

Earthquake Detector Design Competition

地震探測器設計比賽

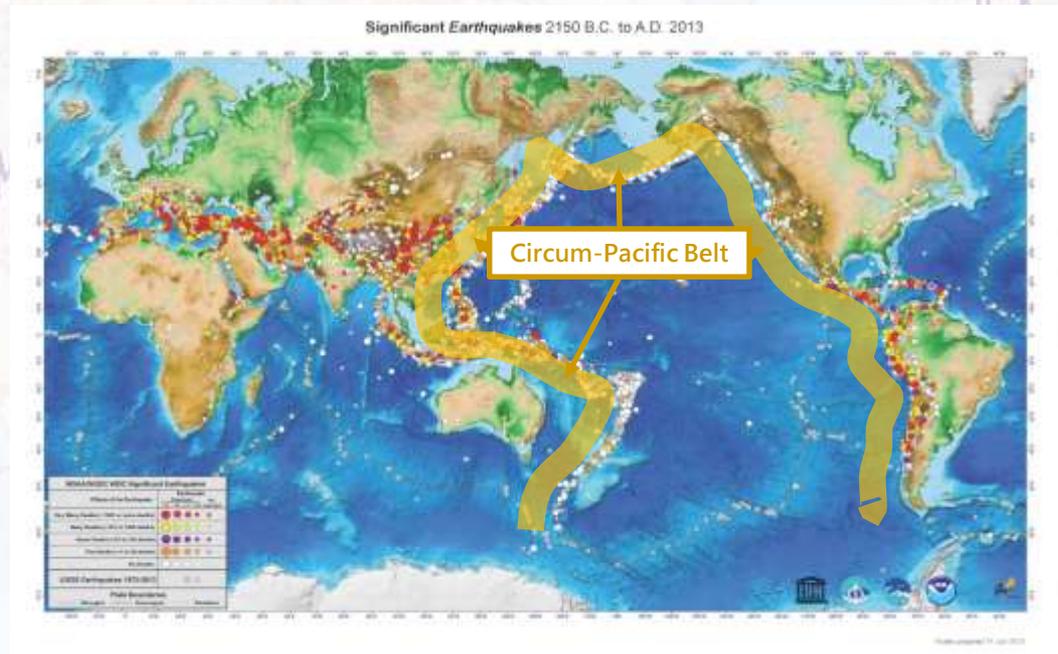
<http://www.cs.hku.hk/~quake/>

比賽組別 CATEGORIES

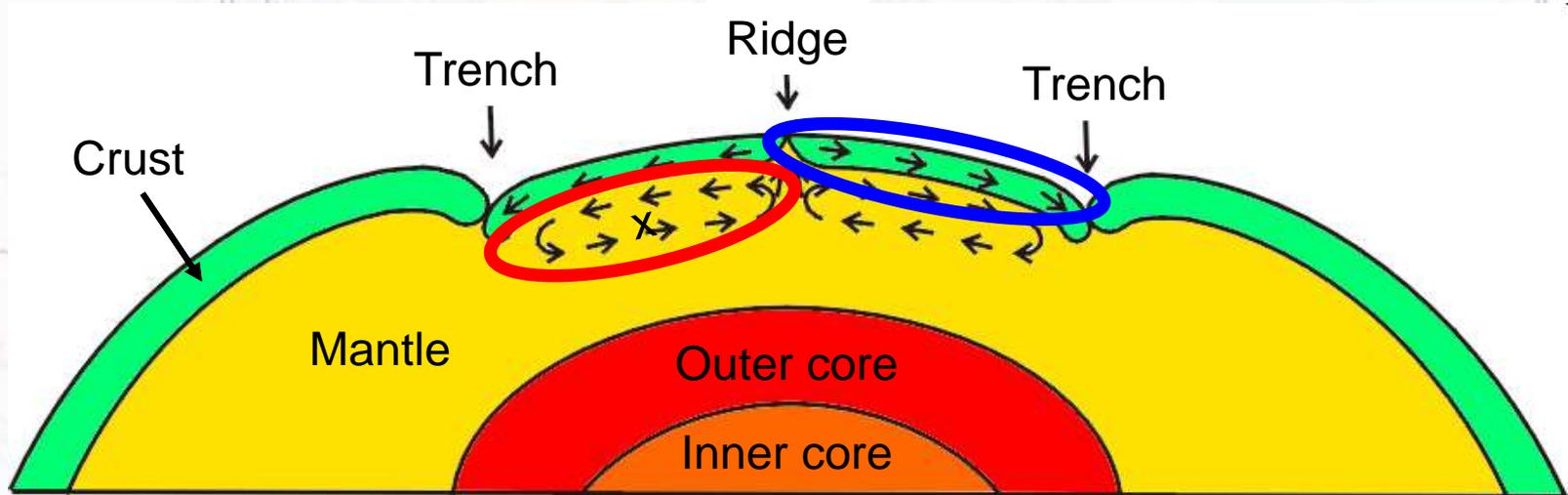
-  **初級組** 設計及製造一台地震探測器
JUNIOR Design and implementation of an earthquake detector
-  **高級組** 設計及製造一台自動地震探測器
SENIOR Design and implementation of an automatic earthquake detector

Causes of Earthquake

- Naturally occur Earthquake
 - Tectonic Movement
 - Volcanic Eruption
- Man-made Earthquake
 - Human Activities

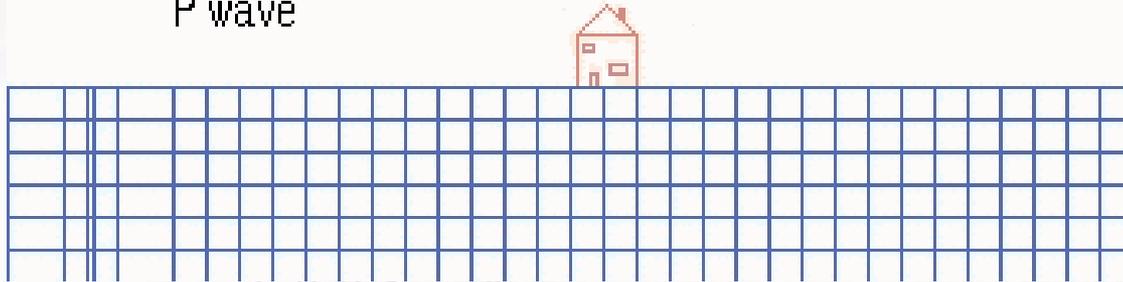


Tectonic Plates Movement



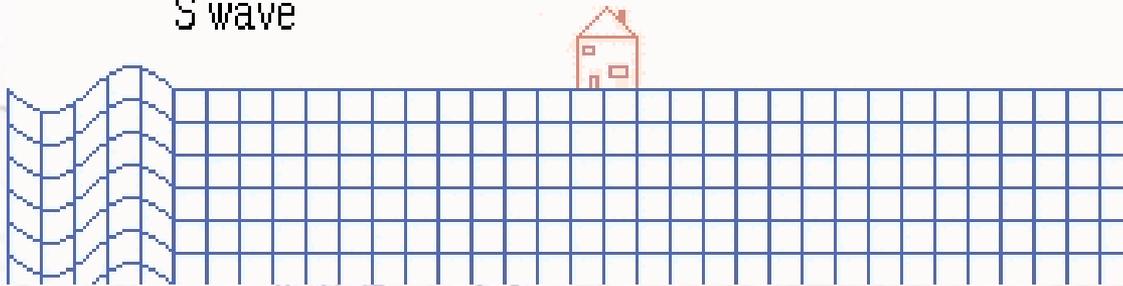
Seismic Waves

P wave



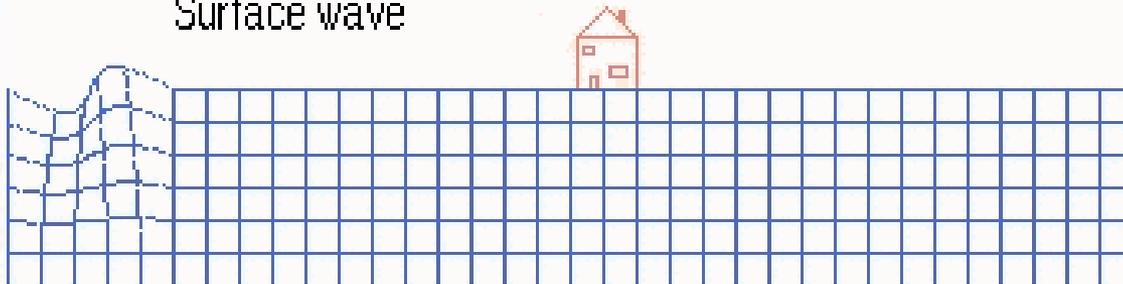
Longitudinal wave – Particle vibration parallel to the wave propagation direction

S wave



Transverse wave – Particle vibration perpendicular to the wave propagation direction

Surface wave



Surface wave – Wave propagates along the surface of the Earth

Magnitude and Intensity

- Magnitude (E.g. Richter Scale)
 - Energy Released
- Intensity (Modified Mercalli Scale)
 - Violence of earth motion
 - http://www.hko.gov.hk/gts/quake/mms_e.htm
HKO webpage > Earthquakes and Tsunamis > Magnitude and Intensity of an Earthquake > Modified Mercalli Scale

Earthquake Magnitude

Largest Earthquake Recorded

- Calculate from the amplitude and period recorded by standard equipment, indicating the amount of energy released at the epicenter.
- Logarithm scale between magnitude, a difference of 1 in magnitude corresponds to an energy difference of about 32 times, and about 1000 (32x32) times for a difference of 2 in magnitude.

Mag.	Location	Year
9.5	Chile	1960
9.2	Alaska	1964
9.1	Indonesia	2004
9.0	Russia	1952
9.0	Japan	2011

Earthquake Intensity

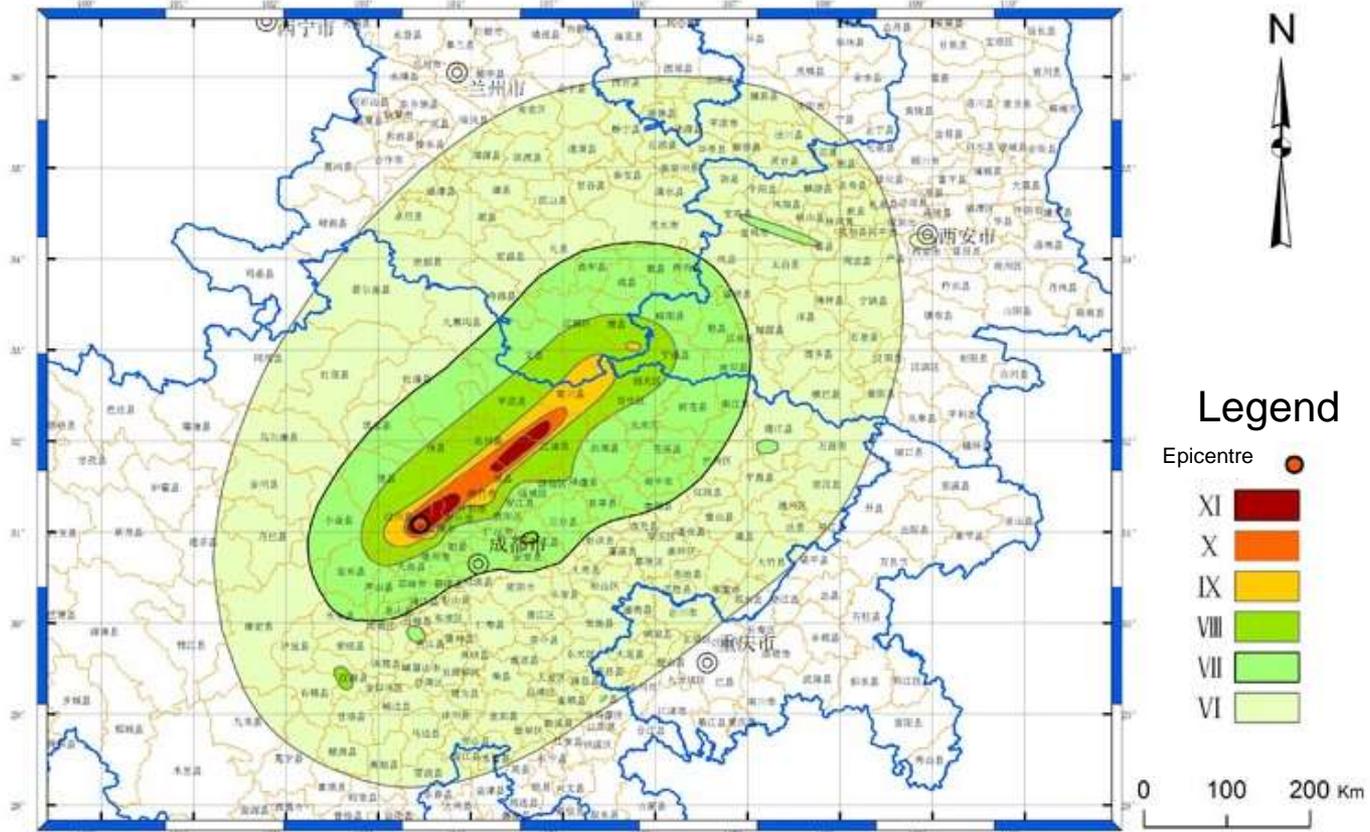
- The intensity of an earthquake at a particular locality indicates the violence of earth motion produced there by the earthquake. It is determined from reported effects of the tremor on human beings, furniture, buildings, geological structure, etc.

Int.	Effect
I	Not felt.
II	Felt by persons at rest, upper floors, or favorably placed.
III	Felt indoors.
IV	Hanging objects swing.
V	Felt outdoors.
VI	Felt by all. Many frightened and run outdoors.
VII	Difficult to stand. Damage to certain type of masonry.
VIII	Steering of motor cars affected. Some masonry damage and collapse.
IX	General panic. Weak brick masonry destroyed.
X	Most brick and wooden masonry destroyed with their foundations.
XI	Rails bent greatly. Underground pipelines completely out of service.
XII	Damage nearly total.

Modified Mercalli Intensity Scale

Intensity Map

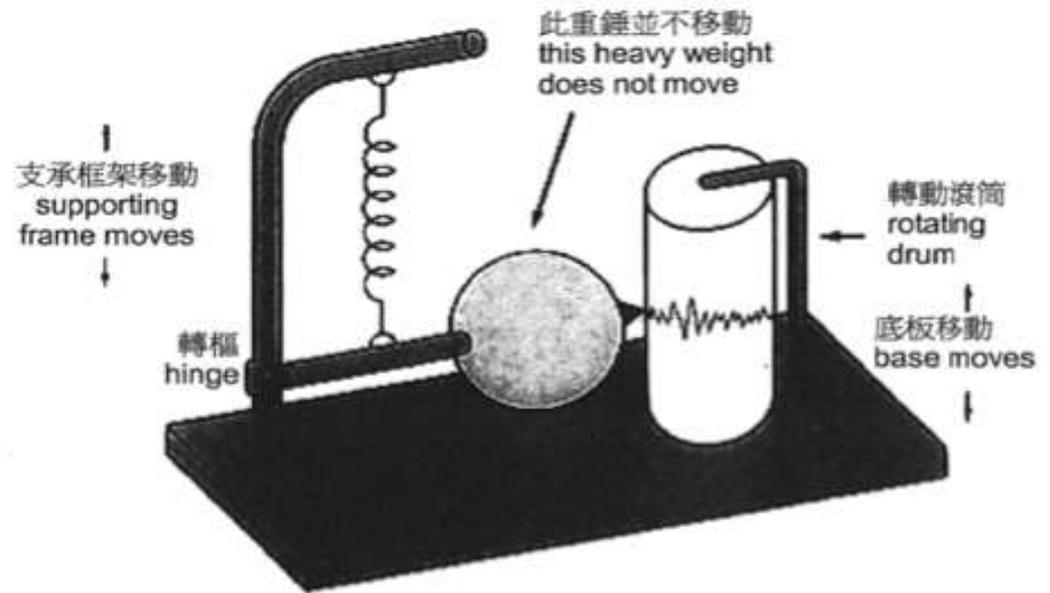
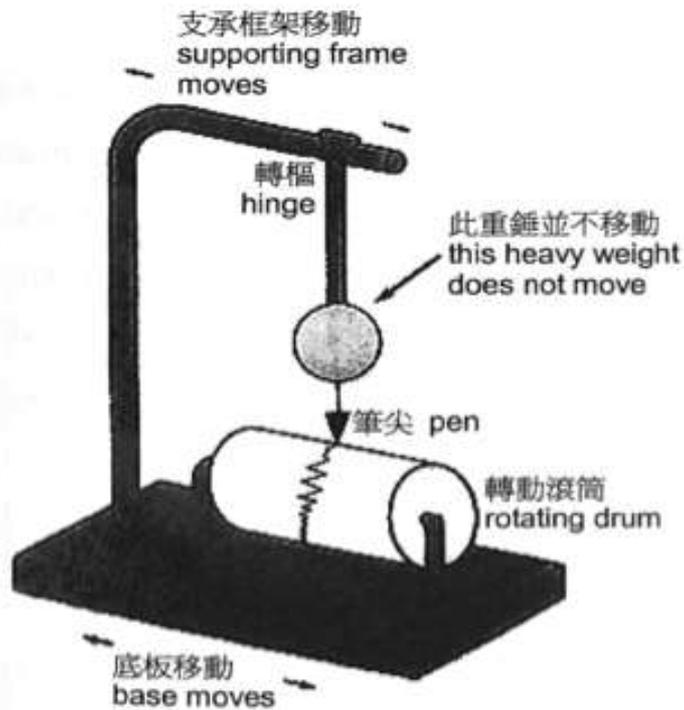
Intensity map of M8.0 Earthquake in Wenchuan

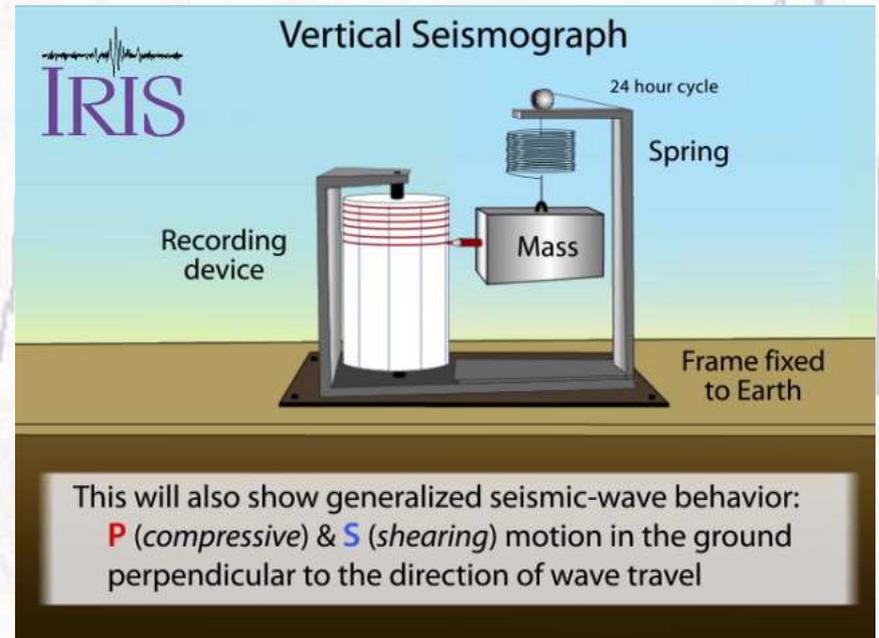
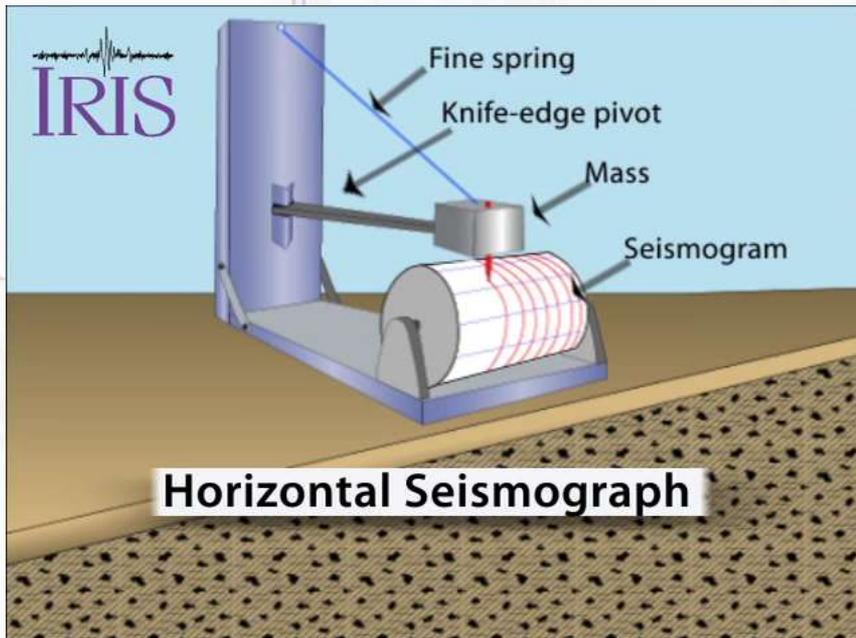


Source: China Earthquake Administration

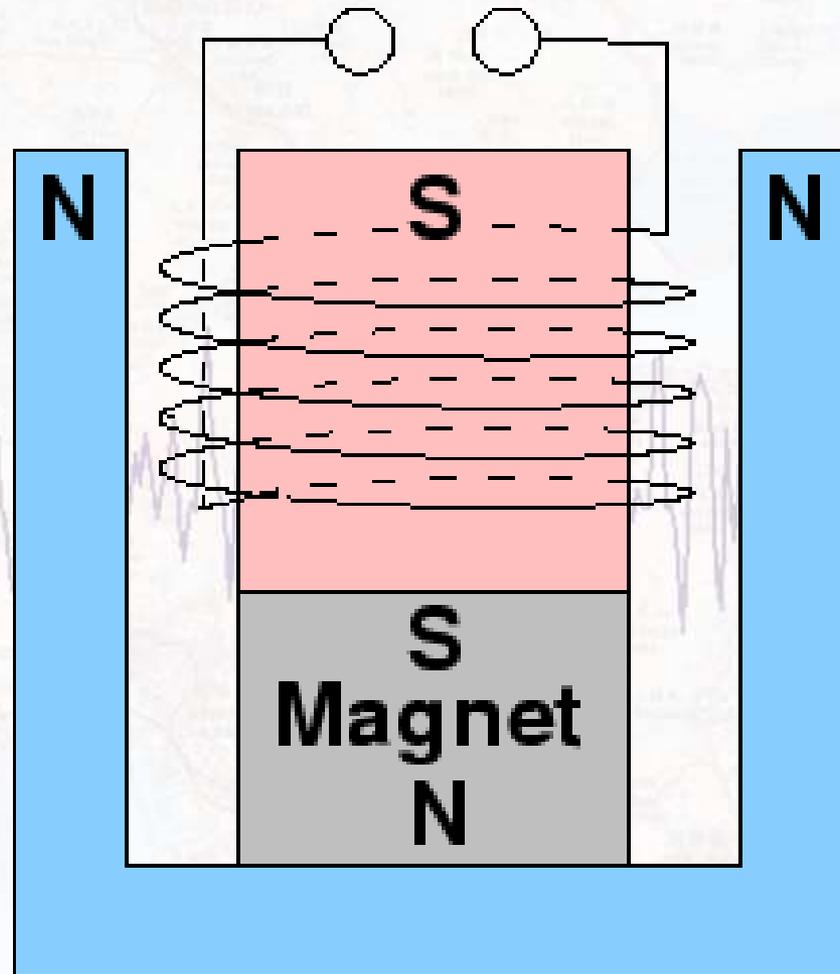
Principle of Earthquake Detector

- Newton's First Law of Motion
- Inertia





- Faraday's Law
- Lenz's Law

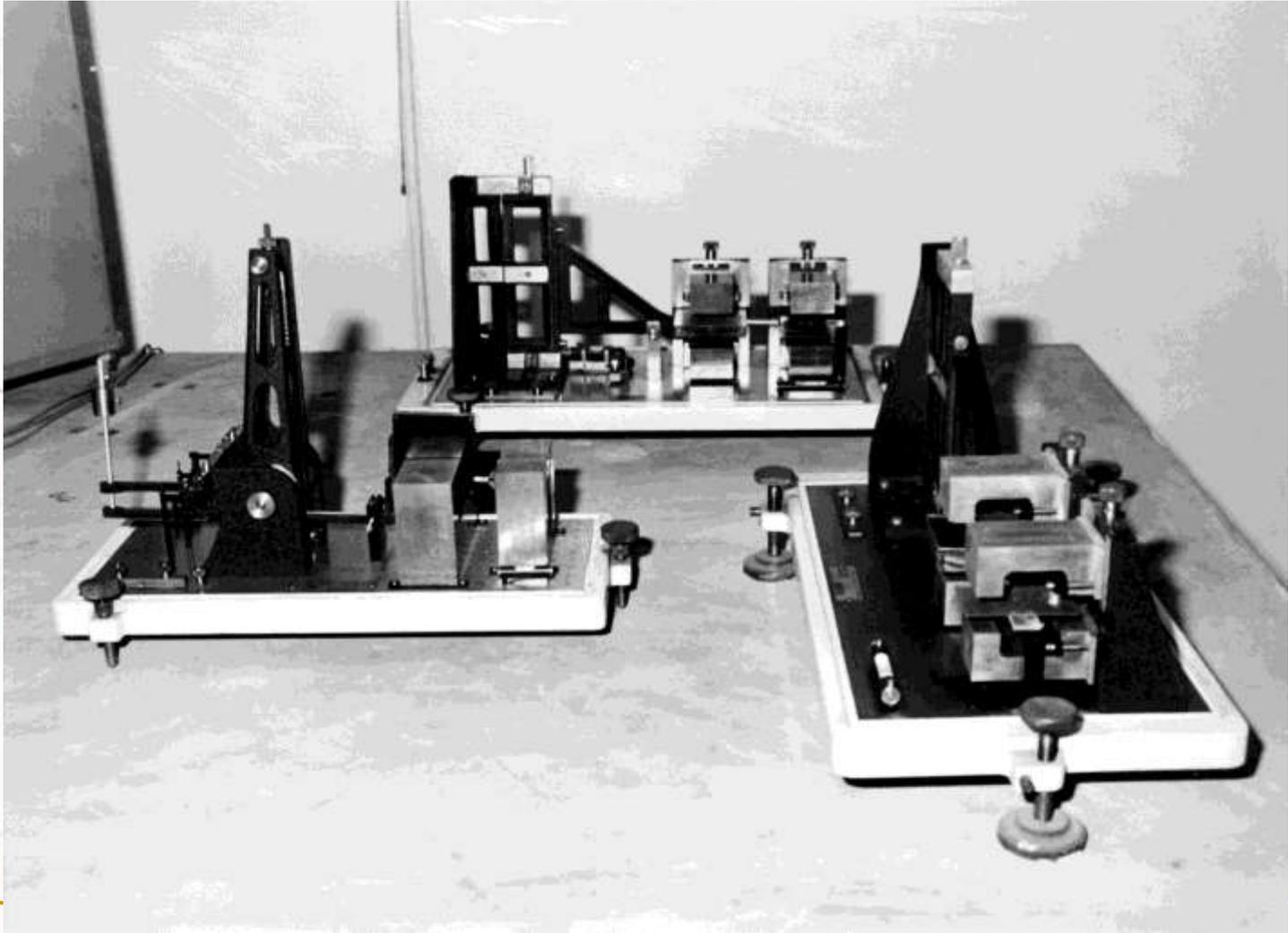


Houfeng Didong Yi

- **First seismoscope (Earthquake Detector) in History.**
- **Invented by Zhang Heng of Han dynasty in 132AD.**



Sprengnether Seismometer (1951-1976)



Benioff Seismometer (1963-1985)

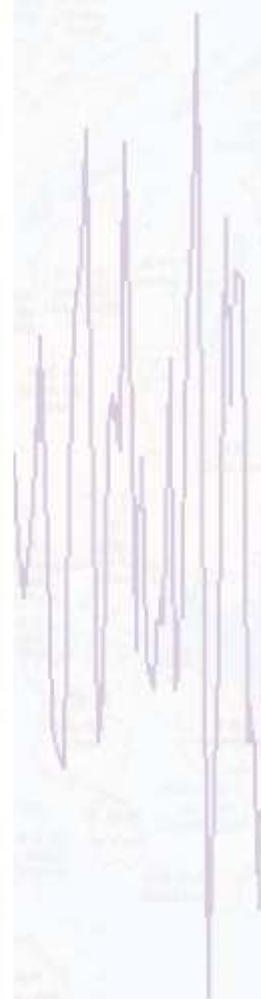


Sprengnether Seismometer (1963-1985)

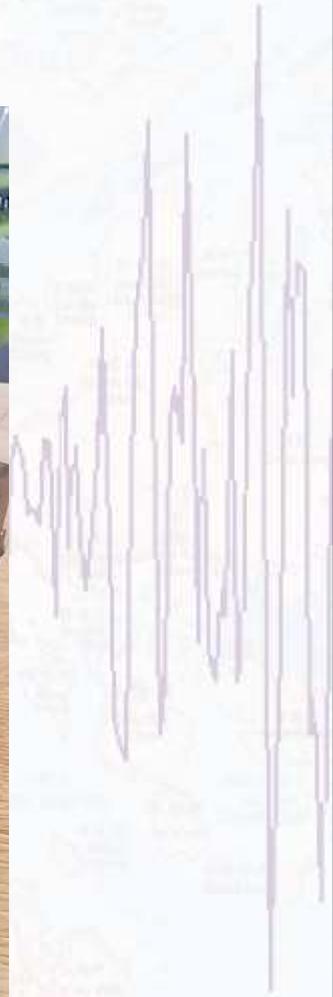
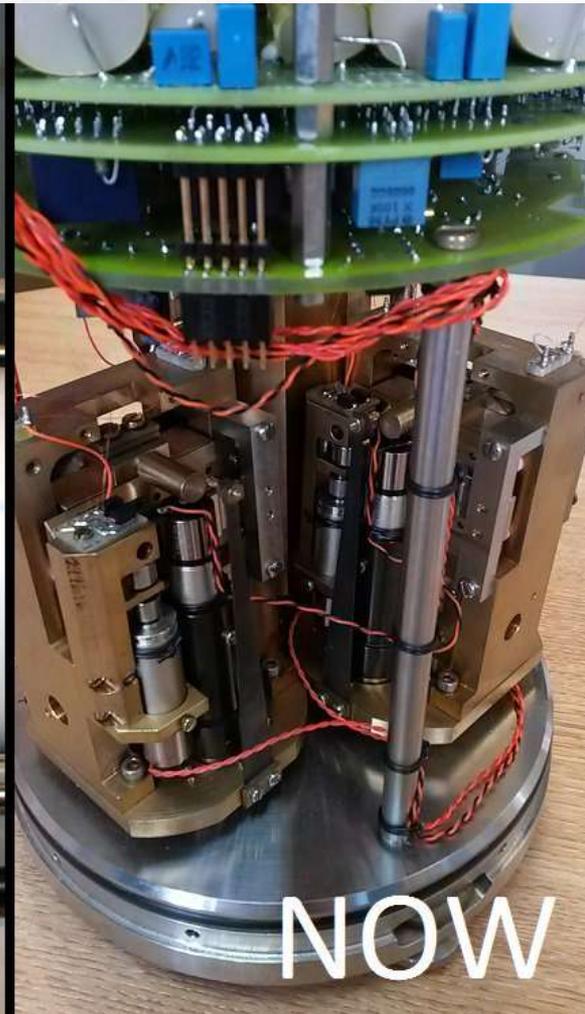
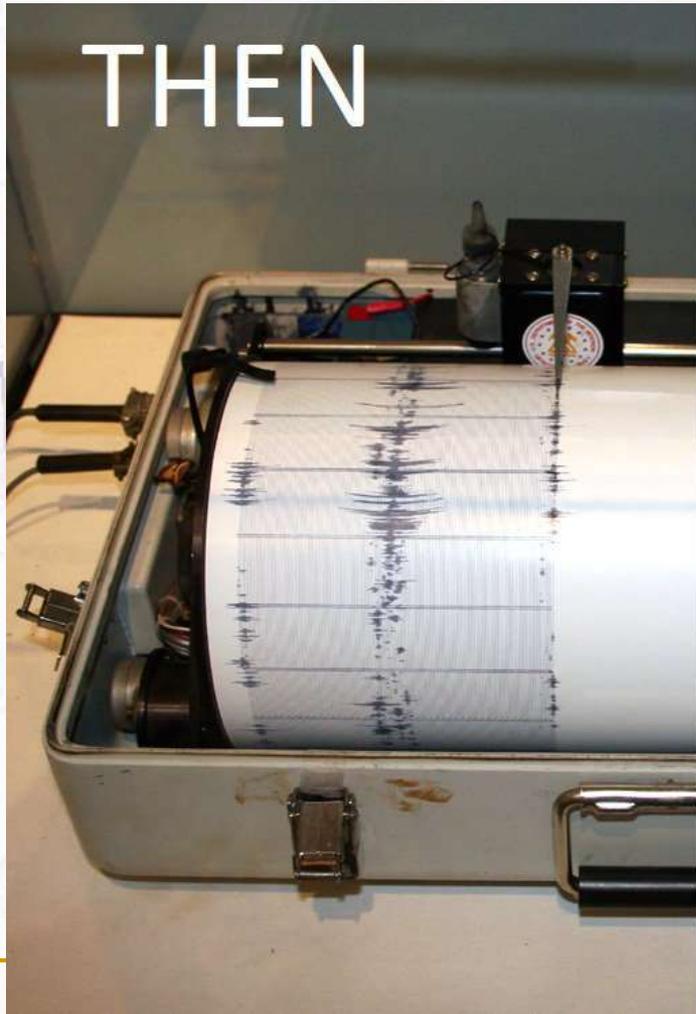


Press Ewing Seismometer (1958-1976, 1979-2011)





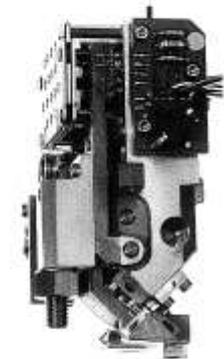
Modern Seismometers



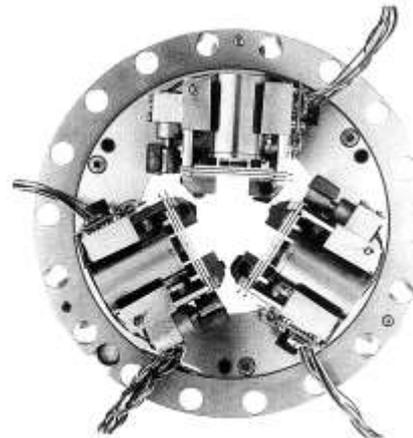
Streckeisen STS-2



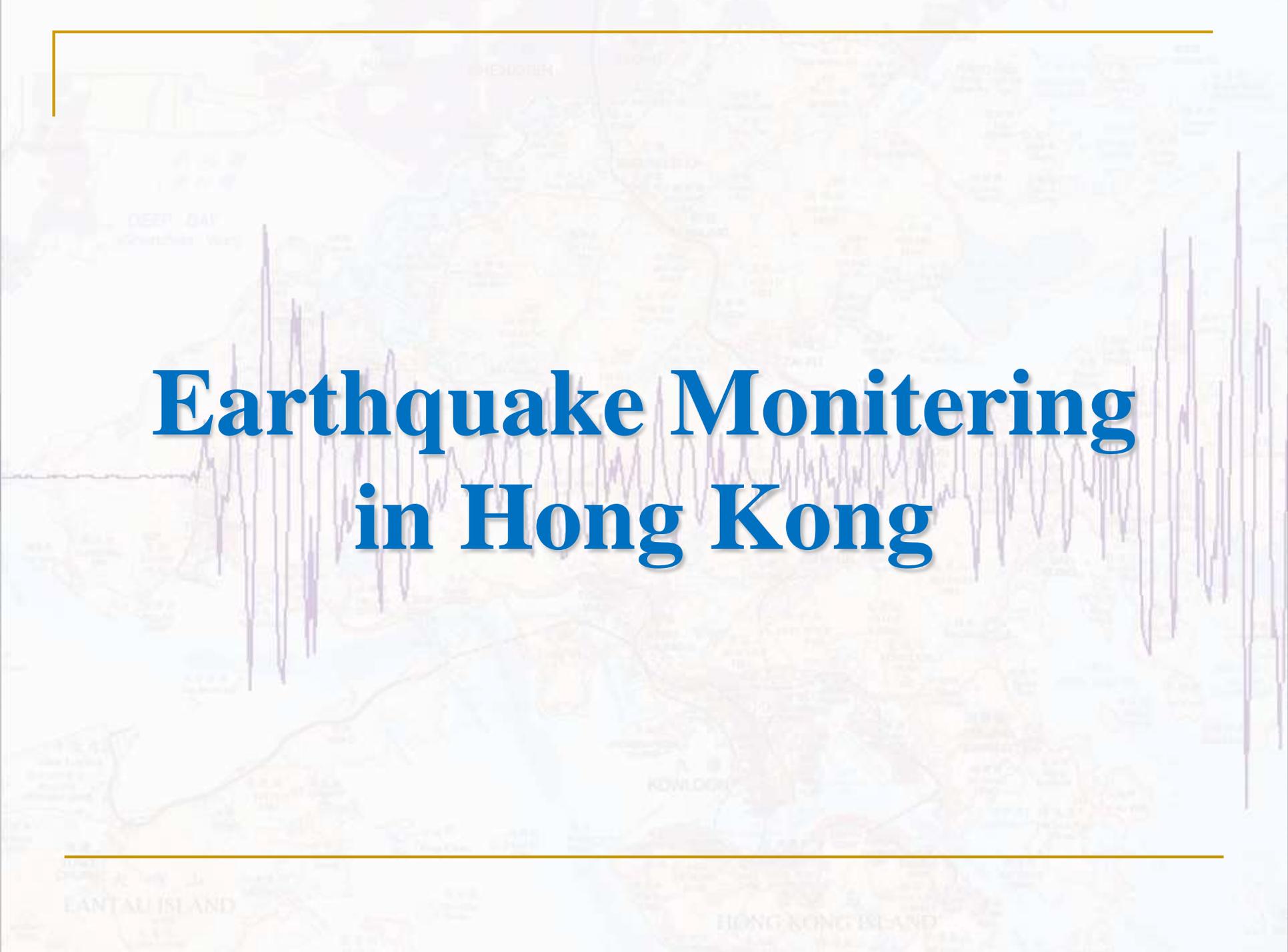
STS-2 COVER REMOVED



STS-2 SINGLE SENSOR

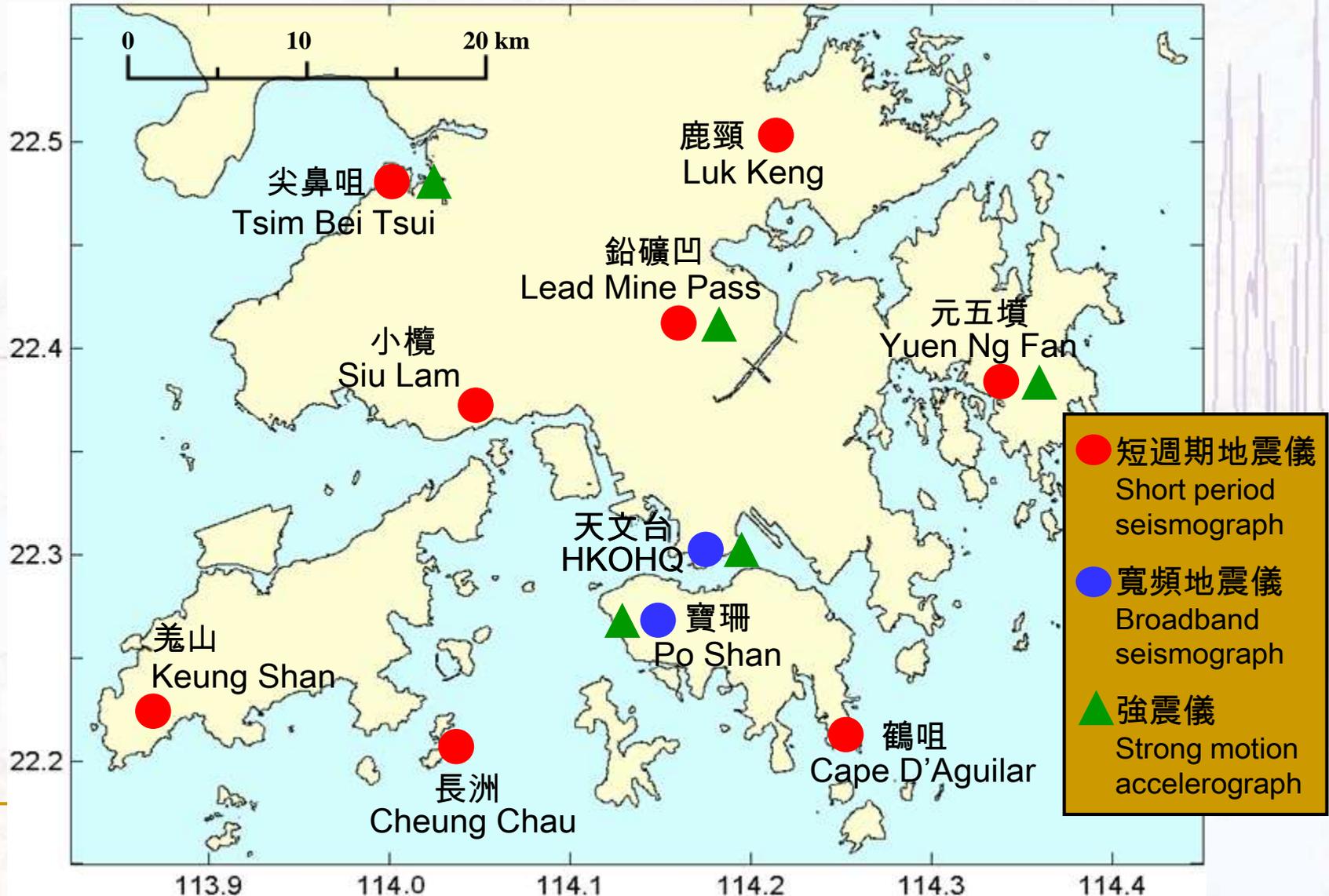


STS-2 THREE SENSORS IN FRAME, TOP VIEW

The background of the slide is a light-colored map of Hong Kong, showing the New Territories, Kowloon, and Hong Kong Island. A purple seismic waveform is overlaid on the map, with several sharp peaks and troughs. The text "Earthquake Monitoring in Hong Kong" is centered in a large, bold, blue font.

Earthquake Monitoring in Hong Kong

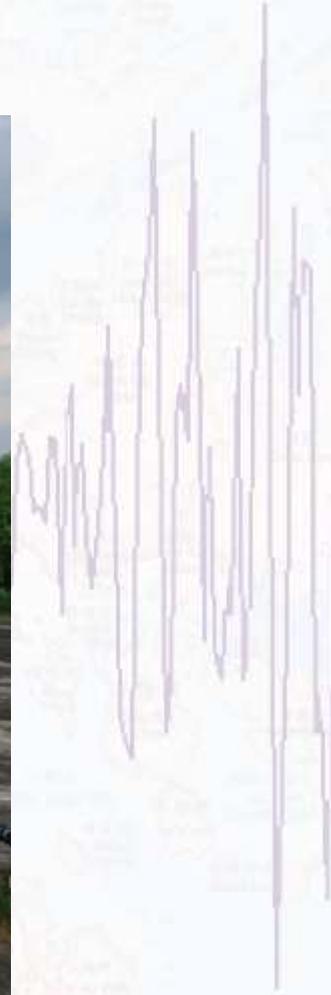
Hong Kong Seismograph Network



Keung Shan Seismograph station



Tsim Bei Tsui Seismograph station



Equipment inside the station



Strong Motion
Accelerograph

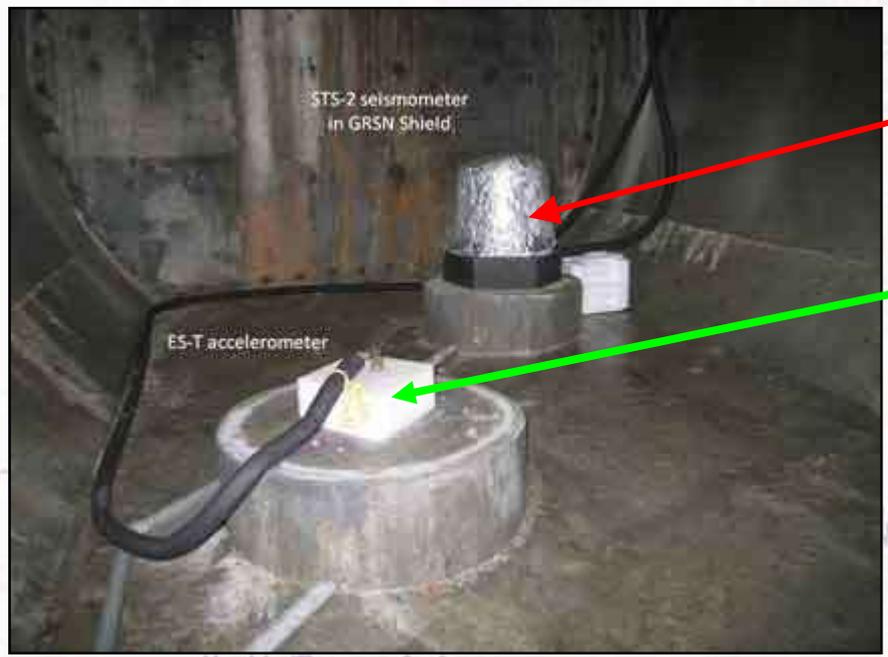
ADC Converter
and GPRS
transmitter

Seismometer

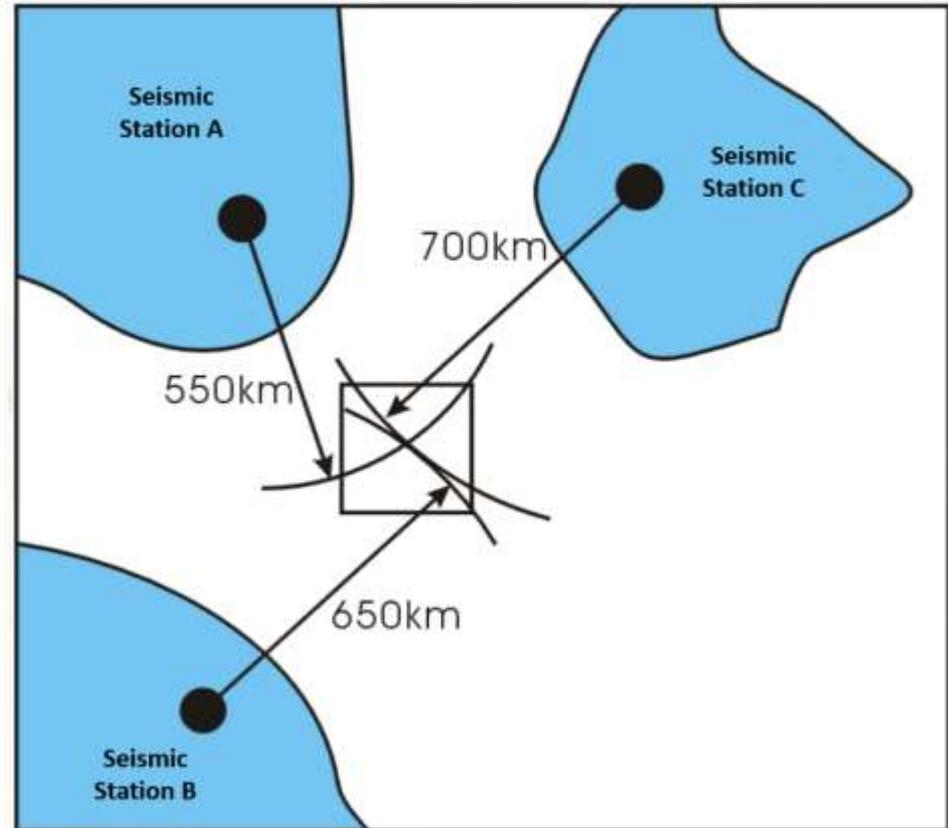
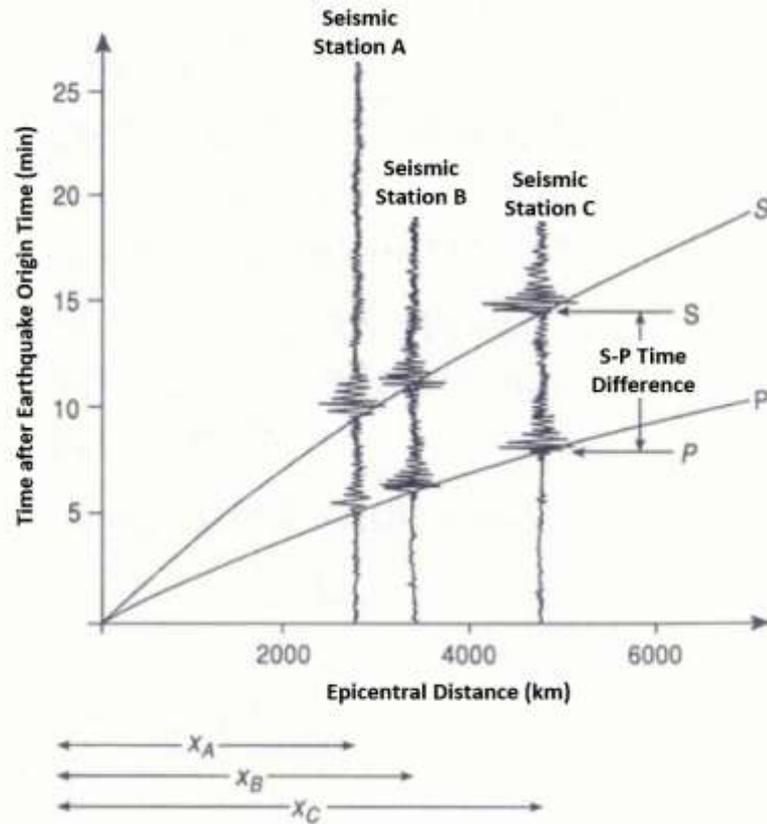


Po Shan Seismograph station

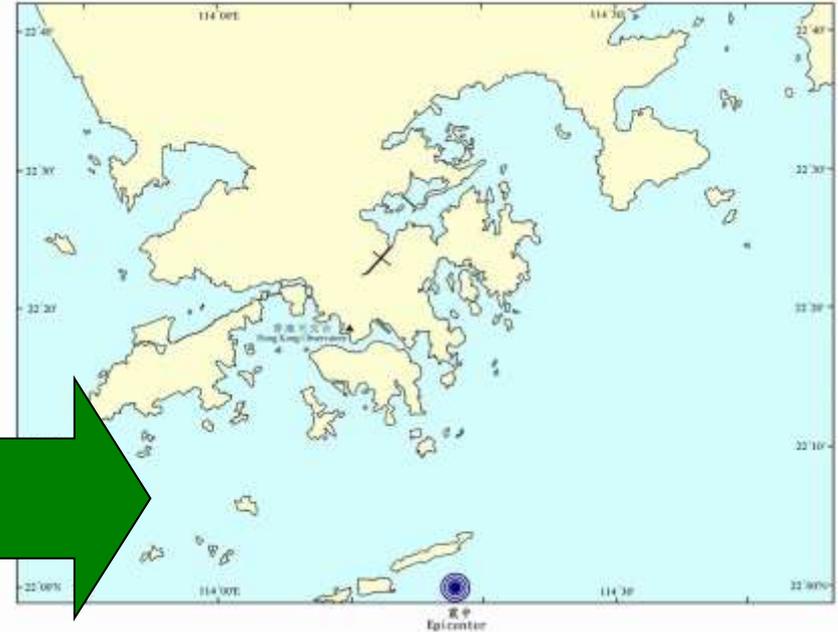
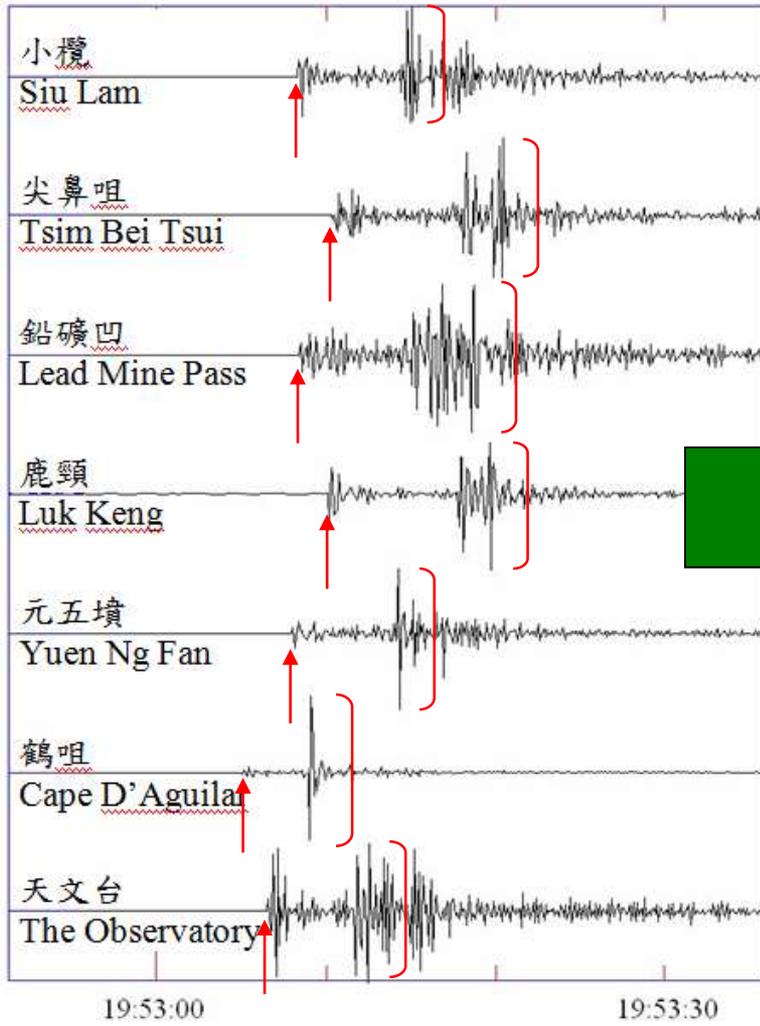




Locating Epicentre



Seismic Wave Analysis



Date : 2006-9-14

Time : 19:53 (HKT)

Location : Sea area around Dangan Island
(22.0N 114.3E)

Mag. : M3.5



Hong Kong Observatory