J-RAPID Report Symposium for Anak Krakatau volcano eruption and Sunda Strait tsunami

November 28th, 2019, Indonesia

Hypocenter Relocation and Focal Mechanism Analysis of Aftershock of 2018 M 7.5 Palu-Donggala Earthquake (Periods of September 28 to November 20, 2018)

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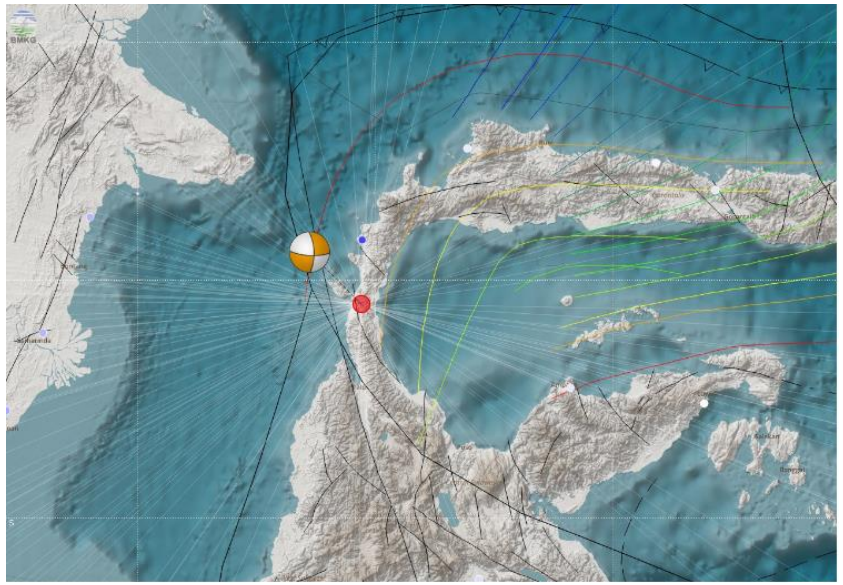
Introduction

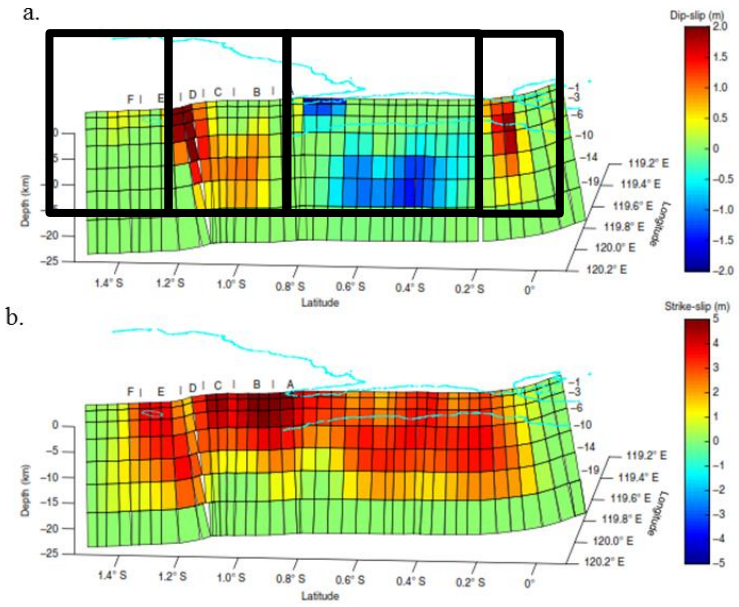


Palu-Donggala EQ 28 September 2018
(BMKG, 2018)

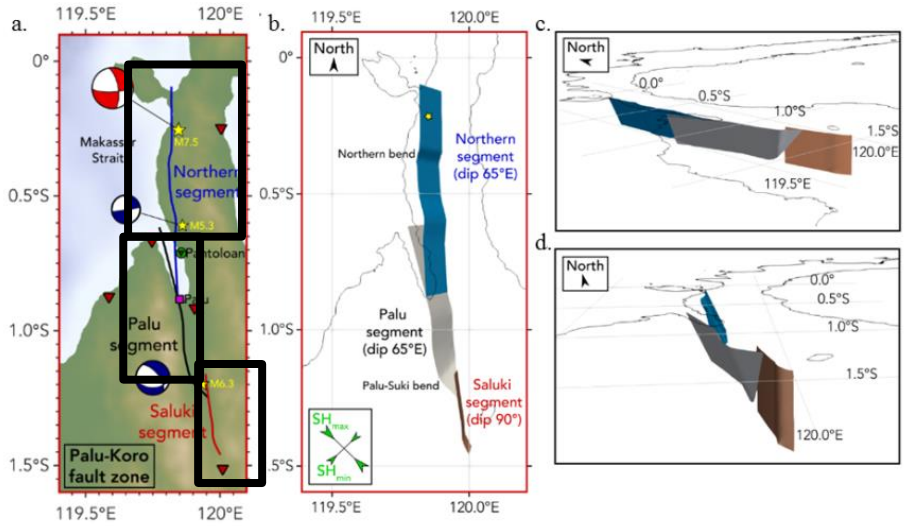
- Palu-Donggala earthquake on 28 September 2018 with M 7.5 at 17:02:43 WIB within source depth of 10 km due to the Palu-Koro fault activity with strike slip mechanism originating 27 km NE of Donggala (BMKG, 2018).
- The activity of Palu-Koro fault resulting mainshock and also afteshock, BMKG recorded the earthquake from September 28th to November 20th.
- BMKG recorded 1,225 events with magnitude > 2.
- Research about Palu earthquake has been done i.e. by Sockquet et. al. (2019) Urlrich et. al. (2019).
- Hypocenter distribution and focal mechanism of the aftershocks within 2 months used for indicitace continuity and segmentation of the Palu-Koro fault.

Previous study about segmentation of Palu-Koro Fault

Palu-Koro fault model in Socquet et. al..(2019)



Palu-Koro Geometry result from Ulrich et. al. (2019)



Objective

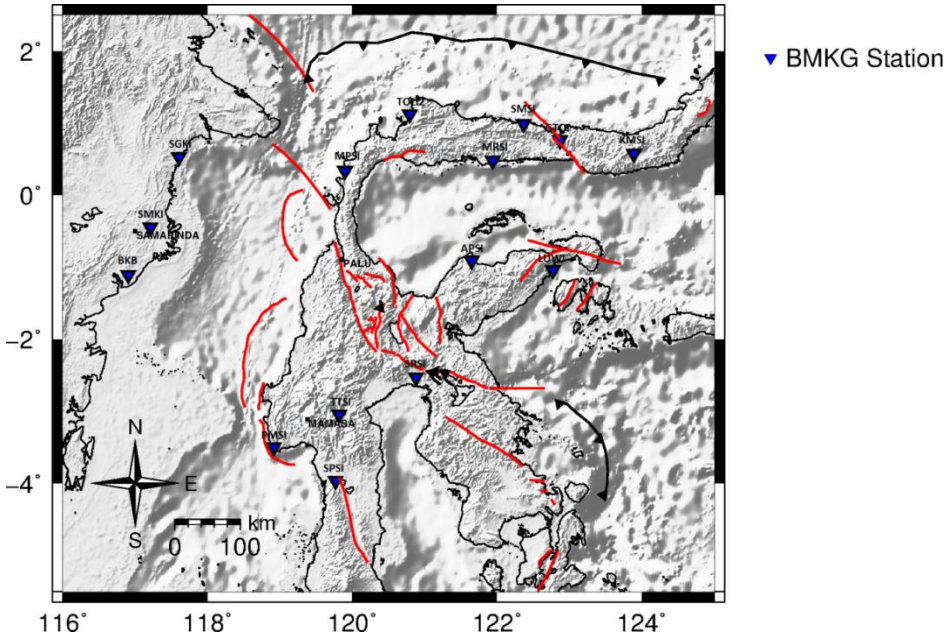
To image a sharp geometrical continuation of Palu-Koro fault as well as to infer the time and spatial growth of fault rupture using aftershocks distribution.

Data

- Earthquake that recorded by BMKG's station from Sept 28 – Nov 20 2018.
- Recorded by 15 BMKG's station.
- Recorded both by BMKG's seismogram and catalogue.
- Magnitude ≥ 3.6, which has clear seismogram and recorded by more than 6 stations.
- Seismic velocity model used AK135.

Depth	P vel.	S vel.	Density	Older Density
0	5.8	3.46	2.449	2.72
20	6.5	3.85	2.7142	2.92
35	8.04	4.48	3.2976	3.3198

Distribution of BMKG station used

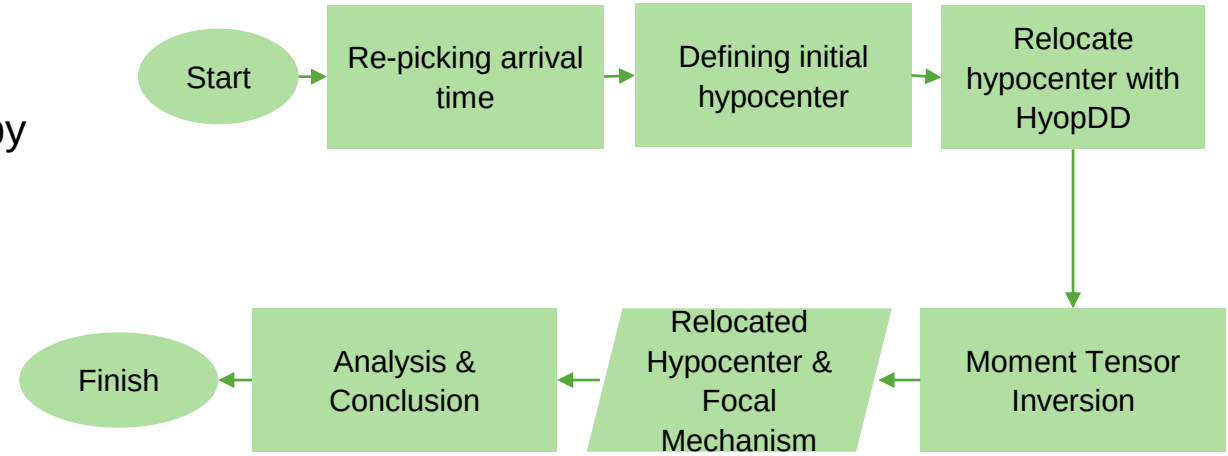


Fault shown by red line (PuSGeN, 2018)

Methodology

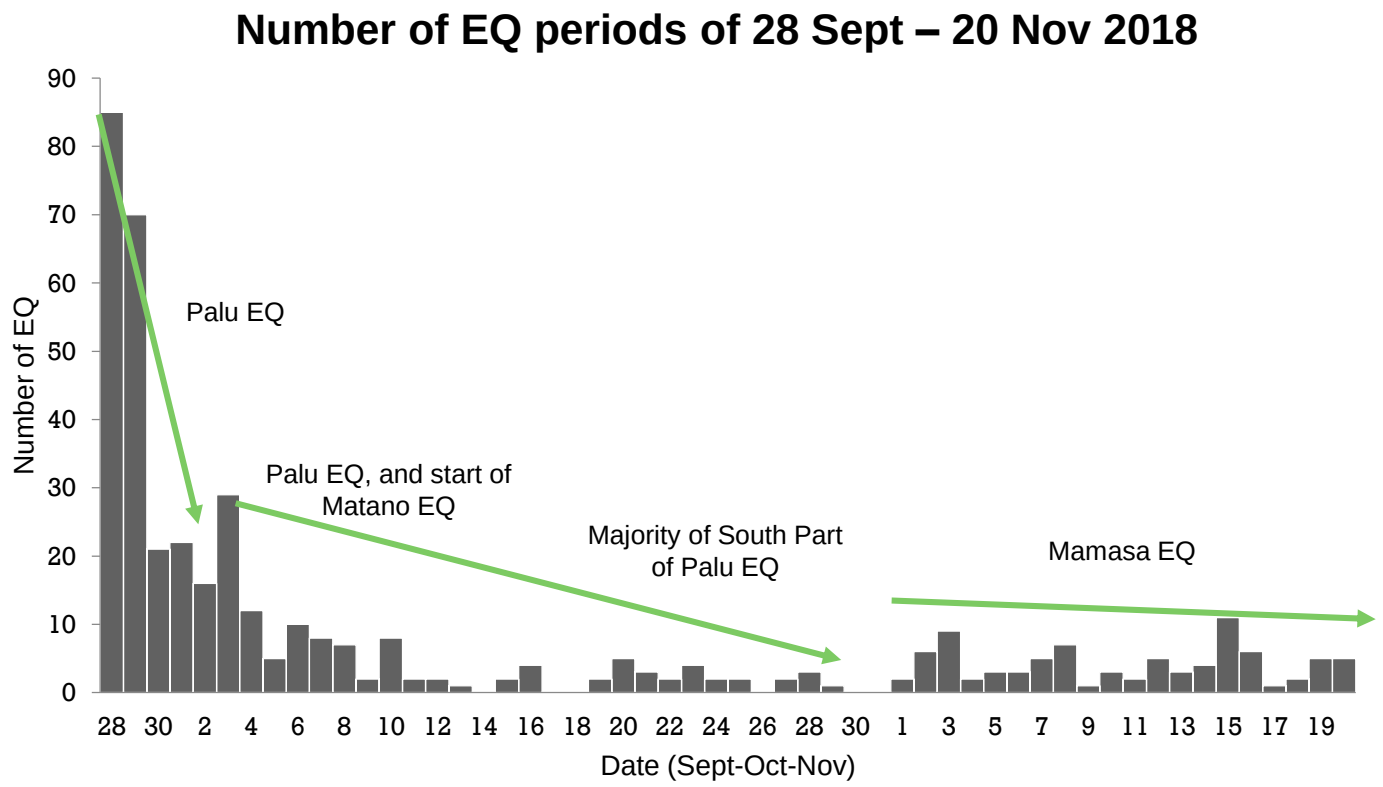
1. Re-Picking arrival time of P and S phase.
2. Determination of initial hypocenter by *nonlinloc program*.
3. Relocation hypocenter by *double difference method*.
4. Focal mechanism analysis by *moment tensor inversion*.

Workflow from overall processing



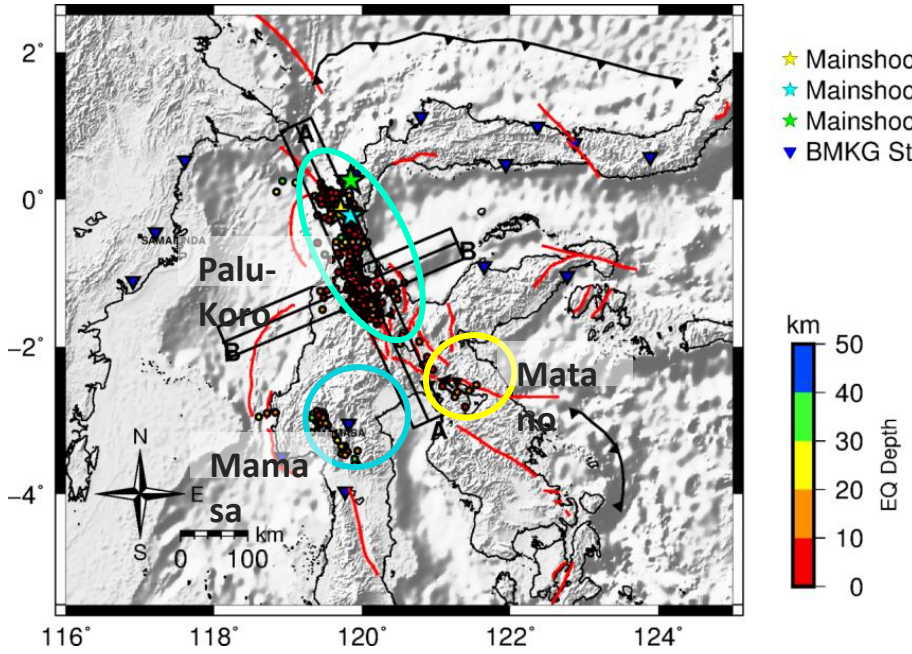
Result from re-picking arrival time

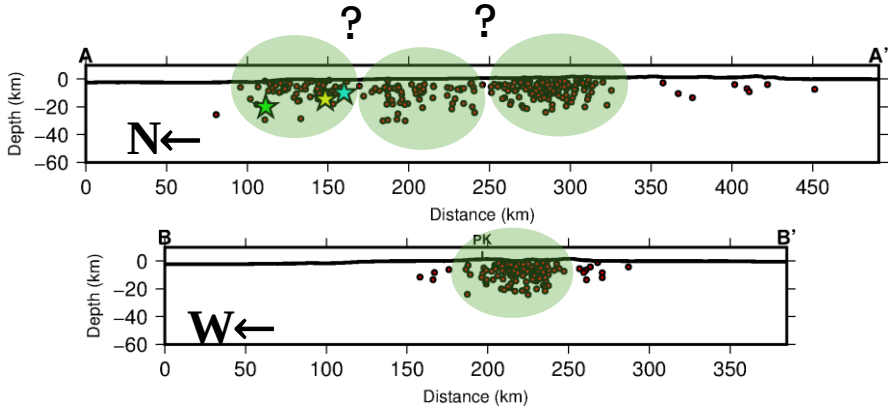
- Total 410 events.
- Each phase P and S has 3919 phase.



Result from Hypocenter Relocation

Data from 28 September – 20 November 2018

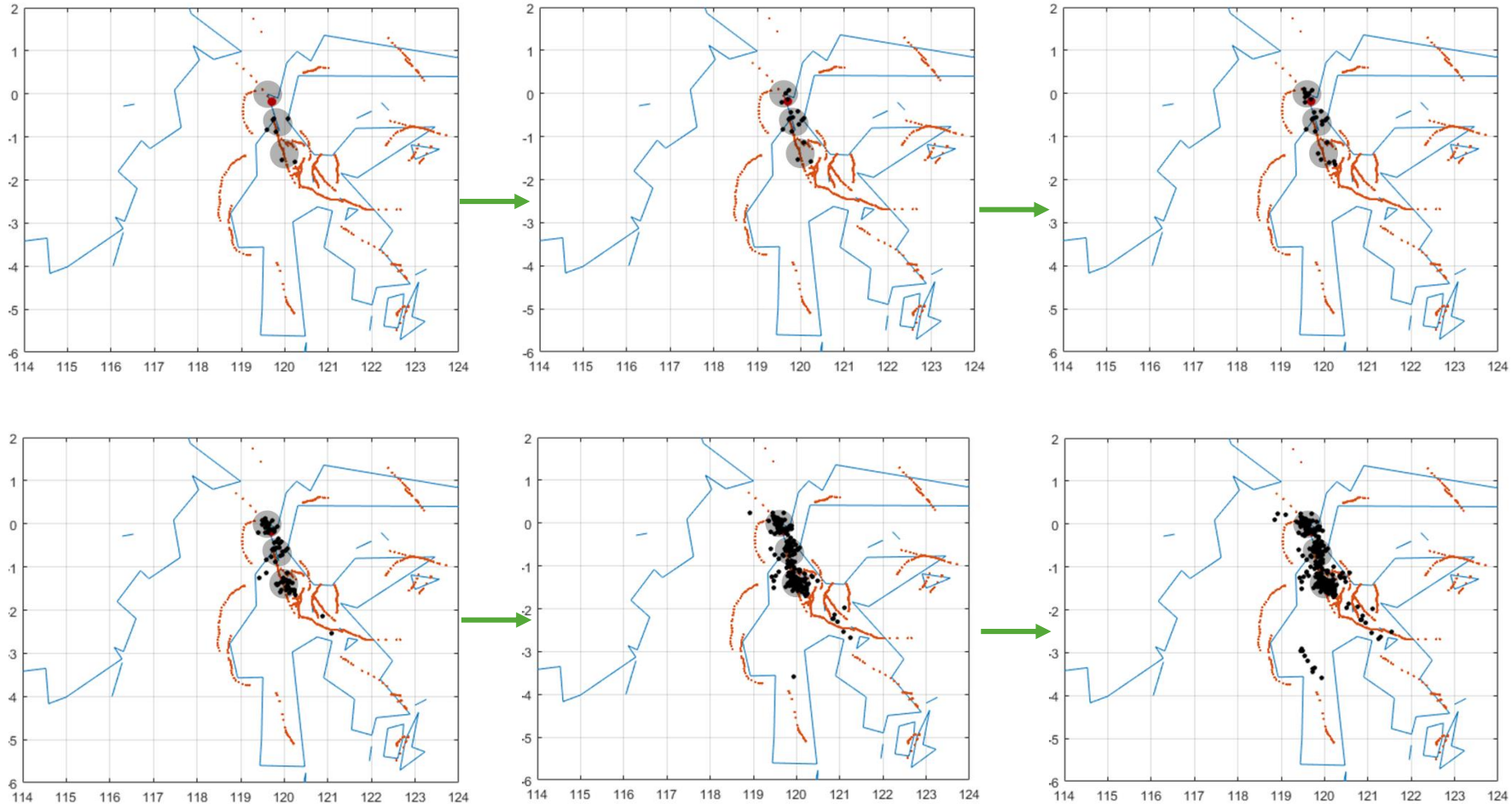




- Out of 410 event, 341 events were relocated.
- 3 Big Clusters: **Palu-Koro, Mamasa,** and **Matano**.
- In Palu-Koro clusters, there are 3 clusters: **North**, **Middle**, and **South**.

Arrival sequence of the Palu EQ

periods of 28 Sept – 20 Nov 1018



Focal Mechanism of Palu EQ along Palu-Koro Fault

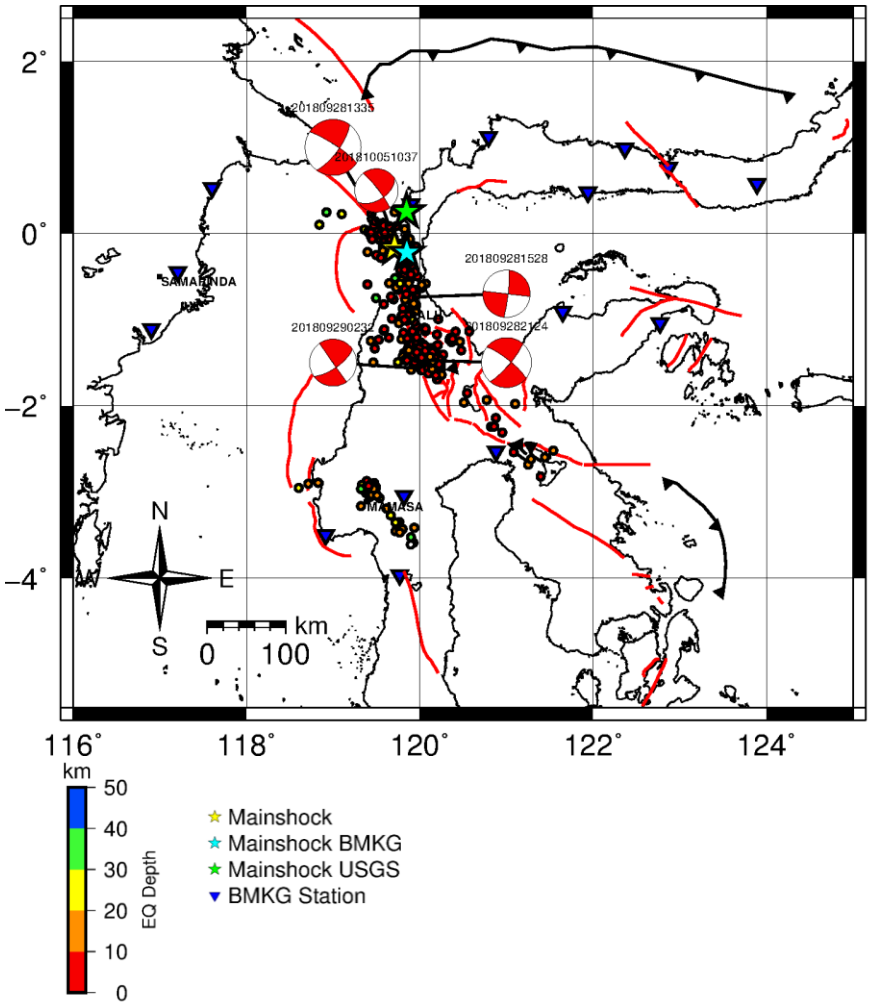
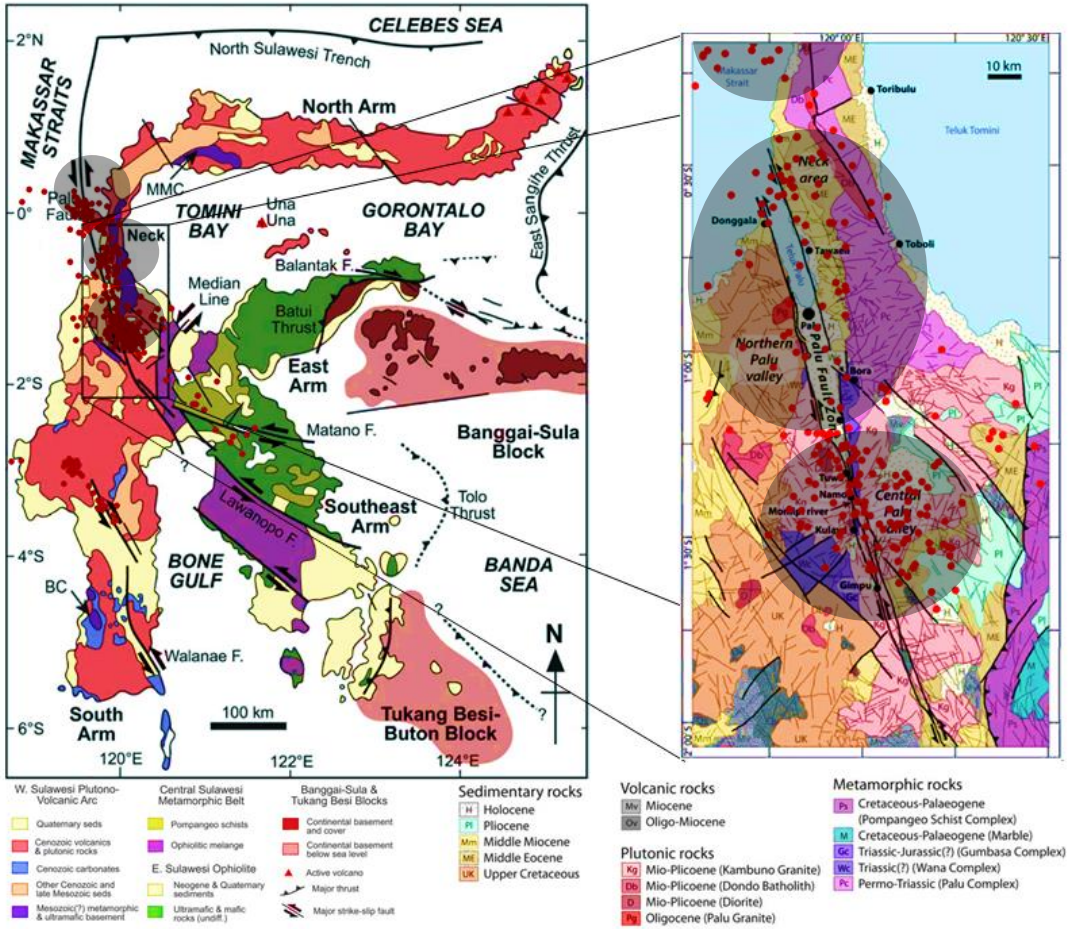


Table of Palu-Koro fault plan from moment tensor inversion

S	Event	Long (º)	Lat (º)	Depth (km)	VR (%)	Mw (º)	*Strike* (º)	*Dip* (º)	*Rake* (º)
N	20180928133 5	119.55	0.035	9.2	50	7.9	301	81	-16
M	20180928152 8	119.91	-0.741	5.5	63	6.7	6	84	0
S	20180928212 4	120.09	-1.475	5.5	57	7.1	309	79	-11
S	20180929023 2	120.0	-1.503	4.9	44	6.6	325	89	19
N	20181005103 7	119.65	0.085	9.6	40	6.1	322	83	-36

- 5 Focal Mechanism, show 3 clusters; north, middle and south.
- North cluster tends to have NW-SE strike.
- Middle cluster has N-S strike.
- South cluster tends to have NW-SE strike.

Analysis of Geometry and Relocated Hypocenter Distribution



- 3 clusters along Palu-Koro are expected to be the segmentation.
- North cluster, swarm around NW of Sulawesi Neck
- Middle cluster, dispersed around aseismic area (Palu Basin).
- South cluster, gather around the end of the Palu Basin.

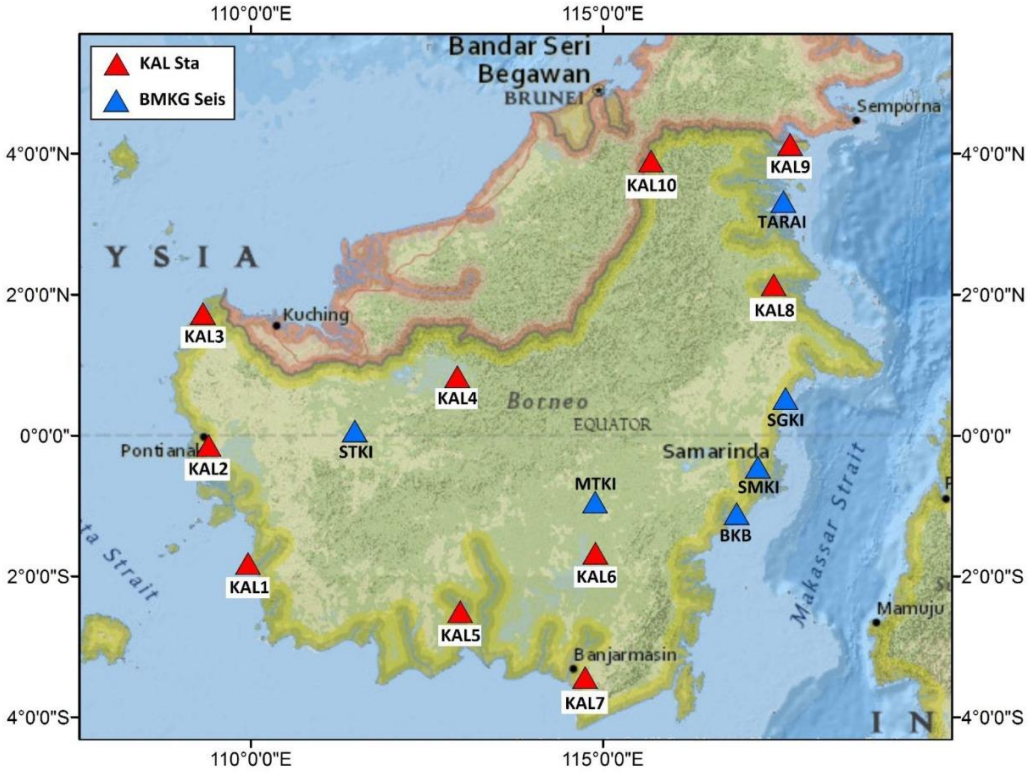
(Modification from Watkinson, 2011)

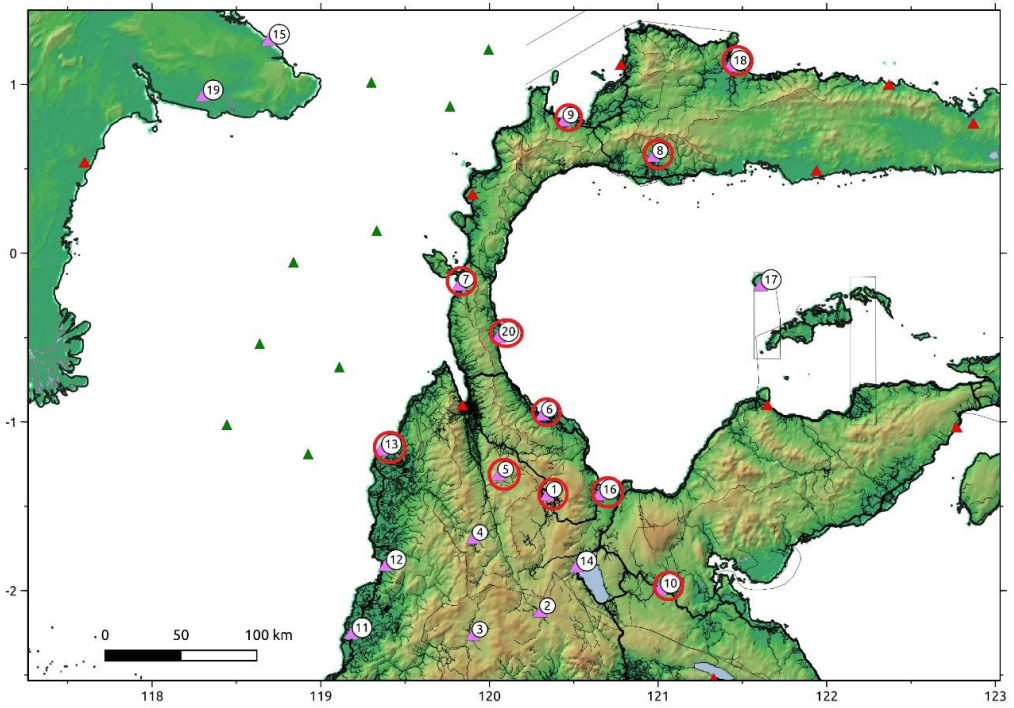
Preliminary results

1. The relocated hypocenters distribution shows three clusters which might represent the Palu-Koro Fault segmentations in the north, middle, and south of the Palu-Koro Fault.
2. This segmentation is in agreement with the Palu-Koro geometry model obtained in the previous studies.
3. The spatial and temporal aftershocks distribution indicates the rupture propagation of the fault away from the mainshock, towards a south direction.

ITB-Cambridge University Joint Research

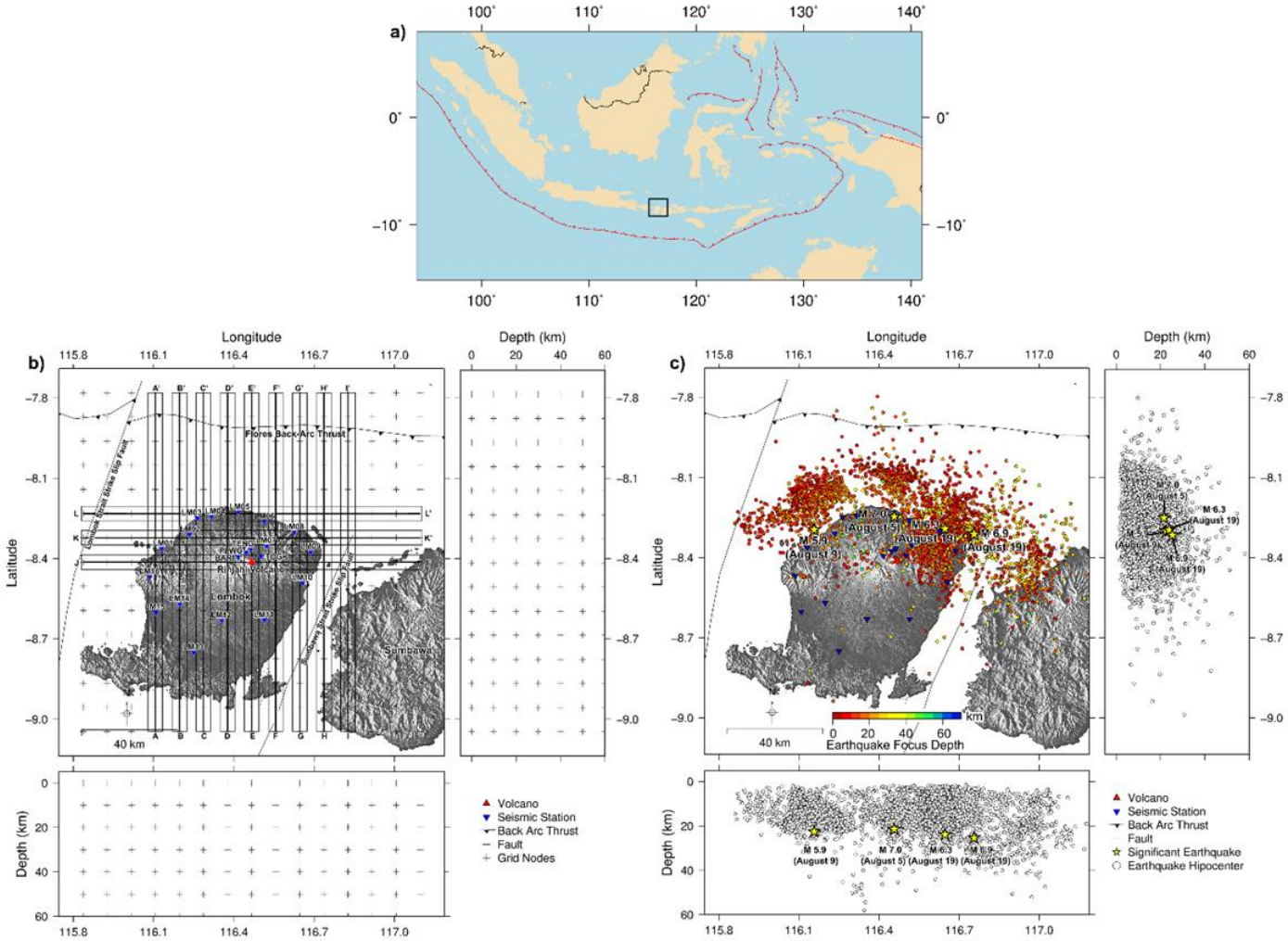
- 28 Ocean Bottom Seismometers – **Makassar Strait + Celebes Sea (2019)**
- 10 new stations (6 BMKG) – **Borneo (2019)**
- 19 new stations (10 BMKG) – **Celebes (on-going)**





Lombok 2018 Earthquake

- 20 new Stations deployed (starting August 2nd, 2018)
- Major earthquakes
  - July 29th, 2019 (M6.3)
  - August 5th, 2019 (M7.0)
  - August 9th, 2019 (M5.9)
  - August 19th,2019 (M6.3)



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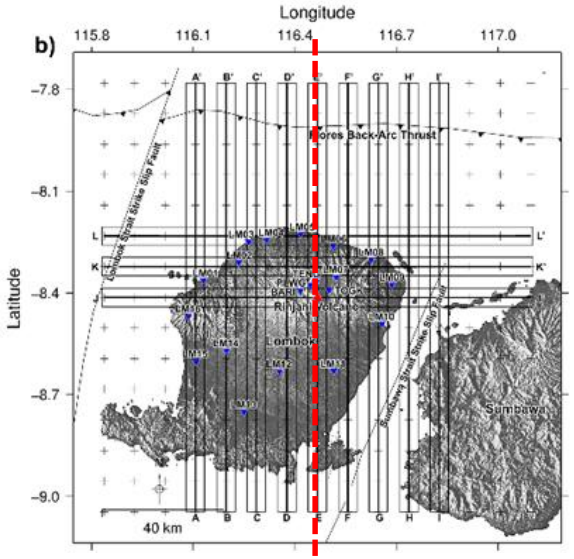

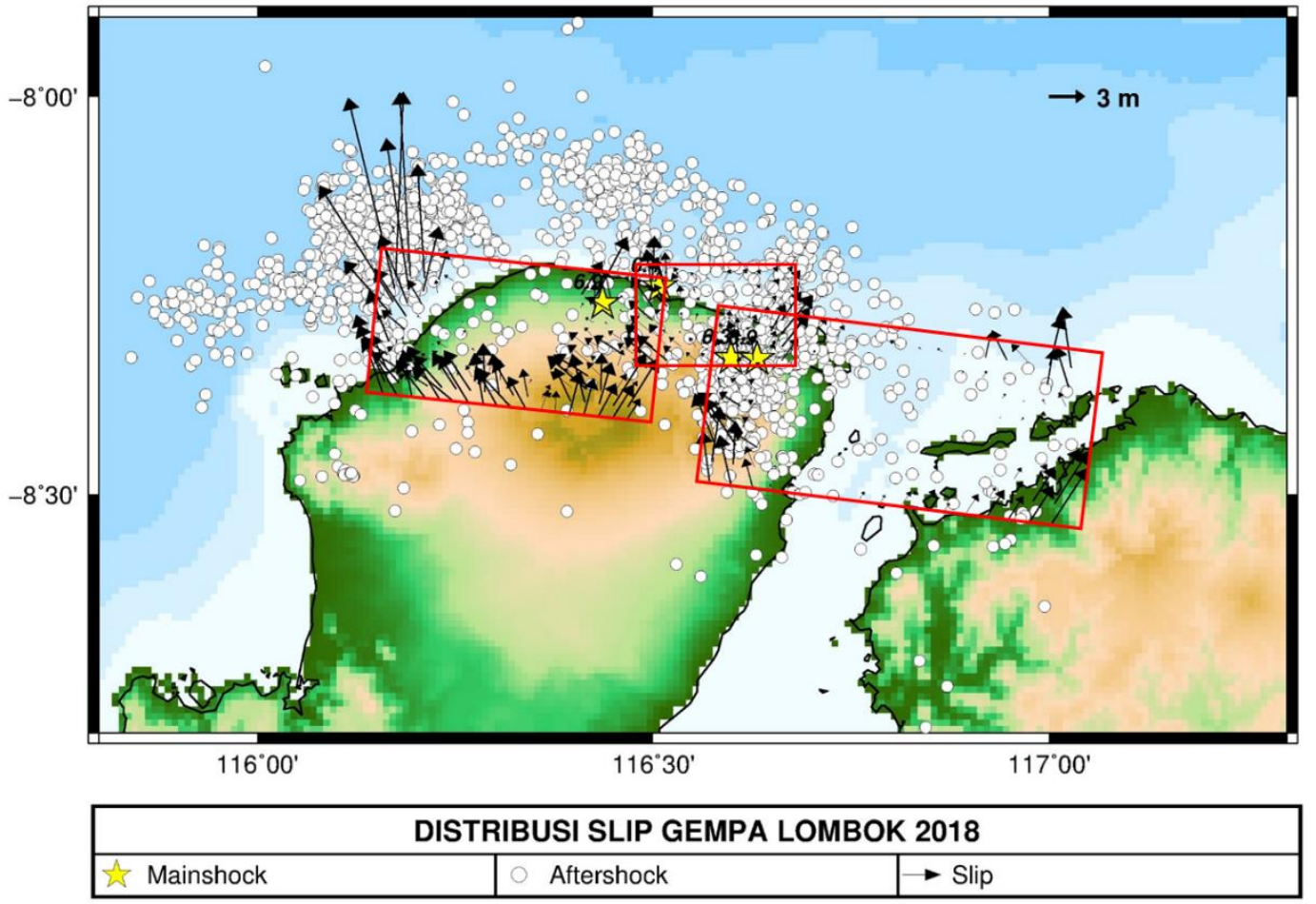

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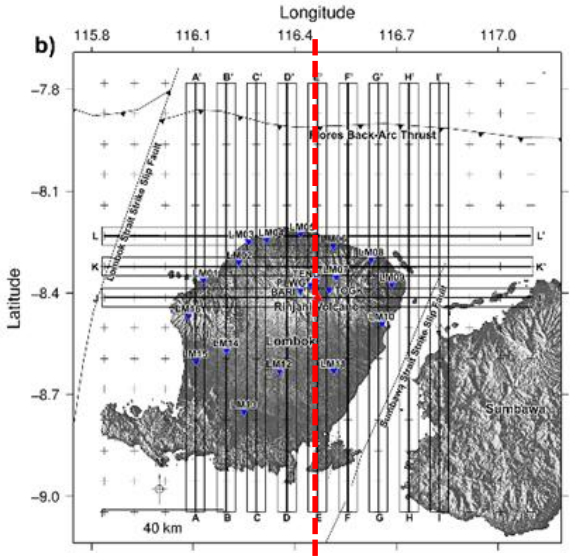

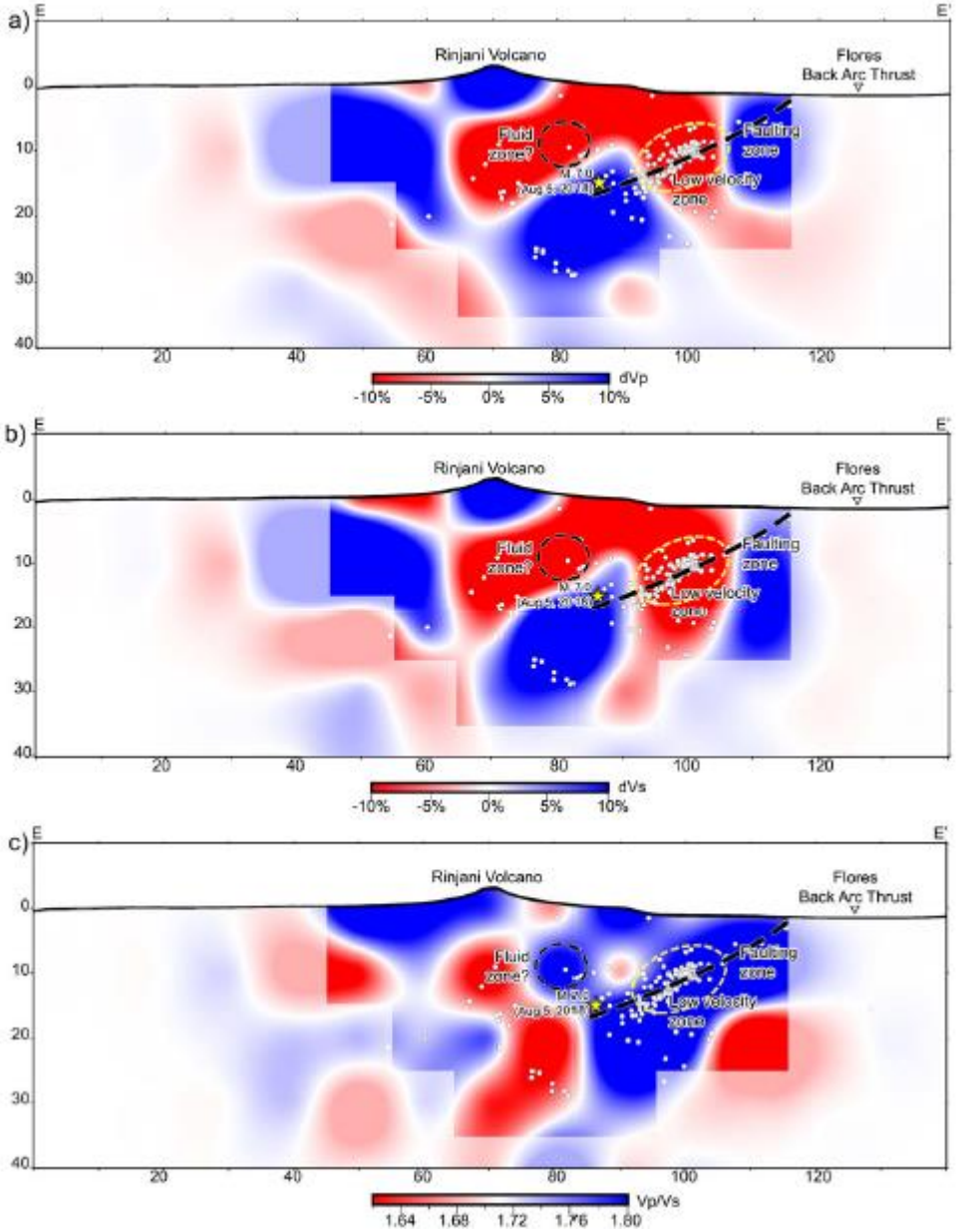

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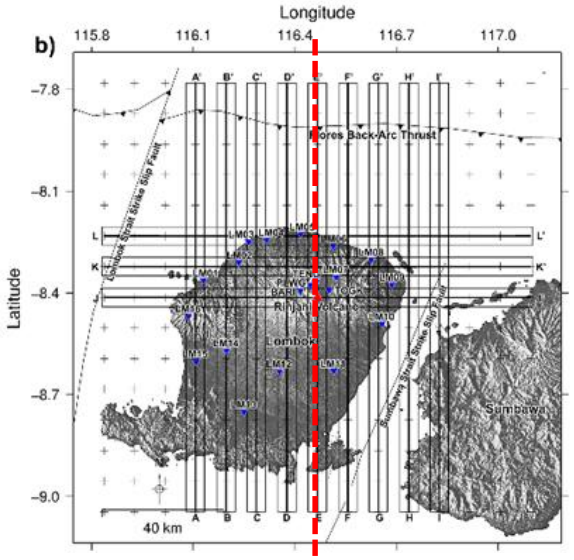

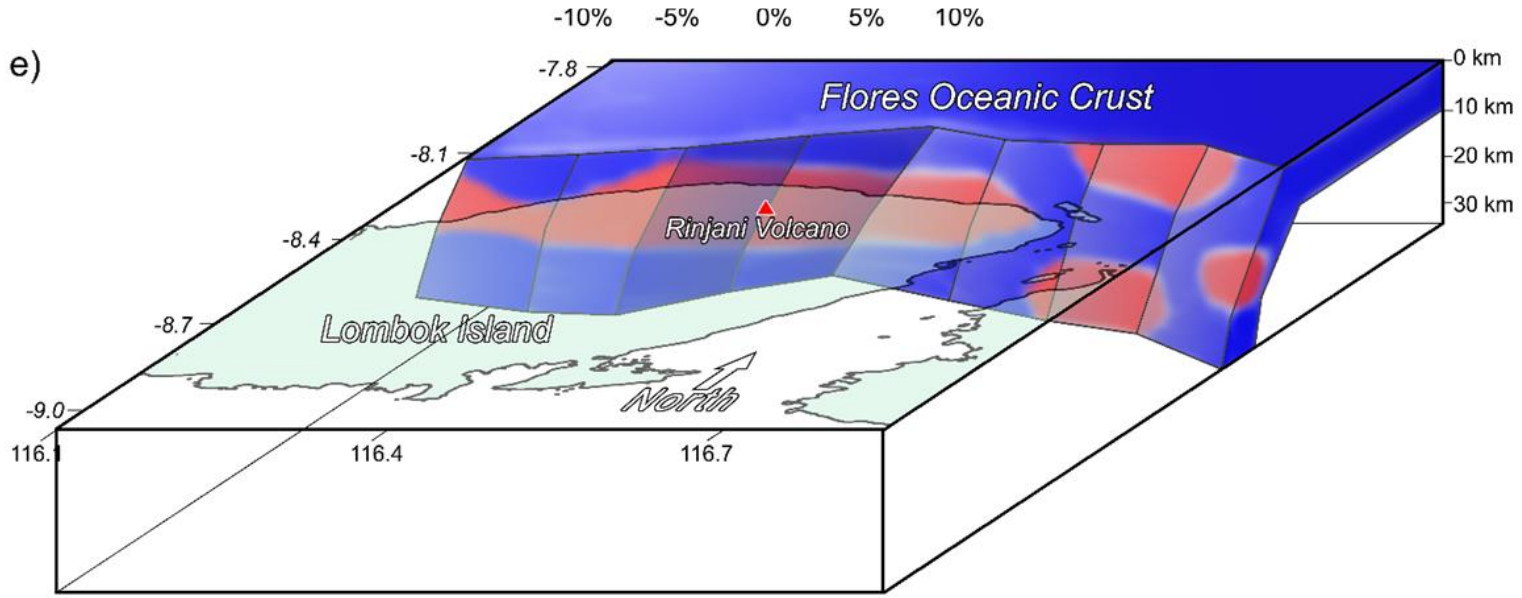

Thank you

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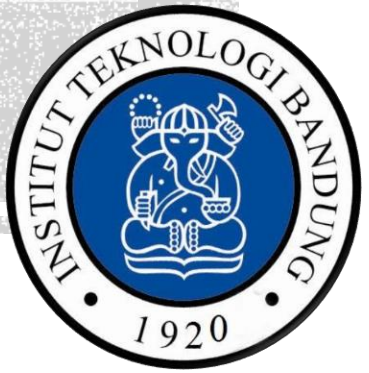

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Arrival sequence of the Palu Aftershock periods of 28 Sep to 20 Nov 2018