
182	1973	11	7	20	53	23.40	113.80		2.6				
183	1973	11	7	20	57	23.40	113.80		2.2				
184	1973	11	16	7	1	21.70	113.90		2.6				
185	1973	12	16	14	7	22.80	114.00		2.8				
186	1974	2	22	6	44	22.00	115.50		4.5				
187	1974	4	2	10	23	22.60	112.90		2.8				
188	1974	8	28	11	1	22.10	113.00		2.6				
189	1974	9	5	12	20	22.10	113.00		2.1				
190	1974	10	29	21	38	22.90	115.20		2.6				
191	1974	11	25	0	48	22.90	115.20		2.9				
192	1974	11	25	1	28	22.90	115.20		2.2				
193	1974	11	28	11	56	22.90	115.20		2.7				
194	1974	11	28	18	8	22.90	115.20		2.3				
195	1974	12	11	16	56	22.20	112.80		2.5				
196	1975	1	17	19	55	22.80	115.40		2.2				

Table D1 Local Earthquake Catalogue (Sheet 8 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
197	1975	5	15	5	34	22.40	114.30		2.6				
198	1975	5	26	7	24	23.20	114.30		2.6				
199	1975	8	5	9	2	21.10	114.60		3.6				
200	1975	10	14	16	13	23.30	113.30		2.5				
201	1976	6	14	6	3	22.40	114.40		2.7				
202	1976	6	17	6	28	22.80	114.50		2.5				
203	1976	10	8	8	59	23.00	114.40		2.5				
204	1976	10	9	16	12	22.10	112.90		2.3				
205	1976	11	17	22	41	22.88	115.27		2.7				
206	1976	11	20	1	50	23.00	113.13		3.9				
207	1977	1	2	4	49	23.50	114.70		2.8				
208	1977	2	8	20	43	22.10	112.90		2.6				
209	1977	6	17	14	48	22.60	114.00		2.3				
210	1977	7	5	23	15	21.40	114.20		2.8				
211	1977	10	22	10	42	22.60	114.00		3.1				
212	1978	6	14	19	14	22.30	113.70		2.1				
213	1978	12	12	11	16	22.80	115.20		2.8				
214	1979	3	21	7	4	22.80	115.40		2.3				
215	1979	3	27	4	21	22.40	113.50		2.1				
216	1979	4	13	9	27	22.90	115.00		3.0				
217	1980	3	14	7	46	22.90	112.90		2.5				
218	1980	3	31	11	52	21.90	114.00		2.5				
219	1980	6	6	4	26	22.00	113.30		2.6				
220	1980	6	6	16	0	22.00	113.30		2.2				
221	1980	6	6	19	15	22.00	113.30		2.4				
222	1980	6	8	3	23	22.80	115.20		2.7				
223	1980	6	9	8	46	22.00	113.30		2.4				
224	1980	6	19	20	21	22.00	113.40		2.4				

Table D1 Local Earthquake Catalogue (Sheet 9 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
225	1980	6	27	9	36	22.88	115.27		2.8				
226	1980	11	23	18	8	21.65	114.95		2.6				
227	1980	12	23	17	41	21.20	114.82		2.4				
228	1981	2	25	18	48	22.88	115.27		3.4				
229	1981	3	14	13	34	22.88	115.27		3.4				
230	1981	3	15	2	2	22.88	115.27		3.0				
231	1981	3	15	2	11	22.88	115.27		2.6				
232	1981	3	15	2	14	22.88	115.27		2.6				
233	1981	3	15	2	55	22.88	115.27		2.5				
234	1981	4	6	3	1	23.45	113.45		2.7				
235	1981	4	9	1	3	22.88	115.27		4.2				
236	1981	4	9	3	10	22.88	115.27		3.2				
237	1981	4	9	20	22	22.88	115.27		2.8				
238	1981	4	12	1	26	22.88	115.27		3.2				
239	1981	4	12	13	38	22.88	115.27		3.2				
240	1981	5	5	22	40	21.17	114.60		3.3				
241	1981	7	2	15	21	23.50	114.10		3.3				
242	1981	7	8	23	26	23.35	114.50		2.9				
243	1981	9	2	2	36	22.88	115.27		2.4				
244	1981	9	20	14	37	22.88	115.27		2.6				
245	1981	9	24	6	4	22.88	115.27		2.4				
246	1981	12	14	23	11	22.88	115.27		3.8				
247	1982	2	5	14	28	22.88	115.27		3.4				
248	1982	6	1	6	27	22.88	115.27		2.7				
249	1982	6	6	14	17	22.88	115.27		2.4				
250	1982	7	5	18	33	22.88	115.27		2.3				
251	1982	8	3	13	40	21.48	114.27		3.3				
252	1982	8	27	2	29	22.32	114.02		2.5				

Table D1 Local Earthquake Catalogue (Sheet 10 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
253*	1982	8	29	20	23	22.30	114.00		2.5	22.30	114.02		2.5
254	1982	9	27	3	29	22.48	114.27		2.3				
255	1982	10	6	10	4	22.88	115.27		3.0				
256*	1982	10	7	14	13	22.27	113.90		2.6	22.27	113.90		2.6
257	1982	10	25	23	26	23.13	113.25	4	2.5				
258	1982	10	26	9	23	23.13	113.25	4	2.7				
259	1983	3	22	17	22	22.30	113.57		2.8				
260	1983	7	22	3	0	22.62	114.10		2.8				
261*	1983	12	6	14	26	22.58	114.02		2.8	22.48	114.06		2.8
262	1984	3	15	13	14	22.83	113.98		2.2				
263	1984	6	29	1	43	21.63	112.97		2.1				
264	1984	7	20	17	3	22.73	113.62		2.2				
265	1984	7	25	3	14	22.67	113.63		2.3				
266	1985	2	15	23	36	22.75	113.73		2.3				
267	1985	4	28	21	29	22.40	113.80		2.3				
268	1985	6	4	16	2	22.25	113.57		2.7				
269	1985	6	4	16	25	22.25	113.57		2.4				
270	1985	10	12	1	8	23.32	115.13		2.4				
271	1985	10	20	18	37	21.90	113.30		2.3				
272	1986	4	24	1	31	22.22	112.75		2.2				
273	1986	11	9	20	53	22.70	114.90		3.0				
274	1986	12	10	18	46	22.57	113.55		2.2				
275	1987	3	12	10	55	22.15	115.03		2.7				
276	1987	7	19	1	26	22.00	112.85		2.6				
277	1987	9	2	8	43	22.67	115.30		2.7				
278	1987	9	17	20	53	21.95	113.05		2.1				
279	1988	1	24	3	6	22.57	114.18		2.3				
280	1988	12	28	21	40	22.85	115.12		3.0				

Table D1 Local Earthquake Catalogue (Sheet 11 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
281	1989	2	27	5	58	23.40	114.43		2.2				
282	1989	8	5	6	0	21.57	113.38		2.3				
283	1990	1	2	5	46	23.15	114.40		2.5				
284	1990	1	13	3	30	22.40	114.93		2.7				
285	1990	3	18	6	57	22.10	113.62		2.9				
286	1990	4	25	9	44	23.05	115.35		2.7				
287	1990	6	1	7	27	21.90	113.32		3.2				
288	1990	6	11	16	23	22.68	114.93		3.3				
289	1990	6	11	19	17	22.75	114.92		3.0				
290	1990	6	18	6	28	21.93	113.35		3.4				
291	1990	7	16	22	1	22.63	114.10		2.3				
292	1990	7	26	2	27	22.62	114.20		2.6				
293	1990	7	26	3	23	22.50	114.90		2.5				
294	1990	11	15	5	0	21.85	113.32		2.7				
295	1990	12	8	5	25	21.90	113.27		2.2				
296	1990	12	13	6	28	22.00	113.37		2.8				
297	1991	2	13	6	29	21.70	113.57		2.8				
298	1991	3	11	2	58	21.70	113.55		2.2				
299	1991	4	20	23	0	22.50	113.90		2.7				
300	1991	4	21	0	19	21.63	113.35		2.5				
301	1991	4	21	6	58	21.80	113.27		2.8				
302	1991	4	23	23	0	22.50	113.90		2.7				
303	1991	4	25	19	18	22.97	115.32		2.3				
304	1991	4	29	0	45	22.97	115.32		2.3				
305	1991	4	29	0	55	22.97	115.32		2.1				
306	1991	5	3	4	35	22.50	114.27		2.9				
307	1991	5	11	6	5	21.83	113.32		2.9				
308	1991	5	15	8	11	22.33	115.15		3.6				

Table D1 Local Earthquake Catalogue (Sheet 12 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
309	1991	5	16	9	0	22.55	114.33		2.9				
310	1991	5	24	10	39	21.90	113.25		3.5				
311	1991	6	10	7	40	22.17	113.37		2.9				
312	1991	6	27	21	57	22.83	115.13		2.8				
313	1991	6	27	22	42	22.97	115.32		2.1				
314	1991	6	28	4	46	22.97	115.32		2.1				
315	1991	6	28	15	31	22.83	115.13		3.3				
316	1991	6	28	15	32	22.97	115.32		2.2				
317	1991	6	28	20	8	22.83	115.13		2.6				
318	1991	7	1	18	8	22.87	115.23		2.8				
319	1991	7	6	3	23	22.87	115.23		2.9				
320	1991	7	6	3	39	22.97	115.32		2.1				
321	1991	7	6	3	43	22.87	115.25		2.6				
322	1991	7	7	2	10	22.87	115.23		3.5				
323	1991	7	7	2	13	22.87	115.22		2.6				
324	1991	7	8	4	59	22.87	115.27		2.5				
325	1991	7	16	4	24	23.17	114.38		2.7				
326	1991	7	29	9	31	22.87	115.28		3.0				
327	1991	7	29	9	49	22.62	114.25		2.6				
328	1991	8	8	19	56	22.88	115.30		2.5				
329	1991	8	17	2	57	21.80	113.25		2.6				
330	1991	8	23	8	59	22.53	114.27		3.0				
331	1991	9	6	3	54	23.60	114.00		2.4				
332	1991	11	25	19	37	23.50	114.03		2.5				
333	1992	3	20	9	6	22.63	114.30		2.9				
334	1992	4	25	7	4	21.77	113.63		3.2				
335	1992	4	29	8	58	22.55	114.05		2.8				
336	1992	6	3	4	27	22.65	114.65		2.8				

Table D1 Local Earthquake Catalogue (Sheet 13 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
337	1992	6	18	3	59	22.85	114.50		2.9				
338	1992	8	25	2	59	22.12	113.42		2.9				
339	1992	10	17	6	3	23.17	113.67	5	2.7				
340	1992	12	27	17	5	21.78	112.98		3.0				
341	1993	3	1	9	7	22.60	114.40		2.8				
342	1993	3	9	7	21	22.20	113.15		2.7				
343	1993	3	14	2	12	22.80	113.42	11	3.2				
344	1993	7	31	10	22	21.70	112.97		2.6				
345	1993	8	8	16	22	22.97	115.32		2.1				
346	1993	8	21	8	20	22.50	113.03		2.1				
347*	1995	5	11	1	59	22.27	114.08		2.9	22.29	114.06		2.9
348	1995	7	30	5	8	23.13	114.38		2.8				
349	1995	10	3	20	39	23.22	113.72	10	2.7				
350	1995	11	30	16	51	22.85	115.25		2.9				
351	1996	2	12	17	22	23.28	113.90		2.8				
352	1996	10	20	0	3	21.87	114.68		3.4				
353	1997	3	15	8	28	21.87	113.33		2.7				
354	1997	4	10	15	7	21.72	114.62		3.3				
355	1997	4	12	22	16	21.48	114.62		2.8				
356	1997	4	17	23	45	21.58	114.62		2.5				
357	1997	4	18	13	22	21.80	114.60		3.1				
358	1997	7	18	20	35	23.33	115.12	12	3.6				
359	1997	9	5	7	49	22.18	115.50		3.1				
360	1997	10	16	5	54	23.30	115.10		2.8				
361	1997	10	16	9	19	21.85	113.27		2.5				
362	1997	11	27	1	29	22.15	112.73		3.5				
363	1997	12	9	20	22	21.77	114.75		3.1				
364	1997	12	9	20	45	21.75	114.77		3.4				

Table D1 Local Earthquake Catalogue (Sheet 14 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
365	1997	12	12	0	42	22.20	112.73		2.7				
366	1998	4	13	3	0	21.93	113.52		2.7				
367	1998	4	27	2	44	23.53	114.55		2.2				
368	1998	5	10	10	33	22.77	115.32		2.3				
369	1999	1	3	19	23	23.30	113.35	10	2.8				
370	1999	8	15	0	25	22.60	114.50		3.3				
371	1999	8	25	3	17	22.47	114.45		2.9				
372	1999	9	26	10	19	22.87	115.43		2.8				
373	1999	9	30	5	13	22.57	114.55		3.4				
374	1999	9	30	5	24	22.57	114.55		3.9				
375	1999	9	30	19	30	22.53	114.58		3.5				
376	1999	11	10	7	19	22.97	115.32		2.3				
377	1999	11	10	7	26	22.97	115.32		2.3				
378	2000	5	9	9	9	22.00	113.18	11	2.2				
379	2000	5	26	10	24	22.85	113.42	9	2.2				
380	2000	7	6	17	41	23.25	114.17	8	2.7	23.21	114.12	15	3.1
381	2000	7	7	0	4	23.27	114.17	9	3.1	23.20	114.13	17	3.4
382	2000	7	16	18	25	22.73	114.37	8	2.7				
383	2000	7	18	18	40	22.70	114.37	9	2.1				
384	2000	8	1	6	25	22.72	114.35	8	2.6	22.66	114.33	13	2.5
385	2000	8	17	11	1	22.83	115.18	8	2.6				
386	2000	8	17	18	28	22.82	115.15	7	2.4				
387	2000	8	17	19	38	22.83	115.18	9	2.3				
388	2000	8	18	17	20	22.85	115.20	10	2.2				
389	2000	8	21	12	42	22.83	115.20	9	2.7				
390	2000	8	21	12	56	22.80	115.18	6	2.2				
391	2000	8	22	11	47	22.83	115.20	8	2.3				
392	2000	8	23	14	56	22.83	115.20	13	2.8				

Table D1 Local Earthquake Catalogue (Sheet 15 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
393	2000	9	4	11	12	22.80	115.20	9	2.1	22.91	115.01	15	2.3
394	2000	10	21	23	12	23.22	113.62	8	2.1				
395	2000	11	18	10	1	21.23	114.78	24	2.2				
396	2001	5	23	2	22	22.30	113.32	7	2.3	22.23	113.47	15	2.4
397	2001	5	23	2	22	22.23	113.30	10	3.1				
398	2001	5	23	2	23	22.23	113.28	7	2.1				
399	2001	8	6	17	5	22.88	115.42	7	2.1				
400	2002	1	25	5	49	22.47	113.55	4	2.5				
401	2002	5	14	19	18	22.87	114.75	13	2.8				
402	2002	6	28	16	41	21.37	113.85	6	2.5	21.49	113.96	15	2.5
403	2002	7	28	2	58	22.43	114.90	9	2.2				
404	2002	9	28	9	10	21.50	113.62	8	2.5	21.56	113.63	17	2.4
405	2002	10	12	4	30	22.12	115.28	2	2.4				
406	2002	10	14	17	48	22.90	114.43	7	2.1				
407	2002	11	18	17	21	22.87	114.37	7	2.3				
408	2002	11	20	21	17	22.40	113.60	7	2.5				
409	2002	11	21	19	1	22.82	115.45	8	2.1				
410	2002	11	21	19	43	22.78	115.47	4	2.1				
411	2002	12	9	8	50	23.50	114.73	8	2.5				
412	2002	12	15	16	1	23.50	114.72	7	2.8	23.40	114.65	15	2.6
413	2003	3	3	3	48	21.62	115.05	5	2.5	21.67	115.02	16	2.6
414	2003	3	3	9	50	21.65	115.02	3	2.7	21.64	115.00	16	2.9
415	2003	12	8	23	54	21.90	115.55	4	2.7	21.88	115.41	< 1	2.7
416	2003	12	10	3	51	21.93	115.53	8	2.9	21.90	115.43	< 1	2.9
417	2003	12	14	1	21	21.92	115.55	3	2.9	21.85	115.31	15	2.8
418	2003	12	15	20	47	22.47	113.85	9	2.1	22.39	113.89	15	2.1
419	2003	12	15	21	0	22.43	113.85	6	2.4	22.40	113.88	16	2.2
420	2003	12	19	14	37	22.63	114.67	9	2.4				

Table D1 Local Earthquake Catalogue (Sheet 16 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
421	2004	1	13	12	56	21.13	113.48	11	2.2				
422	2004	2	13	17	52	21.60	114.52	3	2.6				
423	2004	2	13	21	11	21.60	114.53	5	2.6				
424	2004	2	14	7	44	21.60	114.58	3	2.3				
425	2004	2	24	17	21	21.58	114.50	10	3.1				
426	2004	3	12	12	57	21.60	114.52	4	3.0				
427	2004	3	26	12	34	22.48	114.55	7	2.5	22.46	114.51	18	2.5
428	2004	4	19	9	43	23.08	114.17	11	2.2				
429	2004	4	23	15	0	21.60	114.52	6	2.5	21.54	114.31	15	2.4
430	2004	4	30	9	3	21.55	114.52	5	2.9				
431	2004	6	23	17	31	22.68	115.00	7	2.2	22.31	114.99	15	3.2
432	2004	8	22	15	12	21.60	114.50	11	2.9	21.61	114.33	1	3.0
433	2004	8	23	22	34	21.62	114.70	7	2.1	21.46	114.42	20	2.2
434	2004	9	15	2	34	21.60	114.50	11	2.3				
435	2004	11	16	21	19	22.58	114.65	6	3.0	22.51	114.67	15	3.1
436	2005	3	15	1	26	22.75	113.95	9	2.1	22.74	113.97	< 1	2.0
437	2005	7	4	16	12	22.40	113.83	9	2.4	22.39	113.92	15	2.3
438	2005	8	18	14	55	22.05	113.63	8	2.5	22.07	113.70	10	2.1
439	2005	9	2	21	23	21.63	114.55	8	2.2	21.60	114.51	15	2.1
440	2005	10	22	20	24	21.55	114.50	12	2.4	21.62	114.42	15	2.2
441	2005	12	6	0	45	22.50	113.57	5	2.7	22.46	113.58	15	3.2
442	2005	12	6	18	21	23.38	114.27	13	2.1	23.34	114.30	15	2.3
443	2005	12	7	8	48	23.38	114.28	7	2.4	23.35	114.34	15	2.6
444	2005	12	16	12	8	21.57	113.12	9	2.9	21.63	113.17	4	3.1
445	2006	1	12	17	23	21.55	114.53	10	2.4				
446	2006	1	21	14	37	22.97	115.33	5	2.6	23.01	115.28	15	2.8
447	2006	2	9	16	42	21.60	114.55	9	2.7	21.64	114.46	7	2.3
448	2006	8	10	22	3	22.92	115.43	7	2.1	22.90	115.23	1	1.8

Table D1 Local Earthquake Catalogue (Sheet 17 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
449	2006	9	14	11	52	21.98	114.27	13	4.0	21.99	114.22	17	3.6
450	2007	2	14	17	51	22.13	115.47	7	2.1				
451	2007	3	5	3	40	22.43	113.78	7	2.4				
452	2007	3	13	17	0	22.02	113.53	8	2.2	22.10	113.59	12	1.9
453	2007	3	20	20	49	22.05	113.55	5	2.4	22.10	113.61	12	1.9
454	2007	4	25	5	54	22.58	114.60	6	2.3				
455	2007	5	7	2	6	22.43	114.92	9	2.1				
456	2007	7	2	5	23	22.48	113.80	7	2.2	22.42	113.83	19	2.1
457	2007	8	17	23	24	22.85	115.35	6	3.8	22.73	115.30	2	3.9
458	2007	9	25	6	29	22.62	114.45	7	2.6	22.58	114.41	11	2.2
459	2007	10	30	6	44	22.77	115.32	8	2.2				
460	2008	2	11	10	20	23.58	113.75	7	3.1	23.63	113.94	17	2.7
461	2008	3	20	13	26	22.27	114.97	7	2.7				
462	2008	4	4	7	10	21.85	112.83	8	2.2				
463	2008	7	4	13	29	22.88	115.25	7	2.9				
464	2008	7	16	19	54	22.07	112.80	9	2.2	22.15	112.77	11	2.7
465	2008	8	8	7	15	22.35	112.85	7	2.6				
466	2008	8	20	6	50	22.57	114.50	8	2.5	22.54	114.45	12	2.4
467	2008	8	20	7	41	22.55	114.52	7	2.1	22.53	114.45	12	2.1
468	2008	9	3	20	21	22.57	114.50	7	2.3				
469	2008	9	3	22	6	22.57	114.50	10	2.2				
470	2008	9	7	15	53	22.57	114.50	8	2.6	22.54	114.46	13	2.4
471	2008	11	13	14	1	22.62	114.67	6	2.2	22.58	114.62	15	2.4
472	2008	11	30	2	35	21.77	112.88	7	2.4				
473	2010	8	9	12	17	21.38	114.83	11	2.2				
474	2010	8	10	17	59	21.38	114.83	7	2.6				
475	2010	8	10	18	7	21.37	114.85	7	2.6				
476	2010	8	16	23	16	22.80	115.18	10	2.5				

Table D1 Local Earthquake Catalogue (Sheet 18 of 18)

No.	Universal Date and Time					EAGP				HKO			
						Location		Depth (km)	M_L	Location		Depth (km)	M_L
	Year	Month	Day	Hr.	Min.	Lat.	Long.			Lat.	Long.		
477	2010	11	2	0	15	22.82	113.35	28	2.4				
478	2010	11	19	6	42	22.57	113.93	20	3.8	22.50	113.96	15	3.7
479	2010	11	19	9	18	22.57	113.93	20	2.5				
480	2011	4	6	11	41	21.38	114.83	10	2.5				
481	2011	4	8	10	15	21.72	115.18	13	2.5				
482	2011	4	21	15	42	22.33	115.13	16	3.3				
483	2011	7	27	12	1	21.67	113.35	11	2.6				
484	2011	8	7	7	49	21.65	113.35	15	3.0				

Symbol:

* Earthquakes occurred in the territory of Hong Kong (listed by HKO).

Notes:

(1) This catalogue covers the period between January 1970 and September 2011.
(2) Earthquake magnitude provided by HKO and EAGP is in M_L.
(3) Figure 3.2 shows the earthquake data provided by EAGP, except those marked with an asterisk "*". For those "*" cases, locations of earthquakes given by HKO are shown in the figure.

Appendix E

Seismic Parameters Extracted from GCO Publication No. 1/91

Contents

E.1 Introduction

This appendix contains seismic parameter summary sheets for some of the post-1900 earthquakes listed in Appendix C of this document. These sheets were originally reported in GCO Publication No. 1/91 (GCO, 1991) and are included here for completeness. In each sheet, the seismic parameters collected from various sources are listed to determine the earthquake magnitude. Where the surface-wave magnitude of the earthquake has been calculated, the data used in the calculation and the results are shown in the summary sheet.

Since 1964, the seismic parameters are available on the ISC website (http://www.isc.ac.uk), therefore, these data are not reproduced in this document. Explanatory notes on the layout of the summary sheets and the symbols used are given in the following sections.

E.2 Explanatory Notes

E.2.1 Summary of Seismic Parameters

The information given in the various columns is described below.

Column (1) : Source code

Code	*Source*
ABE	Abe (1985)
ALG	Algiers, Algeria
BAK	Baku, USSR
BOM	Bombay, India
BUD	Budapest, Hungary
CH	Editorial Committee on Historical Materials on Chinese Earthquakes (ECHMCE, 1983-1986)
DBN	De Bilt, the Netherlands
DUR	Durham, UK
FUR	Furstenfeldbruck, West Germany
GOT	Gothenburg, Sweden
GUT	Gutenberg and Richter (1954)
HFS	Hagfors, Sweden
HKC	Hong Kong
HYD	Hyderabad, India
IRK	Irkutsk, USSR
ISC	International Seismological Centre, UK
ISS	International Seismological Summary, UK
JEN	Jena, East Germany
KEW	Kew, UK
KIR	Kiruna, Sweden
KUC	Kucino, USSR
KYO	Kyoto, Japan
LEI	Leipzig, East Germany
MAT	Matsushiro, Japan
MOS	Moscow, USSR

MOX	Moxa, East Germany
NEC	National Earthquake Information Centre, Golden Co., USA
NES	National Earthquake Information Service, Colorado, USA
OBM	Ulan-Bator, Mongolia
OSA	Osaka, Japan
PAR	Paris, France
PEK	Beijing, China
POT	Postdam, India
PRA	Prague, Czechoslovakia
PRU	Pruhonice, Czechoslovakia
PUL	Pulkovo, USSR
RIV	Riverview, Australia
STR	Strasbourg, France
TAC	Tashkent, USSR
UCC	Uccle, Belgium
UPP	Uppsala, Sweden
USC	United States Coast and Geodetic Survey
VIE	Vienna, Austria
ZBO	Zongo La Paz, Bolivia

Apart from ABE, CH and GUT, all other codes are associated with seismological agencies.

Under the source code CH, there are always a few lines of seismic parameters. These are parameters given in various publications as collated by the Editorial Committee on Historical Materials on Chinese Earthquakes (ECHMCE, 1983-1986), which also give the original sources of the parameters.

Column (2) : Time of event (*t*)

Universal time in hours, minutes and seconds are given.

Columns (3) and (4) : Latitude (*Lat.*) and Longitude (*Long.*) of the earthquake epicentre in degrees

An asterisk "*" indicates that the figures have been derived from macroseismic data. Figures in brackets "( )" indicate lower reliability.

Column (5) : Focal depth (*h*) in kilometres

"Sh." Means shallow earthquake, the depth of which has not been given a numerical value by the original source.

Columns (6) to (8) : Magnitude

Columns (6) and (7) give m_b and M_S respectively. A value followed by an asterisk "*" indicates that it has been derived from macroseismic data. Values in brackets "( )" indicate lower reliability. In column (8), the magnitude scale has not been specified.

Column (9) : Remarks.

E.2.2 Data Used in the Calculation of Surface-wave Magnitudes

The information given in the various columns is described below.

Column (1) : Source code for the seismological station

The codes used are the same as those given in Section E.2.1.

Column (2) : Period T_N or T_Z in seconds

A figure followed by the letter "z" indicates that it is T_Z, otherwise it is T_N.

Column (3) : Amplitude A_N or A_Z in microns.

Column (4) : Period T_E in seconds.

Column (5) : Amplitude A_E in microns.

Column (6) : Distance Δ in degrees between the seismological station and the earthquake epicentre.

Column (7) : Surface-wave magnitude M_S calculated in accordance with the Prague formula (Vanek et al, 1962), see Section E.2.3.

The mean M_S, its standard deviation (*S. D.*) and the number of data sets (n) used in the calculation are also given.

E.2.3 Prague Formula

$$M_S = \log_{10} (A/T) + 1.66 \log_{10} (\Delta) + 3.3 + C \quad \text{..... (E.1)}$$

where
- A = maximum amplitude of the surface wave in microns measured from the trace recorded by the seismograph
- T = corresponding period of the surface wave in seconds
- Δ = $\cos^{-1} [\sin \phi_1 \sin \phi_2 + \cos \phi_1 \cos \phi_2 \cos (\lambda_2 - \lambda_1)]$, the distance in degrees between the seismological station and the epicentre
- ϕ_1 = latitude of the seismological station
- ϕ_2 = latitude of the epicentre
- λ_1 = longitude of the seismological station
- λ_2 = longitude of the epicentre, and
- C = station correction.

The parameter C above has been determined empirically for each seismological station. Reference should be made to Pun (1990) for details of these determinations.

SUMMARY OF SEISMIC PARAMETERS ON THE 1905 AUG 12 EARTHQUAKE

Source	*t*	*Lat.*	*Long.*	*h*	m_b	M_S	*M*	Remarks
CH		22.1*	113.5*			5½*		
		22.2*	113.6*			4¾*		
		22.1*	113.5*			5½*		

SUMMARY OF SEISMIC PARAMETERS ON THE 1918 FEB 13 EARTHQUAKE

Source	*t*	*Lat.*	*Long.*	*h*	m_b	M_S	*M*	Remarks
GUT	060713	24.0	117.0	Sh.		7.3		
ISS	060710	24.0	116.5					
CH	060713	24	117		7.2	7.4		
						7¼		
	060713	23.5*	117.2*			7¼		
	0608	24	116			8.0*		
	060713	24.0	117.0	Sh.		7.3		
	060713	24.0	117.0		7.2	7.4		
	060713	23.5	117.0			7.3		
ABE		24.0	117.0		7.2	7.4		

Data used in the calculation of surface-wave magnitudes

Source	T_N/T_Z	A_N/A_Z	T_E	A_E	Δ	M_S
UPP	48	90	48	240	74.4	7.17
	12	42	12	98		7.40
DBN	32	404			84.1	7.41
	20	390				7.49
POT	30	190	30	320	79.8	7.33
	10	80	10	110		7.37
OSA	24	5750			19.5	7.66
BUD	18	115	18	87	77.6	7.54
					Mean =	7.42
					S. D. =	0.15
					n =	8

SUMMARY OF SEISMIC PARAMETERS ON THE 1921 MAR 19 EARTHQUAKE

Source	*t*	*Lat.*	*Long.*	*h*	m_b	M_S	*M*	Remarks
ISS	081945	24.0	116.5					
CH	081945	24.0	116.5			6.5		
	081945	23.5*	117.0*			6¼		
	081945	23.5*	117.2*			6¼		
	081945	23.5	117.0			6.25		
	081950					6½		

Data used in the calculation of surface-wave magnitudes

Source	T_N/T_Z	A_N/A_Z	T_E	A_E	Δ	M_S
UCC	18.5	15	18.5	10	84.4	6.38
UPP	10	4	15	5	73.7	6.41
PAR	20	15	20	11	86.5	6.39
ALG	16	2	16	2	92.7	6.31
OSA	10	97			19.7	6.27
DBN	18	18	19	28	82.9	6.45
					Mean =	6.37
					S. D. =	0.07
					n =	6

SUMMARY OF SEISMIC PARAMETERS ON THE 1926 JUN 13 EARTHQUAKE

Source	*t*	*Lat.*	*Long.*	*h*	m_b	M_S	*M*	Remarks
ISS	020300	20.0	116.5					
CH	020300	20.0	116.5			(5¼)		
	020300	20.0	116.5			(5½)		
	020300	20.0	116.5			(5½)		

SUMMARY OF SEISMIC PARAMETERS ON THE 1931 SEP 21 EARTHQUAKE

Source	*t*	*Lat.*	*Long.*	*h*	m_b	M_S	*M*	Remarks
GUT	102717	19¾	113	Sh.		6¾		
ISS	202722	19.5	113.2					
CH	102720	19.8	113.1	20		6¾		
	102720	19.8	113.1			6¾		
	102720	19.8	113.1			6¾		
	102720	19.8	113.1			6.75		
	102640					7.0		
	102720	19.8	113.1	20				

Data used in the calculation of surface-wave magnitudes

Source	T_N/T_Z	A_N/A_Z	T_E	A_E	Δ	M_S
LEI	18	15	20	20	81.1	6.58
	16	21	16	29		6.82
VIE	10	9	13	10	79.7	6.70
UCC	19	27	18	22	85.9	6.70
JEN	17	5	17	3	81.7	6.13
	13z	7				6.32
POT	14	32	14	55	80.3	6.90
GOT	20	22	20	30	82.4	6.70
BUD	15	14			78.2	6.71
BOM	15	132			37.9	6.98
IRK	12	61			33.2	6.70
TAC	14	42			42.8	6.70
BAK	18	29	18	70	57.2	6.70
KUC	15	31	17	17	65.4	6.58
	16z	61				6.81
PUL	15	37	15	27	69.4	6.71
	15z	43				6.68
UPP	15	26	12	7	75.6	6.76
STR	14	31	14	25	84.9	6.76
	14z	30				6.63
PAR	28	40	25	25	87.9	6.69
ALG	20	4	20	6	93.2	6.78
DBN	18	36	17	50	84.9	6.76
	12z	24				6.51
					Mean =	6.68
					S. D. =	0.17
					n =	24

SUMMARY OF SEISMIC PARAMETERS ON THE 1941 SEP 21 EARTHQUAKE

Source	*t*	*Lat.*	*Long.*	*h*	m_b	M_S	*M*	Remarks
CH	061945	25.1*	115.7*			5¾*		
		25.1*	115.8*			5¾*		
		25.1*	115.7*			5¾*		

SUMMARY OF SEISMIC PARAMETERS ON THE 1962 MAR18 EARTHQUAKE

Source	*t*	*Lat.*	*Long.*	*h*	m_b	M_S	*M*	Remarks
ISS	201851	23.88	114.62	0				
OBM	201838	23.8	114.7				6.38	
MOS	201850	23.0	115.0				5.0	
PEK	201853	23.8	114.7				6.0	
CH	201853	23.72	114.67	5		6.1		
	201853	23.72	114.67	5		6.4		
	201853	23.8	114.7			6		
	201855	23.8	114.6	25				
	201850	23½	114½			5½		

Data used in the calculation of surface-wave magnitudes

Source	T_N/T_Z	A_N/A_Z	T_E	A_E	Δ	M_S
BOM	12	3	13	3	39.2	5.49
HYD	15	10	15	8	34.6	5.77
KEW	19	5.5	20	4.5	85.6	5.77
RIV	15	0.5			67.4	5.77
DUR	18	7			84.4	5.77
JEN	16	7	18	4	79.4	6.25
KYO	10.5	2	8	1.8	21.2	5.77
UPP	21	7.3			72.9	6.07
	17z	3.8				5.78
KIR	19	8.1	19	3.9	69.5	5.91
	13z	5.3				5.85
MAT						5.77
MOS						5.69
					Mean =	5.82
					S. D. =	0.18
					n =	13

SUMMARY OF SEISMIC PARAMETERS ON THE 1962 APR 05 EARTHQUAKE

Source	*t*	*Lat.*	*Long.*	*h*	m_b	M_S	*M*	Remarks
PEK	131012	23.75	114.5				4.5	
CH	131012	23.8	114.5	6		4.9		
	131012	23.8	114.5	6		4.9		
	131012	23¾	114½			4½		

SUMMARY OF SEISMIC PARAMETERS ON THE 1962 JUL 29 EARTHQUAKE

Source	*t*	*Lat.*	*Long.*	*h*	m_b	M_S	*M*	Remarks
PEK	085741	23.75	114.5				4.75	Felt
CH	085741	23.8	114.4	8		5.3		
	085741	23.8	114.4	8		5.3		
	085741	23¾	114½			4¾		
	085746	23.6	114.3	65				

Data used in the calculation of surface-wave magnitudes

Source	T_N/T_Z	A_N/A_Z	T_E	A_E	Δ	M_S
KIR	17	0.5	16	0.5	69.6	4.72

SUMMARY OF SEISMIC PARAMETERS ON THE 1962 AUG 30 EARTHQUAKE

Source	*t*	*Lat.*	*Long.*	*h*	m_b	M_S	*M*	Remarks
CH	134352	23.8	114.5	8		4.8		
	134352	23.8	114.5	8		4.8		
	134352	23¾	114½			4¼		

SUMMARY OF SEISMIC PARAMETERS ON THE 1962 NOV 06 EARTHQUAKE

Source	*t*	*Lat.*	*Long.*	*h*	m_b	M_S	*M*	Remarks
CH	091432	23.8	114.5	6		4.8		
	091432	23.8	114.5	6		4.8		
	091432	23¾	114½			4½		

E.3 References

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Gutenberg, B. & Richter, C.F. (1954). *Seismicity of the Earth and Associated Phenomena (Second Edition)*. Princeton University Press, New Jersey, 310 p.

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Vanek, J., Zátopek, A., Kárnik, V., Kondorskaya, N.V., Riznichenko, Y.U.V., Savarensky, E.F., Solov'ev, S.L. & Shebalin, N.V. (1962). Standardization of magnitude scale. *Izvestia Akademii Nauk*, Seriya Geofizitsekaya, Moscow, vol. 2, pp 152-158.

Appendix F

Isoseismal Maps

Contents

List of Figures

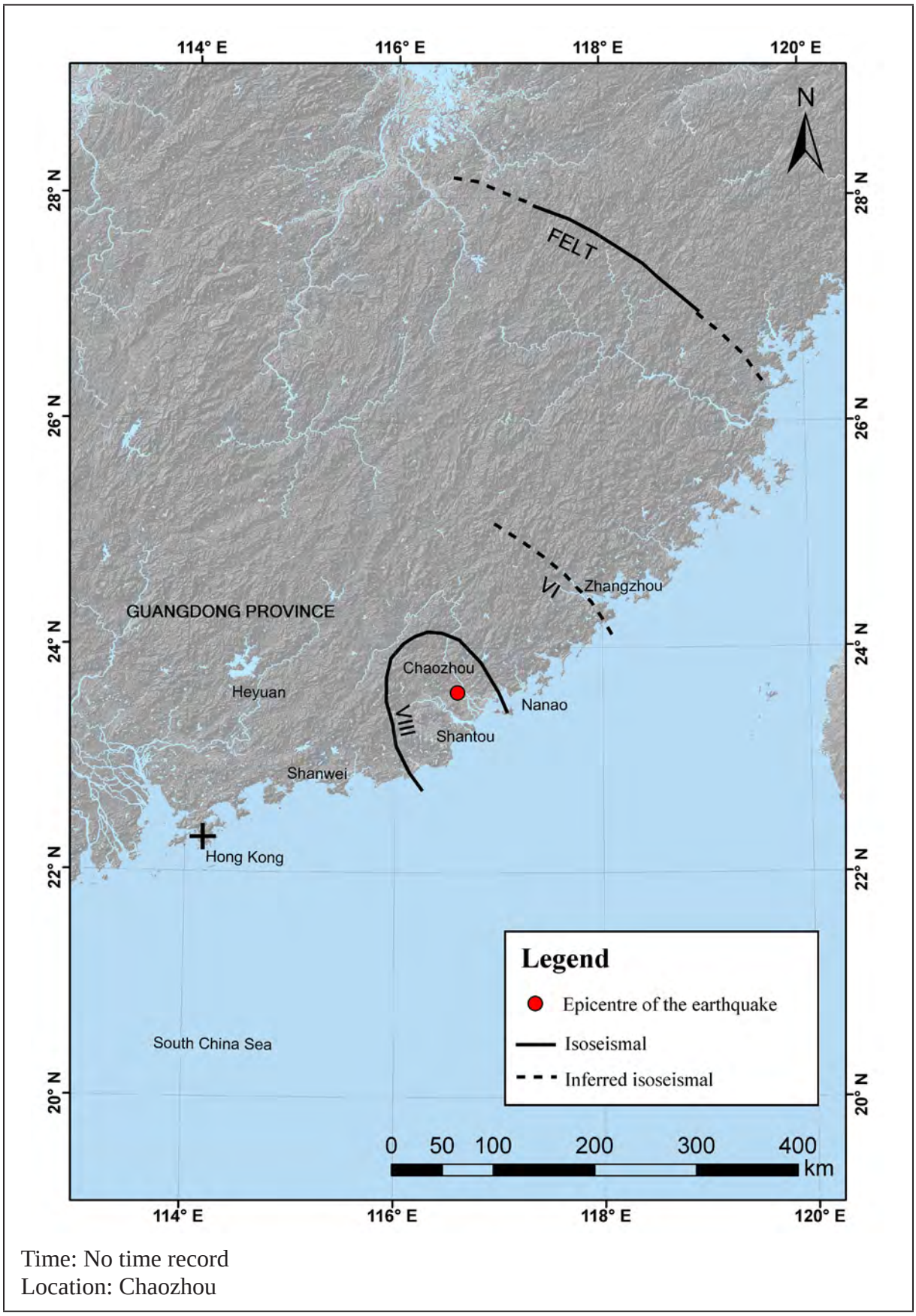
F.1 General

This appendix presents isoseismal maps of some earthquake events given in Table 5.1 and Table 5.2. The earthquake events were likely to have been felt in Hong Kong as determined from the isoseismal maps or records provided by HKO. The isoseismal maps in Figures F1 to F20 were generated from the Department of Earthquake Disaster Prevention (DEDP, 1995 & 1999).

F.2 References

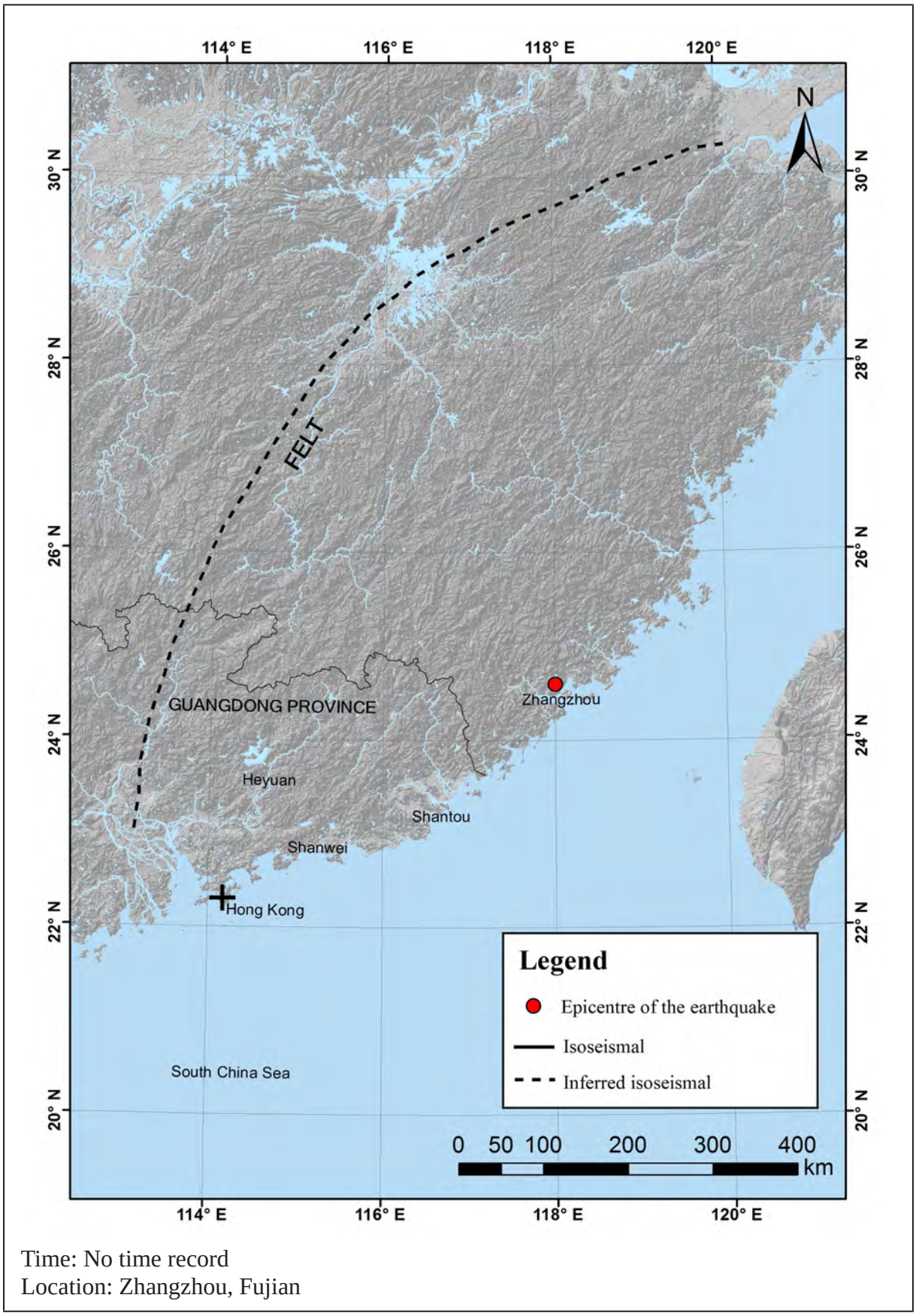
DEDP (1995). *Directory of Historical Strong Earthquakes in China (23rd Century B.C. - 1911 A.D.)*. Department of Earthquake Disaster Prevention, China Earthquake Administration, Seismological Press, China. *中國歷史強震目錄 (公元前23世紀 - 公元1911年)*, 震害防禦司, 中國地震局, 地震出版社, 514 p (in Chinese).

DEDP (1999). *Directory of Recent Earthquakes in China (1912 B.C. - 1900 A.D.)*. Department of Earthquake Disaster Prevention, China Earthquake Administration, Seismological Press, China. *中國近代地震目錄 (公元前1912年 - 公元1900年)*, 震害防禦司, 中國地震局, 地震出版社, 637 p (in Chinese).



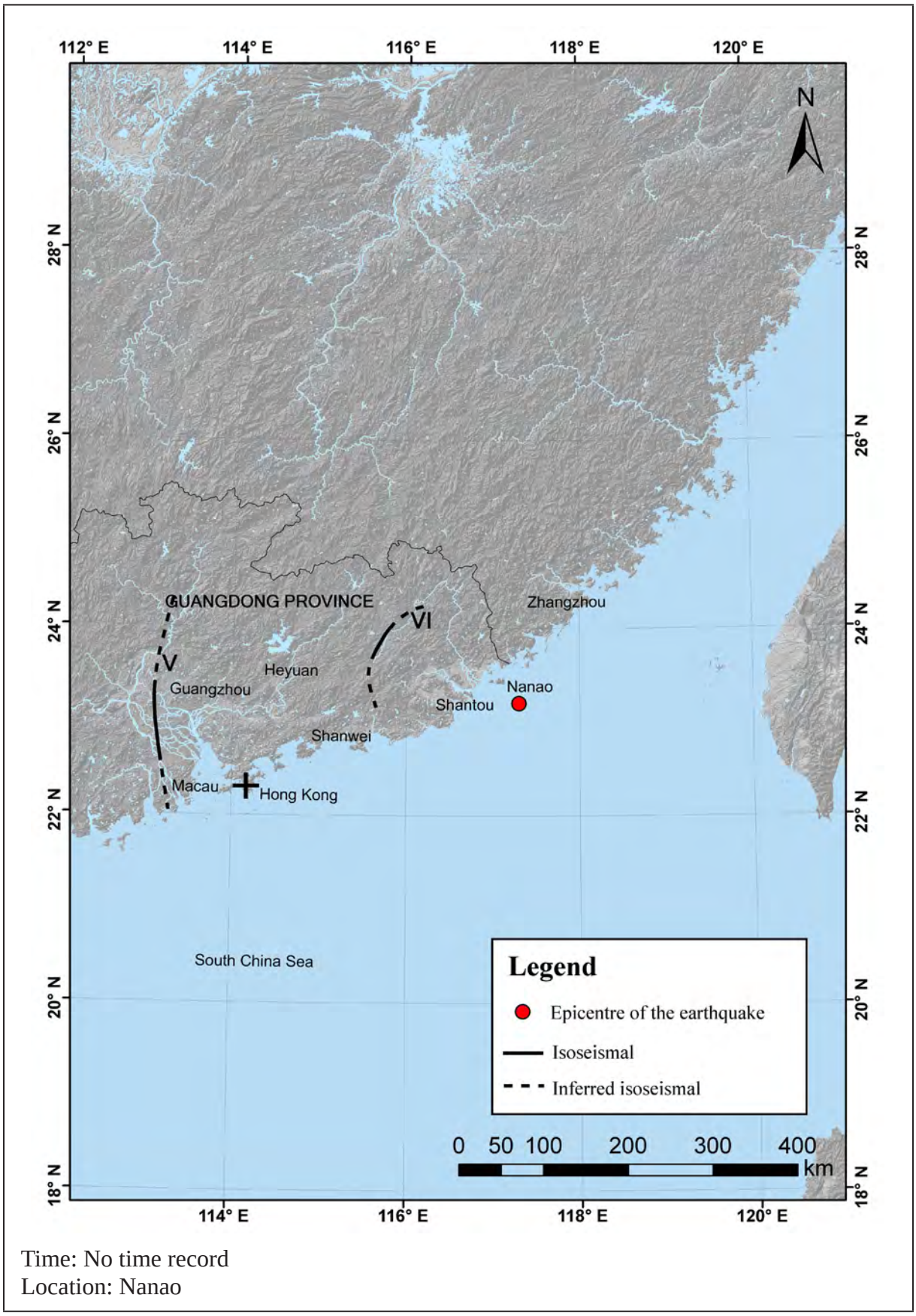
Time: No time record
Location: Chaozhou

Figure F1 Earthquake Event 12 November 1067 (Chaozhou)



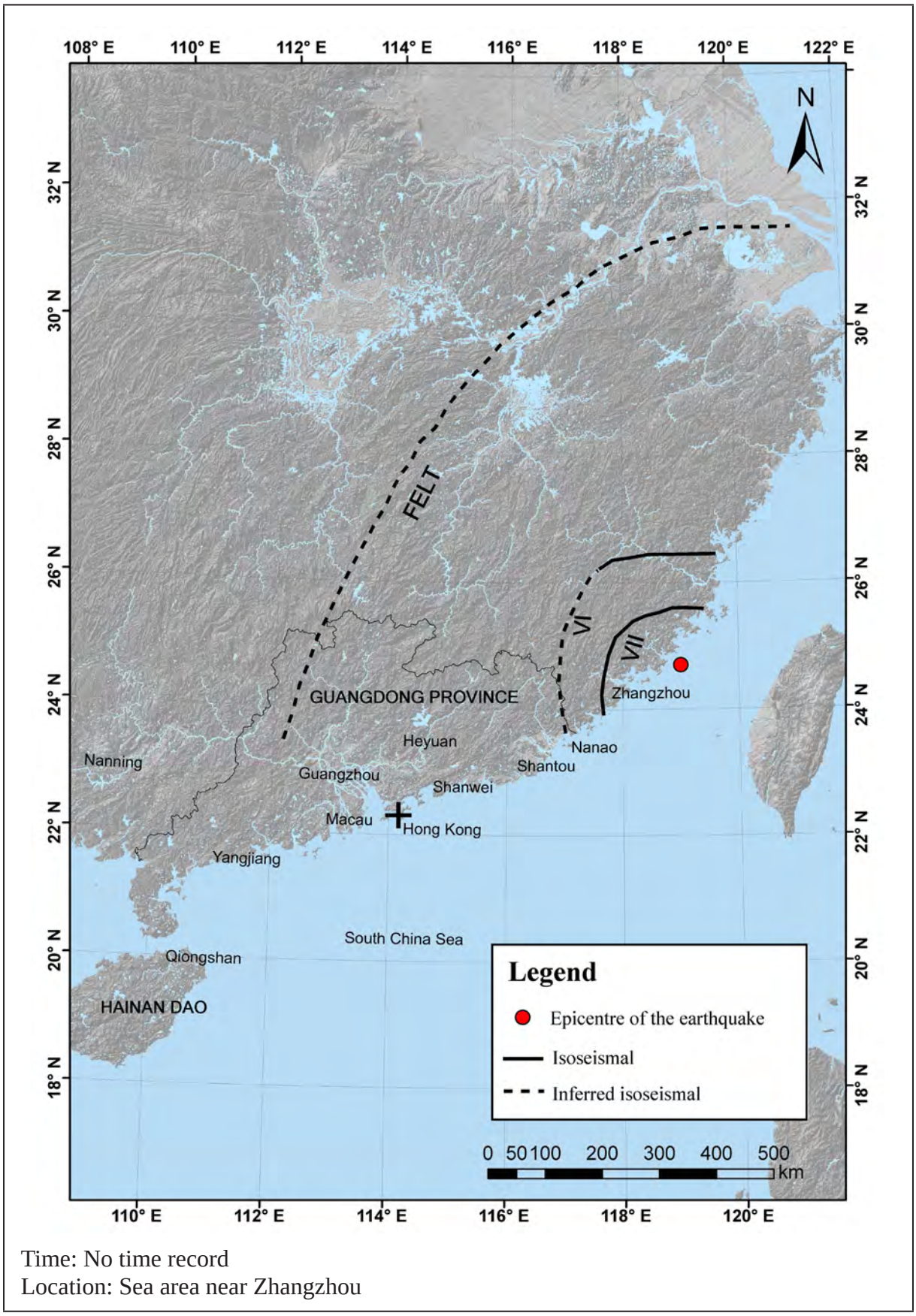
Time: No time record
Location: Zhangzhou, Fujian

Figure F2 Earthquake Event 15 June 1185 (Zhangzhou, Fujian)



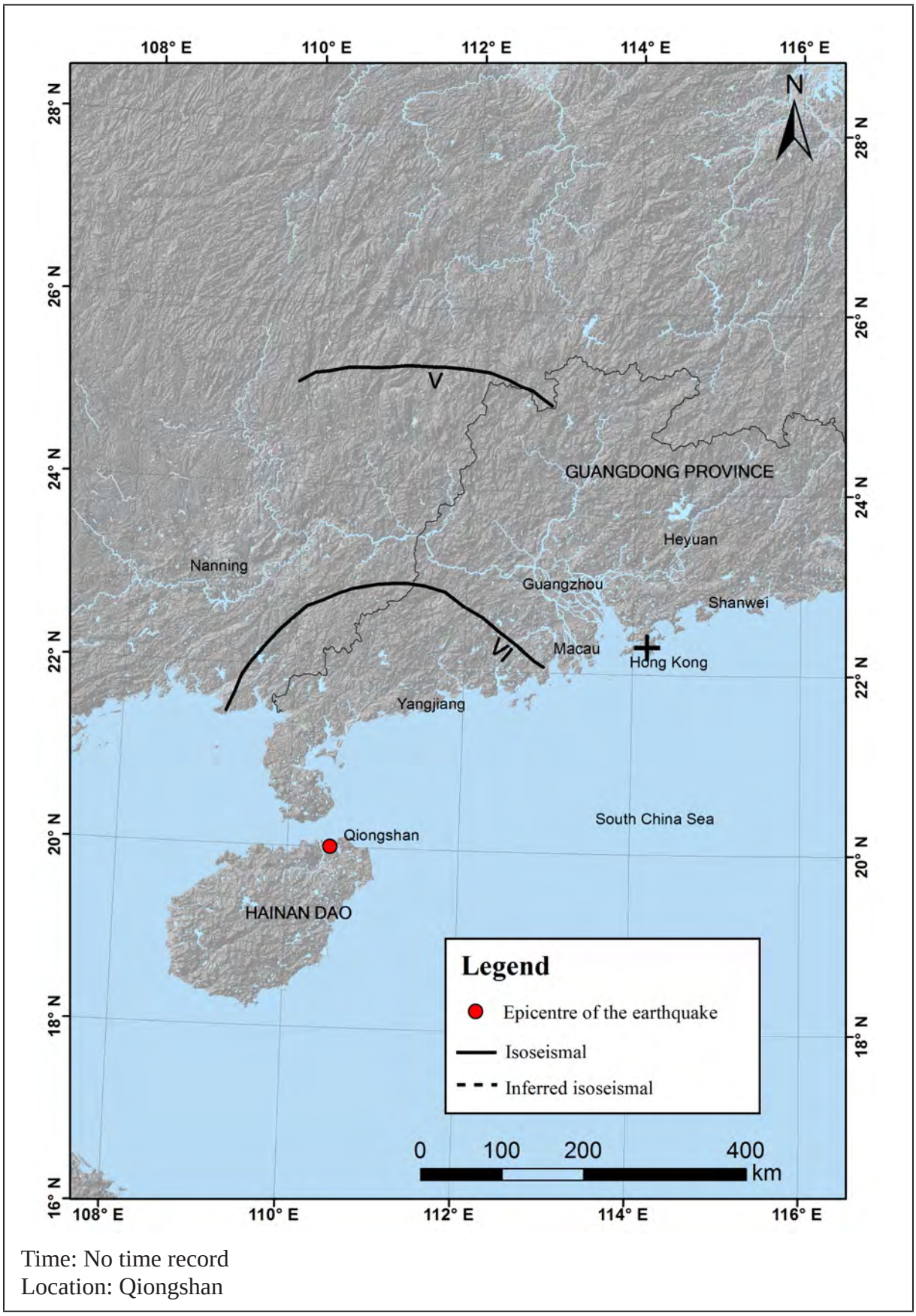
Time: No time record
Location: Nanao

Figure F3 Earthquake Event 29 September 1600 (Nanao)



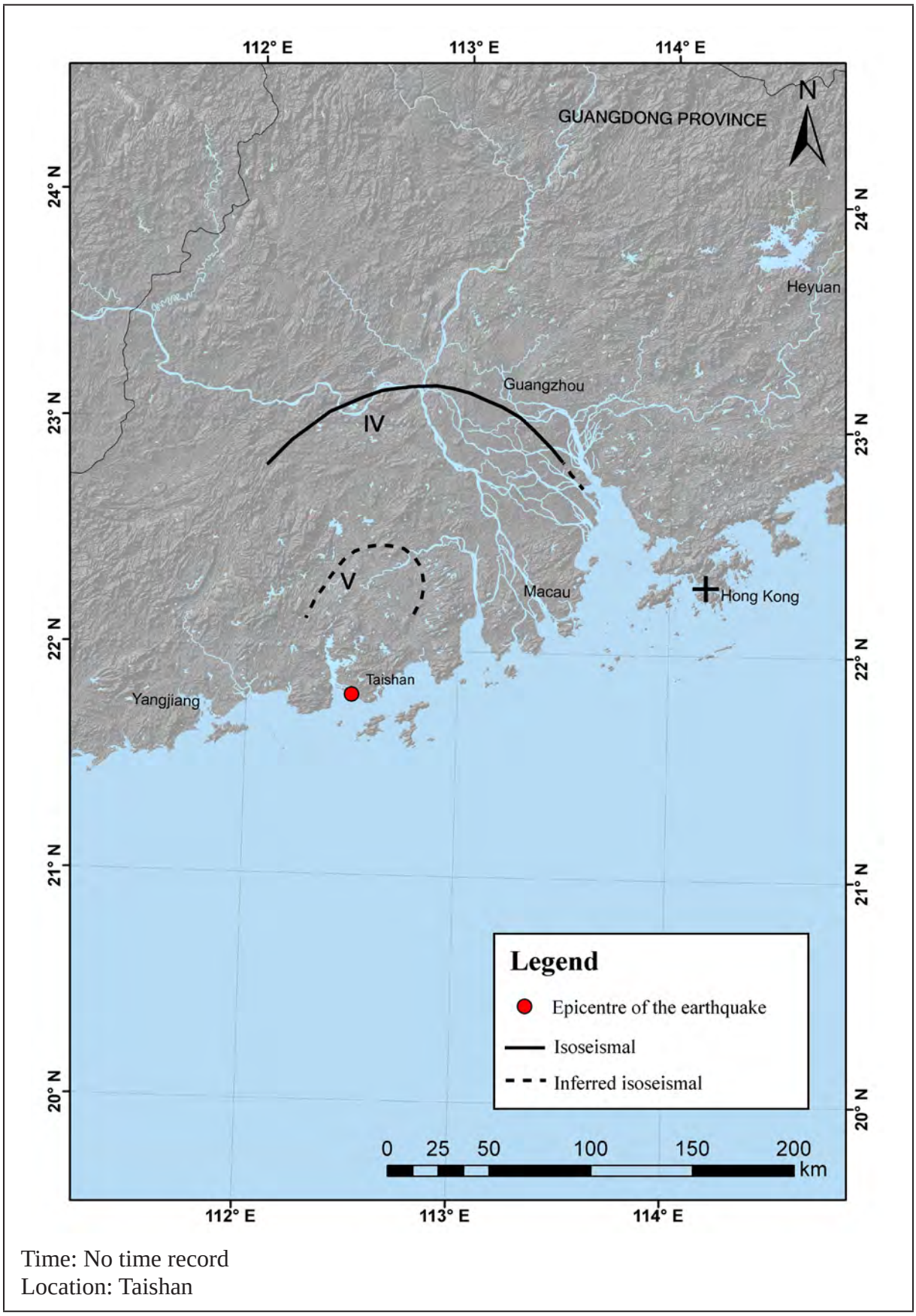
Time: No time record
Location: Sea area near Zhangzhou

Figure F4 Earthquake Event 29 December 1604 (Sea Area near Zhangzhou)



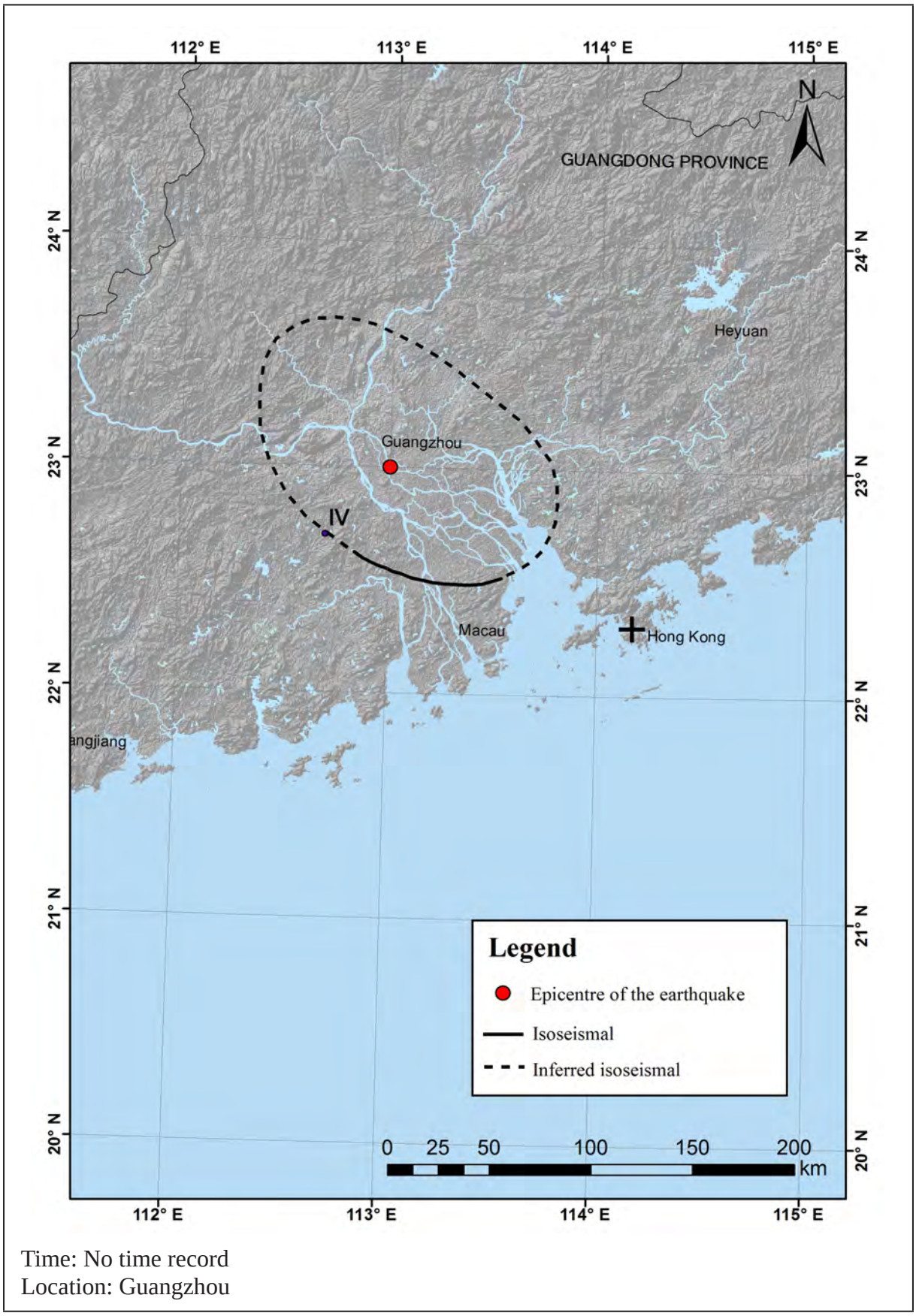
Time: No time record
Location: Qiongshan

Figure F5 Earthquake Event 13 July 1605 (Qiongshan)



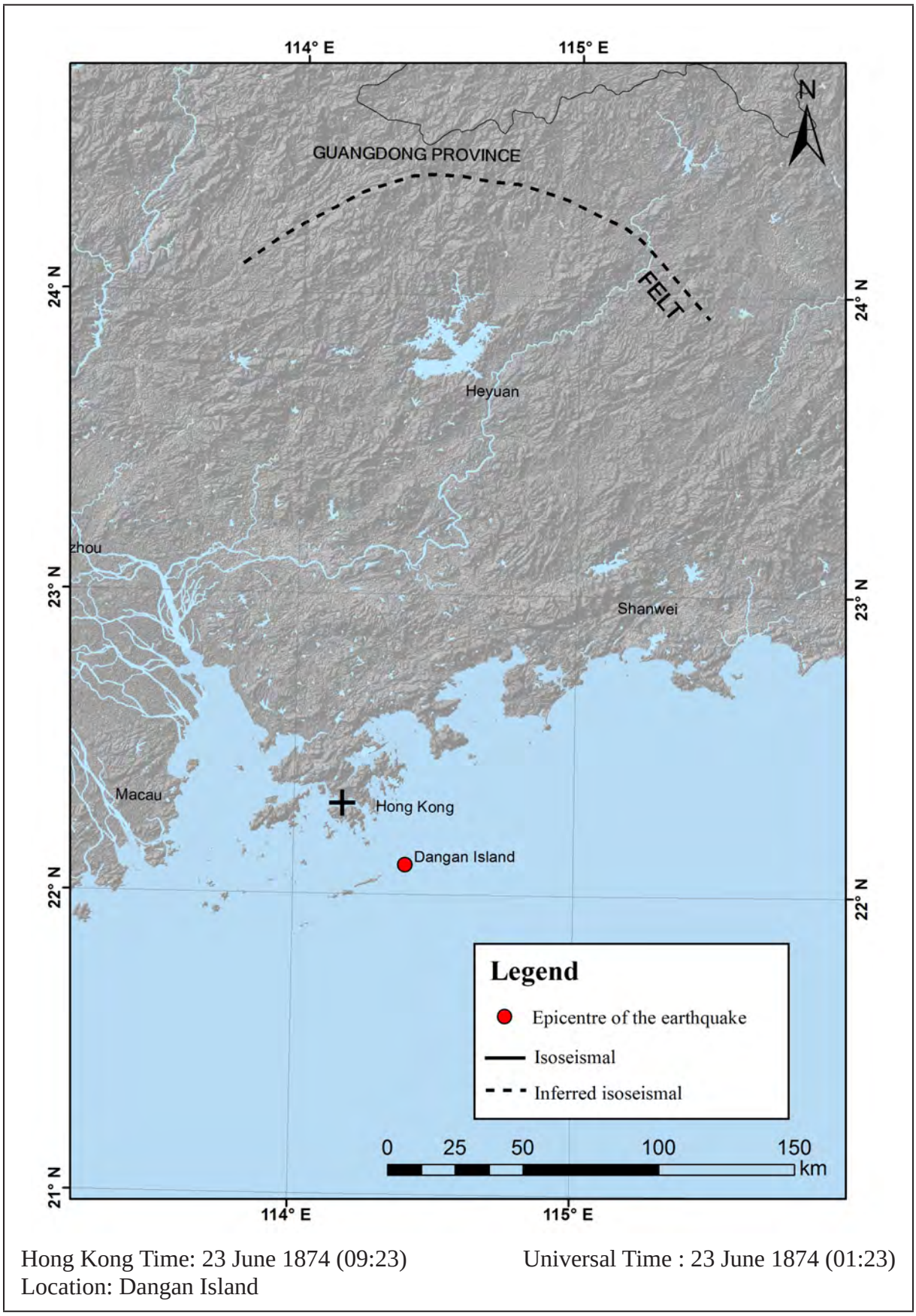
Time: No time record
Location: Taishan

Figure F6 Earthquake Event 30 September 1664 (Taishan)



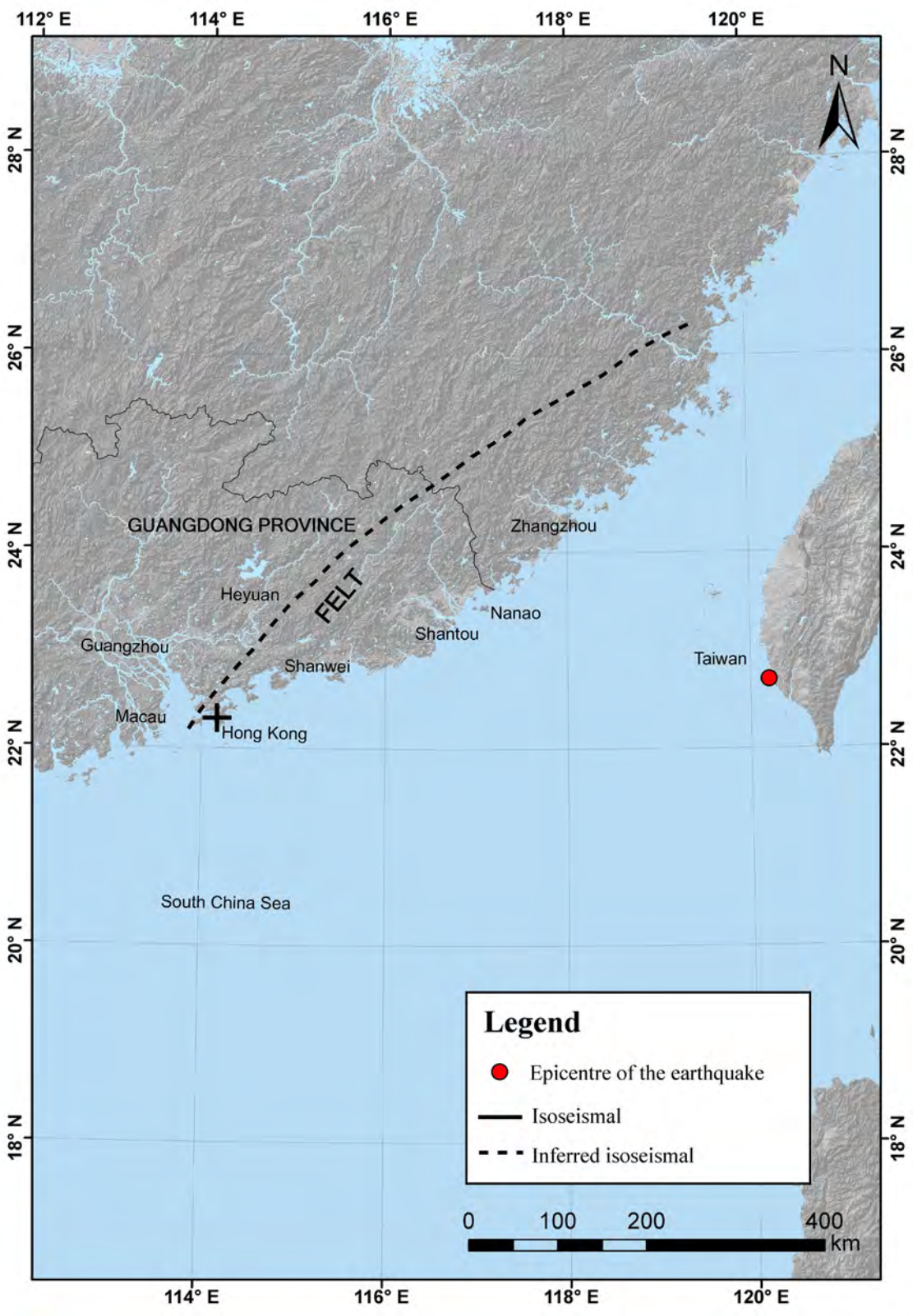
Time: No time record
Location: Guangzhou

Figure F7 Earthquake Event 14 August 1824 (Guangzhou)



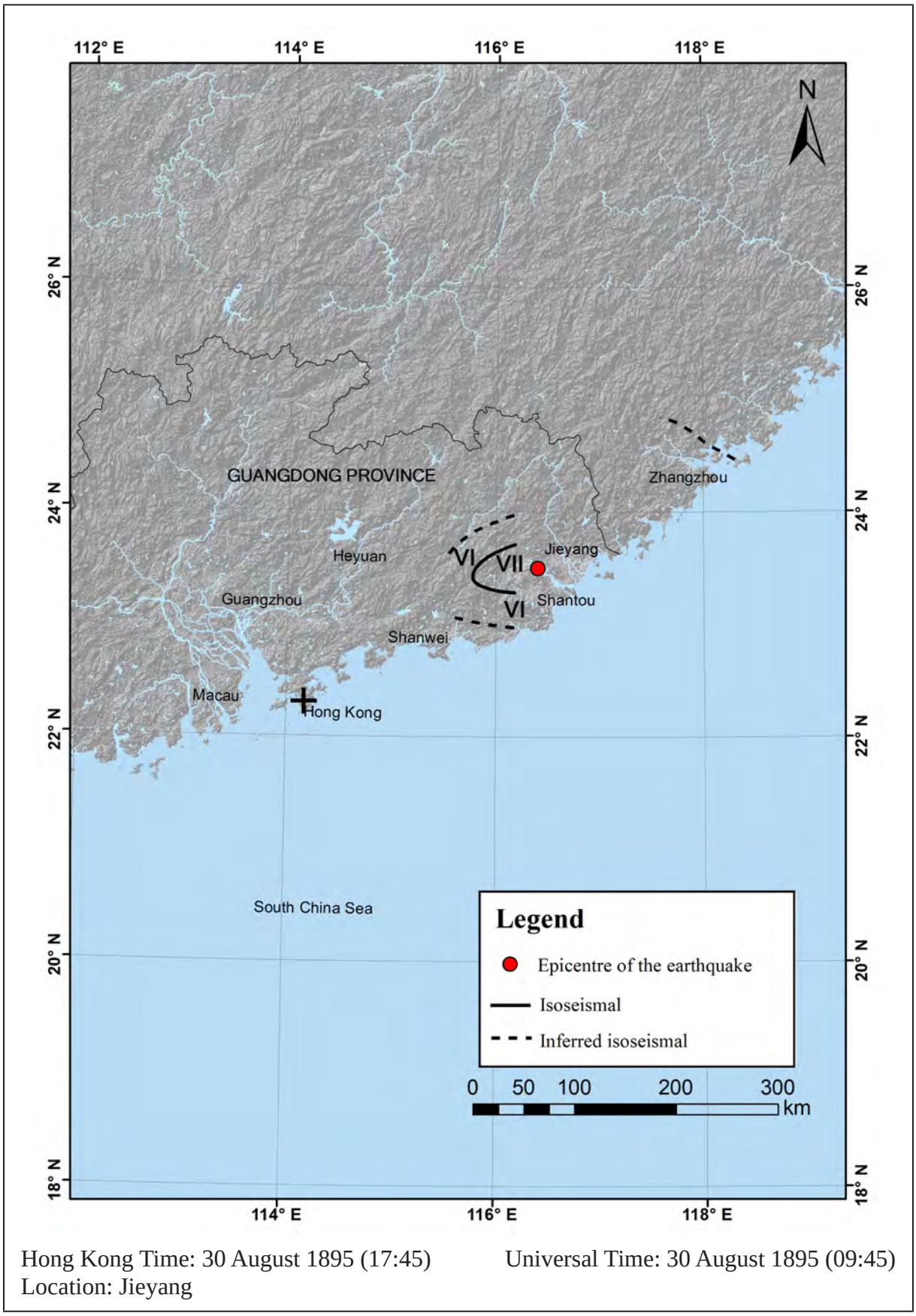
Hong Kong Time: 23 June 1874 (09:23) Universal Time : 23 June 1874 (01:23)
Location: Dangan Island

Figure F8 Earthquake Event 23 June 1874 (Dangan Island)



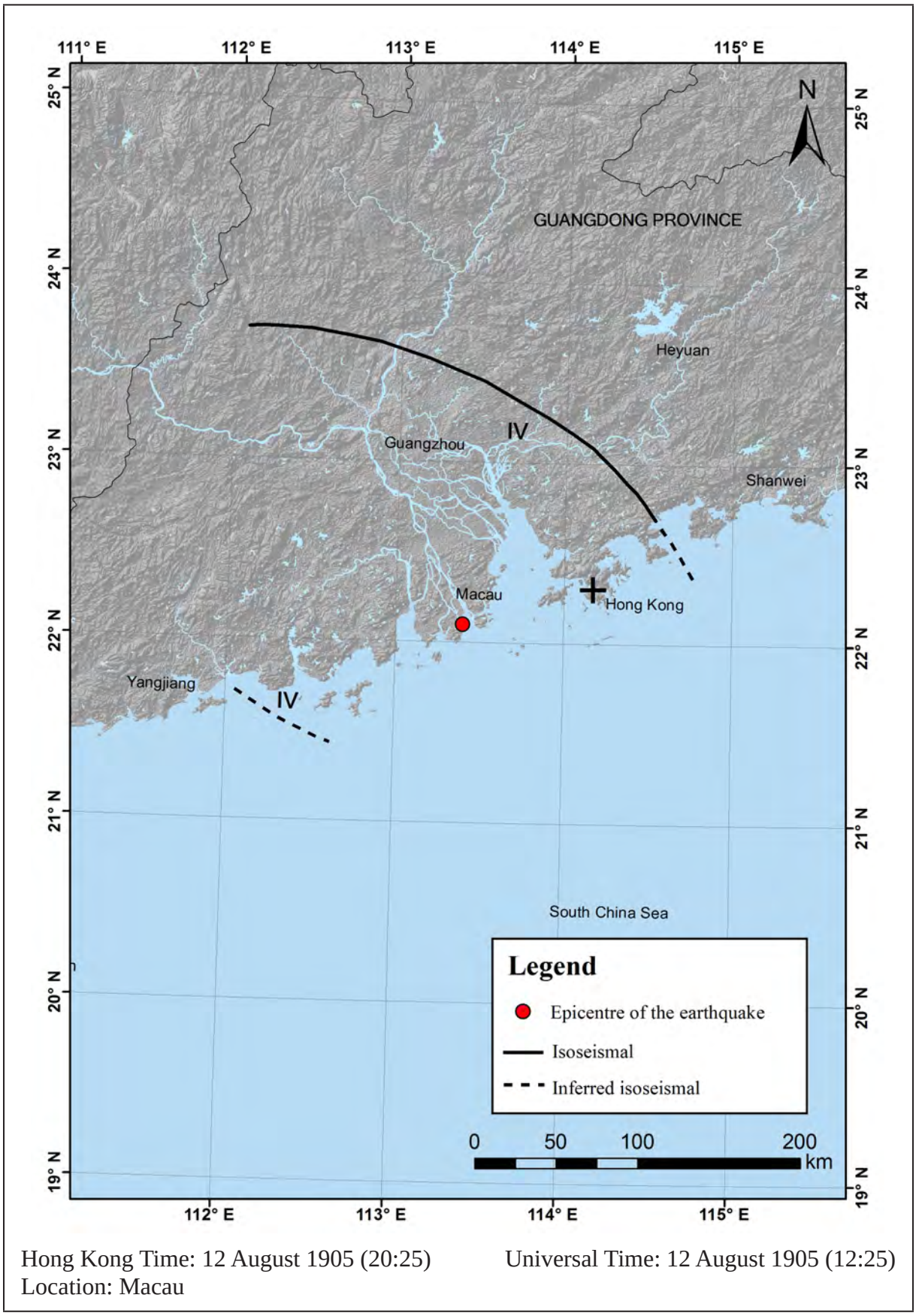
Hong Kong Time: 22 April 1892 (09:40) Universal Time: 22 April 1892 (01:40)
Location: Taiwan

Figure F9 Earthquake Event 22 April 1892 (Taiwan)



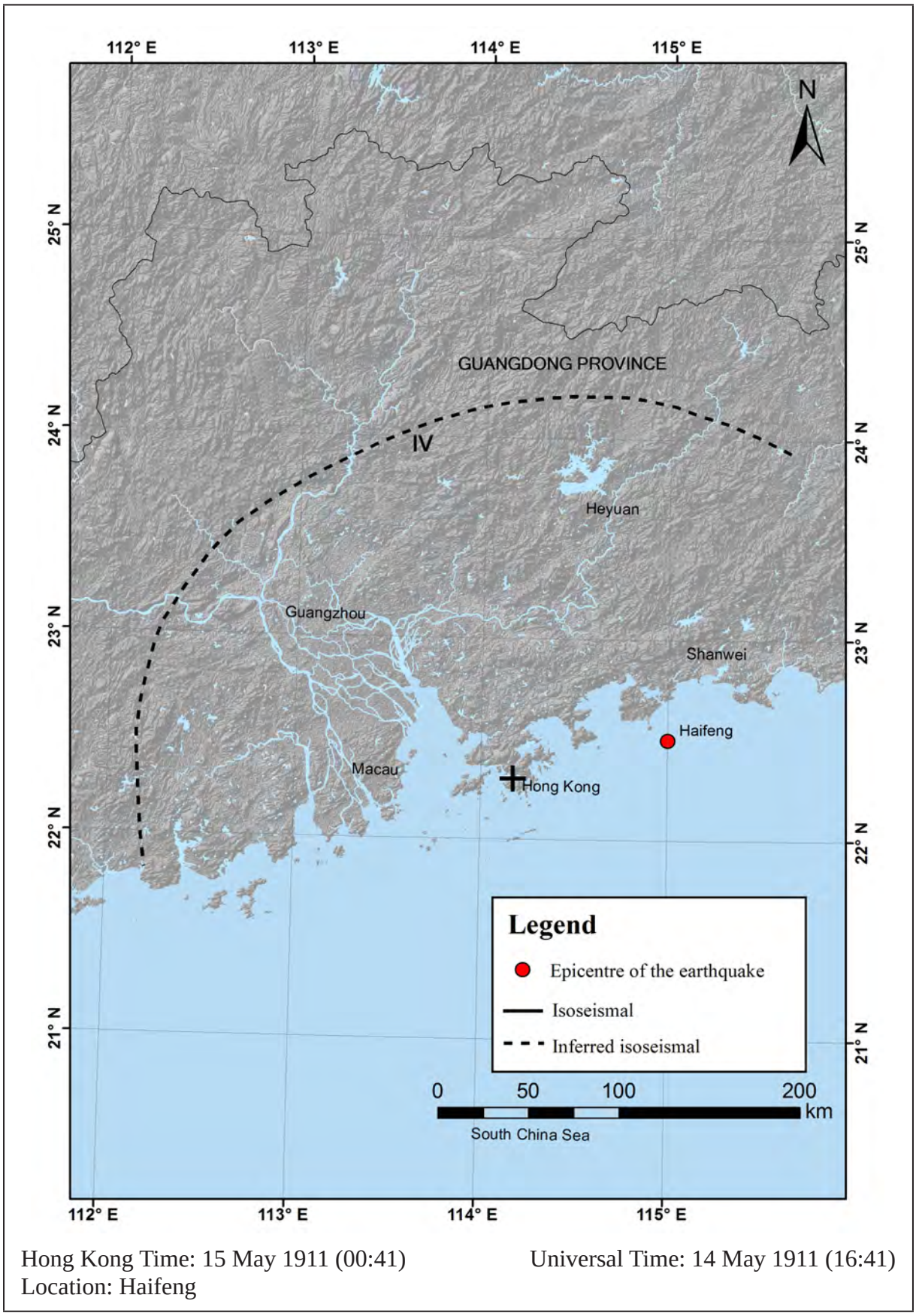
Hong Kong Time: 30 August 1895 (17:45) Universal Time: 30 August 1895 (09:45)
Location: Jieyang

Figure F10 Earthquake Event 30 August 1895 (Jieyang)



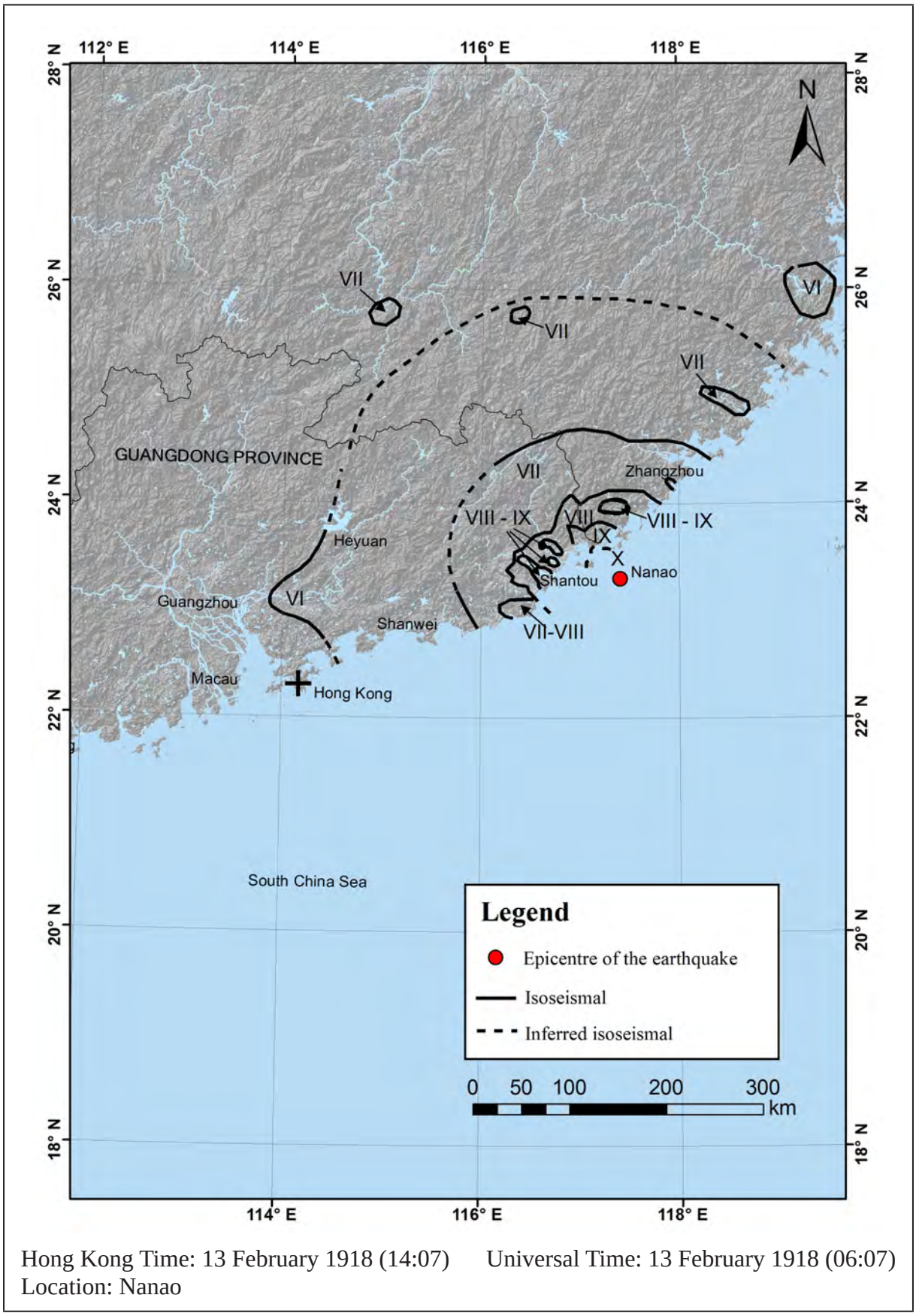
Hong Kong Time: 12 August 1905 (20:25) Universal Time: 12 August 1905 (12:25)
Location: Macau

Figure F11 Earthquake Event 12 August 1905 (Macau)



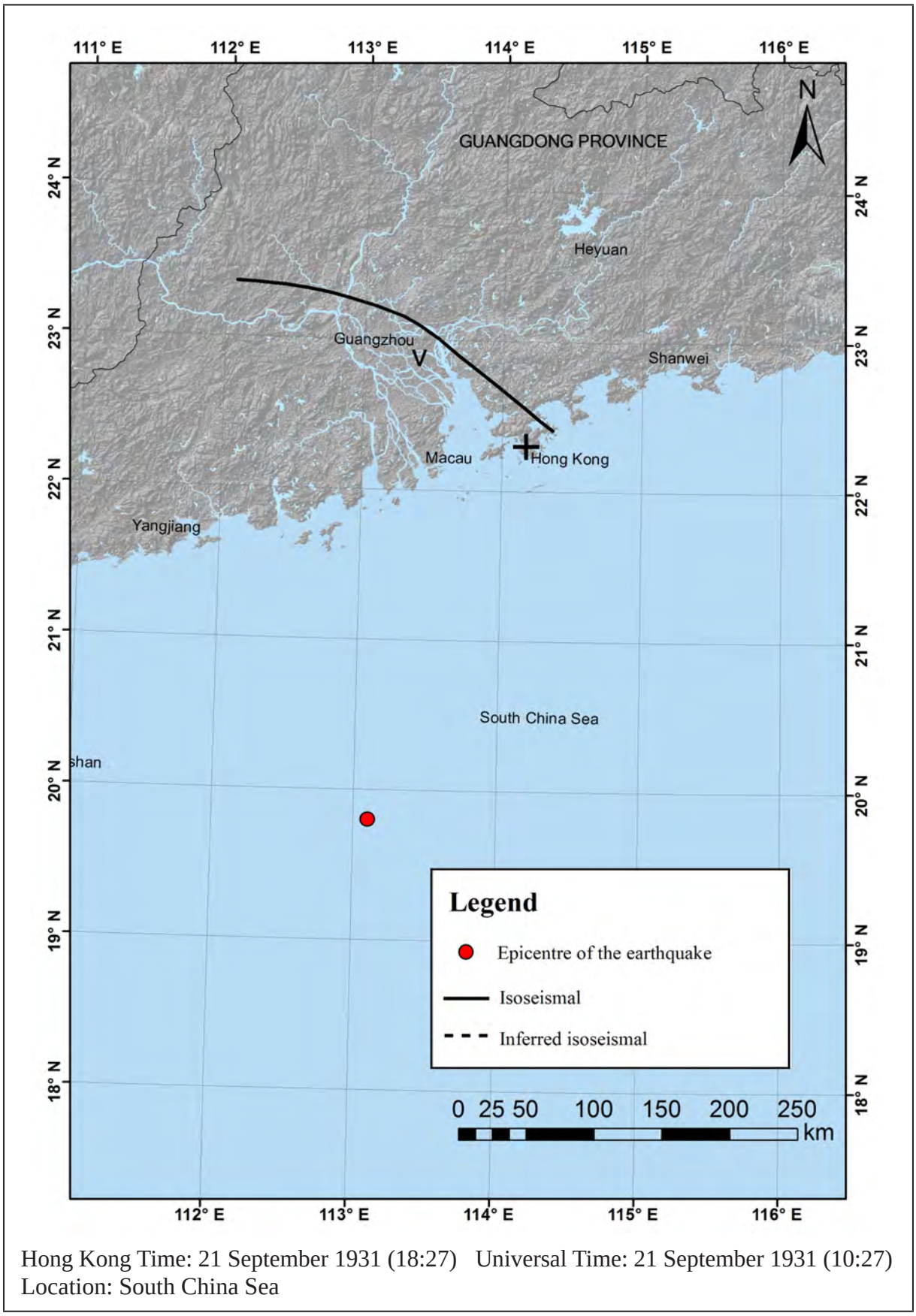
Hong Kong Time: 15 May 1911 (00:41) Universal Time: 14 May 1911 (16:41)
Location: Haifeng

Figure F12 Earthquake Event 15 May 1911 (Haifeng)



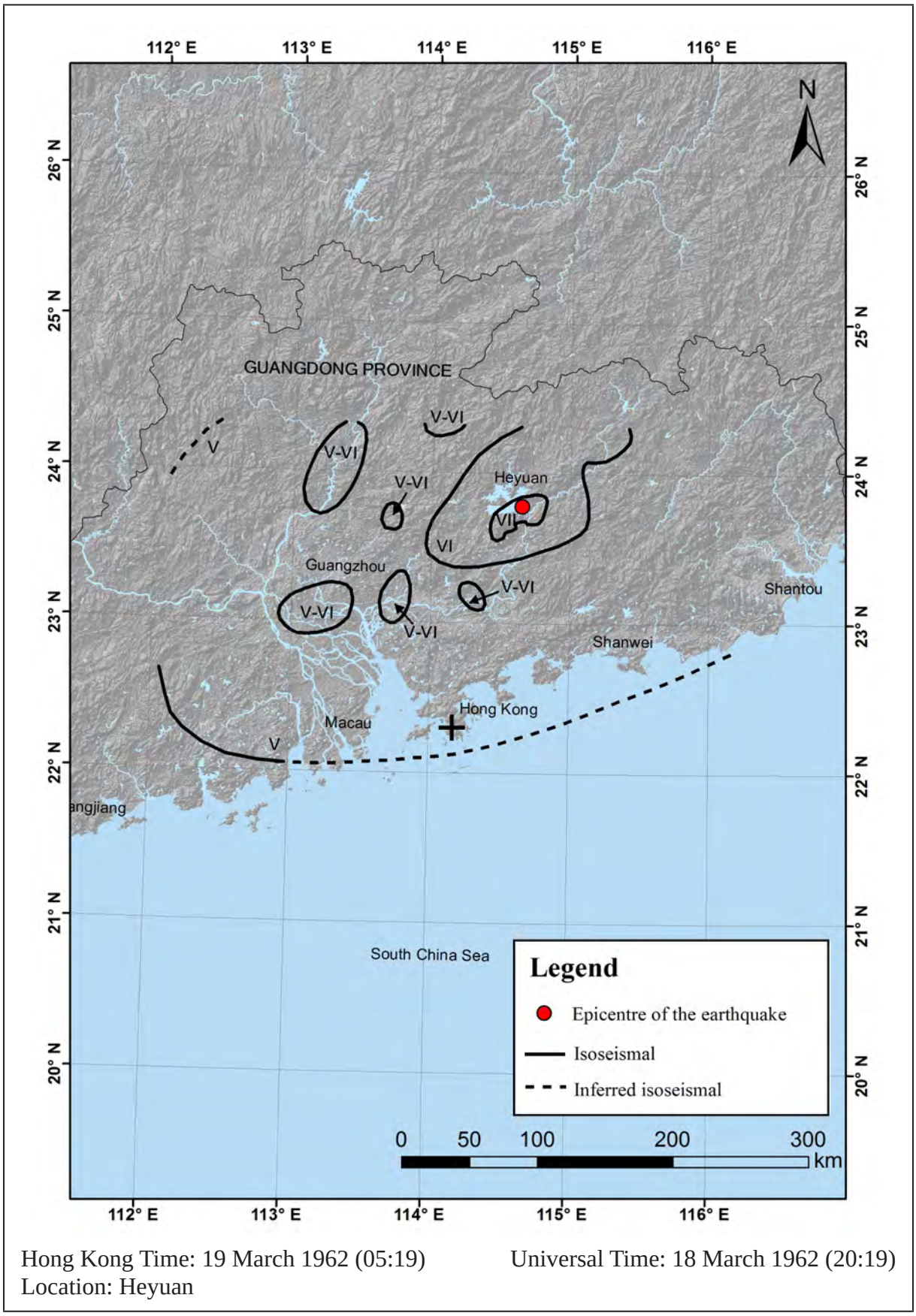
Hong Kong Time: 13 February 1918 (14:07) Universal Time: 13 February 1918 (06:07)
Location: Nanao

Figure F13 Earthquake Event 13 February 1918 (Nanao)



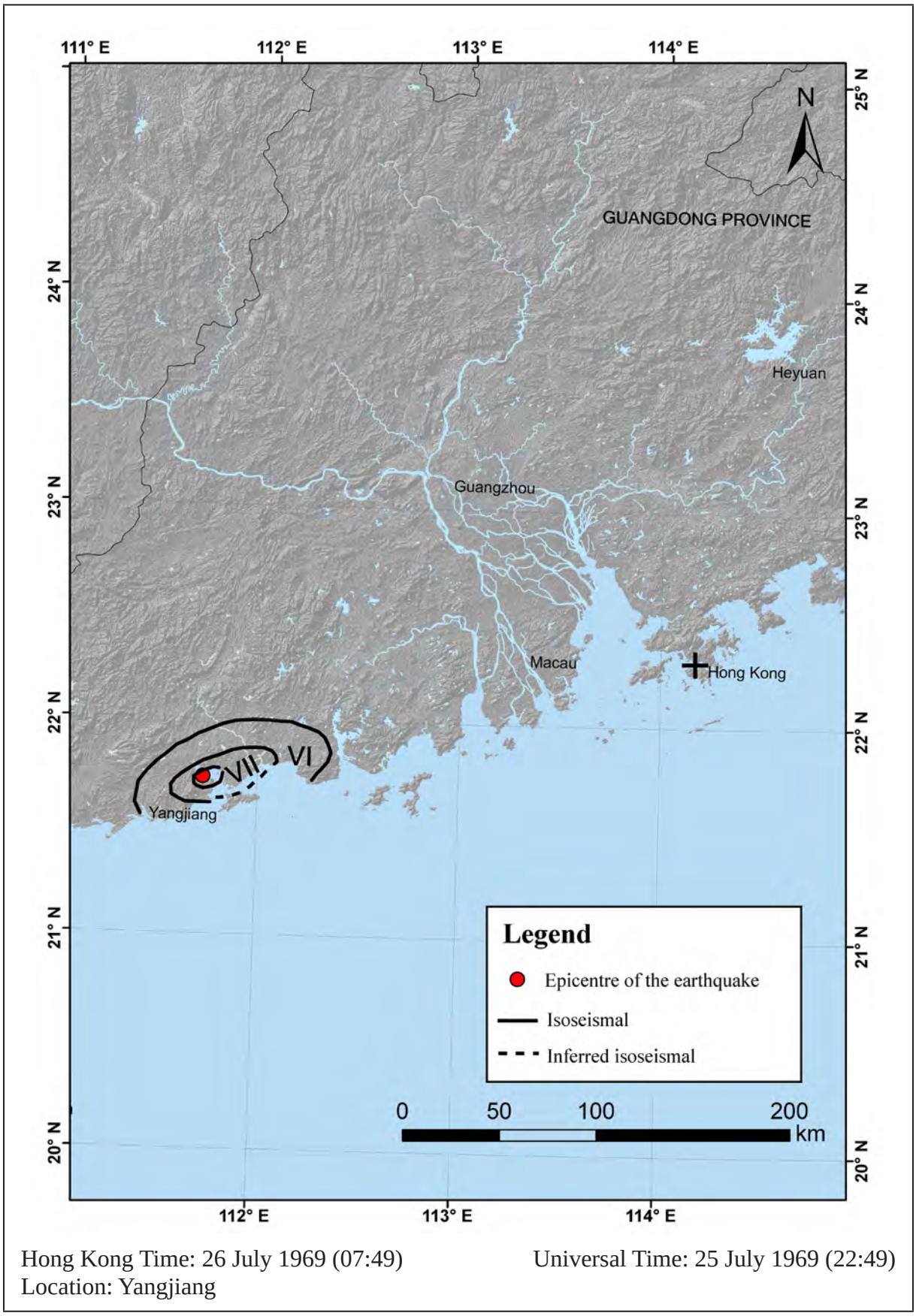
Hong Kong Time: 21 September 1931 (18:27) Universal Time: 21 September 1931 (10:27)
Location: South China Sea

Figure F14 Earthquake Event 21 September 1931 (South China Sea)



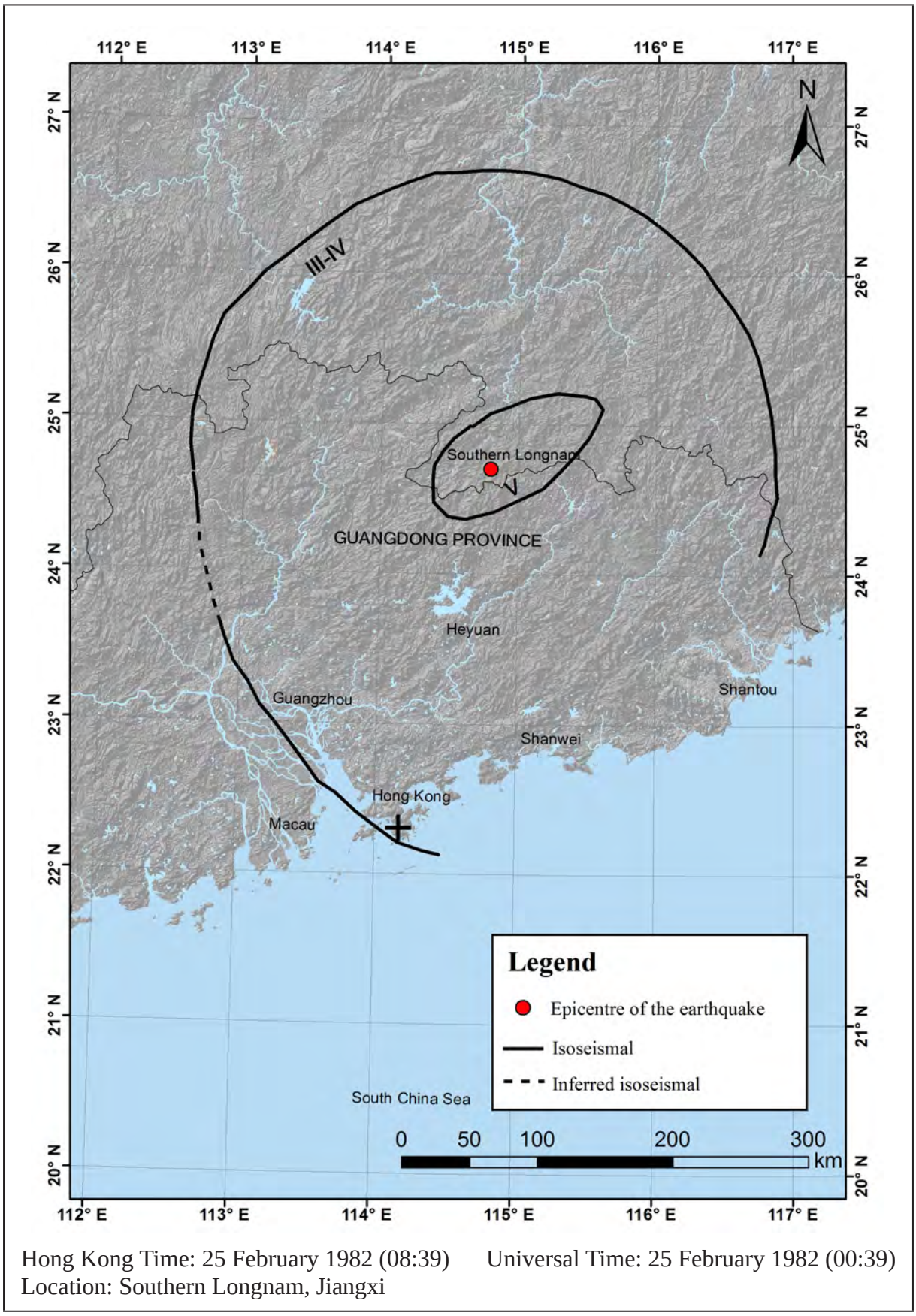
Hong Kong Time: 19 March 1962 (05:19) Universal Time: 18 March 1962 (20:19)
Location: Heyuan

Figure F15 Earthquake Event 19 March 1962 (Heyuan)



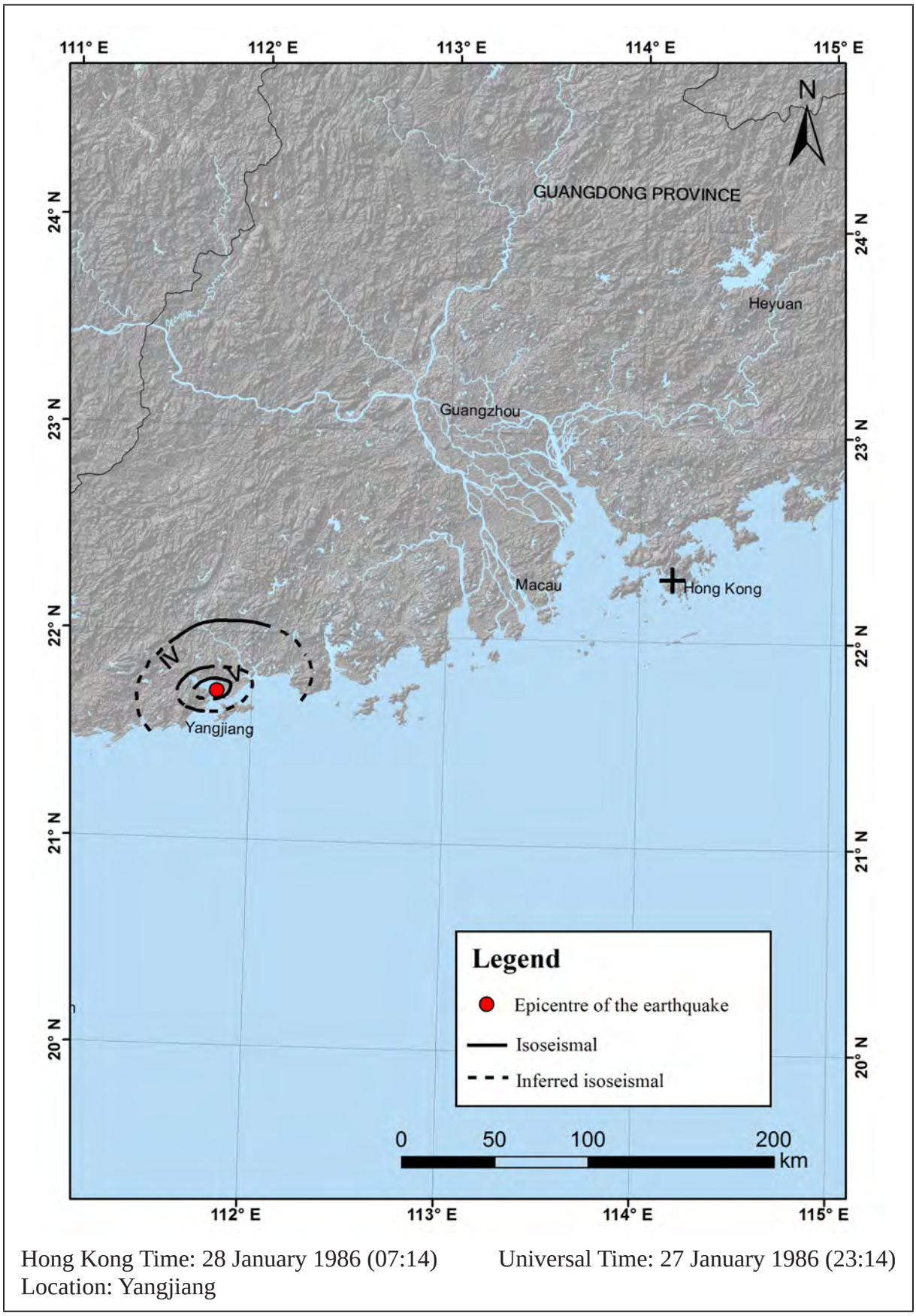
Hong Kong Time: 26 July 1969 (07:49) Universal Time: 25 July 1969 (22:49)
Location: Yangjiang

Figure F16 Earthquake Event 26 July 1969 (Yangjiang)



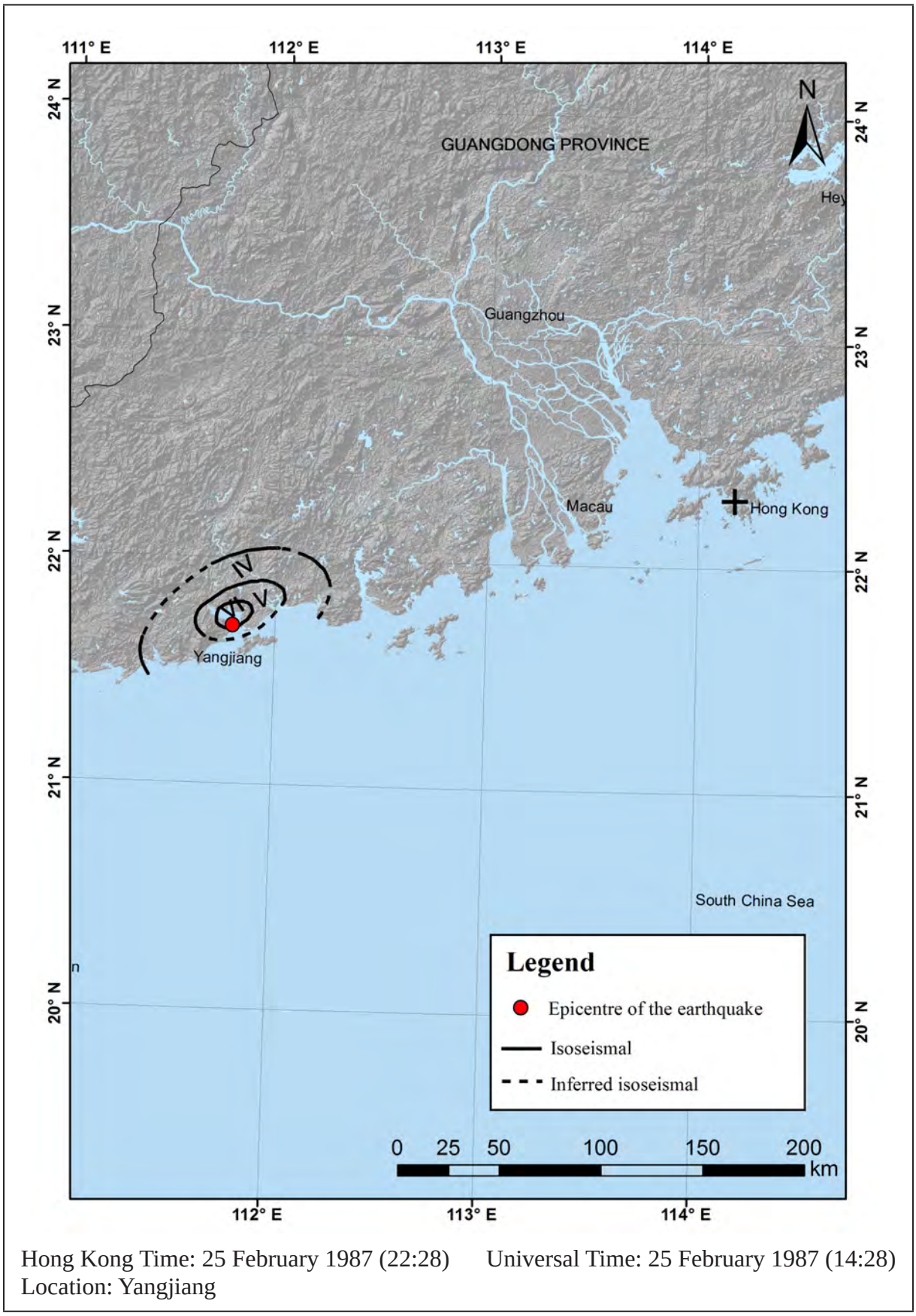
Hong Kong Time: 25 February 1982 (08:39) Universal Time: 25 February 1982 (00:39)
Location: Southern Longnam, Jiangxi

Figure F17 Earthquake Event 25 February 1982 (Southern Longnam, Jiangxi)



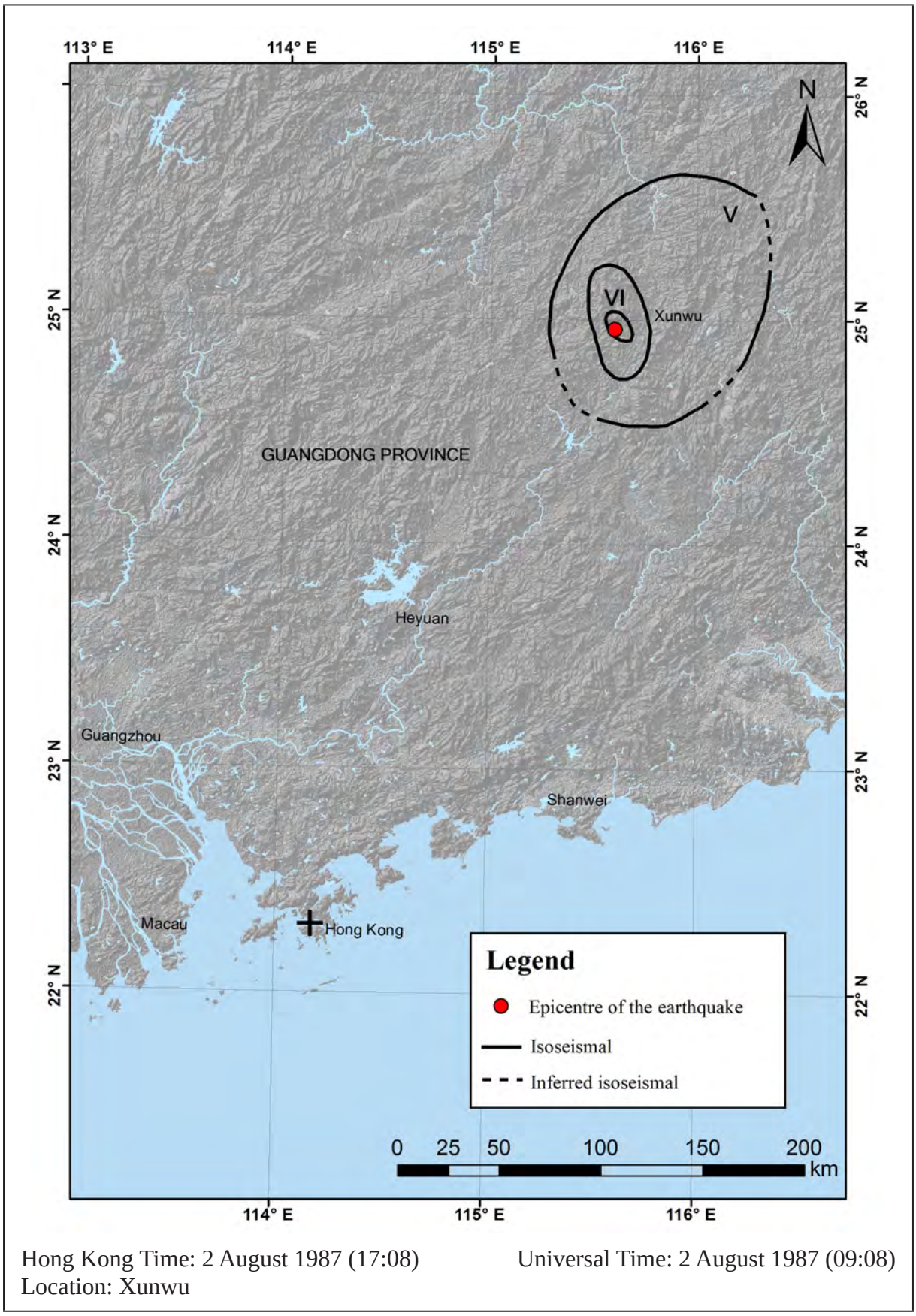
Hong Kong Time: 28 January 1986 (07:14) Universal Time: 27 January 1986 (23:14)
Location: Yangjiang

Figure F18 Earthquake Event 28 January 1986 (Yangjiang)



Hong Kong Time: 25 February 1987 (22:28) Universal Time: 25 February 1987 (14:28)
Location: Yangjiang

Figure F19 Earthquake Event 25 February 1987 (Yangjiang)



Hong Kong Time: 2 August 1987 (17:08) Universal Time: 2 August 1987 (09:08)
Location: Xunwu

Figure F20 Earthquake Event 2 August 1987 (Xunwu)

Appendix G

Intensity Scales

Contents

List of Tables

G.1 General

This appendix gives the Modified Mercalli Intensity (MMI) scale used in the United States (USGS, 2009) and "A new scale of seismic intensity adapted to the conditions in Chinese Territories" (Hsieh, 1957) adopted by the historical Chinese earthquake catalogues.

G.2 Intensity Scale

The effect of an earthquake on the Earth's surface at any location can be described by way of an intensity scale. The intensity scale currently used by USGS in the United States is the Modified Mercalli Intensity (MMI) scale. This scale comprises 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction. It does not have a mathematical basis but only an arbitrary rating based on observed effects. Abbreviated descriptions of the 12 levels of the Modified Mercalli Intensity scale are shown in Table G1. The Chinese Seismic Intensity scale (Hsieh, 1957) also comprises 12 levels of intensity and their general descriptions are also summarised in Table G1 for comparison. The two seismic intensity scales as shown in Table G1 do not have the implied one-to-one correspondence to each other, however, they are similar in comparison.

Table G1 Earthquake Intensity Scales (Sheet 1 of 4)

Intensity	Modified Mercalli Intensity Scale	Chinese Seismic Intensity Scale
I	Not felt except by a very few persons under especially favourable conditions.	無感覺，僅儀器才能記錄到。 Not felt, can be detected by instruments only.
II	Felt only by a few persons at rest, especially on upper floors of buildings.	個別非常感敏，且在完全靜止中的人感覺到。 Felt by sensitive people who stay still.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.	室內少數靜止中的人感覺到。門、窗輕微作響、懸掛物微動。 Felt by a few people who stay still indoors. Slight rattle of doors and windows. Slight swing of suspended objects.

Table G1 Earthquake Intensity Scales (Sheet 2 of 4)

Intensity	Modified Mercalli Intensity Scale	Chinese Seismic Intensity Scale
IV	Felt indoors by many, outdoors by a few during the day. At night, some awakened from sleep. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rock noticeably.	室內多數人感覺到。室外少數人感覺到。少數人夢中驚醒。門、窗輕微作響。懸掛物擺動、不穩定的器皿作響。 Felt indoors by many and outdoors by a few. At night, some awakened from sleep. Rattle of doors, windows and unstable vessels; swing of suspended objects.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.	室內差不多所有人和室外大多數人感覺到，多數人夢中驚醒。懸掛物明顯擺動，少量液體從裝滿的器皿溢出、不穩定器物翻倒。門、窗、屋架等輕微作響、灰土掉落、抹灰出現微細裂縫。不流通的水池裡起不大的波浪。 Felt by nearly everyone indoors and many outdoors. Many awakened from sleep. Obvious swing of suspended objects. Small amount of liquid spills out from containers; unstable objects overturned. Doors, windows, and building frames vibrate and make cracking sound; falling of dusts, small cracks in plaster. Ripples generated in ponds.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage to buildings is slight.	很多人從室內跑出，行動不穩，家畜跑出；器皿中的液體劇烈地動蕩，有時濺出。大多數房屋損壞。牌坊、牆和磚、石砌的塔輕微損壞。潮濕、鬆軟土上出現裂縫。 Many people run out from buildings and cannot walk stably. Livestock frightened. Rough surface of liquid in containers generated and liquid spills out sometimes. Damage in many buildings. Damage in arches, walls and towers built with bricks and stones. Cracks in moist, soft soil.

Table G1 Earthquake Intensity Scales (Sheet 3 of 4)

Intensity	Modified Mercalli Intensity Scale	Chinese Seismic Intensity Scale
VII	Damage negligible in buildings of good design and construction; slight to moderate damage in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.	多數人倉惶逃出戶外，駕車的人也能感覺到，懸掛物強烈擺動。牆、牌坊，磚、石砌的塔部份破壞和很多損壞。多數房屋損壞、局部破壞。乾土中有時產生細小裂縫，潮濕和鬆軟土上地裂縫較多，有夾泥沙的水冒出，個別情況下有滑坡。 Many people frightened and run out from buildings. Felt by people in moving vehicles. Suspended objects swing around. Damage on masonry walls, arches and towers with some localised destruction. Damage to most houses with localised destruction. Small cracks in dry soil and more cracks in moist, soft soil with muddy water gush out. Landslides on individual slopes.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments and walls. Heavy furniture overturned.	人很難站得住，人、畜有傷亡，傢俱移動。墻、牌坊，磚、石砌的塔很多損壞，部份破壞甚至倒塌。大多數房屋破壞、部份傾倒。地上亦有裂縫，常有夾泥沙的水冒出，在岩石破碎和土質疏鬆的地區有土石散落和滑坡。 People can hardly stand. Casualties and fatalities caused. Furniture moved. Damage in many masonry arches, houses and towers with partial collapse. Cracks on ground and muddy water gush out frequently. Landslides and rockfalls in the areas of highly fractured rocks and loose soil.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.	傢俱翻倒並損壞。牌坊和石砌的塔有很多破壞甚至倒塌，部份地下管道破裂。許多房屋傾倒。地上裂縫很多，寬達10米，很多滑波和土石散落。 Furniture overturned and damaged. Considerable damage in or even fall of many arches and stone towers. Some underground pipelines broken. Collapse of many houses. Many cracks on ground up to 10 m wide. Many landslides and rockfalls.

Table G1 Earthquake Intensity Scales (Sheet 4 of 4)

Intensity	Modified Mercalli Intensity Scale	Chinese Seismic Intensity Scale
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed together with their foundations. Rails bent.	傢俱和室內用品大量損壞。許多房屋倒塌。路基和土堤毀壞，道路變形並有很多裂縫，地下管道破裂。山崩和地震斷裂出現；山區和岸邊的懸崖崩塌。疏鬆的土大量崩滑。形成相當規模的新湖泊。 Extensive damage in furniture and household accessories. Many houses collapsed. Damage in sub-grade of roads and embankments, road deformed with a lot of cracks. Underground pipelines broken. Faults ruptured. Hillsides and cliffs collapsed. Massive landslides in loose soil. Large quake lakes formed.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.	房屋普遍毀壞甚至倒塌，壓死大量人畜。路基和土堤等大段毀壞；大段鐵軌彎曲；地下管道完全不能使用。地面形成許多寬大裂縫，大規模的滑坡、崩滑和山崩。地表產生相當大的垂直和水平斷裂。地表水情況和地下水位劇烈變化。 Collapse of buildings, causing a large number of casualties and fatalities. Sub-grade of roads and earth embankments destroyed; extensive railway tracks bent; underground pipes completely damaged. Many large cracks on ground surface, large scale landslides and rockfalls. Vertical and horizontal faults ruptured. Dramatic changes in surface-water hydrology and level of groundwater.
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.	廣大地區內，地形和地表水劇烈變化。 Drastic transformation in topography and landform and changes in surface-water hydrology.

G.3 References

Hsieh, Y.S. (1957). A new scale of seismic intensity adapted to the conditions in Chinese Territories. *Acta Geophysica Sinica*. 中國地震烈度新標準, *地球物理學報*, vol. 6, pp 35-47 (in Chinese).

United States Geological Survey (USGS) (2009). The Modified Mercalli Intensity Scale. (http://earthquake.usgs.gov/learn/topics/mercalli.php).

Appendix H

Newspaper Collection and Assessment of Earthquake Intensity for Historical Earthquakes Reported in Hong Kong

Contents

List of Tables

H.1 Introduction

This appendix provides local newspaper records of historical earthquakes that affected Hong Kong. Direct quotes are taken from the newspaper records for each earthquake event to provide factual information on casualties and damage, as well as the reaction of the general public.

These newspaper records supplement the earthquake catalogue by providing data for assessment of earthquake intensity experienced in Hong Kong arising from historical earthquake events. The earliest available newspaper records in the Hong Kong Public Library date from 1866, and the HKO has reported intensity in Hong Kong since 1979. A search of newspaper records for earthquake events that have occurred between 1866 and 1979 has therefore been carried out. The selected events are presented in Table H1. The newspaper records available for each event are summarised in Table H2.

Information of these earthquake events reported in the following publications is also included in this Appendix:

(i) Pun W.K. (1990). *Seismicity of Hong Kong*. MSc Dissertation, Department of Civil Engineering, Imperial College of Science, Technology and Medicine, University of London, 277 p; and

(ii) Chen, X. & Guo, Z. (1997). *Illustrated Chronicle of Hong Kong (Volume 1)*. Shanghai Ren Min Chi Ban She, Shanghai, 460 p (in Chinese).

The intensity of each event has been assessed based on the newspaper records following the intensity definitions described by Hsieh (1957) (see Appendix G). The intensity levels extracted from isoseismal maps (presented in Appendix F) are also given for comparison.

Table H1 Summary of the Earthquake Events (EAGP Data)

No.	Hong Kong Time				Universal Time				Location	Lat.	Long.	M_S	M_W	Intensity Felt at HK from EAGP	Distance (km)
	Year	Month	Day	Time	Year	Month	Day	Time							
1	1874	6	23	09:23	1874	6	23	01:23	Dangan Island	22.1	114.4	5¾	5.8	< VII	32
2	1892	4	22	09:40	1892	4	22	01:40	Taiwan	22.7	120.2	6	6.0		660
3	1895	8	30	17:45	1895	8	30	09:45	Jieyang	23.5	116.4	6	6.0		250
4	1905	8	12	20:25	1905	8	12	12:25	Macau	22.1	113.4	5	5.3	IV - V	100
5	1911	5	15	00:41	1911	5	14	16:41	Haifeng	22.5	115.0	6	6.0	< VI	80
6	1918	2	13	14:07	1918	2	13	06:07	Nanao	23.3	117.4	7.3	7.3	V - VI	350
7	1931	9	21	18:27	1931	9	21	10:27	South China Sea	19.8	113.1	6¾	6.7	IV - V	170
8+	1962	3	19	05:18	1962	3	18	20:18	NW Heyuan	23.71	114.67	6.1	6.1	≤ V	80
9+	1969	7	26	07:49	1969	7	25	22:49	Yangjiang	21.73	111.73	6.4	6.3		290

Note: + Summer Time used in Hong Kong (See explanatory note in Appendix B.2.1).

Table H2 Hong Kong Newspaper Records Available for Each Event

No.	Chinese Name	English Name	Year of Earthquake Event								
			1874	1892	1895	1905	1911	1918	1931	1962	1969
1	香港華字日報	The Chinese Mail			Y	Y	Y	Y			
2	循環日報	/	Y								
3	德臣西報	The China Mail		NR	Y	Y	Y	Y	Y		
4	香港孖剌西報	The Hong Kong Daily Press	Y	Y	Y	Y	Y	Y			
5	士蔑報	The Hong Kong Telegraph		Y	Y	Y	Y	Y			
6	/	The Hong Kong Times : Daily Advertiser and Shipping Gazette	Y								
7	/	The Hong Kong Weekly Press			Y						
8	星島日報	Sing Tao Daily								Y	Y
9	英文虎報	Hongkong Standard									NR
10	南華早報	South China Morning Post						Y	Y	Y	Y

Notes: (1) Other relevant publications:

(i) Pun W.K. (1992). *Seismicity of Hong Kong*. MSc Dissertation, Department of Civil Engineering, Imperial College of Science, Technology and Medicine, University of London, 277 p.

(ii) Chen X. & Guo Z. (1997). *Illustrated Chronicle of Hong Kong (Volume 1)*, Shanghai Ren Min Chi Ban She, Shanghai, 460 p (in Chinese).

(2) Y = Newspaper records available; NR = Newspaper records available but no earthquake news reported.

H.2 Earthquake Event: 23 June 1874 (Tuesday - HK Time 09:23)

H.2.1 Direct Quotes from Newspaper Records

H.2.1.1 循環日報

Date: 24 June 1874
Heading: NIL

- …五月初十已正港地忽震雖僅一息間而搖撼甚猛屋宇窓蜻皆頓挫作聲居人至驚爲有傾圮之患按港中地震二十餘年來所未有也或云道光二十七八年間普逢之然未如今日之甚也地震之說不一大抵皆近於火山處爲多頃有電報自後山至謂後山地震更甚於前山連震三次居人頗爲驚惶…

Date: 24 June 1874
Heading: NIL

- …前日港中地震始時人皆未知有若被人牽掣其足者有覺屋宇四圍俱搖撼作聲疑爲傾圮者有覺儿案自動而仰視樓上如有數十人躍舞者或聞有聲如重物下壓者其情狀種種不一時街衢間已如鼎沸或云火警者或云屋頹者久之始知爲地震新公司所懸之燈搖搖作欲墜狀下午聞赤柱筲箕灣一帶無不俱震係西而來約歷時一秒許第廬舍固無恙也大書院正常課讀學童忽遘此異無不奔走驚竄有從窓口躍出者此以向未知有地震…

H.2.1.2 Hong Kong Daily Press

Date: 24 June 1874
Heading: Shock of an Earthquake

- At about 9:25 a.m., this City was visited by a severe shock of an Earthquake moving from N.E. to S.W.
- Windows rattled and broke, floors shook, and buildings were felt to tremble.
- Numbers of people rushed out of their houses, terror stricken, and it was not for sometimes that the cause of the shock was uncertain.
- The gaol and Police Court were terribly shaken, and there was a loud noise as if the Police were drawing iron stands across the floors.
- In the Court compound there was a perfect wave observed, and almost everyone there turned pale on seeing it.
- A telegram was sent in from Causeway Bay Station saying that three shocks were felt there and that during one the verandas parted from the building, but fell back again over its place, leaving a crack visible.
- Several cornices from houses on the Praya fell, and the Hong Kong Fire Insurance Engine ran out of the house on to the Praya.
- The fire-bell at the Central Station gave one or two strokes and in private houses the bells rang loudly.
- One house in Bridges-street nearly came down, and in others the furniture shock violently, even heavy iron safes and the like things being moved by the force of the shocks.
- The gaol at Stone-cutter’s Island was shaken throughout and that the lattices of the windows rattled.
- The harbour was much disturbed and the water rough and buoyant.
- Some parts of water were covered with masses of jelly-fish, which had come up to the surface in thousands. After the shock they had all disappeared.
- The Government Central School in Gough-street one of the walls was cracked from the

top to bottom. Much consternation was caused among the boys but it was not of long duration.

H.2.1.3 The Hong Kong Times

Date: 24 June 1874
Heading: Earthquake

- At 23 minutes past-nine, while seated in our "sanctum sanctorum," a trepidation was felt, followed by a rumbling, vibrating noise, which caused us to bend low, thinking for some dire offence, we were about to find the ceiling, if not roof, coming about our ears.
- The Chinese were alarmed and rushed from their houses into the streets, and well they might, for had the shock been more serious, scores of dwellings if they may be so called separated by the thinnest walls - certainly not nine inch party ones - would have stopped the traffic in innumerable quarters.
- The Club reading room the chandelier, oscillated.
- It has been stated to us houses were seen to shake.
- At Stanley, Sou-ka-wan, East and West point, the shocks were also felt. They were from W. to E., and the duration about 15 seconds.
- As far as we can learn, no damage has been done by this strange visitation, called by the Chinese "Tea Long - earth dragon," and the shaking of the soil is attributed to the change of position by the mysterious brute.
- In the Central School, the boys, who were all in their respective classes, ran pell mell into the street, panic stricken, at the first signal of the phenomenon.

Date: 24 June 1874
Heading: The Earthquake

- …the earthquake which took place on the morning of 23 June 1874, at the hour of 9:23, should be carefully recorded, with many…
- …people got a "big scare," is to keep well within the bounds of truth.
- The shouts that took place amongst the Chinese, were dreadful to listen to…

Date: 25 June 1874
Heading: The Earthquake

- We cannot hear that any serious damage was caused in the Colony. The shocks were felt at Kowloon and at Macau.

Date: 27 June 1874
Heading: The Weather

- Following upon the shock of earthquake on Wednesday morning, we have experienced two most tempestuous days. At intervals of a few minutes, the squalls of wind have been somewhat alarming, exciting fear as to a coming typhoon.

H.2.1.4 申報 (Shanghai Newspaper)

Date: 1 July 1874
Heading: 香港地震

- …初十日早九點鐘時逾一刻地忽大震自東北而西南殊足令人駭異是處之人皆惶遠不知所措房內窗戶叮噹有聲幾被拆毀地板亦搖動…側港內眾人俱駭擺趨出房外…
- 監牢阪捕房其震動尤甚地亦作聲如有曳鐵板於石片上者…
- 風逐浪見者無不色駭沿海灘屋詹之石半多墜落…
- 香港保險公司內水龍從廠內震舉而至廠外於灘路之中…
- 房告稱火警大鐘乃白鳴數響各房內之小鐘亦皆叮咚而附和…
- 皮器路西房幾致傾倒房中器皿盡搖動...最重之鐵櫃亦爲震力所移…
- 海水...異常...海底之細魚皆浮騰海面…
- 又聞一華人院內一牆自上至下裂一大縫院內肆舉諸...俱驚不可言…

H.2.2 Summary

The earthquake happened on 23 June 1874 at about 9:23 a.m. in Dangan Island. It was felt by most of people in Hong Kong, especially at Causeway Bay, Central, Stanley, East and West Point, Kowloon. People were scared and worried their houses would collapse and ran to streets during the earthquake. Several cornices fell off and visible cracks observed in several buildings, and one crack was running from top to bottom of a building was reported. The furniture was shaken violently, window lattices rattled, chandeliers oscillated, floors moved, buildings shook with loud noise and stones from coastal houses fell down, fire-bells and clocks rang. Even a heavy iron cabin moved. Sea water was disturbed and many small fish floated to the surface.

H.2.3 Intensity Assessment

H.2.3.1 Intensity Assessed

- Intensity assessed from newspaper records: a strong V.

While most buildings had no damage and only several buildings were reported to have slight damage, the intensity is assessed to be V.

H.2.3.2 Comparison with EAGP and Isoseismal Map

On the isoseismal map (see Figure F8) Hong Kong is within isoseismal IV (Felt), which is the only isoseismal shown. As Hong Kong is much closer to the epicentre it is therefore, likely to be noticeably higher than IV. EAGP listed it as < VII.

H.3 Earthquake Event: 22 April 1892 (Friday - HK Time 09:40)

H.3.1 Direct Quotes from Newspaper Records

H.3.1.1 Hong Kong Daily Press

Date: 23 April 1892
Heading: NIL

- Yesterday at 9:40 a.m. a very distinct and rather sharp shock of earthquake was experienced in this Colony.
- The direction appeared to be east and west, and the duration between 5 and 10 seconds.
- A clock stopped in one house at 9:40 from the force of the shock. In Taipingshan the Chinese were somewhat alarmed, and many ran out of their houses.
- No damage resulted.

H.3.1.2 The Hong Kong Telegraph

Date: 23 April 1892
Heading: NIL

- Two very perceptible shocks of earthquake were experienced at Swatow yesterday morning at 9:40 a.m., almost the same time that this “dot on the ocean” trembled from stem to stern.

H.3.2 Summary

The earthquake happened on 22 April 1892 at about 9:40 a.m. in the Taiwan region. Some people lived in the Peak felt and ran out of their houses. No damage was recorded.

H.3.3 Intensity Assessment

H.3.3.1 Intensity Assessed

- Intensity assessed from newspaper records: IV.

The earthquake was felt by many people and no damage was reported which is consistent with Intensity IV.

H.3.3.2 Comparison with Isoseismal Map

- The isoseismal map shows that Hong Kong is just within the Felt area (see Figure F9).

H.4 Earthquake Event: 30 August 1895 (Friday - HK Time 17:45)

H.4.1 Direct Quotes from Newspaper Records

H.4.1.1 香港華字日報 (The China Mail)

Date: 31 August 1895
Heading: 特電
- 十一日下午五點四十三分鐘本港地震約有數秒...
- 雖搖蕩如在舟次中惟震勢不甚猛烈...

Date: 2 September 1895
Heading: 城西地震
- 十一日傍晚五點半鐘城西居民寶仁坊十二甫等處...
- 聞喧聲震天皆仮地震瞬息即止其樓上...
- 縣之燈聲響鏗然竟有因而下墜時鐘亦多停想...
- 不行有屋宇新建而未完好者杉陣搖而墜...

H.4.1.2 The China Mail

Date: 30 August 1895
Heading: NIL
- As we go to press (5:15 p.m.) there is a distinct shock of earthquake noticeable, lasting about 30 seconds.

Date: 31 August 1895
Heading: The Earthquake
- We inadvertently gave the time wrongly. It was 5:45, not 5:15.
- The movement may be described as a horizontal vibration between east and west, roughly; there was no vertical motion, and hardly any perceptible travelling direction.
- The first distinct oscillation was felt a minute or so before a quarter to six, and lasted about 30 seconds.
- Fainter tremors were felt for some minutes afterwards; and another distinct shock occurred about 11:30 p.m.
- The whole earthquake was so slight as to be hardly noticed by anyone walking about; but most persons who were sitting or lying down felt it plainly.
- It was sufficient to interfere a little with writing.
- In high buildings it was of course most noticeable.
- Two gentlemen in the upper floors of the Hongkong Hotel were tendered dizzy, and thought the place was coming down.
- In the Engineers' Institute, bottles and glasses in the bar were rattled about, and in the top floor of the Central Police Station the effect was similar.
- In the streets, coolies sitting on the pavement sprang up and rushed into the roadway, looking up at the buildings and shouting that the houses were falling.
- In many of the poorly-built basements of the native quarter, the inmates were greatly alarmed, and some rushed out into the streets asserting definitely that parts of the buildings had fallen.
- One Chinaman, scared out of his wits, told a policeman that the house was on fire.
- No actual damage was done anywhere, as far as can be ascertained.

H.4.1.3 Hong Kong Daily Press

Date: 31 August 1895
Heading: NIL
- A slight earthquake occurred yesterday afternoon shortly after five o'clock.
- The oscillation appeared to be from south to north.

Date: 2 September 1895
Heading: The Earthquake
- I am writing for the benefit of those who may not have felt the two distinct shocks of earthquake which occurred yesterday (Friday) afternoon.
- …the shock at 5:43:30, it lasting about 15 seconds, the second at 5:50:15, but this one lasted only four seconds.
- …the chairs on which we were seated rocked to and fro, while doors and glasses rattle, and all the bells in the house rang.
- A small copper kettle on a gas-stand was jerked backwards and forwards, so strong was the oscillation.

H.4.1.4 The Hong Kong Telegraph

Date: 30 August 1895
Heading: The Earthquake
- At 5:47 p.m. an earthquake was felt here. It lasted for several seconds and was sufficiently pronounced to be unmistakable.

H.4.1.5 Hong Kong Weekly Press

Date: 4 September 1895
Heading: Earthquakes at Hong Kong and Swatow
- A slight earthquake occurred on Friday afternoon shortly after five o'clock.
- We felt the first shock at 5:43:40, it lasting about 15 seconds, the second at 5:50:15, but this one lasted only four seconds.
- We hardly believed it to be an earthquake until the chairs on which we were seated rocked to and fro, while floors and glasses rattled, and all the bells in the house rang.
- A small copper kettle on a gas-stand was jerked backwards and forwards, so strong was the oscillation.

H.4.2 Summary

There were two shocks on 30 August 1895 happened at around 5:45 p.m. in Jieyang. This event was more noticed by people sitting lying down and felt by people at upper floors with dizzy feeling. People walking were hardly aware. Chairs with people sitting on moved to and fro, floors and glasses rattled, all the bells in the house ran and a small copper kettle was found jerked backwards and forwards on a gas-stand.

H.4.3 Intensity Assessment

H.4.3.1 Intensity Assessed

- Intensity assessed from newspaper records: III.

The newspaper records described that only people sitting or lying down felt the earthquake but people walking were hardly aware of it. The intensity is assessed to be III.

H.4.3.2 Comparison with Isoseismal Map

On the isoseismal map, Hong Kong is well outside isoseismal VI (see Figure F10), which is the smallest isoseismal presented. Hong Kong would be expected to have a much lower intensity.

H.5 Earthquake Event: 12 August 1905 (Saturday - HK Time 20:25)

H.5.1 Direct Quotes from Newspaper Records

H.5.1.1 香港華字日報 (The Chinese Mail)

Date: 14 August 1905
Heading: 地震紀錄

- 西報云十一晚九點六分鐘時本港署有地震十二早一點鐘復覺地震以此兩次比較以一點鐘之震爲甚按十二晚八點四十五分鐘時覺地震二三昔近久又聞人言是晚十一點餘鐘又震一次夜半又一次惟八點餘鐘之地震之知之甚晰此後是否再震兩之則未之也...

Date: 14 August 1905
Heading: 地震二次

- 十一晚九點五分鐘城廂內外同時地震至十二點二十分鐘復震一次均窓櫺搖動有聲…西人謂地中有硫磺氣偶一洩發故有此異錄之以質諸研究地質學者...

Date: 15 August 1905
Heading: 港澳同震

- 前禮拜五晚九點鐘本港居人多有覺地微震者禮拜六晚八點二十五分鐘又震其勢略烈幾於無人不覺聞瓦面與騎樓微傷者僅一二處...

H.5.1.2 China Mail

Date: 14 August 1905
Heading: Seismic Disturbance

- The earth tremor which was experienced here on Friday evening. It was felt with greater force in parts of the New Territories.
- At Sha Tau Kok and Sheung Shui it was distinictly felt, so much so that Sha Tau Kok immediately rang up Sheung Shui to ask if anything unusual had happened there.
- Later on, about 1:00 a.m. another shock was felt, stronger, if anything than the first.

- The crockery on the dresser rattled, and other moveable articles swayed to and fro until seismic disturbance had passed off.
- The shock that was experienced on Saturday evening was felt all over the Colony, and seemed to be the worst so far felt. It was accompanied by a sound likened to that of a train on an underground railway, whilst the motion appeared to be circular.
- A correspondent informs us that at about 11:15 a.m. on Saturday morning a distinct shock was felt at the Head-quarter offices…

H.5.1.3 Hong Kong Daily Press

Date: 14 August 1905
Heading: Earthquakes at Macao

- But Hongkong is beginning to feel the earth tremors too. Many residents, especially on the Peak, noticed a slight shock about nine o'clock on Friday night, and a much sharper one was experienced at 8:25 p.m. on Saturday.
- That on Friday night was scarcely perceptible but there was no mistaking the shock on Saturday night, an undulating lateral motion of the earth being most unpleasantly perceptible and causing momentary alarm to a good many people.
- Damage to house property, it might be supposed would more likely be caused by Saturday's shock than by that on Friday, yet the only damage we have heard of is the fall of the roof of a verandah at the back of one of the houses in Belilios Terrace on Friday night, the crash giving residents in the neighbouring houses a great fright.
- The movement of Friday night's earthquake shock appeared to be vertical, while that of Saturday was lateral.
- It is ten years since a shock of earthquake so noticeable as that on Saturday night was felt in Hongkong.
- It was then recorded that people in the upper stories of the Hongkong Hotel felt dizzy and concluded that the building would fall, and that many Chinese were much alarmed.

H.5.1.4 Hong Kong Telegraph

Date: 14 August 1905
Heading: Earthquakes at Macao

- However, as the shock which was felt at Macao on Saturday night, also disturbed Hongkong and Kowloon at almost the same hour as it passed over Macao the idea that safety was to be found in Hongkong has been dissipated.
- …the worst effects were felt in the vicinity of Queen's Road.
- In the upper part of the city, the sensation was comparatively slight, but along the water front, the ground quivered and trembled in a most uncanny fashion.
- The residents in the Hotels, especially those living in the upper stories could feel the ground shaking, while houses seemed to sway.
- One gentleman stated that he was sitting in his room at the time and the shock threw him off his chair on to the floor.
- It is reported that the roof of a building in Belillios Terrace fell on Friday night in consequence of the trembling, but nobody was injured.

H.5.2 Summary

There were four distinct shocks between 11th and 12th August 1905 from the Macau earthquake. These happened at about 9:06 p.m. on the 11th then at about 1:00 a.m., 11:15 a.m. and 8:45 p.m. on the 12th. A roof of verandah fell off after the earthquake on the 11th. The earthquakes were felt by many people all over Hong Kong. People at the upper stories felt dizzy and realised that the buildings swayed. A man was thrown off from his chair on to the floor. Crockery rattled, moveable articles swayed to and fro. Many people were scared and escaped to open space.

H.5.3 Intensity Assessment

H.5.3.1 Intensity Assessed

- Intensity assessed from newspaper records: IV.

The newspaper reported that people distinctly felt the earthquake but no damage of buildings was reported. The intensity is assessed to be IV.

H.5.3.2 Comparison with EAGP and Isoseismal Map

On the isoseismal map, Hong Kong is within isoseismal IV (see Figure F11), which is the only isoseismal shown. No higher isoseismal is presented on the map. EAGP have assigned the intensity in Hong Kong as IV to V.

H.6 Earthquake Event: 15 May 1911 (Monday - HK Time 00:41)

H.6.1 Direct Quotes from Newspaper Records

H.6.1.1 香港華字日報 (The Chinese Mail)

Date: 16 May 1911
Heading: 香港地震詳記

- 十六晚約十二點四十分鐘忽地震數秒鐘几久居民皆慌忙失措多走出街中間...
- 屋內門扇床帳及細小物件皆爲之震動數分鐘後人心始安未幾即大雨如注雷電交作各處地方幸無損傷...
- 此處地震九龍壹帶甚於本港...
- 聞有壹婦人臥於床上尙未入睡鄉忽見床從地上跳起又見其衣櫃自行轉動所有門窗皆格格作響全屋幾有傾覆之勢又壹人正熟睡間忽然驚醒見其床離去墻垣自己則輾至床邊爲蚊帳所纏...
- 寓於船政署附近之出洋工人亦大受驚恐當有數百人各携行李出德輔道其驚慌之狀不能盡述...
- 駐局船政署內之人皆同時驚醒據稱確覺由北震至南...
- 由香港仔至筲箕灣及油麻地紅磡等俱覺地震...
- 海面上亦覺地震據昨日急洛燈塔報告約十二點四十五分鐘地震頗劇烈數秒鐘久乃止其餘各燈塔則並無報告…據航業中人…震動之處是必在南方甚遠所其者是第五號警輪是晚在海面巡遊竟不知有此事...
- 惜天文台未有註記地震之器…據其所測出者謂於十二點四十一分鐘先有微震約十五秒鐘

久然後猛震四秒鐘其震動之方向是由東至西天文台各時鍾俱未停息惟報時球之時候針則逾兩秒鐘之位此必由地震所致可想而知矣...

- 香港歷年地震表如下:
  - 一千八百七十四年六月廿三號香港微震。
  - 一千八百九十壹年七月廿一號上午六點四十分鐘山頂九龍各處俱覺地震。
  - 一千八百九十一年八月工號下午二點十分鐘香港微震。
  - 一千八百十二年四月廿二號香港及中國各口岸連震數次約數秒鐘久其聲甚響幸無害。
  - 一千八百九十二年七月廿一號上午六句四十分鐘山頂九龍各處俱覺微震。
  - 一千八百九十二年八月四號香港微震。
  - 一千八百九十四年八月十一號上午十句五十五分及下午一句二十分鐘本港俱覺微震。
  - 一千九百零五年八月一號十一號及十二號俱覺有微動回年九月九號則更加猛動。

H.6.1.2 The China Mail

Date: 15 May 1911
Heading: NIL (difficult to retrieve because poor quality of original copy)

- … in Hongkong and Kowloon was rudely disturbed in their slumbers.
- …in early hour of the morning by pronounced earthquake tremors…
- …to one o'clock and although it only last for less than a minute it was sufficient…to awaken practically everybody from their sleep…
- …while the "quake" was being felt…
- ...one or two...women were…into hysteric as a result…weird and uncanny sensation experienced.
- …the first…of the disturbance was a noisy rattling…door, toilet sets, etc, and as the tremor increased in violence beds began to…and shake until people wondered…
- …lighted were switched on in nearly every…
- The shock seems to have been felt…at Kowloon than on the island, and several reports reach us of how it was…by residents on the peninsula…
- …who happened to be lying awake...the time was regularly…when she found her bed violently jumping off on floor in fitful starts…she was horrified to see a wardrobe…rolling about…Doors and windows rattled and ornaments clatter together until the noise was almost…jumping out of bed…
- A gentlemen who was lying asleep…find his bed drifting away from the wall. He was thrown from one side of the bed to the other side…
- Another man…his bed was doing a…two-step and his wardrobe carrying out a vigorous war dance.
- At the Peak we gather that "a consider…shock was felt" and numerous residents were scared.
- The Chinese all over the Colony were greatly frightened at the disturbance, and quite a number rushed out of their tenements and declined to remain indoors or some hours after the shock.
- …great crowds of Chinese rushed into the streets.
- Dogs added…to the noise by barking and howling…and people ran hither and thither in the...of the moment thinking that…big collapse had taken place in their…vicinity.
- No word of any damage has so far been…
- Unfortunately the Hongkong Observatory…no instruments for registering disturbance of this kind, and consequently there is no actual record of the occurrence.
- The observations, however, it appears that there was a preliminary shock at 12:41…which

was followed some 15 seconds than by a stronger shock lasting four seconds. The motion appears to have been…east to west. None of the clocks in the Observatory stopped, but the time…by which the time ball is not was…to be two seconds out…by the fact that it must have…by the shock.

Date: 20 May 1911
Heading: Rambling Notes (poor quality of original copy)

- …whole rows of houses visibly swaying to and fro…
- One newspaper, I see, discovered that the shock of the 15th inst. was the second within a space of seven days - that really there was another one felt on the previous Monday…it would appear the writer of this informative bit of news didn't discover the fact until a week after the initial shock. Or it may be that as tremors of this kind are so very, very common in Hongkong he didn't think it worthwhile mentioning at the time…

H.6.1.3 Hong Kong Daily Press

Date: 16 May 1911
Heading: Severe Earthquake Shock in Hongkong

- Yesterday morning about a quarter to one a severe earthquake shock was experienced in Hongkong, which roused people from their slumbers and created no little alarm.
- The tremors were felt, at least in some parts of the Colony, for nearly a whole minute.
- In the substantially-built houses of the Colony it was the shaking of beds and the vigorous rattling of doors and windows…
- People sleeping on the upper stories of hotels, the Hongkong Club, and other high buildings, probably felt the shock most…
- …but all over the Colony - in Kowloon, in the city and on the Peak - the shock was severe enough to rouse most sound sleepers and to fill many people with nervous…fortunately no damage was done.
- …men, women and children rushed into the street.
- There the blowing of whistles for police assistance…the barking of dogs, produced a most unusual din, and pandemonium reigned for several minutes.
- The same thing occurred in the Chinese localities at Kowloon, Hunghom and Yaumati, and the fears created were not easily subdued.
- Many Europeans are emphatic that they heard a rumbling noise. Some describe it as being like the sound of a traction engine passing along the street and shaking the houses as it went. Others declare that it was a sharper sound. Some who were awake heard no sound at all, except the shaking of the doors and windows.
- Several ladies who were alarmed by the violent shaking of their beds…
- …he ascribed it to his companion falling more heavily than usual into bed.
- …another who was roused from a deep sleep by a vigorous shaking of his bed-room door…
- Not a few state that they experienced a feeling akin to sea-sickness.
- …the observatory has no instruments…the shock must have been very slight at Kowloon.
- The event was timed at 12:41 a.m., the preliminary shock being followed fifteen seconds later by a stronger shock which lasted four seconds...
- It is believed that the motion was from west to east.
- None of the clocks were stopped, but the clock by which the time ball is fired was found to be two seconds out, which is explained by the fact that it must have "tripped" at the time of the shock.

H.6.1.4 The Hong Kong Telegraph

Date: 15 & 20 May 1911
Heading: Earthquake - The morning severe disturbance

- Last night, or rather early this morning, a severe earthquake was experienced.
- It was of the horizontal tremor variety, and from the statements of various people it is judged that it ran from east to west, lasting only a few seconds in each case, for there were in reality two shocks.
- From people, who were awake at the time, it appears that the first shock was a sudden and violent one, while the second was more gradual and after rising in a crescendo, to its full strength, died away.
- People in bed were shaken, mosquito nets and their supports were violently swayed against the wall, and small objects were displaced on the table.
- The Chinese rushed out of the houses and gathered in the streets, excitedly comparing notes and Blake pier was crowded with natives, who were making ready to take to the boats if necessary.
- Others ran about the streets blowing polices whistles and betraying general signs of panic.
- In Kowloon the shock was also greatly felt and though small ornaments were not disturbed, moderate sized pictures were found in the morning to be hanging askew, beyond that there were few traces of the visitation.
- …the observatory…the approximate time was given as 12:41 a.m.
- Our representative was able to procure at the Observatory a copy of Rossi-Forel Scale I to X which has been adopted by seismologists throughout the world, and which will be of use to the general public for ascertaining the gradations of violence of earthquakes in future…the disturbance of last night comes somewhere in the proximity of classes 3 and 4.
- The scale is as follows:
  - 3. Felt by several persons at rest, strong enough for the direction to be appreciable.
  - 4. Felt by persons in motion; cracking of ceilings.
- …Hongkong is situated in the zone of seismological disturbances in the South of China, and is some distance from the general track of earthquakes which extends through the Philippines and Japan to Alaska.

Date: 15 & 20 May 1911
Heading: Earthquake Items

- At the Central Police Station the shock of the earthquake was felt very severely.
- Europeans, Indians and Chinese alike rushed out to the compound and remained there till day light.
- Reports from the outstations show that the shock was felt all over the island from Aberdeen to Shaukeiwan, as well as in Yaumati and Hunghom on the other side of the harbour.
- This is said to be the third earthquake which has occurred in Hongkong within the past sixteen years, and is the most severe as well we the most prolonged of recent seismic shocks experienced in the Colony.
- So far the police have had no report of any serious casualty arising out of the earthquake.
- The inmates of the Matilda Hospital were roused by the shocks.

Date: 15 & 20 May 1911
Heading: The Earthquake

- Twice this week…
- The first shock of what we must suppose to be a series, was felt at 4:00 a.m. on Monday last, lasting about two minutes.
- It was slight as compared with this morning's shake, which "in all" was nearly of five minutes duration and at its full strength was violent enough actually to displace beds and throw ornaments from tables.
- Failing the necessary instruments, the Observatory authorities are unable to give us any very definite facts about this visitation.
- It may be the "tail" of an earthquake in Japan or Formosa or even farther south, or it may be purely local disturbance within what we may call the Hongkong-Macao zone.

H.6.2 Summary

The earthquake on 15 May 1911 from Haifeng was noticeable especially at Aberdeen, Shau Kei Wan, Yaumati and Hunghom. It happened at about 12:41 a.m. People saw beds and wardrobes rolling about, windows, doors and toilet sets rattled and shaken vigorously, ornament clattered, one man on bed shaken to and fro and was trapped by a mosquito net. Lots of people in deep sleep were awakened. People were very scared, many ran to streets and some prepared to leave Hong Kong Island by boat. One lighthouse was reported damaged. There was no other damage reported. Some people reported a feeling of sea-sick during the tremors.

H.6.3 Intensity Assessment

H.6.3.1 Intensity Assessed

- Intensity assessed from newspaper: V.

There were many people wakened from sleep but no significant damage was reported, the intensity should be about V.

H.6.3.2 Comparison with EAGP and Isoseismal Map

The isoseismal map shows Hong Kong to be within isoseismal IV, which is the only isoseismal line shown (see Figure F12). Hong Kong is much closer to the epicentre, and is therefore very likely to have experienced an intensity higher than IV. EAGP list the intensity in Hong Kong as smaller than VI.

H.7 Earthquake Event: 13 February 1918 (Wednesday - HK Time 14:07)

H.7.1 Direct Quotes from Newspaper Records

H.7.1.1 香港華字日報 (The Chinese Mail)

Date: 16 Feb 1918
Heading: 香港新聞一

- …舊歷初三日下午兩點七分鐘本港地震壹時屋宇搖震動居樓內者如在舟中之受風浪然至十八分鐘再震壹次較前尤甚致令居民咸吃壹大驚多有以爲屋宇傾塌者壹時紛紛下樓。
- …真光公司對面某號舖宇已出現壹大裂痕狀極危險後工務司署聞報已立派多人用大竹前往支撐…聞墻有裂痕者尙多待查確。
- 先施公司…地壹震而所有高處之磁器隨之而倒壹時爛磁滿地。
- 緣品茗者見屋宇搖搖誠恐壹旦傾塌遂紛紛逃走惟恐不及遂跴傷壹年方拾歲之男童並將壹年約八九歲之女童跴至重傷…已斃命。
- 鵝頸之水上人云當地震時在艇上望見岸上一帶屋宇極形震動大有危危不可支持狀態。
- 有一縫衣婦因受驚昏倒。
- …由樓走出街外且有連呼救命者有啼哭者。
- 又九如坊戲院碾動尤烈其椅幾乎反側觀劇者皆大驚。
- 四點半鐘地復再震但斯時人皆入黑甜少有知者惟聞…數人由碌架床上跌下樓板上有壹伴竟跌傷其足。
- 酒樓茶居…客人紛紛逃走。
- 屋宇牆土之崩裂每處均有之昨日到警局報告者亦有廿餘起之多。
- 石澳處初三下午兩點十五分鐘地震約壹分鐘之久…行人多有不覺。
- 林莫一燈塔爲拾叁號地震損壞現燈光雖現然已多費躊躇云。

Date: 18 Feb 1918
Heading: NIL

- 香港地震之餘聞據西報所載謂香港近二拾七年來共地震拾次云。

Date: 19 Feb 1918
Heading: 香港新聞一

- 拾叁號地震之事其聞如下(今日下午兩點零八分鐘覺似地震小輪震動甚大約歷壹分鐘之久乃止震動之後復有一片聲浪壹若敲擊大火爐者約兩星期前有大魚游泛于水面觀其情形殊欠生氣有漁人向余解釋謂此乃因海底大熱所致)。

H.7.1.2 The China Mail

Date: 14 Feb 1918
Heading: Earthquake Shocks

- ...some residents of the colony counting as many as five distinct shocks. There was one about 10:30 and a more severe one at 4:20. These two especially were felt.
- The shock occurring yesterday afternoon appears to have done some light damage to property.
- St. John's Cathedral, we understand, was badly shaken but the damage done was slight. A chimney was partly shaken down at Mr. M. J. D. Stephen's residence.
- The Albany and the house adjoining, occupied by Mr. W. C. Jack, suffered to some extent. After the shock cracks were discovered in a few buildings, including the Hongkong Club.
- The probability of that the damage done by the shock will be revealed when rains come, and show how the roofs have been damaged.

- Reports were made at the Police Station that the walls of houses at 17, Old Bailey, 25, Hollywood Road, and 15 and 17, Elgin Street, were in considerable danger.
- The walls of a house at 21, Staunton Street, are also reported to be in a dangerous condition.
- At Yaumati, the earthquake was felt at 2:08 o'clock in the afternoon and a lesser shock was felt at 8 o'clock. There was no material damaged done to the houses, though much property was shaken.
- People rushed out of their houses in terror and in the stampede, a little Chinese girl, aged twelve years, was knocked down in Reclamation Street, receiving injuries from which she died few hours later.
- …a Chinese lady who was witnessing a performance at the San Hi Yuen Theatre took fright and rushed out of the theatre.

H.7.1.3 Hong Kong Daily Press

Date: 14 Feb 1918
Heading: Earthquake Shock at Hong Kong - An Unusual Experience

- A severe earthquake shock, lasting for over half a minute, was felt in Hongkong yesterday afternoon, shortly after two o'clock.
- Inmates of houses, alarmed by the unusual occurrence, rushed out into the streets, and large numbers of Chinese were afraid to return to their quarters and remained in the streets for some time after the shock had subsided.
- Some plaster fell at the Hongkong Club, and cracks occurred in various walls but no serious damage is reported.
- The first shock was followed shortly before three o'clock by another less marked.
- The disturbance was felt at the Observatory at 2:07 p.m., but as there are no there are no recording machines there Mr. I. F. Claxton, the Director in charge, could not give any precise data.
- The shock was experienced at Mount Davis, Lyemun, Fanling and Taipo, and also at Canton.
- It appeared to travel from north to south.
- A resident in Queen's Road states: - Just after two o'clock, while I was engaged in conversation with some friends in my room on the second floor, I suddenly felt a tremor, and then the whole room seemed to go zig-zag. I thought this was due to giddiness on my part, but a friend explained, "It's an earthquake," and the other residents shouting a warning to us, rushed down the staircase into the street. We followed helter-skelter.
- …the tenements in that neighbourhood terrified. All had left their residences, deeming the street safer, and were unwilling to retain to their dwelling till nearly an hour had passed.

Date: 15 Feb 1918
Heading: Earthquake Shock

- One occurred at ten minutes past eleven o'clock, and the other between four and five yesterday morning.
- …among the Chinese, who fled, scantily…from their houses into the streets.
- The audience at the Sun Theatre, as soon as they felt the vibration and heard the clatter of the zinc roofing, made a general rush for the several exits.
- The second shock at about 4:30 a.m., though lasting only about fifteen seconds, was even

worse than that experienced the previous afternoon.
- …majority of people were blissfully unconscious of it, but those who were awakened by the vibrations experienced a very unpleasant sensation and, in some cases, hurried out into the streets after hastily donning a few clothes.
- The walls of No. 21, Stanton Street, were cracked from top to bottom, also the walls of No. 17, Old Bailey; 25, Hollywood Road, and 15 and 17, Elgin Street.
- Considerable damage to several other buildings has also been reported to the police.
- When the shocks were felt at Yaumati on Wednesday afternoon, people were scared beyond control and rushed out into the streets.
- As a result a Chinese girl, aged twelve years, was knocked down…but succumbed a few hours later.

Date: 19 Feb 1918
Heading: The Recent Earthquake - Report by the Chief Examination Office
- The following report dated 13th February has been received by the Commodore from the Chief Examination Officer in connection with the recent earthquake shocks felt at Hongkong.
- …an earthquake shock at 2:08 p.m. today.
- The launch vibrated severely for about one minute and the vibrations were accompanied by a noise similar to the priming of a large boiler.
- Larger fish have been floating about on the surface in an exhausted condition for the last two weeks or so, and fishermen have explained to me that this was caused by great heat at the bottom.

H.7.1.4 The Hong Kong Telegraph

Date: 14 Feb 1918
Heading: Earthquake Shocks - Excitement in Hong Kong
- Considerable excitement was caused in the Colony about ten minutes past two o'clock this afternoon by a distinct earthquake shock, threw the whole Central District into a site of panic, the large majority of people being under the impression that a serious earthquake was about to occur.
- …a fairly loud rumbling in the earth and then the buildings begin to rock in an alarming fashion.
- Hundreds of people just returned to business after tiffin, rushed out of buildings which seemed likely to be razed to the ground, so violently were they shaking.
- Women and children also poured out of the house terror stricken and some of them fainted through sheer fright.
- …the shock was sufficient to cause one to wonder if the Colony was about to be visited by a danger one earthquake.
- …hundreds, especially from the Chinese quarters, rushed helter-skelter through the streets in an endeavour to find open spaces.
- The shock lasted about half-a-minute and was felt all over Hongkong and Kowloon and outlying districts.
- The shock was very distinctly felt in the Central District.
- A lady residing opposite the Hongkong Shanghai Bank was on her verandah when the earth began to shaken she clearly saw the dome of the Bank rock as though it would fall over.

- Beanconsfield Arcade, too, a very old building, rocked in a serious manner and the inmates lost no time in making their way on to Battery Path.
- Practically every building in the colony was more or less shaken.
- At Shaukiwan, the Peak, Wanchai, West Point and Kowloon bad shocks were felt, but as yet no news in through of any serious damage having been done, though there are several reports of walls cracking etc., from the Central District.
- Serious damage has been caused to a house at 17, Old Bailey, it having been cracked from top to bottom and is in a very dangerous state for habitation.
- The Central Police Station itself suffered, the extreme western end of the building showing cracks. A retaining wall at Government Quarters, ...Point, for some time past has had a small crack but since the shock this has considerably widened No. 25, Hollywood Road is also severely cracked.
- Many reports have been received of flower pots falling from houses into the street below.
- …another shock was felt at about 2:45.
- As when the first shock was felt, the people in these buildings ran into the street and many of them would not re-enter again.
- …the Police and Fire Brigade stood by…no reports of happenings sufficiently serious…
- Among the buildings cracked by the shock are the Hongkong Club and its annex. On the Praya side of the Club building a large and distinct crack can be seen extending through the tow floors, and a considerable quantity of outside planter has fallen down into the road.
- On the Cricket Club side of the building, a long but narrow crack can be seen and the crack in the wall of the…can easily be seen from the roof.
- On enquiry at the Royal Observatory this afternoon, we were informed that no actual record of the shock has been obtained, though it was felt very distinctly.
- Reports have come to hand that the shock was also felt at Taipo and Fanling, showing that it was a general tremor.
- The last occasion on which Hongkong was visited by an earthquake shock was on May 15, 1911, when two slight tremors were felt. In August, 1905, a series of shocks were felt in Hongkong and Macao, lasting nine hours.

H.7.1.5 South China Morning Post

Date: 14 February 1918
Heading: Earthquake Tremor

- Hongkong had an unwonted experience yesterday, in the form of an earthquake tremor which, however, was fortunately light enough to cause more fun than real alarm.
- A few of the nervous folk had a healthy fright; a few ladies cried and others fainted.
- Some of the Chinese got busy with crackers and tom-toms.
- The “quake” occurred at about 2:00 p.m.; and its duration is variously reported as from 8 to 15 seconds.
- Another shorter one occurred at 3:00 p.m. and there were reports that others were felt later.
- Little damage has been reported, and the movement does not seem to have been sufficient to cause “the glasses to jump on the table.” The usual report that is current on such occasions; but there were some entertaining experiences which made for lively chatter among the crows that stood in the streets, watching for sign of inebriacy among our substantial buildings.
- Customers at office counters remonstrated with neighbours for pushing the counter tried

to push it themselves and realised what was happening.

- Then they joined the staff in a pell-mell rush out of the premises. These hasty evacuations were many, the staffs remaining in the streets for some time. Many working on round floors had failed to realise what was a afoot and the excited clatter down stair prompted thoughts of fire.
- People scolded each other for clumsiness and ordered dogs outside for shaking the place, but most quickly realised the cause of the shaking.
- In the streets some pedestrians noticed nothing others allege having taken part in involuntary; but there was everywhere a spirit of levity and reports were exaggerated.
- Passengers who were on the harbour saw and felt no earthquake, and were surprised to see the hatless crowds in the street.
- A well known resident received the shock attired in his pyjamas and hastened into the street so dressed with a military overcoat covering his sleeping attire to receive an amused welcome from his friends.
- The experience at Kowloon was much the same as in Hongkong.
- Enquiry has elicited the fact that cracks appeared in a few houses in different parts of the Colony.
- The occupants of one house on Peak Road had to leave it and the place is being shored up to guard against a collapse.
- The cracks are not important now, but in the events of a heavy wet season collapse are possible and as the rain will be here soon the authorities should lose no time in taking precautionary measures.
- There was some other minor damage, plaster falling from ceilings etc and the top shapped off a flagstaff on one of the central office buildings.
- A wire from Shameen, Canton, reports: Earthquake 2:15 p.m. No damage.

H.7.1.6 Pun (1992) Seismicity of Hong Kong

Date: 21 Feb 1918 <<申報>>
Heading: NIL

- 東部調查長報告英艦隊司令云，十三日地震之際，彼此小輪震驚約十分鐘之久。震動後有聲，類大汽锅之發汽。近兩星期內，有大魚汙水面，狀若力盡。據漁人云，此因海底大熱之故。

H.7.2 Summary

Five shocks from the Nanao earthquake were noted with the most distinct being the one occurred at 2:08 p.m. on 13 February 1918. The earthquake was felt by most people especially at Central, many people rushed to open space. Several people fell off from the upper deck of the beds and hurt their legs. Most buildings shook visibly observed either on land or from those at sea. Obvious cracks observed from top to bottom of some buildings and one building appeared dangerous after the tremors which need to be temporary supported by bamboos. Some buildings were also reported in dangerous condition. There were more than 20 buildings with cracks reported after the tremors and some plaster fell. Hollywood road was severely cracked and many flower planters fell down onto streets. A retaining wall was discovered with small cracks. One lighthouse was reported damaged. Some people indoor felt the building undergoing zig-zag motions during the earthquake. Zinc roof of a

theatre clattered. This event was also noted in "Illustrated Chronicle of Hong Kong (Volume 1)" (Chen & Guo, 1997).

H.7.3 Intensity Assessment

H.7.3.1 Intensity Assessed

- Intensity assessed from newspaper records: VI.

As slight damage was observed in many buildings, the intensity is about VI.

H.7.3.2 Comparison with EAGP and Isoseismal Map

The isoseismal map shows that Hong Kong as being just outside isoseismal VI (see Figure F13). Therefore, an intensity V is implied. The Intensity listed by EAGP is V to VI.

H.8 Earthquake Event: 21 September 1931 (Monday - HK Time 18:27)

H.8.1 Direct Quotes from Newspaper Records

H.8.1.1 China Mail

Date: 22 September 1931
Heading: News in Brief

- A strong local earthquake was recorded at Royal Observatory at 6 hrs. 27 mins. 59 secs. This evening, September 21.
- The preliminary tremors lasted for 10 seconds, indicating that the centre of disturbance was about 60 miles from the Colony.
- The maximum movement, of 70 millimetres, occurred at 6:28:30 p.m.

H.8.1.2 South China Morning Post

Date: 22 September 1931
Heading: Hong Kong Quake - Strong Tremors Felt Last Evening

- An earthquake shock which was felt in all parts of the Colony-in the city, at Kowloon, on the Peak and in the harbour…
- The shock about 60 miles from Hong Kong, making it entirely local. The probabilities are that it occurred at sea.
- Just before 6:30 p.m. a number of residents suddenly became aware that things were not normal…
- Cricket Club-where the shock was very noticeable.
- In offices and dwellings, the movement of walls and flooring, and rattling of loose objects soon explained matters.
- Certain residents in tall buildings in town experienced considerable movement.
- …water in basins breaking into ripples, bottles and ornaments falling over, and so forth.

- In some cases two distinct “waves” were felt, seemingly an east to west movement, the first lasting nearly a minute and the second, after a few seconds interval, of shorter duration but nearly as severe.

Date: 23 September 1931
Heading: A Bird’s Eye View
- These Observatory records of the earthquake are all very well, but the best evidence offered so far of local seismic trouble on Monday is the shaky signature of Robt. MacWhirter when he signed for the round about 6:30 p.m.

H.8.2 Summary

The event happened on 21 September 1931 at about 6:27 p.m. in the South China Sea Region. It was felt in all parts of Hong Kong, at Kowloon and on the Peak. Certain residents in tall buildings experienced considerable shaking. Water in basins was breaking into ripples, bottles and ornaments were falling over. There were movements of walls and flooring, and rattling of loose objects.

H.8.3 Intensity Assessment

H.8.3.1 Intensity Assessed

- Intensity assessed from newspaper records: IV.

Many people felt the earthquake. The intensity of earthquake is estimated to be about IV.

H.8.3.2 Comparison with EAGP and Isoseismal Map

The isoseismal map shows Hong Kong to be just within isoseismal V (see Figure F14) indicating an intensity in Hong Kong is V. The Intensity listed by EAGP is IV to V.

H.9 Earthquake Event: 19 March 1962 (Monday - HK Summer Time 05:18)

H.9.1 Direct Quotes from Newspaper Records

H.9.1.1 Sing Tao Daily

Date: 20 March 1962
Heading: 昨五級地震四十年來僅見
- 地震於五時十五分開始，震動經歷一小時。
- 又在上午十一時十一分（香港夏季時間），天文台地震儀又紀錄另一次小地震，僅有少數居民感覺，此一小地震可能是凌晨一次大地震之餘波。
- 據港府新聞處昨發表：昨日凌晨之地震，迄今爲止，尚未接獲報告有任何損失。
- 此次地震爲五級地震 (按十二級表計算)…
- 震源可能在香港之東北方，但不能尋出其正確地點…
- 五時三十九分開始，先後三次。

- 一九一七年，當時震動力頗烈，事後并有霰降下，第二次約在距今廿七年前，其嚴重性一如昨晨之猛烈。

H.9.1.2 South China Morning Post

Date: 20 March 1962
Heading: Series of Earth Tremors Shake Hongkong - A series of earthquakes, the most severe recorded by Royal Observatory seismographs since they were installed 10 years ago, shook Hongkong before dawn yesterday

- The tremors, which started at 5:19 a.m., shook people out of their sleep and sent many running into the streets in their nightclothes.
- The shock was most severe during the first two and a half minutes, but the tremors lasted almost an hour.
- A minor tremor was recorded by the seismographs at 10:11 a.m. This was felt by a few residents and was most probably an after-shock of the earlier one.
- The earthquake was of intensity 5 on the Modified Mercalli Intensity scale, which is on a scale of 12, a Royal Observatory spokesman said.
- The epicentre was probably northeast of Hongkong…
- According to old residents, the tremor yesterday was the worst for many years. Some remembered a similar but sharper quake in the 1920s when parts of building collapsed.
- At the start of the tremor yesterday residents living in the Wong Tai Sin resettlement estate rushed into the street in their nightclothes.
- Poon Wai-yuen, of B Block, third floor, said that when he was awakened by a shaking bed he heard people running outside his door. Looking out of the window he saw scores of people in the street looking up towards the sky. His first reaction was that Hong Kong was being bombed…He later thought that it was a plane breaking the sound barrier.
- Many people in old houses in Elgin-street, Hollywood-road, Sat-street, Bridges-street and Aberdeen Street also seized cotton quilts and ran into the streets in their pyjamas for fear of collapses.
- A resident in North Points aid he woke up because of the "uncomfortable rocking"…He saw the light swinging like a pendulum. "I thought that maybe a big explosion had gone off in the distance", he said.
- Another resident said that the "uncanny sound" that accompanied the earthquake was like the flapping of a big bird's wings.
- The Hongkong Royal Observatory records an average of two earthquakes a day. But few are felt locally and are usually recorded only as scrawls on a seismological chart.
- The tremors felt here were from major earthquakes, the epicentres of which were within a radius of about 500 miles.

H.9.2 Summary

The early morning shaking by the Heyuan earthquake on 19 March 1962 woke up many people and many of them were running to streets. The epicentre possibly located to the north-eastern of Hong Kong which reported as Intensity V in Hong Kong, according to the Modified Mercalli Intensity (MMI) scale by the Hong Kong Royal Observatory. Some people saw light fittings swaying like a pendulum after being awakened by the shock.

H.9.3 Intensity Assessment

H.9.3.1 Intensity Assessed

- Intensity assessed from newspaper records: V.

There were many people awakened from sleep and ran away to streets. Hence, the intensity felt in Hong Kong is about V.

H.9.3.2 Comparison with EAGP and Isoseismal Map

The isoseismal map shows Hong Kong to be within isoseismal V (see Figure F15) indicating that the intensity felt in Hong Kong was likely to be V. The intensity listed by EAGP is smaller than V.

H.10 Earthquake Event: 26 July 1969 (Saturday - HK Summer Time 07:49)

H.10.1 Direct Quotes from Newspaper Records

H.10.1.1 Sing Tao Daily

Date: 27 July 1969
Heading: 港澳昨晨五級地震幸俱無損

- 香港及澳門昨晨發生五級地震，歷時十多秒鐘，無損害紀錄。
- 昨晨地震爲七年來最劇烈一的一次。
- 地震時間爲上午七時五十分。
- 據天文台報告，震動程度爲修正十二級制之第五級。
- 一九六二年地震亦爲五級，當時曾有損害報告。
- 這次震源在杠港東北一百公里地區。
- 本港感到震力最大者爲新界元朗，流浮山，本港中區，半山區，九龍城，及土瓜灣地區。
- 半山區十廈居民感覺地震之力比其他區域爲大，有一位居民平素早起，當時站在騎樓外，覺得自己身體有些顫動，繼而望向隔鄰之大廈，則見該大廈左右搖擺不定，較遠之大廈，亦作同樣之搖動。歷時幾數秒之久。
- 一些樓宇的門窗都震動的格格作响，吊著的燈也搖動，樹木被震動得簌簌作响，雀鳥也驚飛起來。
- 有許多高臥未醒的人，也被震醒起床，才知是地震，不再睡覺...
- ...但除少部份茶客驚惶失惜外，大部份都好像若無其事的坐着，杯碟則發出碰撞之聲，但沒有損壞。
- 在地震時有一部份茶客感到很其怪，他們不知道是地震，那些知道的，則若無其事的坐着，並沒有奪門而出的現象發生。

H.10.1.2 South China Morning Post

Date: 27 July 1969
Heading: Buildings sway as quake, centred just 27 miles away, strikes Hong Kong

- A “local” earthquake, centred only 27 miles away, shock Hongkong early yesterday, causing furniture to sway, clocks to fall, crockery to break and in some cases, people to dash out of premises.

- The peak of the earthquake lasted for 20 seconds shortly before 8:00 a.m., but the Royal observatory actually recorded the tremor for about an hour.
- There were some reports of slight damage to concrete surfaces of buildings, but no casualties were reported.
- Residents in almost every corner of the Colony said they felt the tremor, which was described by the Royal Observatory as a local earthquake with its epicentre only 27 miles from Hong Kong.
- The earthquake registered an intensity of five on the Modified Mercalli Intensity scale of 12.
- The only more severe earthquakes recorded here occurred in 1918, 1924 and 1962, said a scientific officer at the observatory Mr. Robert Lau.
- "…The centre must lie on a line which runs from northeast to south-southeast through the Colony," he added. (Mr. Robert Lau).
- Resturant patrons at Wanchai, Causeway Bay and Shaukiwan said the tremors caused chairs to rock and tea to spill from cups.
- The earthquake was widely felt throughout the Kowloon peninsula.
- In Yaumati, people fled from their tenement buildings as the quake struck.
- Some residents reported that crockery fell and broke and that in some houses, the wall clocks fell or swayed.
- Housewives and hawkers dashed frantically into the streets.
- Wooden stalls shook heavily.
- A fish hawker spilled a large bucket of water he was holding.
- An elderly woman living in Jardine's Lookout said she was "scared stiff" when the house "trembled", "As I looked up from my bed, the cupboard in a corner of the room seemed to shift forward," she said.
- A woman, about to leave her Western District flat for work, said she felt the floor sway under her feet.
- A Mid-Levels resident…leaned myself against the wall as it sort of swayed. This did not pass away too quickly. To me, it seemed to last a few minutes.
- Some Mid-Levels residents said the quake did not awaken them from their sleep.
- Many more, however, reported hanging objects falling from walls and ceiling lamps swinging.
- Residents in Stanley, Cheung Chau and other outlying islands reported that the tremor was "strongly felt".
- In the New Territories, farmers and other early risers dashed out of tea-houses in Yuen Long.
- A piano teacher in Taipo was practising on the school piano when she felt her chair swaying.
- Musical instruments lying about began making sounds.
- There was no serious damage in the New Territories.

H.10.2 Summary

The earthquake event on 26 July 1969 in Yangjiang caused furniture to sway, clocks to fall, crockery to break and in some cases, chairs to rock and tea to spill from cups in Hong Kong. One lady reported that the cupboard in a corner of the room seemed to shift forward, and she felt the floor swayed under her feet. One reported that the wall was sort of swaying. Some reported that hanging objects were falling from walls and ceiling lamps were swinging. Musical instruments lying made sounds. Some people dashed out of premises. In a tea

house, the cups and plates shaken with noise but not broken. Only some people rushed out from the tea house. However the quake did not awaken some people from their sleep. Wooden stalls shook heavily. Some reports of slight damage to concrete surfaces of buildings, but no casualties were reported. People in almost all areas in Hong Kong said that they felt the tremor especially at Yuen Long, Lau Fu Shan, Central, Mid-levels, Kowloon City and To Kwa Wan. It was also strongly felt in the outlying islands, such as Cheung Chau. It was described as an Intensity V event by the Royal Observatory.

H.10.3 Intensity Assessment

H.10.3.1 Intensity Assessed

- Intensity assessed from newspaper records: IV.

Most people felt the ground shaking and slight damage were reported for some buildings. Therefore, the intensity in Hong Kong is assessed to be about IV.

H.10.3.2 Comparison with Isoseismal Map

The isoseismal map shows Hong Kong to be well outside Isoseismal VI but no smaller isoseismals are shown (see Figure F16). The intensity felt in Hong Kong is less than VI.

H.11 References

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Glossary of Terms

Glossary of Terms

Body-wave magnitude Earthquake magnitude determined from the high frequency body waves of an earthquake, as measured by seismographs at distances that are large compared with the source size.

Epicentral intensity Intensity assigned to the area at the macroseismic epicentre.

Epicentre Point on the ground surface vertically above the focus of an earthquake.

Focal depth Depth from the ground surface to the earthquake focus.

Focus Underground point, or cluster of points, from which the seismic disturbance originates.

Instrumental data Seismic data obtained by instruments.

Instrumental magnitude Earthquake magnitude derived from instrumental data.

Intensity Degree of shaking at a specific place during a given earthquake; this degree of shaking is a rating assigned by means of a descriptive scale.

Isoseismal Contour line drawn to separate areas of the same earthquake intensity.

Local magnitude Earthquake magnitude determined from the maximum amplitude recorded on a Wood-Anderson seismograph, adjusted to a value corresponding to that at an epicentral distance of 100 km (also known as the Richter Scale magnitude).

Macroseismic data Seismic data based on observations of the effects of an earthquake.

Macroseismic epicentre Point on the ground surface at which isoseismals of an earthquake appear to converge.

Macroseismic magnitude Earthquake magnitude derived from macroseismic data.

Magnitude Rating of a given earthquake, usually based on measurements from seismograph records, expressing the amount of energy released by an earthquake in the form of seismic waves.

Moment magnitude Earthquake magnitude derived from the seismic moment of an earthquake.

Seismic moment Measure of the energy radiated from the source of an earthquake in the form of very long period seismic waves determined either from seismograph records or from field observations.

Seismograph Instrument for recording ground displacements during an earthquake.

Surface-wave magnitude Earthquake magnitude determined from the long period (approximately 20 seconds) surface waves of an earthquake, as measured by seismographs at distances that are large compared with the source size.

Teleseismic Earthquakes at distances greater than 1,000 km from the measurement site.

Glossary of Symbols

Glossary of Symbols

I	Intensity of an earthquake event
M	Magnitude of an earthquake event
M_L	Local magnitude
M_S	Surface-wave magnitude
M_{SC}	Macroseismic magnitude
M_W	Moment magnitude
m_b	Body-wave magnitude
M_0	Seismic moment

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土力工程處之主要刊物

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Geotechnical Manual for Slopes, 2nd Edition (1984), 302 p. (English Version), (Reprinted, 2011).

斜坡岩土工程手冊(1998)，308頁(1984年英文版的中文譯本)。

Highway Slope Manual (2000), 114 p.

GEOGUIDES

Geoguide 1	Guide to Retaining Wall Design, 2nd Edition (1993), 258 p. (Reprinted, 2007).
Geoguide 2	Guide to Site Investigation (1987), 359 p. (Reprinted, 2000).
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Geoguide 5	Guide to Slope Maintenance, 3rd Edition (2003), 132 p. (English Version).
岩土指南第五冊	斜坡維修指南，第三版(2003)，120頁(中文版)。
Geoguide 6	Guide to Reinforced Fill Structure and Slope Design (2002), 236 p.
Geoguide 7	Guide to Soil Nail Design and Construction (2008), 97 p.

GEOSPECS

Geospec 1	Model Specification for Prestressed Ground Anchors, 2nd Edition (1989), 164 p. (Reprinted, 1997).
Geospec 3	Model Specification for Soil Testing (2001), 340 p.

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GEO Publication No. 1/2007	Engineering Geological Practice in Hong Kong (2007), 278 p.
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GEO Publication No. 1/2011	Technical Guidelines on Landscape Treatment for Slopes (2011), 217 p.

GEOLOGICAL PUBLICATIONS

The Quaternary Geology of Hong Kong, by J.A. Fyfe, R. Shaw, S.D.G. Campbell, K.W. Lai & P.A. Kirk (2000), 210 p. plus 6 maps.

The Pre-Quaternary Geology of Hong Kong, by R.J. Sewell, S.D.G. Campbell, C.J.N. Fletcher, K.W. Lai & P.A. Kirk (2000), 181 p. plus 4 maps.

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