# Revisiting Toba Caldera:

## An insight from regional magnetotelluric data

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This work is part of the collaborative research in geothermal resources between The Government of Indonesia and The Netherlands (**GEOCAP**)

Financial support is partly provided by Indonesia Endowment Fund for Education (**LPDP**)

**European Geosciences Union**
**Sharing Geoscience Online 2020**
4 May 2020

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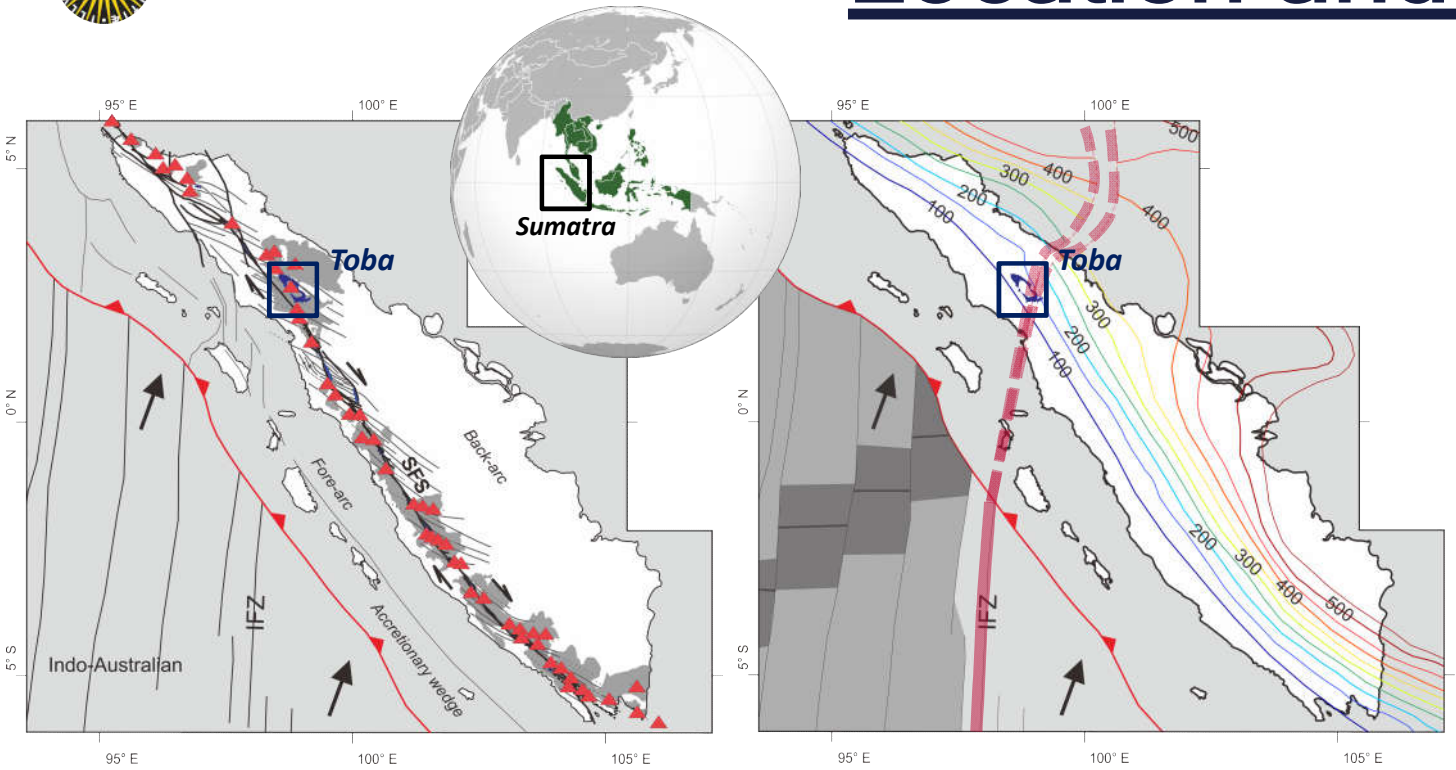
# Location and tectonic setting




Dark grey area represents Quaternary volcanics, notes that Toba has extensive ignimbrites;

Red triangle are active/ inactive stratovolcano;

Grey lines are basement structures;

**Black lines** are SFS, an active dextral Sumatra Fault System;

**IFZ** is Investigator Fracture Zone, inactive transform structure which formed bathymetric high

Colored contour lines are subducted slab (from Hall and Spakman, 2015);

Dashed lines are slab tearing as the northward continuation of IFZ;

Darker grey area in the incoming plate are young oceanic lithosphere of inactive spreading centers

- Oblique subduction
- Strain partitioning; compression in fore-arc and strike-slip along SFS
- Colocation of strike-slip fault system and arc-volcanism
- Slab tearing creates anomalous magmatism beneath Toba

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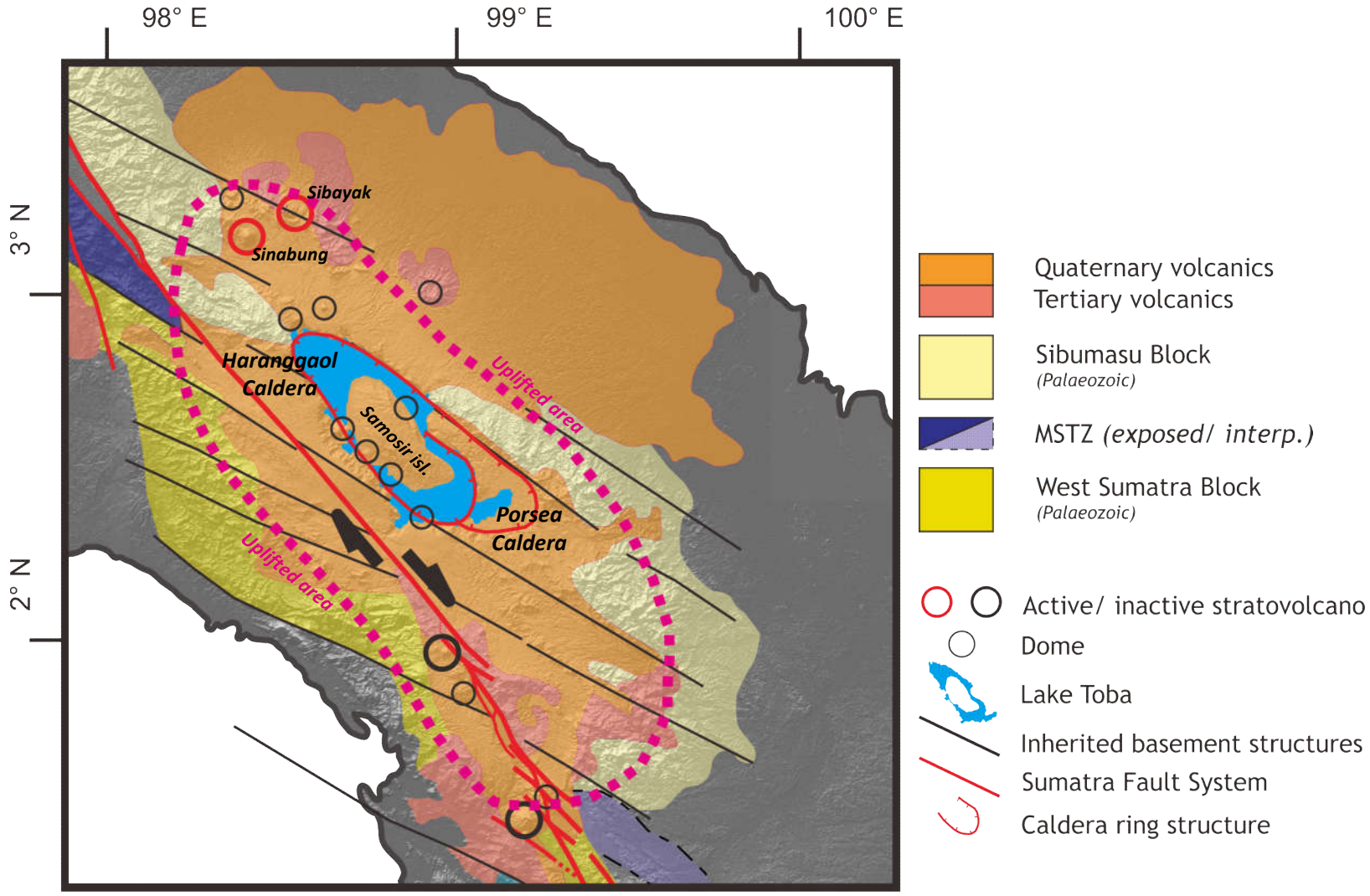
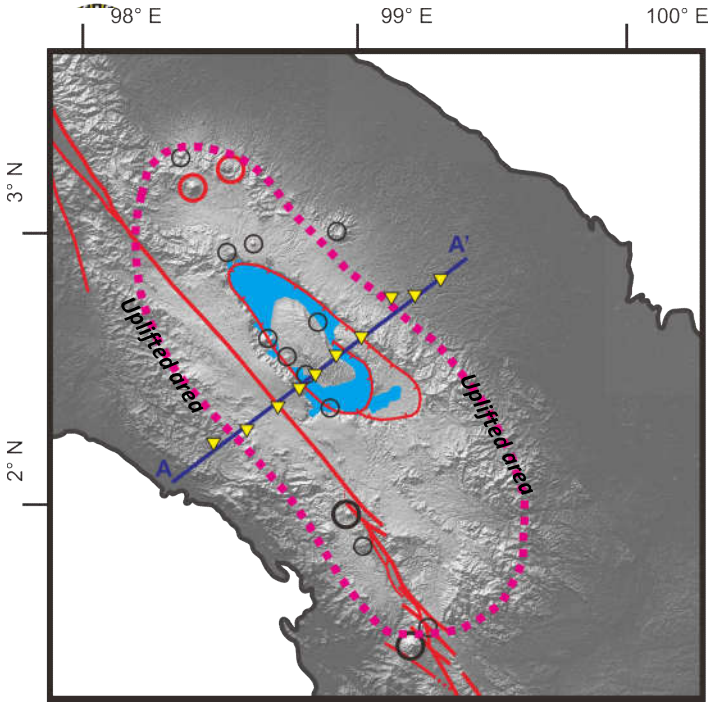
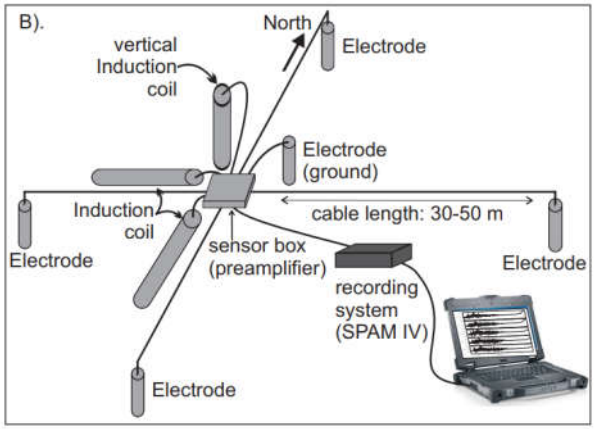
# Regional geology

- Nested calderas (from 1.2 Ma to 0.074 Ma)
  (Chesner, 2012)
- Strongly controlled by basement structures
- Hosted by Paleozoic basement rocks
- Regional uplift around the Caldera

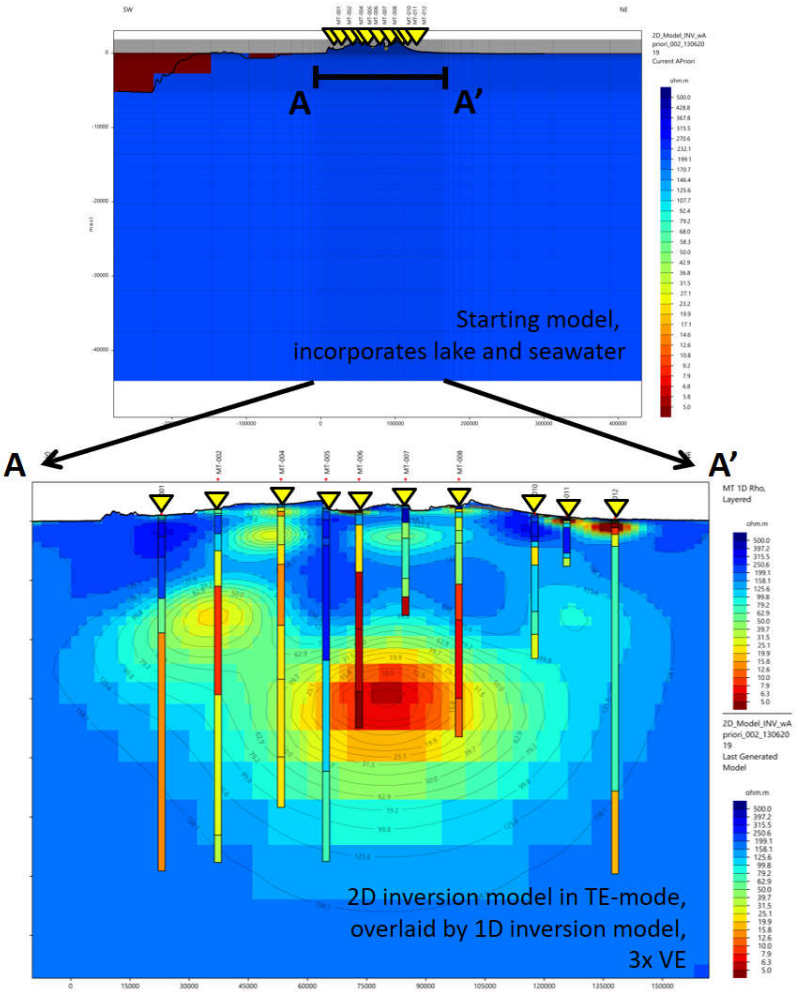


# Magnetotelluric survey



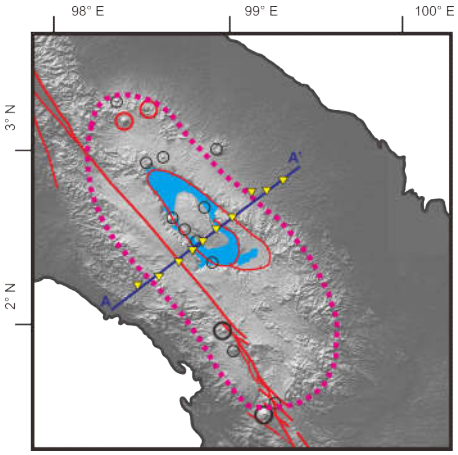




- 10 MT stations, 10-15 km apart in a 2D regional line
- Extended recording time (24-18 hours) to get reliable image at greater depth (up to 30 km)
- Acquired data have ‘good’ to ‘acceptable’ quality



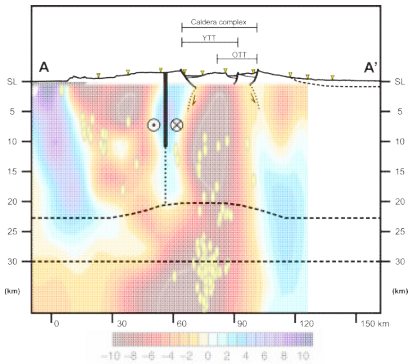

- Several 2D inversion models, with 1D models as comparison
- Nearby lake and sea are considered in the starting model

# Interpretation and comparison to seismic tomography

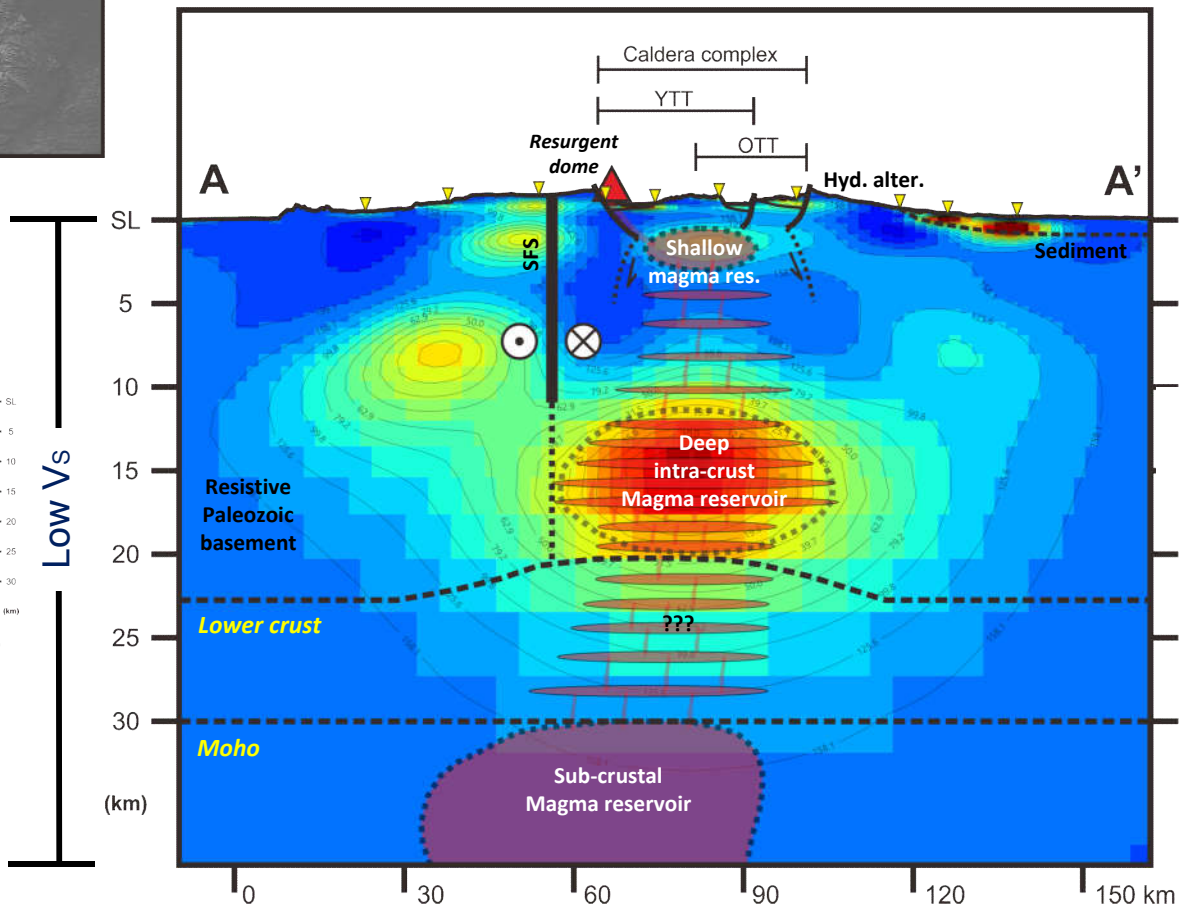



Modified from

**Koulakov et al., 2016**




**VS anomaly (%)**

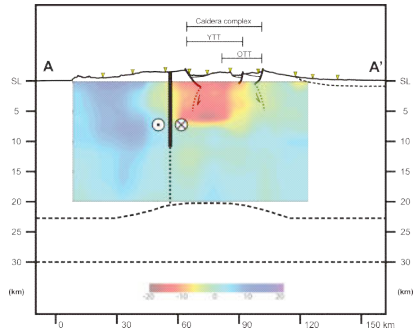



Low VSV and VSH

Low VSV, high VSH

Modified from

**Jaxybulatov et al., 2014**




**VSH anomaly (%)**

**Shallowest conductive layer** assoc. with hydrothermal alt. and thin sediment layer

**Deep conductive bodies** assoc. with shallow magma body, and

Deep intra-crust magma chamber

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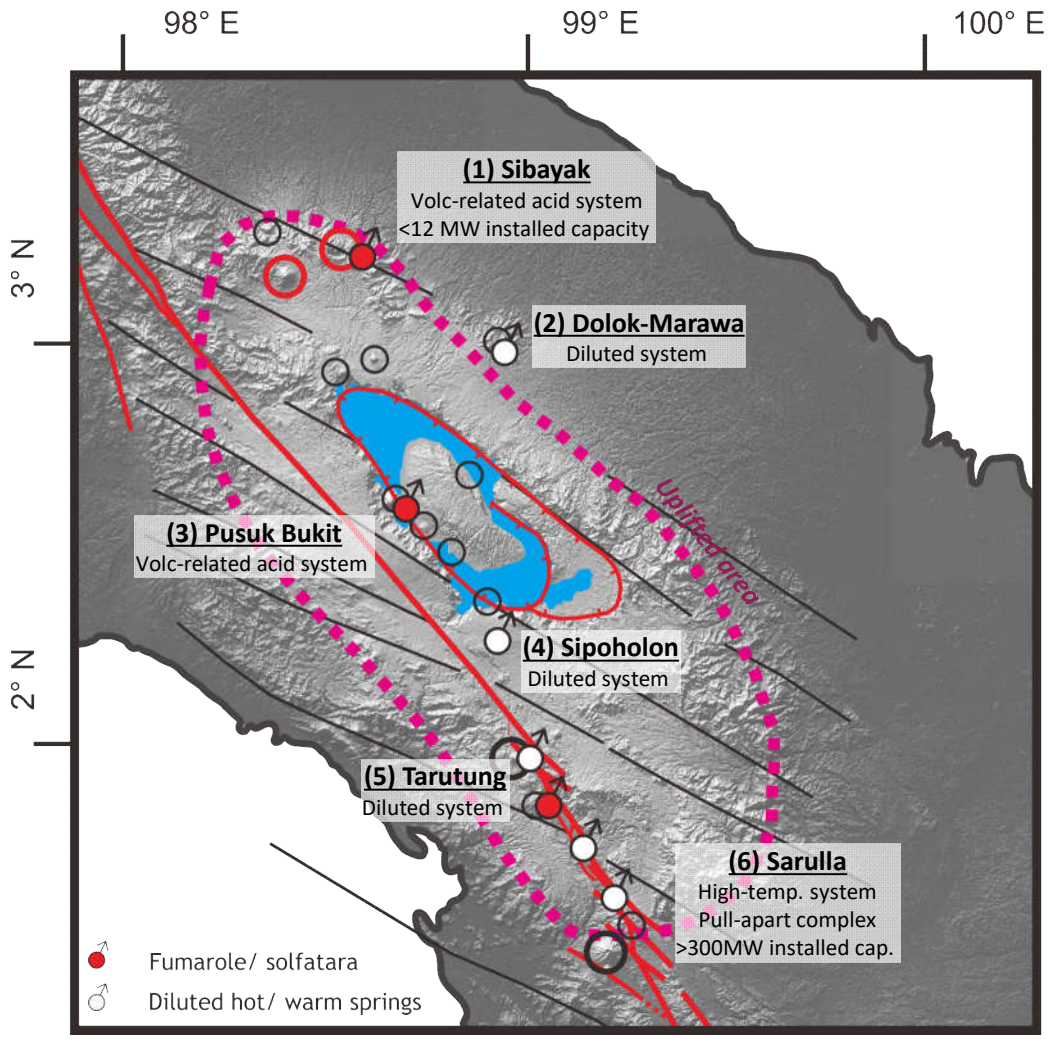
# Geothermal aspect




- Only 2 small systems are directly associated to the caldera complex **(3, 4)**; controlled by resurgent dome
- Mostly are either controlled by strato-volcano/ dome **(1, 2, 3, 4)** or Sumatran Fault **(5, 6)**
- Nearest large geothermal system **(6)** is associated to a pull-apart within the Sumatran Fault

- Limited vigorous thermal manifestations despite the occurrence of large magma/ intrusion bodies
  - ➢ Lack of permeability (Paleozoic basement as host rock; thick welded tuff/ ignimbrite caps the underlying system)
- Relatively shallow magma/ intrusion body
  - ➢ Potentially targeted for super-hot geothermal resource