The Record of the Natural Disaster and the Traditional Monument —Case of Nankai Earthquake and Sediment Disaster of Hiroshima

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INTERNATIONAL SEMINAR ON

APPLICATION OF ADVANCED TECHNOLOGY IN SLOPE ENGINEERING

HANOI,2025

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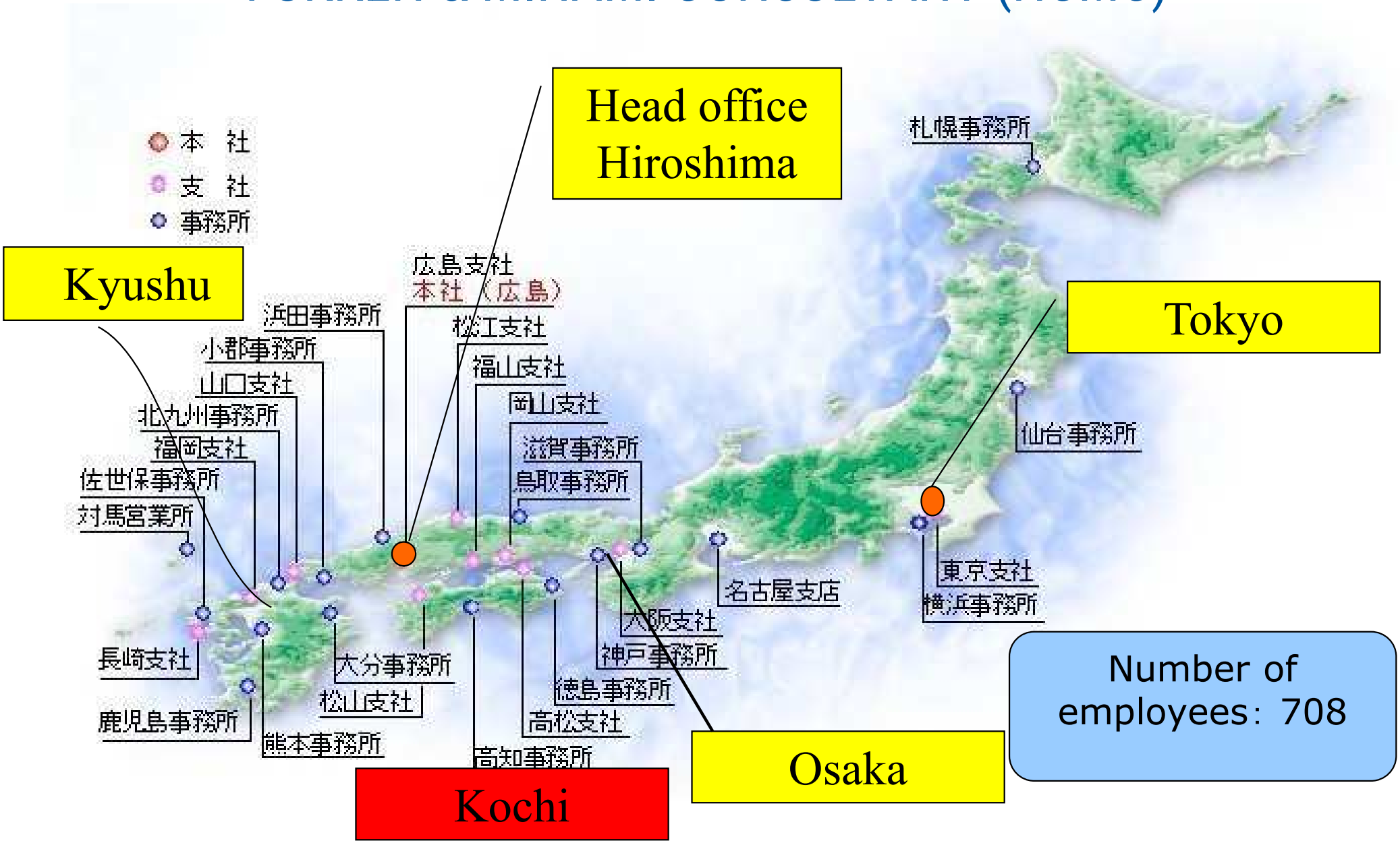
FUKKEN & MINAMI CONSULTANT (HCMC)



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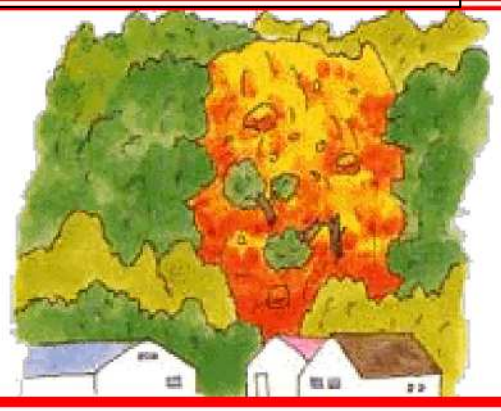
1. The kind and characteristic of the sediment disaster

①Slope failure	②Debris flow	③Land slide
		
がけ崩れ	土石流	地すべり
【がけ崩れの前兆現象】 • がけに割れ目が見える。 • がけから水が湧き出ている。 • がけから小石がぱらぱらと落ちてくる。	【土石流の前兆現象】 • 山鳴りがする。 • 川の流れが濁り流木が混ざっている。 • 雨が降り続いているのに川の水位が下がる。	【地すべりの前兆現象】 • 斜面から水がふき出す。 • 地面にひび割れができる。 • 沢や井戸の水が濁る。
Heavy rain and steep slope influences	Heavy rain influences	Groundwater influences

3. Objectives

- August 2014, heavy rainfall occurred around Hiroshima City, leading to large scale debris flows

- Slope failures, debris flows into the Hiroshima City, killing 77 people

- July 2018, heavy rainfall occurred around western part of Japan, leading to large scale debris flows and sediment disasters

- It is important to elucidate the frequency and impact of previous disasters and assess the probability of future disasters

2.1 Reconstruction of debris flows frequency in Hiroshima, 2014.

-Geology of investigated area

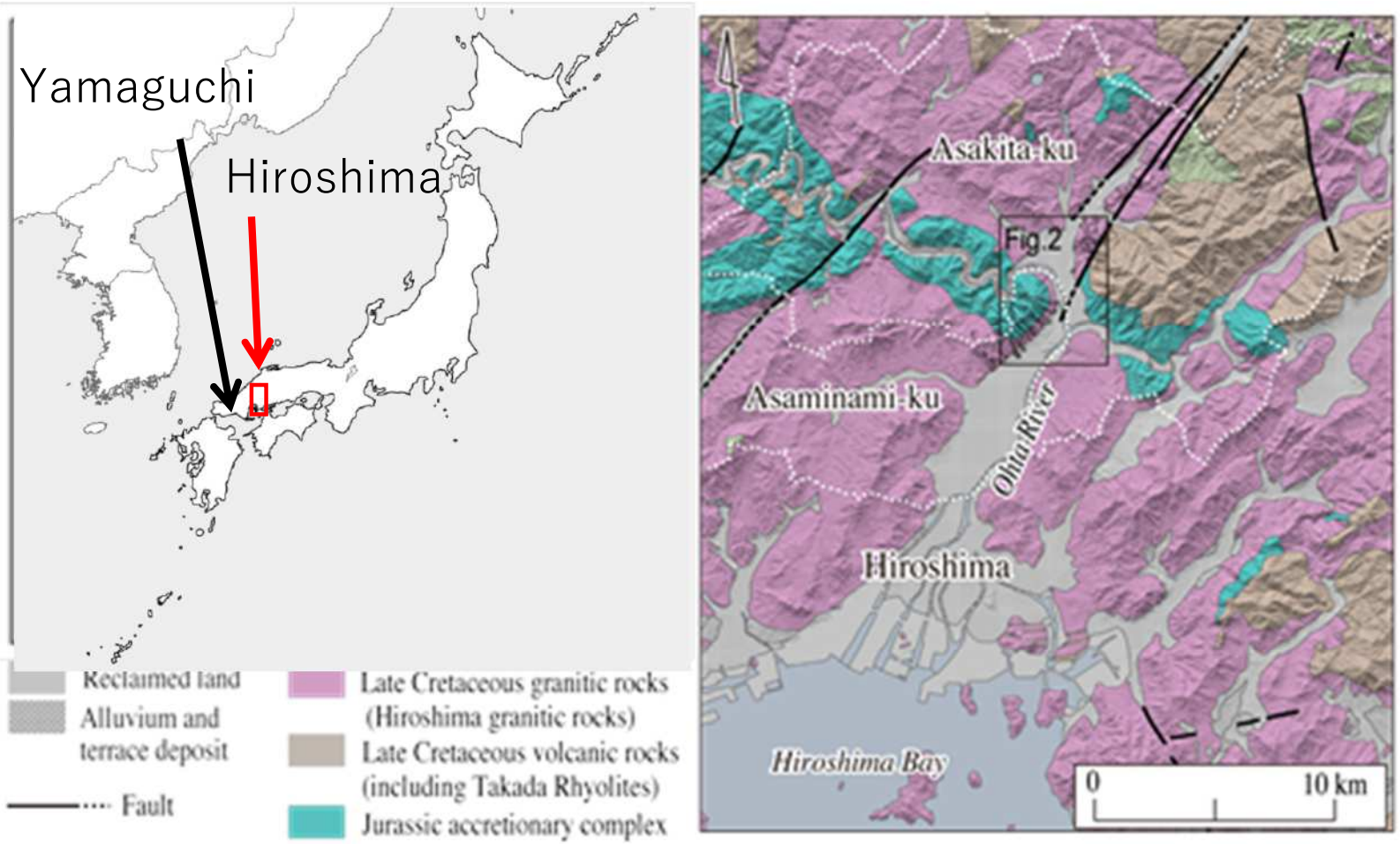
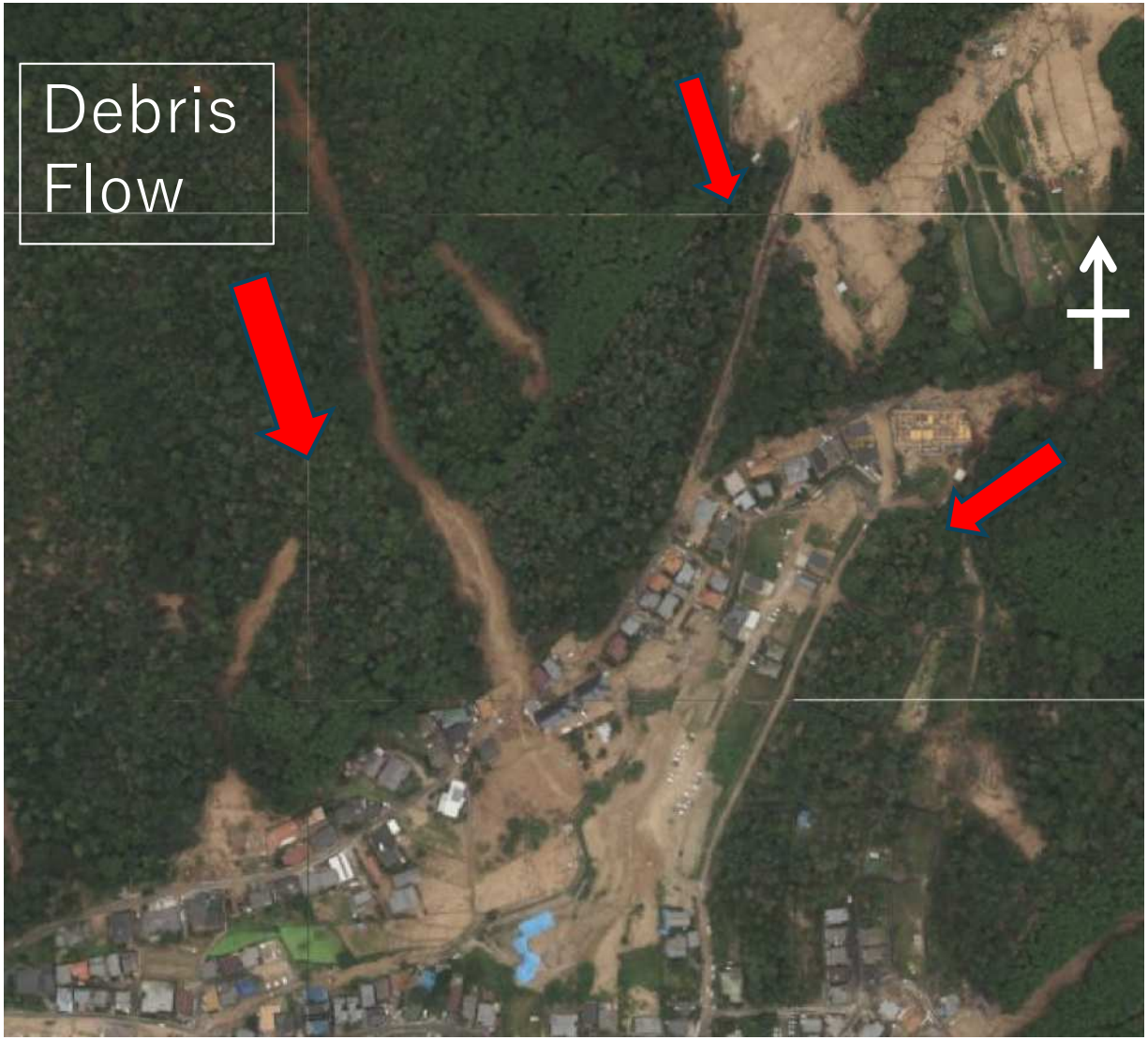


Fig. 1 Index map
Geological map is after Geological Survey of Japan (2012).

Aerial photograph of Asakita-ku area (Hiroshima , Kabehigashi)



2.2 Debris flow

The edge of the dam destroy

The house and car near the river destroys

3. Investigation method of sediment disasters

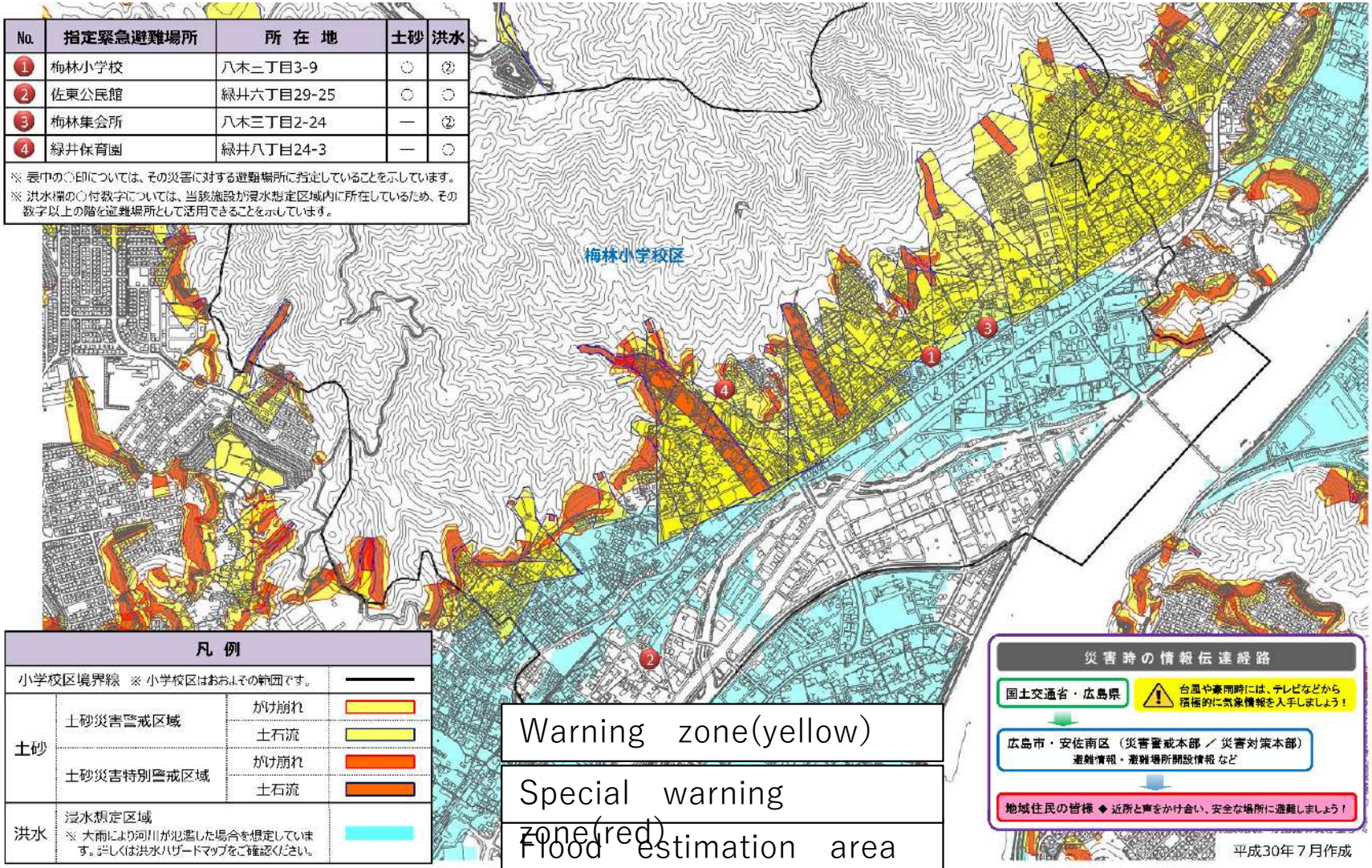
①Morphological analysis（aerial photograph analysis ）
②Geological reconnaissance, morphological survey
③Geological survey（bore hole survey)
④Monitoring survey of displacement of the ground (groundwater monitoring, inclinometer, etc)
⑤Soil test , insite test

4.Survey method our study

- Observation of the debris flow sediments and distinguish the stratum
- Radiocarbon dating(^{14}C) from the debris flow deposits
- Determine the depositional age of the debris flow deposits
- Compare the disaster record with historical documents

4.1 Sediment disaster hazard map by morphological analysis

(Asaminami-ku, Hiroshima)



Warning zone(yellow)

Special warning zone(red)

Flood estimation area

http://www.city.hiroshima.lg.jp/www/contents/1256201335621/index.html

Out crop of the debris flow sediments

layer③ Parallel structure

Upper:Debrisflow sediments
Lower：Medium sand-silt layer

boundary

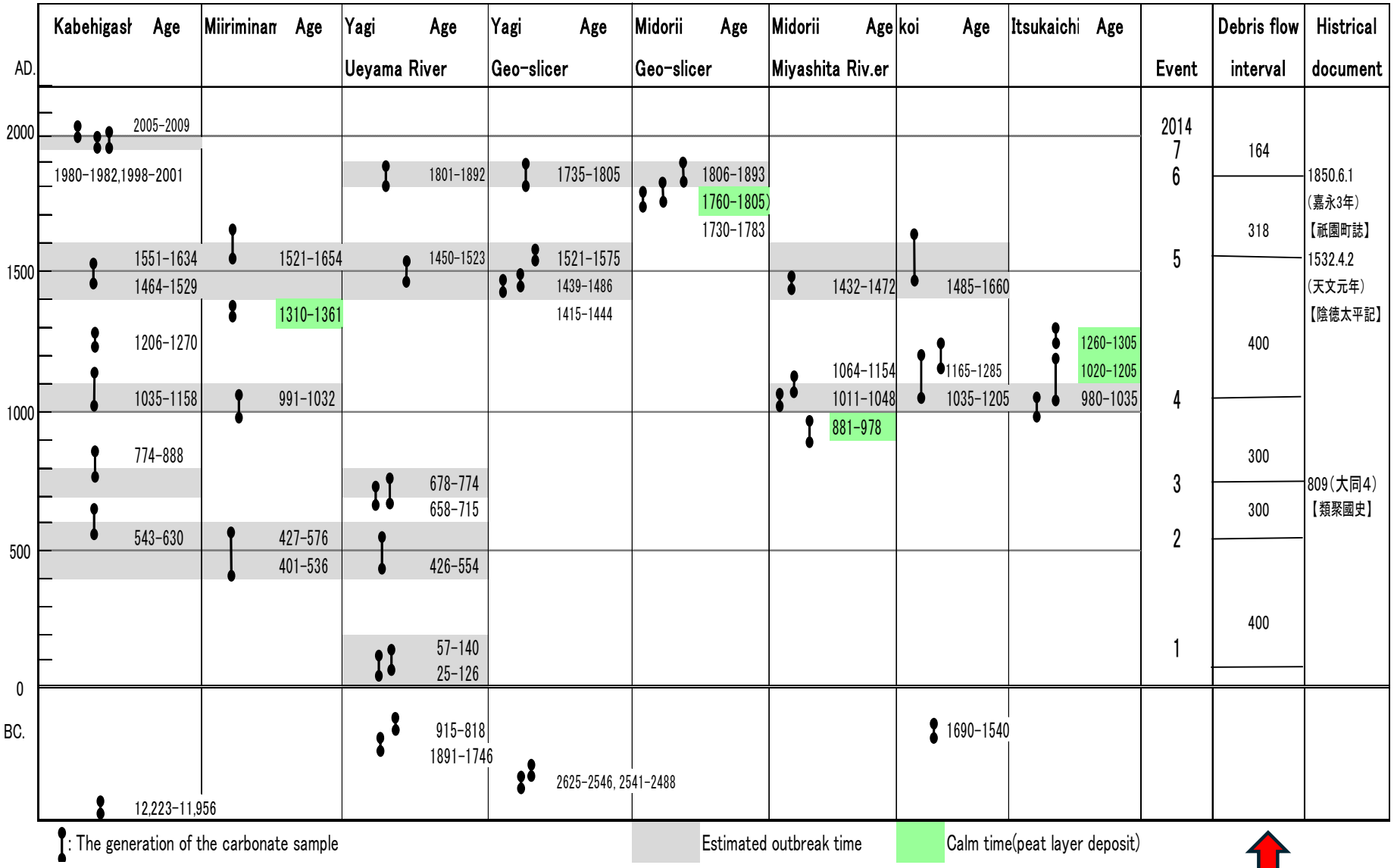
layer② Irregular structure

Cobble size gravel
Debrisflow sediments

Field survey and carbon sample

Radiocarbon dating(^{14}C)
from the debris flow
deposits

5. Chronology of past debris flows events



Debris flow recurrence interval of 150-400 years

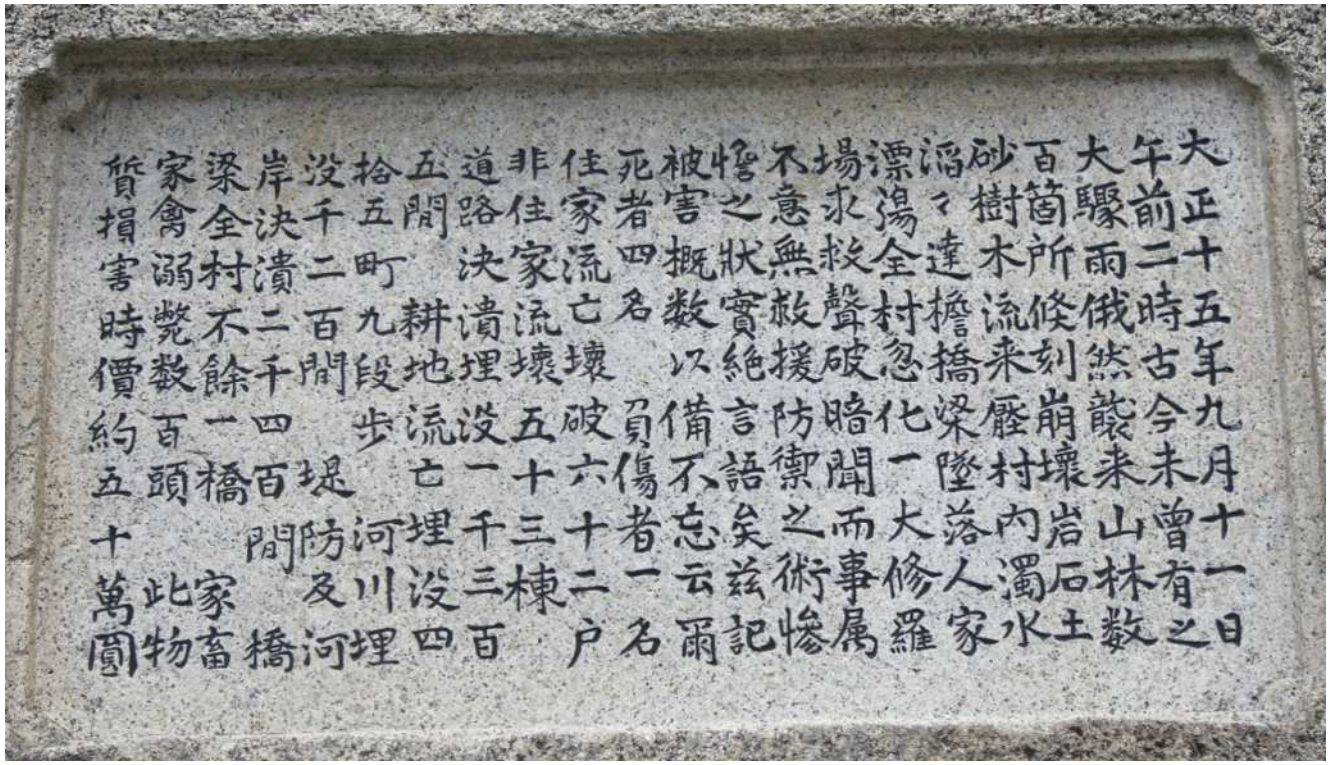
6. Representative record of the stone monument and document in Hiroshima

place	outbreak day	passed year	remarks
1.Asaminami-ku	June 1th 1850	164年	document
2.Nukushina higashi-ku	July 11th 1926	92年	monument
3.Yanohigashi-5	July 15th 1907	111年	monument
4.Koyaura-4 Saka town	July 15th 1907	111年	monument

After Fujimoto (2016)

100～150 years ago from present

Record of the stone　monument
September 11th, 1926.（大正十五年）
Nukushina Village, Hiroshima



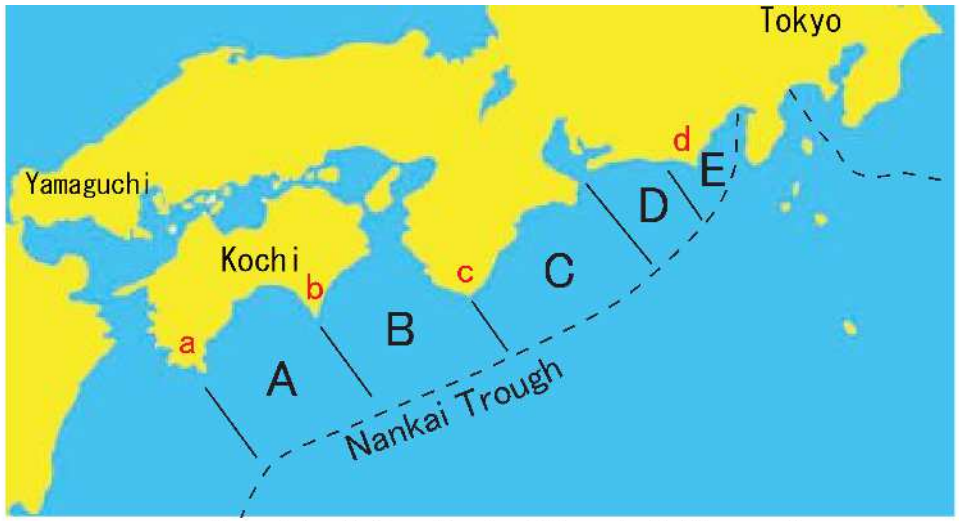
The date and time of the disaster, the scale of damage, and the amount of money were recorded.

7. Purpose of construction of monument

- Memorial service for the victims
- Record of the disaster for the future
- Thank you to everyone for helping with the recovery

⇒The construction costs were likely covered by donations and contributions

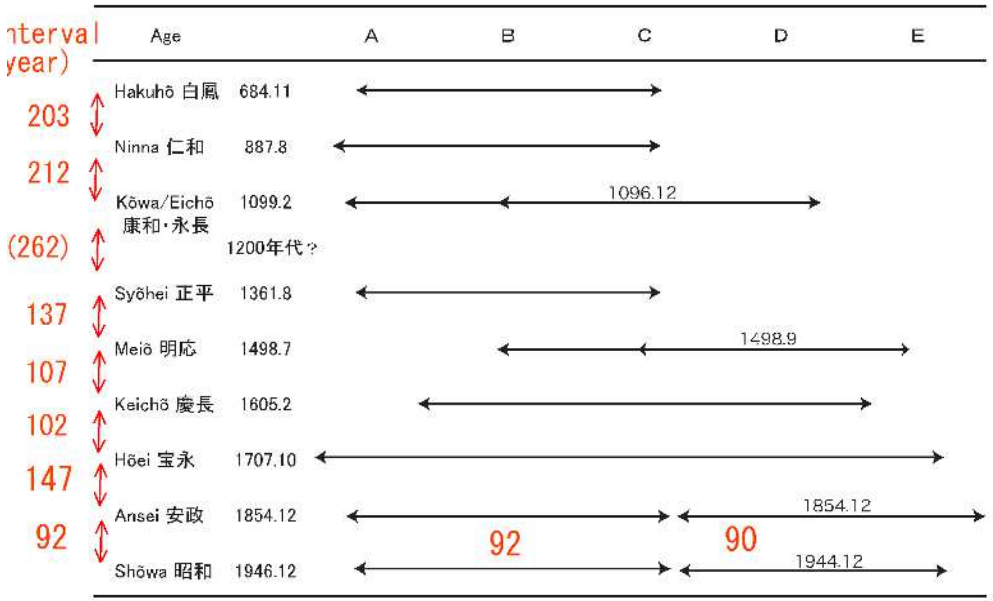
8. Historical record of Nankai-Tokai earthquake



a:Cape Asizuri,b:Cape Muroto,c:Shionomisaki,d:Omaezaki

Interval
92-212 year

Next Earthquake
2038 year ?

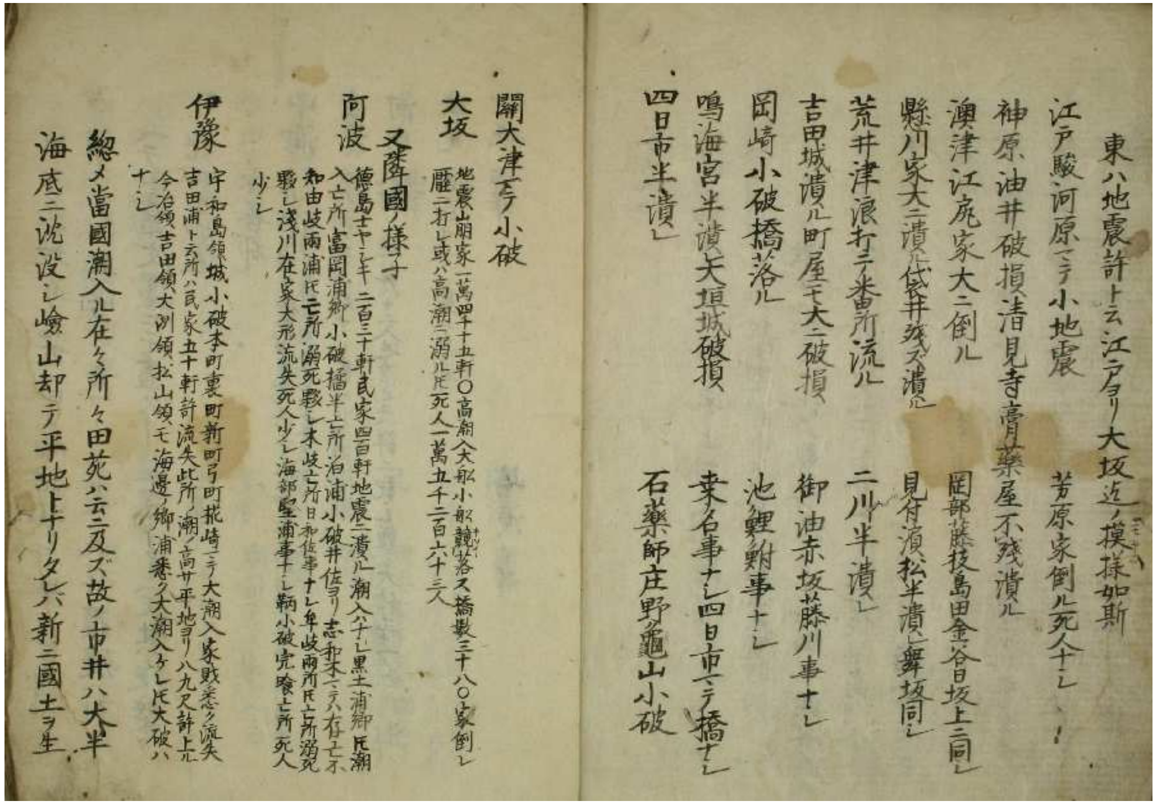


Area and year of occurrence

Flood and damage of house
Nankai earthquwake Kochi city
Dec. 21,1946 (1,400 dead and missing)

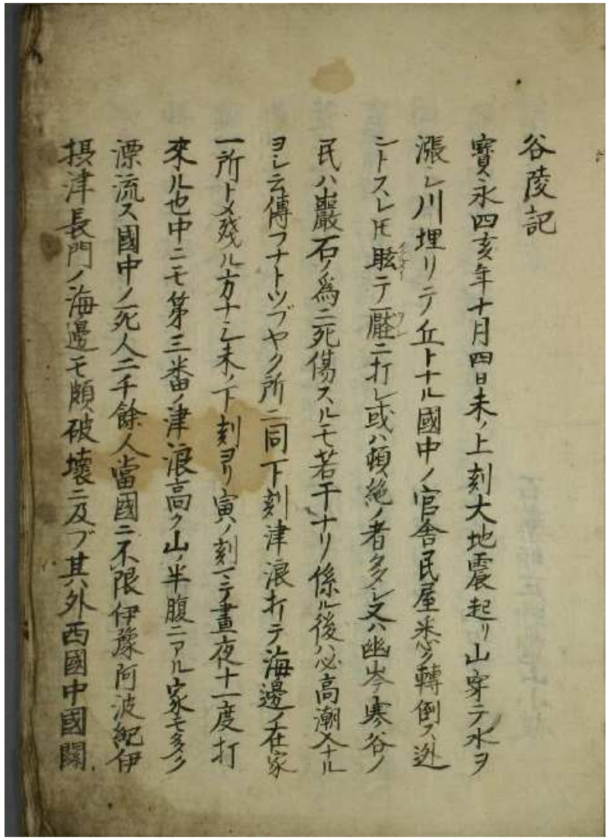
(photo by Kochi Univ.)

Historical document
Earthquake damage report of Kochi
『Kokuryouki』
（Hoei earthquake:October 4, 1707）



東ハ地震許ト云江戸ヨリ大坂近ノ模様如斯
江戸駿河原ニテ小地震　芦原家倒ル死人十二
神原油井破損清見寺薬屋不残潰ル
澳津江尻家大ニ倒ル　岡部藤枝島田金谷日坂上ニ同シ
懸川家大ニ潰ル袋井残ス潰ル　見付浜松半潰シ舞坂同シ
荒井津浪打テ番所流ル　二川半潰シ
吉田城潰ル町屋モ大ニ破損　御油赤坂藤川事ナシ
岡崎小破橋落ル　池鯉鮒事ナシ
鳴海宮半潰大垣城破損　桒名事ナシ四日市ニテ橋ナシ
四日市半潰シ　石薬師庄野亀山小破

関大津ニテ小破
大坂　地震山崩家一萬四千五百二十軒〇高潮入大船小船覆落又橋數三十八〇家倒レ壓ニ打レ或ハ高潮ニ溺ル死人一萬五千二百六十三人
又隣國ノ様子
阿波　徳島ニテハ二百三十軒民家四百軒地震ニ潰ル潮入ハナシ黒土浦郷モ潮入ル所富岡浦郷小破橋半ニ所泊浦小破井佐ヨリ志和木ニテハ存ニ不知由岐両浦モニ所溺死數レ木岐ニ所日和佐事ナシ牟岐両所モニ所溺死數レ浅川在家大形流失死人少シ海部鞆浦事ナシ鞆小破宍喰ニ所死人少シ
伊豫　宇和島領城小破本町裏町新町弓町桃崎ニテ大潮入家數悉ク流失吉田浦ト云所ハ民家五十軒許流失此所ノ潮ノ高サ平地ヨリ八九尺許上ル今治領吉田領大洲領松山領モ海邊ノ郷浦悉ク大潮入ケレ氏大破ハナシ
總メ當國潮入ル在々所々田苑ハ云ニ及ズ故ノ市井ハ大半海底ニ沈没シ嶮山却テ平地トナリタレバ新ニ國土ヲ生



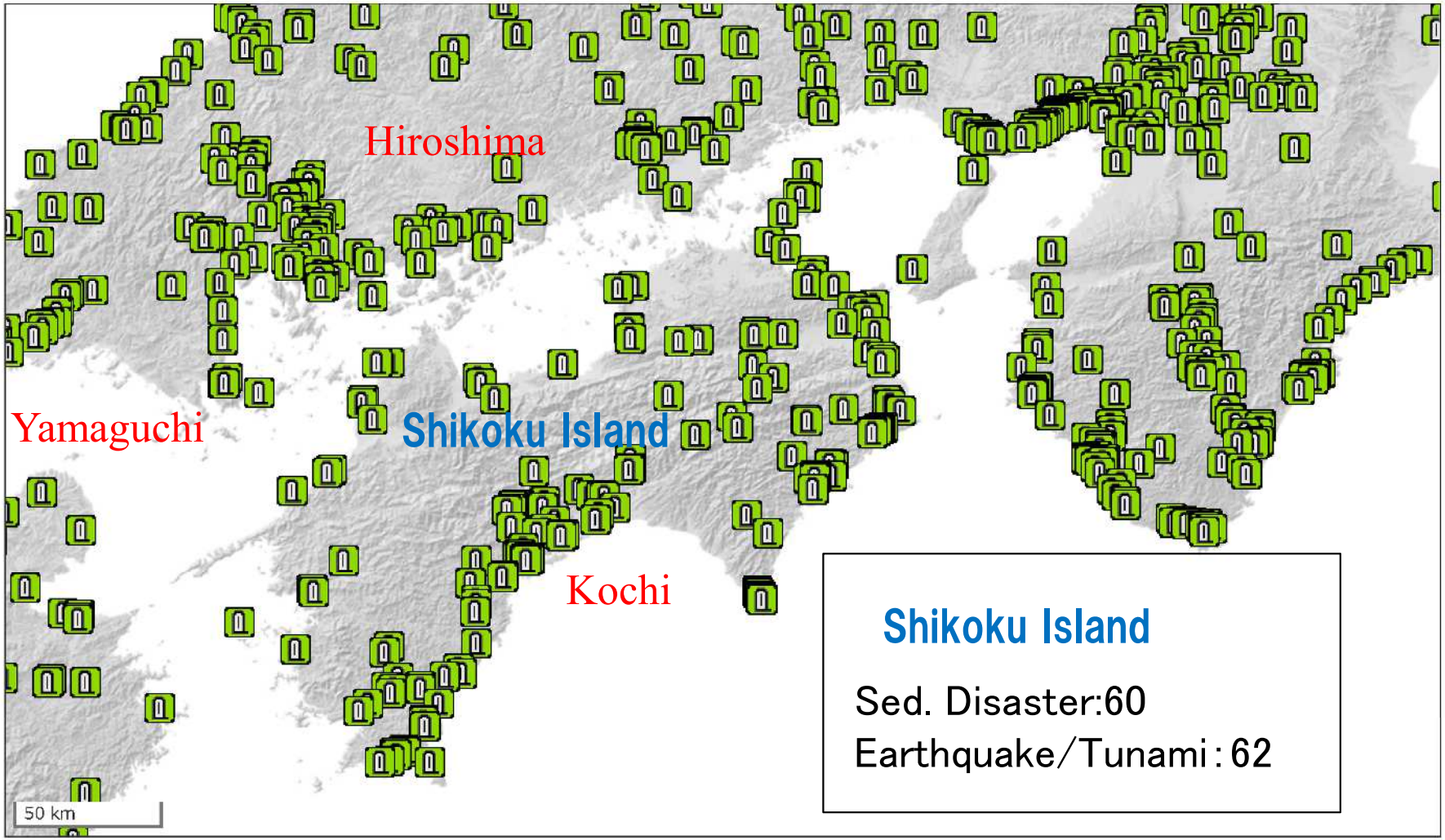
谷陵記
寳永四亥年十月四日未ノ上刻大地震起リ山穿テ水ヲ漲シ川埋リテ丘トナル國中ノ官舎民屋悉ク轉倒ス逃ニトスレモ眩テ壓ニ打レ或ハ頓絶ノ者多シ又ハ幽岑寒谷ノ民ハ巖石ノ為ニ死傷スルモ若干ナリ係ル後ハ必高潮入ルヨシ云傳フナトツブヤク所ニ同下刻津浪打テ海邊ノ在家一所トメ残ルカナシ未ノ下刻ヨリ寅ノ刻ニテ晝夜十一度打來ル也中ニモ第三番ノ津浪高ク山ノ半腹ニアル家モ多ク漂流ス國中ノ死人二千餘人當國ニ不限伊豫阿波紀伊摂津長門ノ海邊モ頗破壊ニ及ブ其外西國中國關

（Transcribed Record）

9. Distribution map

Stone monument of disasters

(Geographical Survey Institute GIS Map)



GIS Map description of the monument

Name

Location

Description of the tradition

安政地震の碑

概要	
碑名	安政地震の碑
災害名	安政南海地震(1854年12月24日)
災害種別	地震・津波
建立年	1858
所在地	高知県土佐市宇佐町宇佐1457-3
伝承内容	嘉永7年(1854)の安政南海地震により津波が8、9度宇佐町を襲った。残った人家は60～70件で、70人余りが溺死した。宇佐の地形は前が高く後ろが低いため東西の低地から潮が入り込む。伝承を信

Stone monument and information sign Hoei earthquake（1707） and Ansei earthquake （1854）: Built in 1858

Tosa City,Kochi

The damage situation was recorded

Conclusion：1

1. Previous debris flows have occurred seven times
2. The frequency of destructive debris flows seems to be once every several hundred years at each stream
3. Comparison with the history record of the disaster
4. Debris flow recurrence interval of 150-400 years, Hiroshima
5. Field survey and ^{14}C dating, literature study to elucidate the frequency

Conclusion：2

6. Telling future generations of the natural disaster
7. Knowing past disasters and local history will help prepare for future disasters
8. It is important to record and communicate disasters
9. Stone monuments are the most powerful method of recording(in temples or schools)

Thank you very much