

Review of cooperative  
hydrological and geochemical  
research for earthquake  
prediction in Taiwan for recent  
three years

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## 7 PROBLEMS SUGGESTED IN THE FIRST WORKSHOP IN SEP.2002

(1) What are conditions of sensitive wells? Or how can we detect sensitive wells systematically? **TAIWAN (~ 500 WELLS)**

(2) What is a mechanism of preseismic changes in unconfined groundwater level? **JAPAN (PRECURSORS IN 1946 NANKAI EARTHQUAKE)**

(3) What is a mechanism of geochemical precursors? Or how can we develop the ' crack model '?

(4) Can we suggest information of pore pressure and permeability in the seismic region? And how can we?

(5) How should we design a long-term stable geochemical observation?

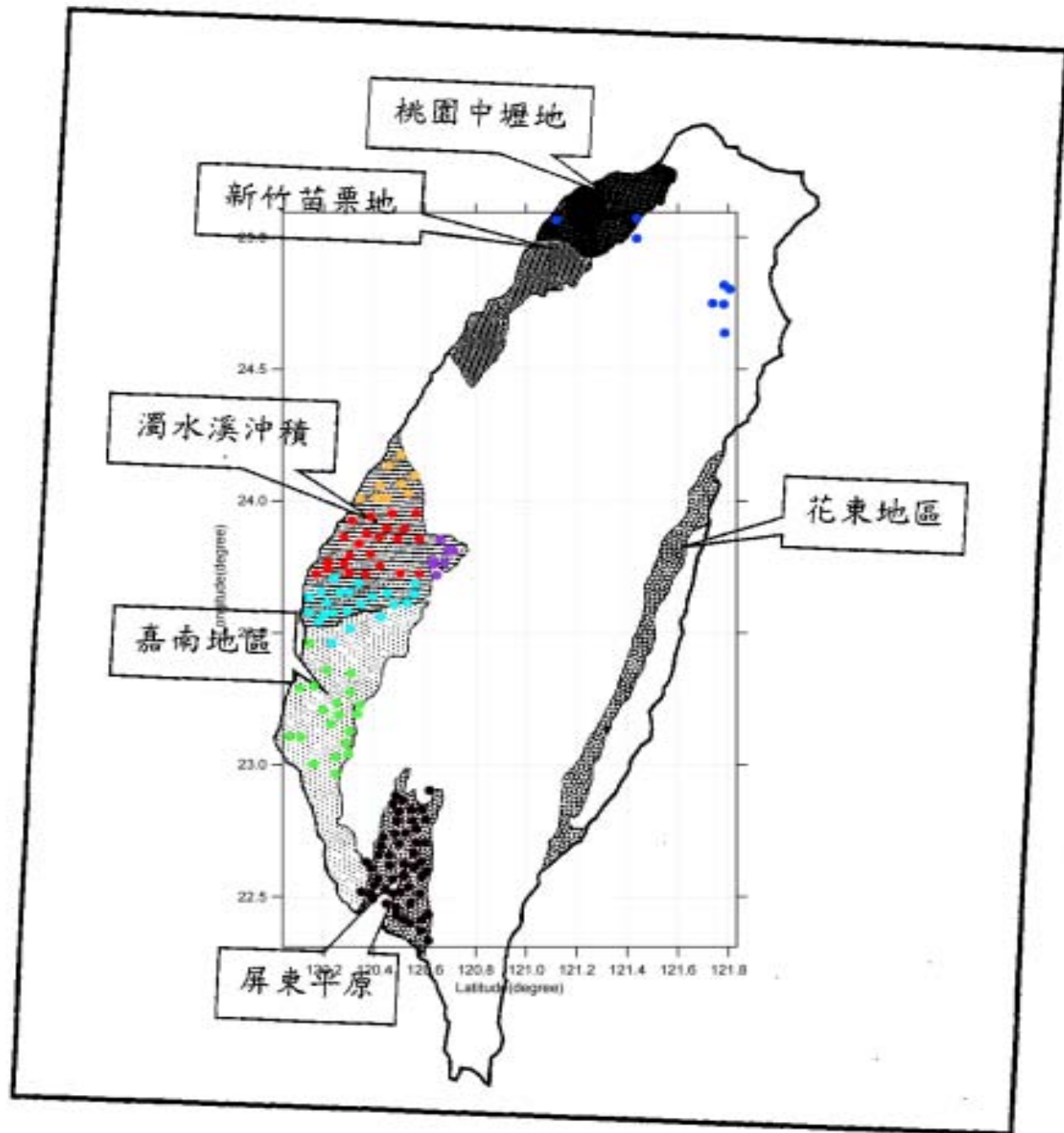
(6) How can we manage a condition of high temperature, high pore pressure and high water or steam content? **USA (OBSERVATION AT HYDROTHERMAL AREA, I.E., LONG-VALLEY)**

(7) What is relationship among GPS data, groundwater level data and (borehole) strain data?

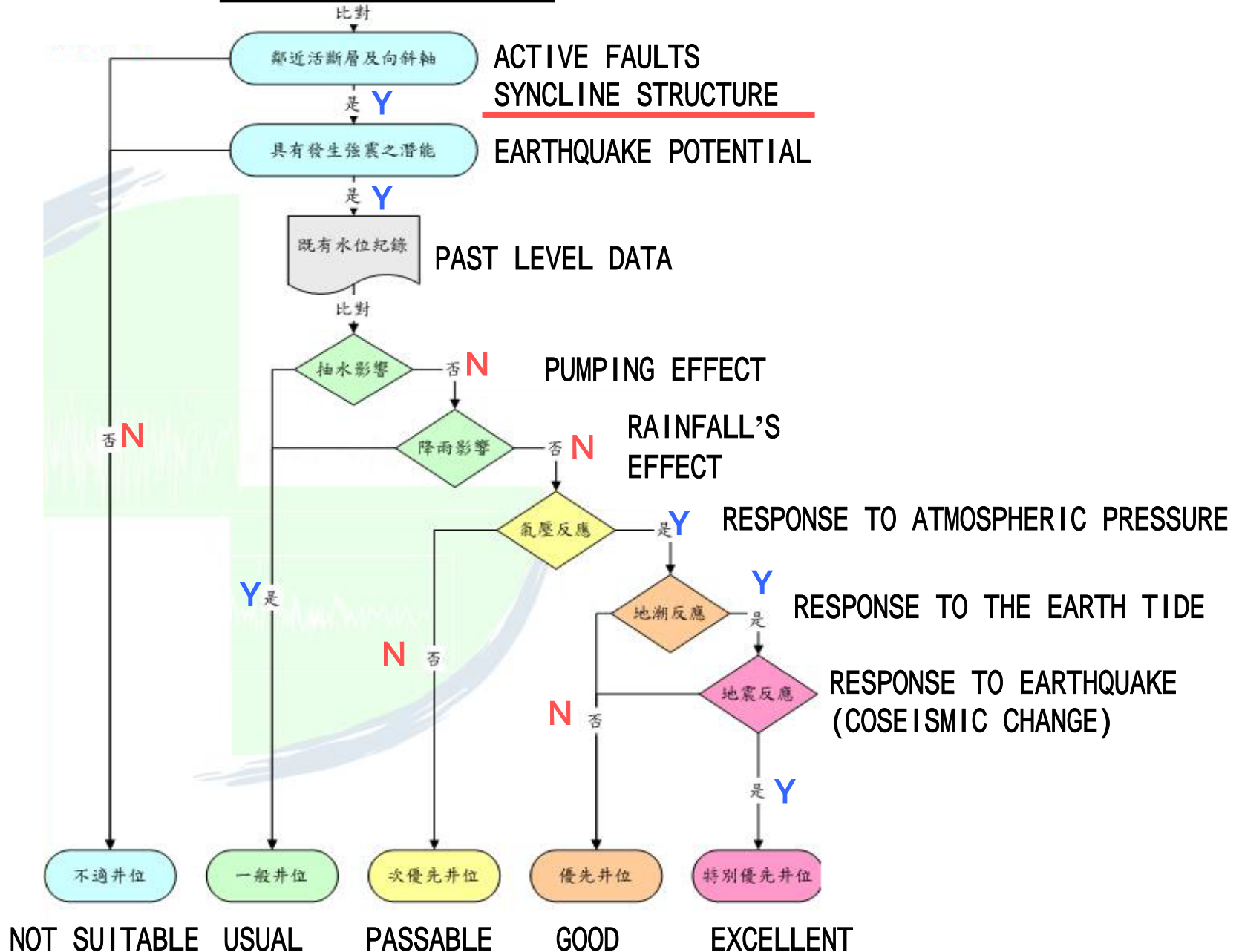
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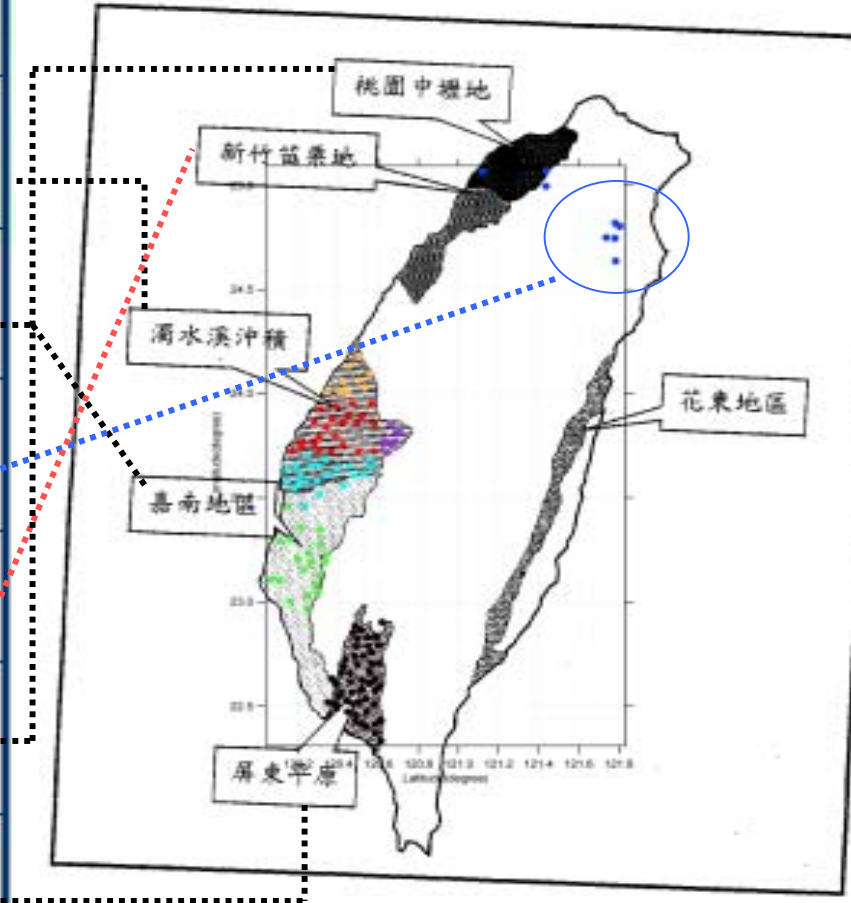


# CHOICE OF WELLS



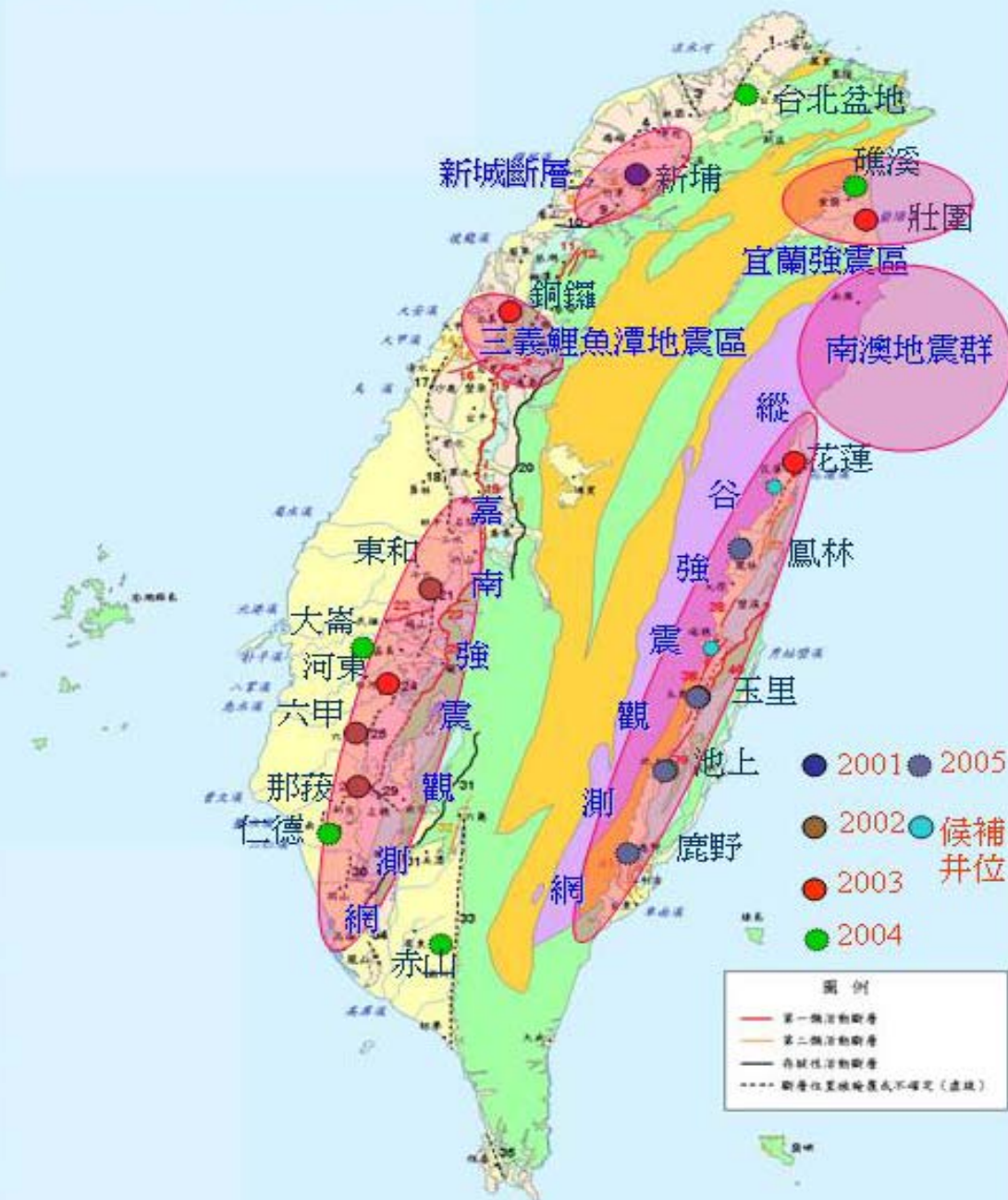
EXCELLENT    GOOD    PASSABLE    USUAL    NOT SUITABLE

地下水 分區	特別優 先井位	優先 井位	次優先 井位	一般 井位	不適 井位
濁水溪 沖積扇	2	8	12	44	100
嘉南平 原區	5	7	22	18	53
宜蘭平 原區	2	3	1	12	7
竹苗地 區	3	2	4	12	9
桃園中 壠台北	-	2	9	10	6
屏東 平原	-	1	24	48	60

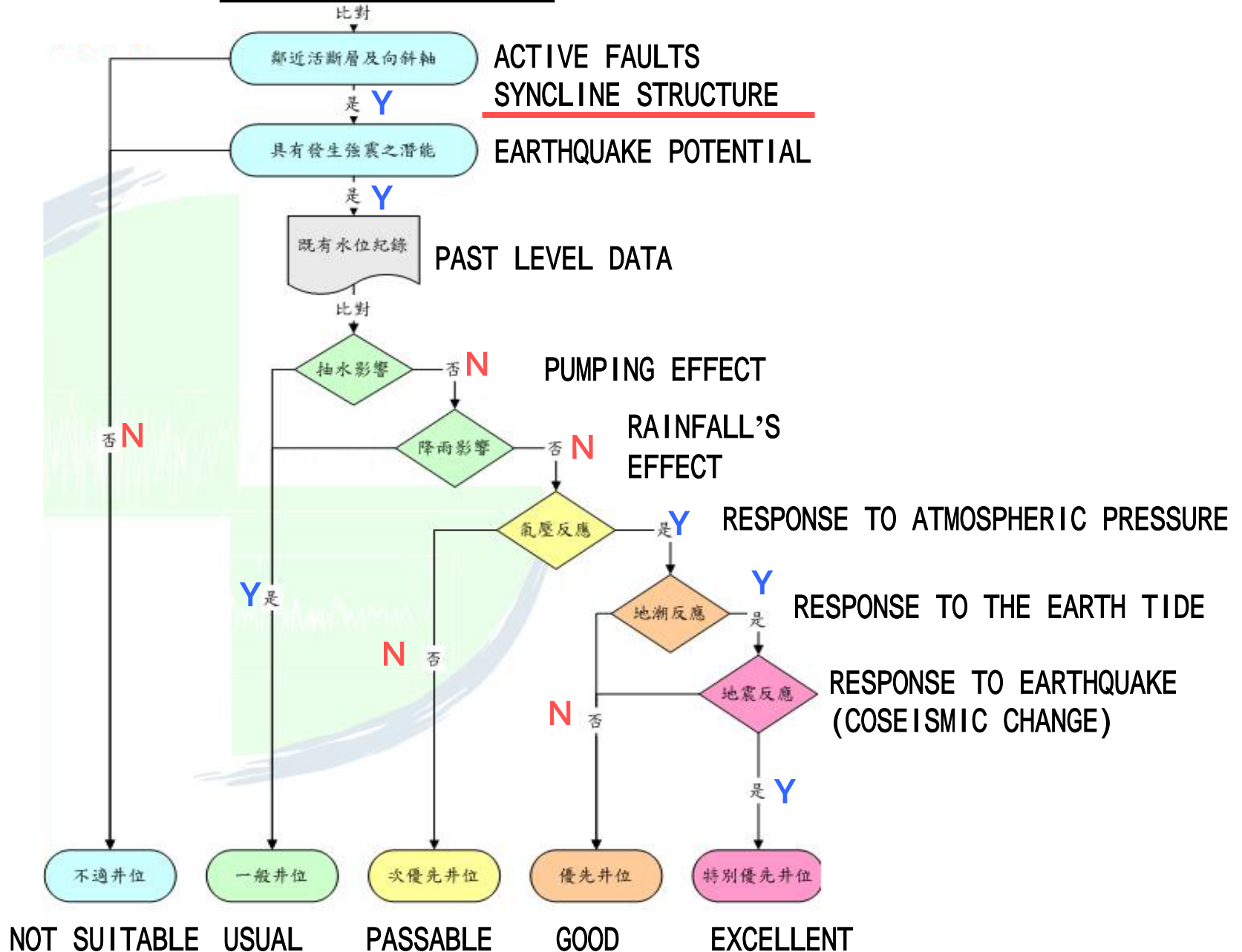




# 臺灣活動斷層分布圖



# CHOICE OF WELLS

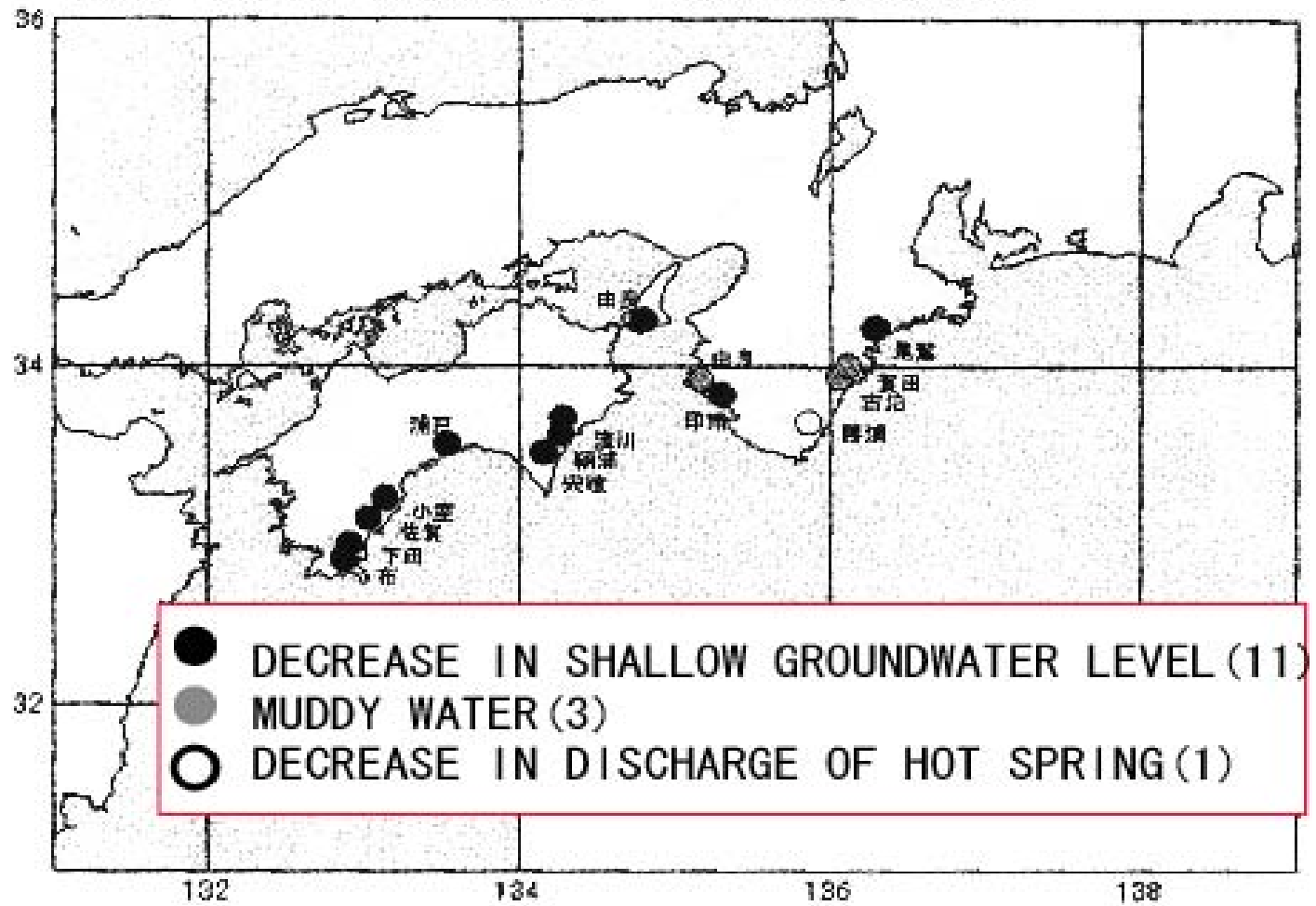




(2) What is a mechanism of preseismic changes  
in unconfined groundwater level?

JAPAN (PRECURSORS IN 1946 NANKAI EARTHQUAKE)

# PRESEISMIC GROUNDWATER CHANGES BEFORE THE 1946 NANAKAI EARTHQUAKE

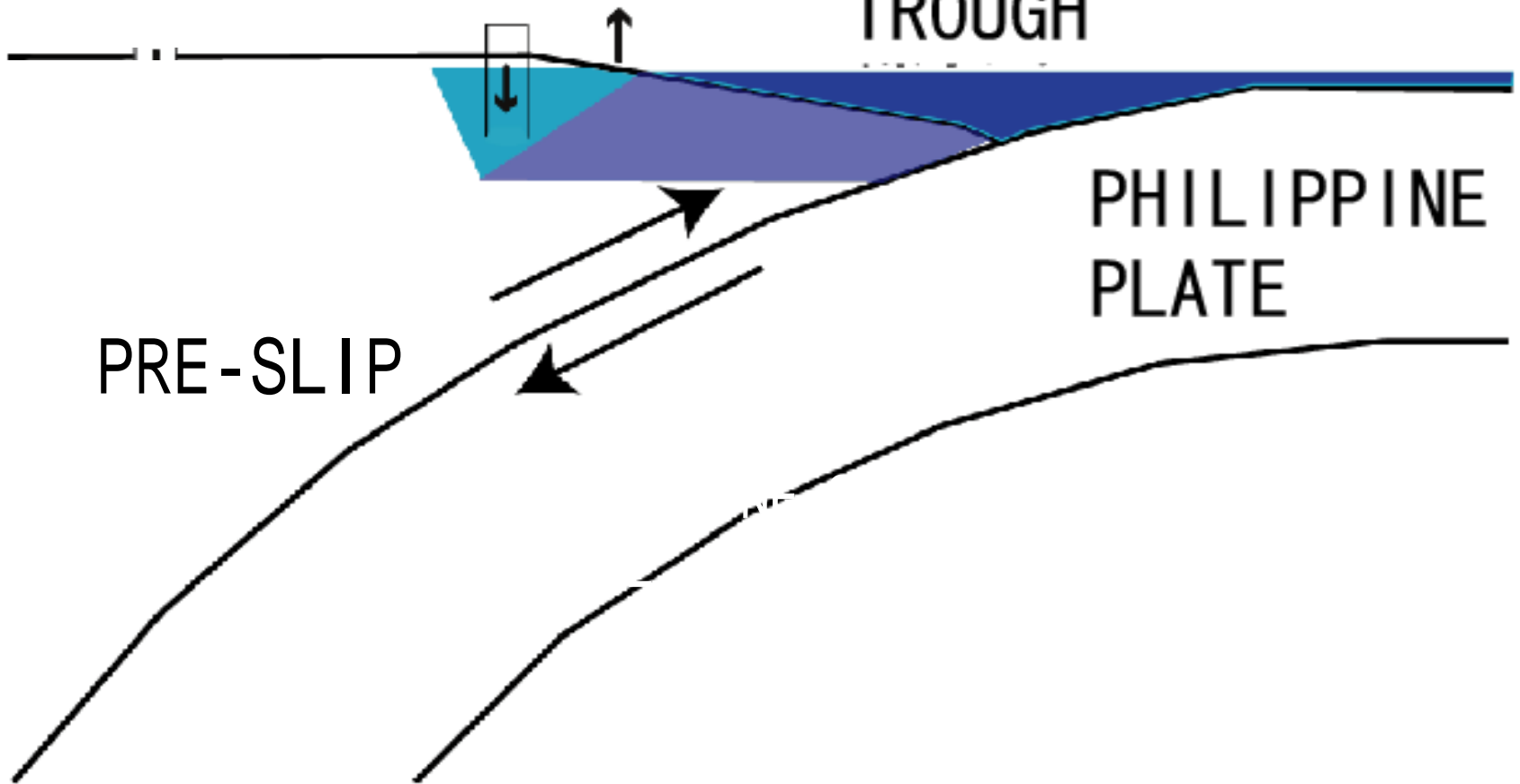


SHIKOKU OR  
KII PENINSULA

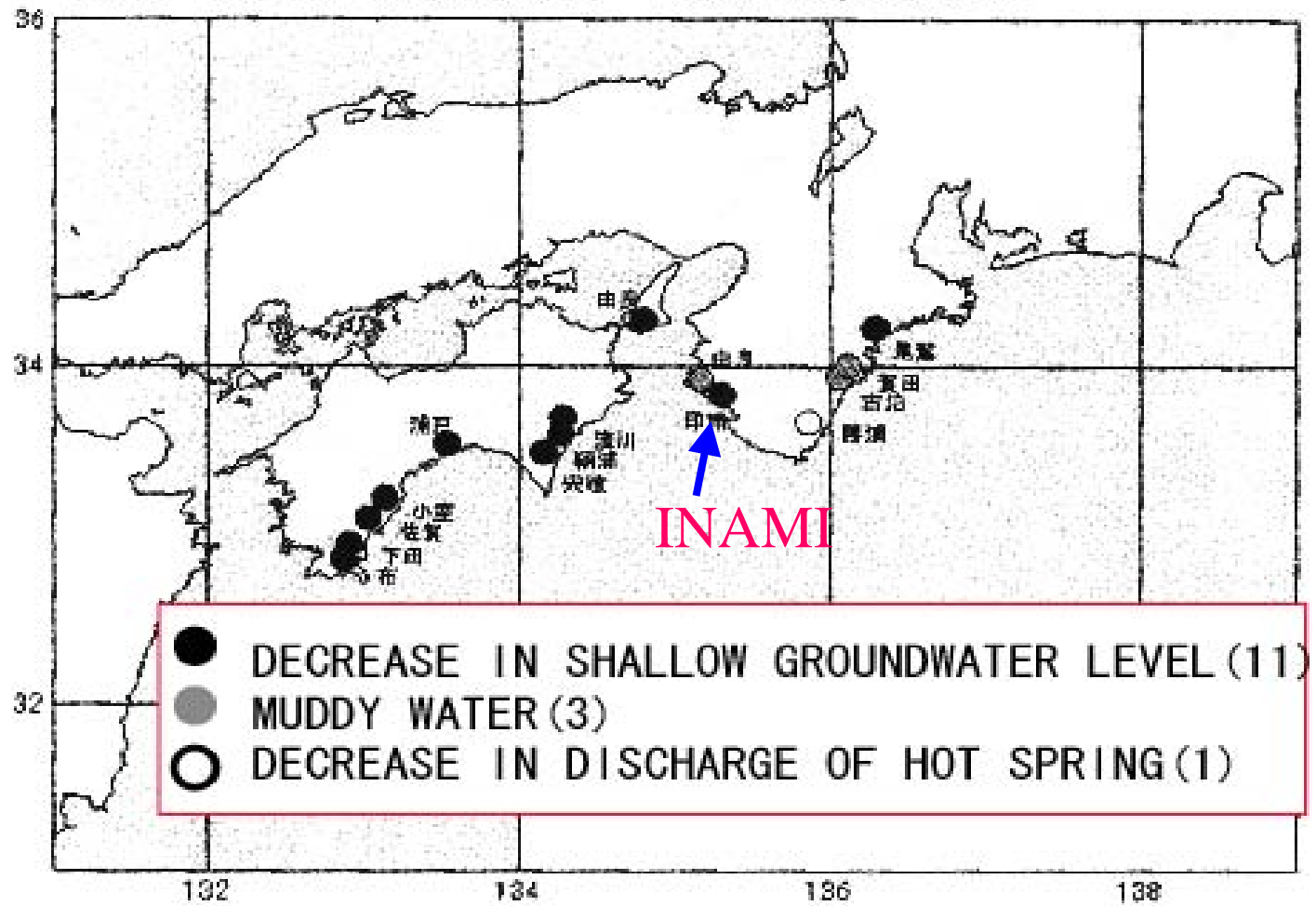
NANKAI  
TROUGH

PHILIPPINE SEA  
PLATE

PRE-SLIP



# PRESEISMIC GROUNDWATER CHANGES BEFORE THE 1946 NANAKAI EARTHQUAKE

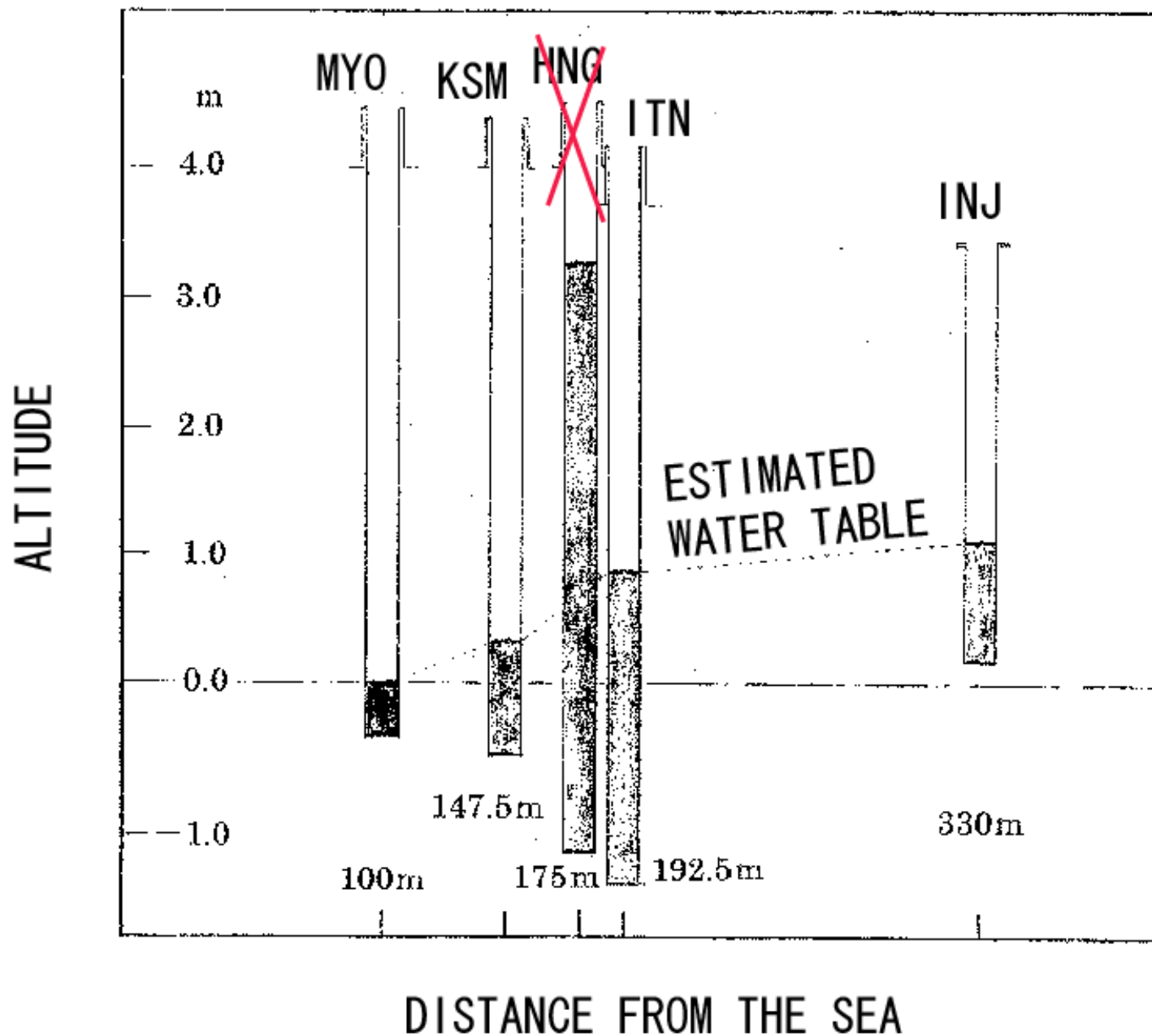




: OBSERVATION WELLS OF **KYOTO UNIV.**

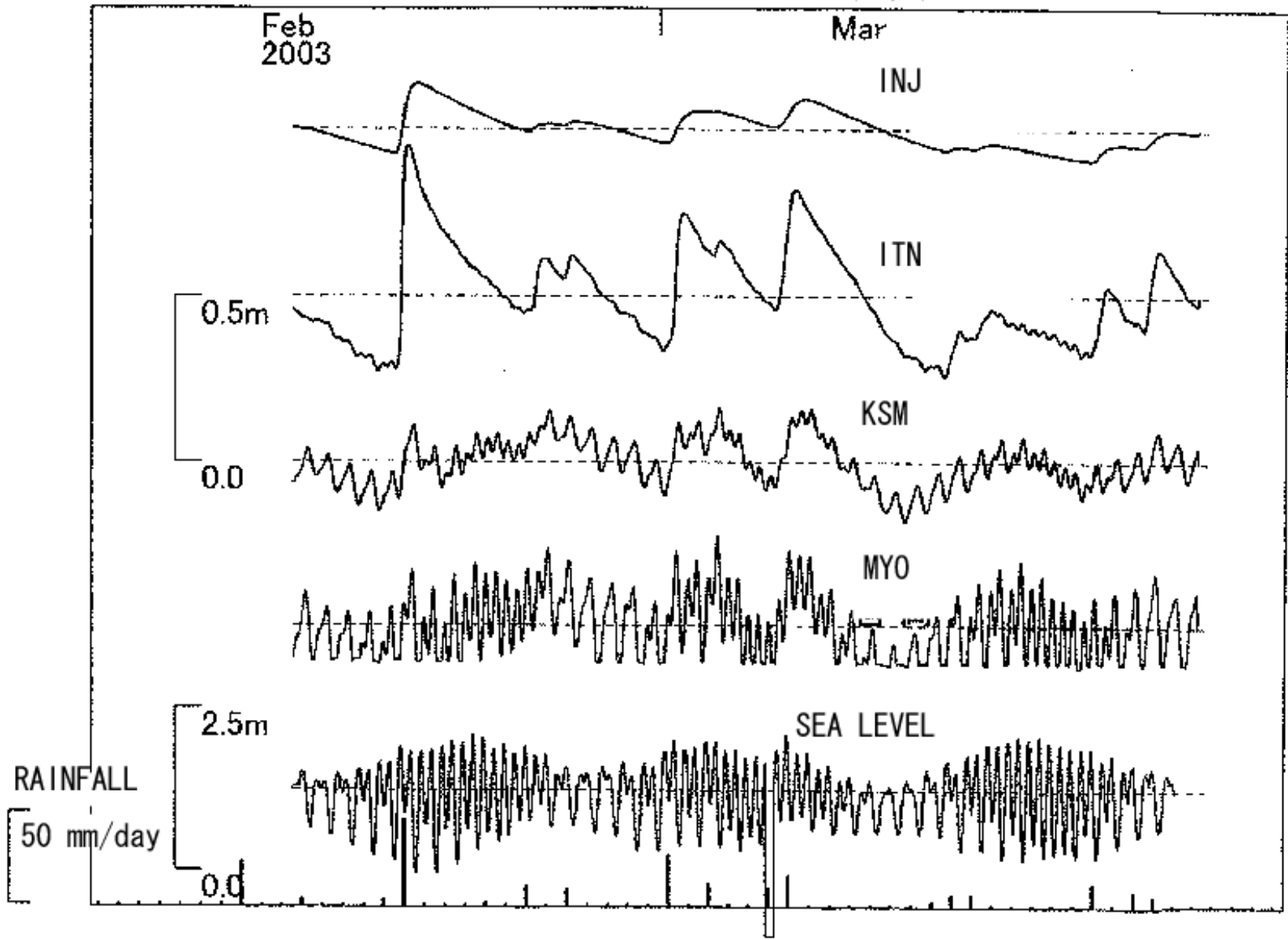
: THE WELL **WHERE PRECURSORY** LEVEL CHANGES WERE **OBSERVED** RELATED TO **THE 1946 NANKAI EARTHQUAKE.** IT IS BURIED NOW.

# HYDRO-GEOLOGICAL CROSS-SECTION AT INAMI TOWN





# WELL WATER LEVEL CHANGES AT INAMI TOWN



SIMULATION



## THE REST 5 PROBLEMS

(3) What is a mechanism of geochemical precursors?

Or how can we develop the ‘ crack model ‘? (5)

(4) Can we suggest information of pore pressure and permeability in the seismic region? And how can we? (6)

(5) How should we design a long-term stable geochemical observation?

(6) How can we manage a condition of high temperature, high pore pressure and high water or steam content? USA (OBSERVATION AT HYDROTHERMAL AREA, I.E., LONG-VALLEY)

(7) What is relationship among GPS data, groundwater level data and (borehole) strain data?

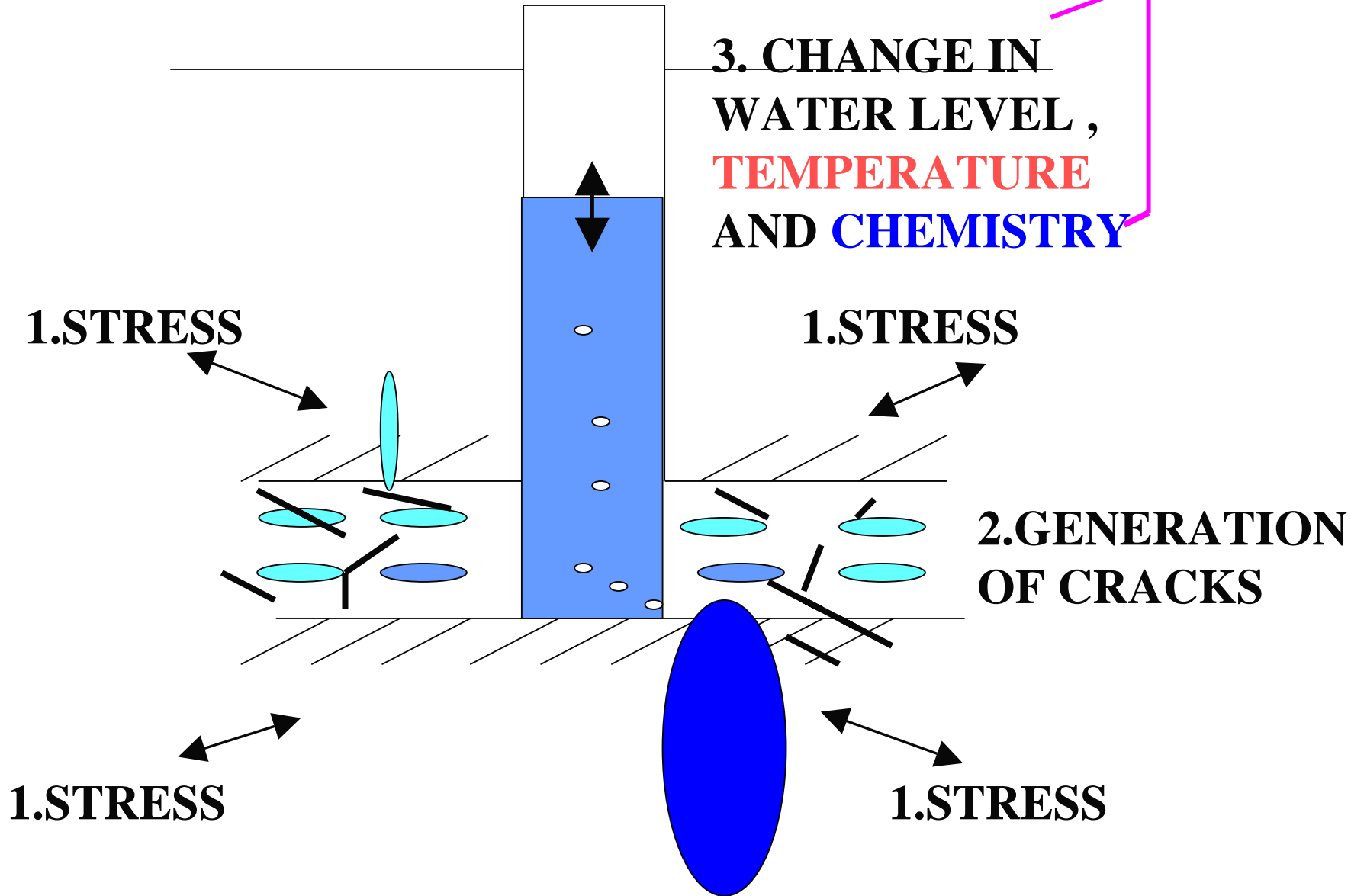
(3) What is a mechanism of geochemical precursors?

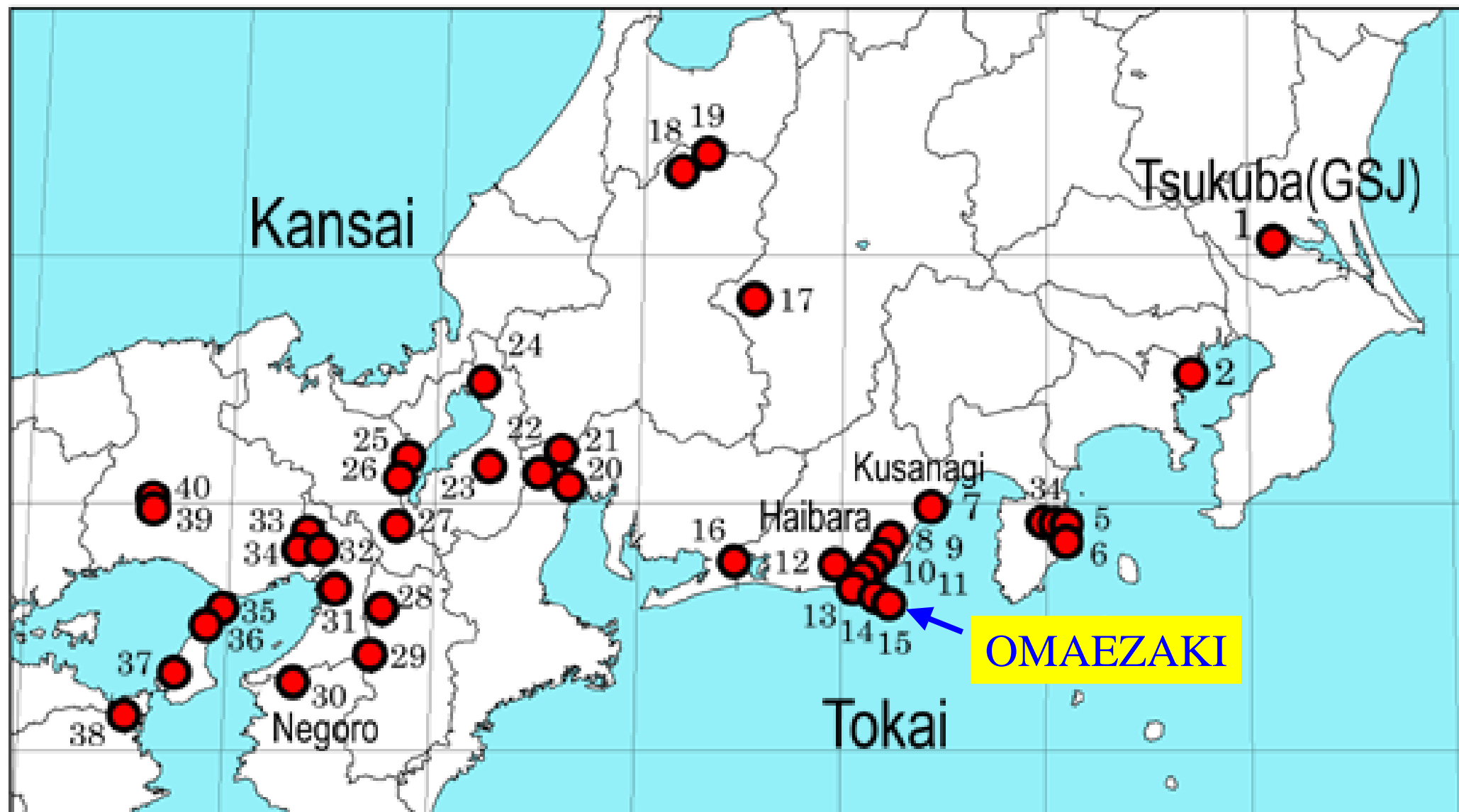
Or how can we develop the ‘ crack model ‘?

How should we design a long-term stable geochemical observation?

# CRACK MODEL

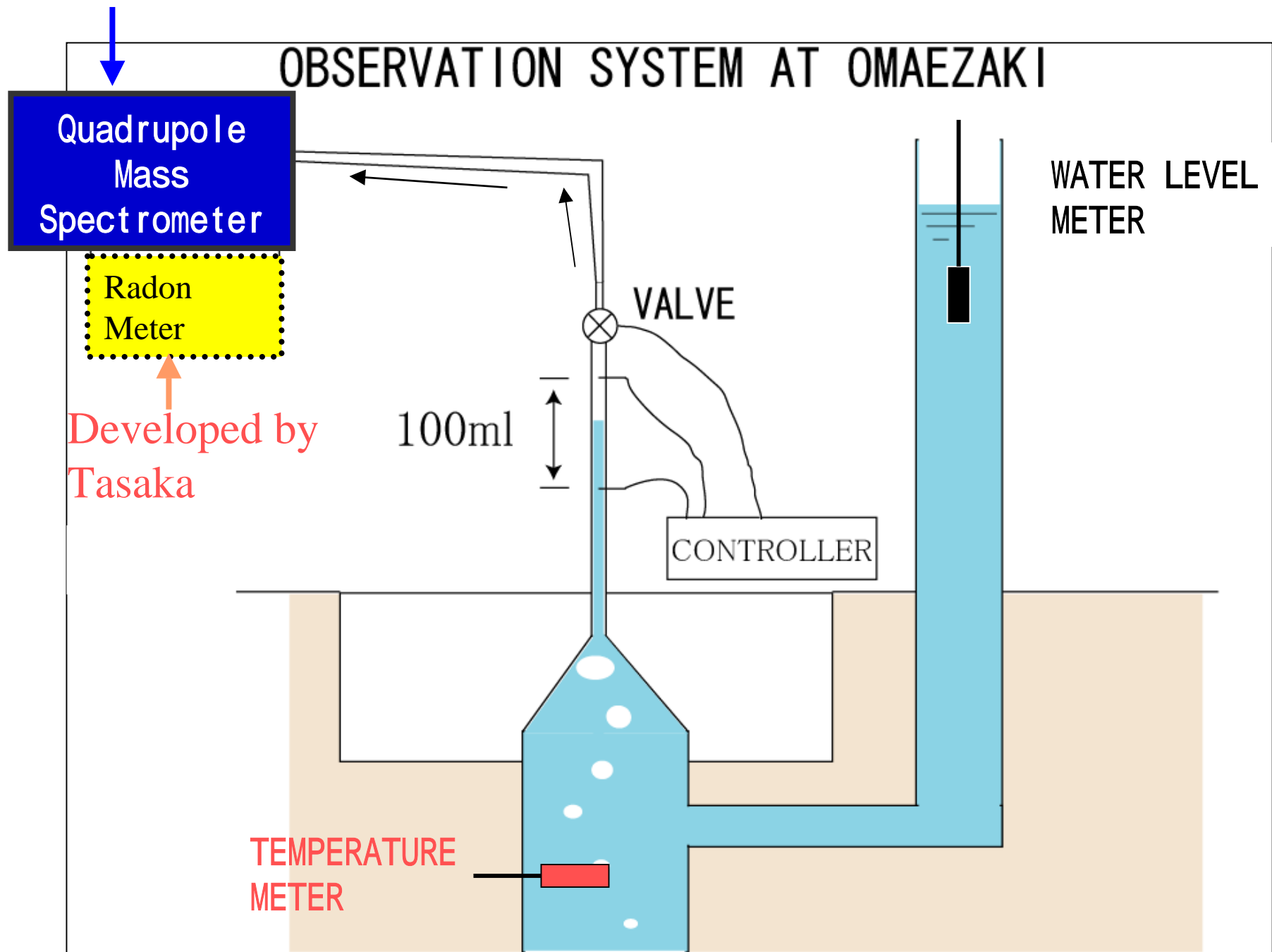
ALL OF THEM SHOULD BE OBSERVED.





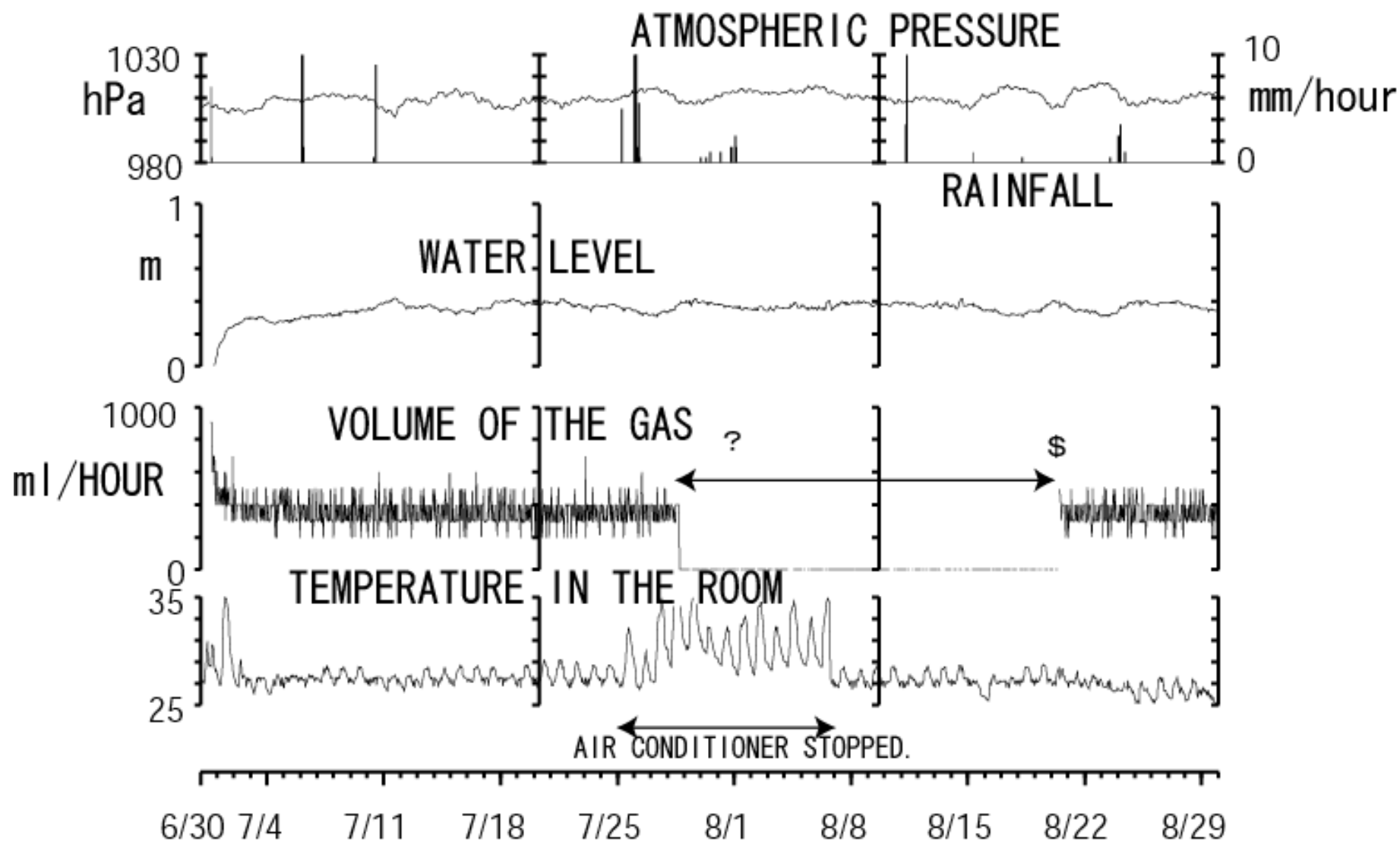
INTEGRATED GROUNDWATER OBSERVATION NETWORK OF GSJ

Developed by Igarashi and Tsunomori





# OMAEZAKI RESULT



2004

## THE REST PROBLEMS

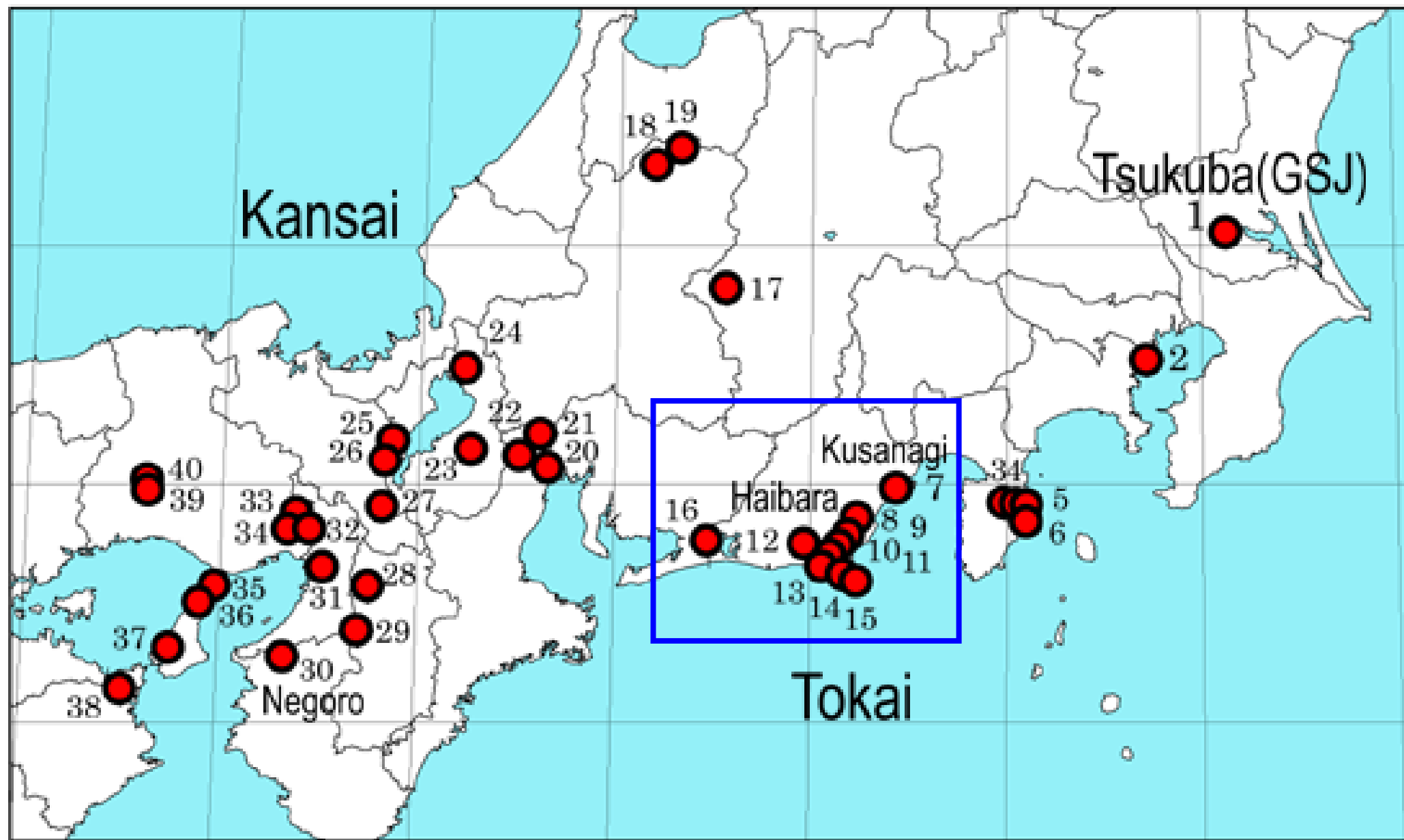
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How can we manage a condition of high temperature, high pore pressure and high water or steam content?

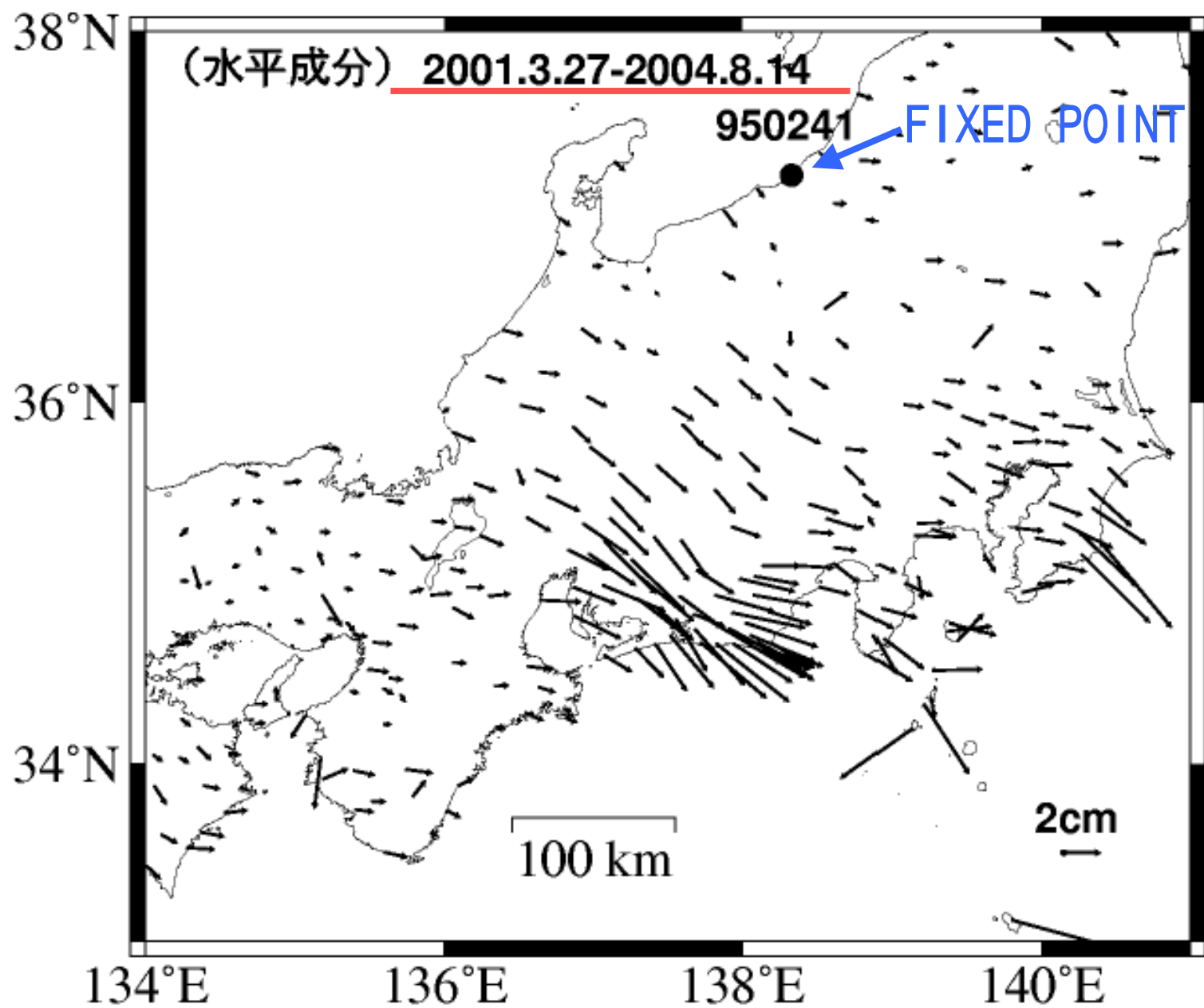
### HOMEWORK FOR NEXT WORKSHOP

(5) What is relationship among GPS data, groundwater level data and (borehole) strain data?

	OBSERVATION	LONG-TERM CHANGE (LONGER THAN 2WEEKS)	SHORT-TERM CHANGE (SHORTER THAN A FEW DAYS)	OBSERVED AREA
GPS	DISPLACEMENT			WIDE
STRAIN METER	STRAIN CHANGE	X		POINT
GROUNDWATER LEVEL	(STRAIN CHANGE)	X		POINT
TRAINING FOR PREVENTION OF THE TOKAI-EARTHEQUAKE RELATED DISASTER IN SEP.1, 2004.				
	TOKAI SLOW SLIP	ACCELERATION	PRE-SLIP	
GPS			X	
STRAIN METER	X			
GROUNDWATER LEVEL	X			



# LONG-TERM ANOMALOUS DISPLACEMENTS INDUCED BY THE TOKAI SLOW SLIP

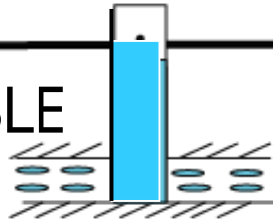


# MODEL FOR THE SLOW SLIP

SHIZUOKA PREFECTURE

SURUGA TROUGH

NO DETECTABLE  
CHANGE



PHILIPPINE SEA PLATE

SLOW SLIP



# MODEL FOR THE PRE-SLIP

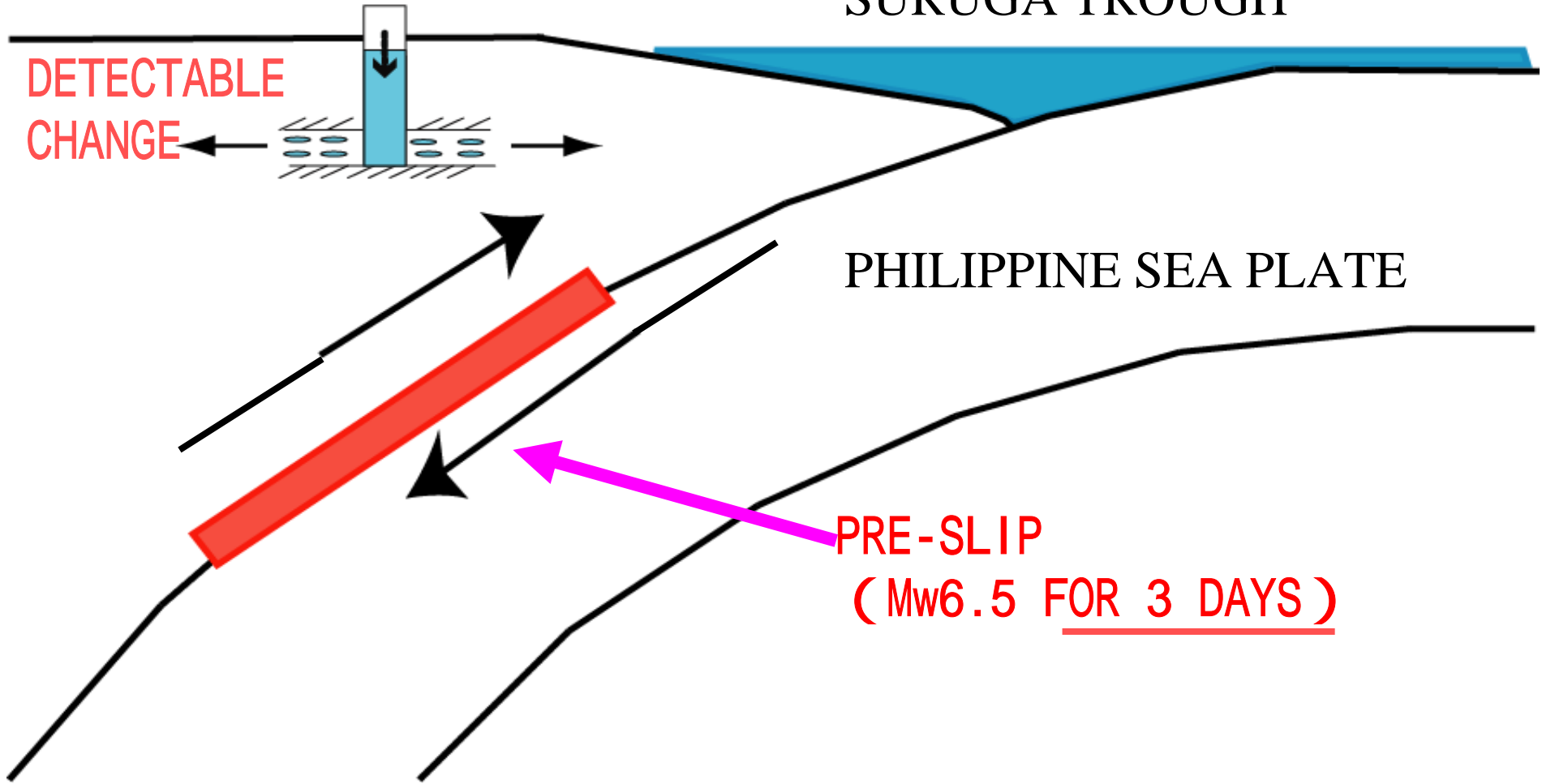
SHIZUOKA PREFECTURE

SURUGA TROUGH

DETECTABLE  
CHANGE

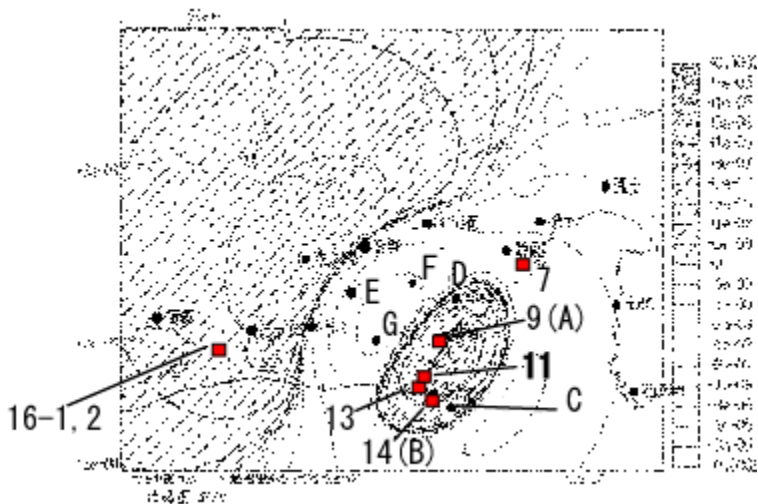
PHILIPPINE SEA PLATE

PRE-SLIP  
(Mw6.5 FOR 3 DAYS)

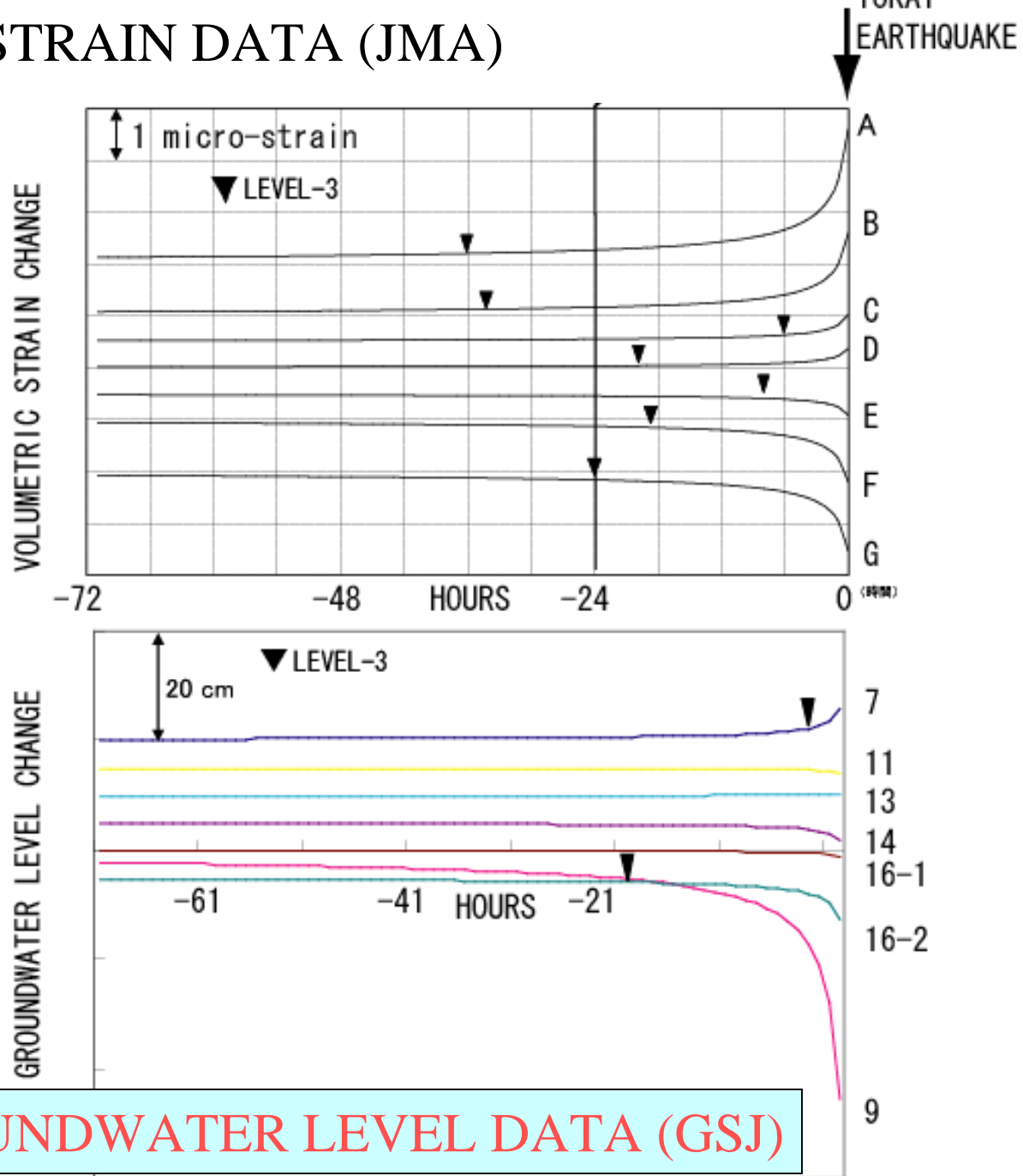


# STRAIN DATA (JMA)

DISTRIBUTION OF  
VOLUMETRIC STRAIN CHANGES  
BY THE PRE-SLIP



LEVEL-3  
= DOUBLE OF THE NOISE LEVEL



GROUNDWATER LEVEL DATA (GSJ)

# EVALUATION OF IN THE VIEW OF THE 7 PROBLEMS

- (1) What are conditions of sensitive wells? Or how can we detect sensitive wells systematically?
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- (5) How should we design a long-term stable geochemical observation?
- (6) How can we manage a condition of high temperature, high pore pressure and high water or steam content? **HOMEWORK**
- (7) What is relationship among GPS data, groundwater level data and (borehole) strain data? **FOR THE TOKAI EARTHQUAKE**

