— V11E-09 —

Detecting Small Volcanic Tsunami Signals from Kita-Ioto Caldera Using Dense DONET Ocean-Bottom Pressure Records

Osamu SANDANBATA[1], and **Tatsuhiko SAITO**[2]

(1) Earthquake Research Institute, The University of Tokyo, Japan

(2) National Research Institute for Earth Science and Disaster Resilience (NIED), Japan,

Contact

Feel free to contact me! Always happy to discuss either *in person at AGU* or *via Zoom* :)

X (Twitter) ➡ @osm3dan

E-mail ➡ osm3@eri.u-tokyo.ac.jp

1. Introduction

Non-double-couple earthquakes (EQs) repeat at the Kita-Ioto submarine caldera, Japan. *—Did the 2017/2019 EQs cause tsunamis?*

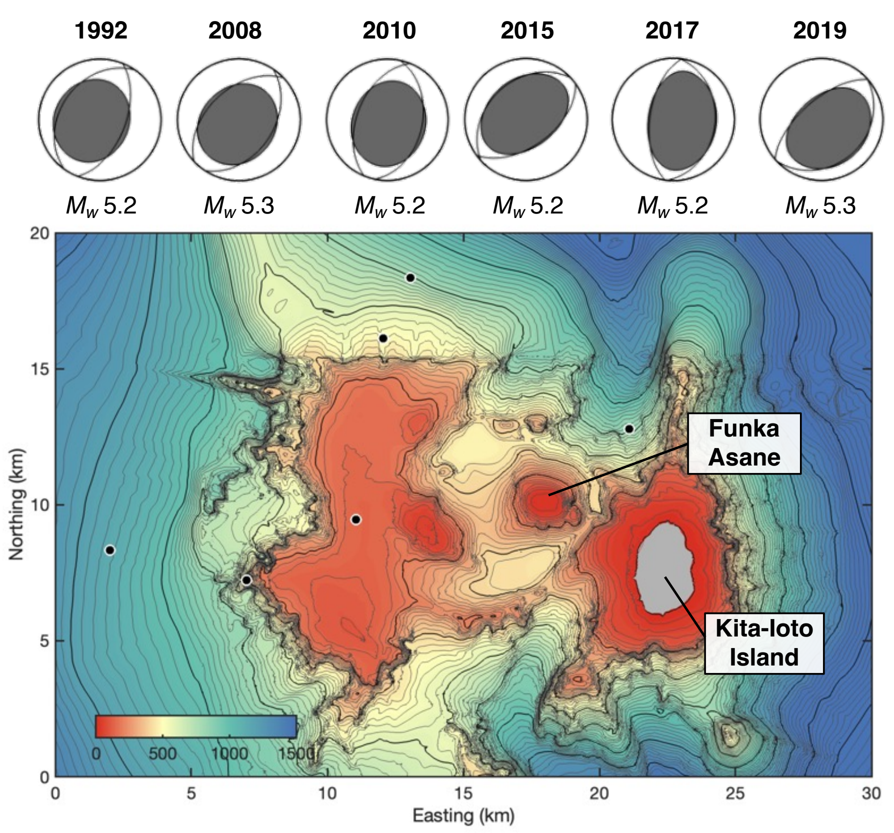


Fig. 1: Non-double-couple earthquakes at the Kita-Ioto submarine caldera, the Izu-Bonin Arc. Dots represents locations of the repeating earthquakes.

2. Data

Did ocean-bottom-pressure (OBP) gauges, ~900 km away, detect the tsunami waves? *—In raw data, tsunami signals are **unclear**!*

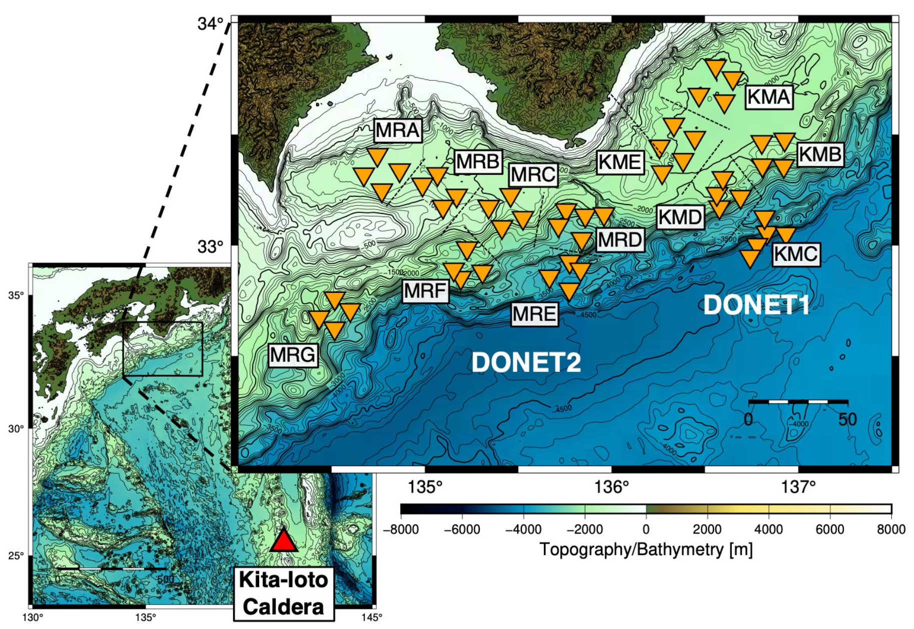


Fig. 2: OBP gauges of DONET (Dense Oceanfloor Network system for Earthquakes and Tsunamis), located ~900 km away from the submarine caldera.

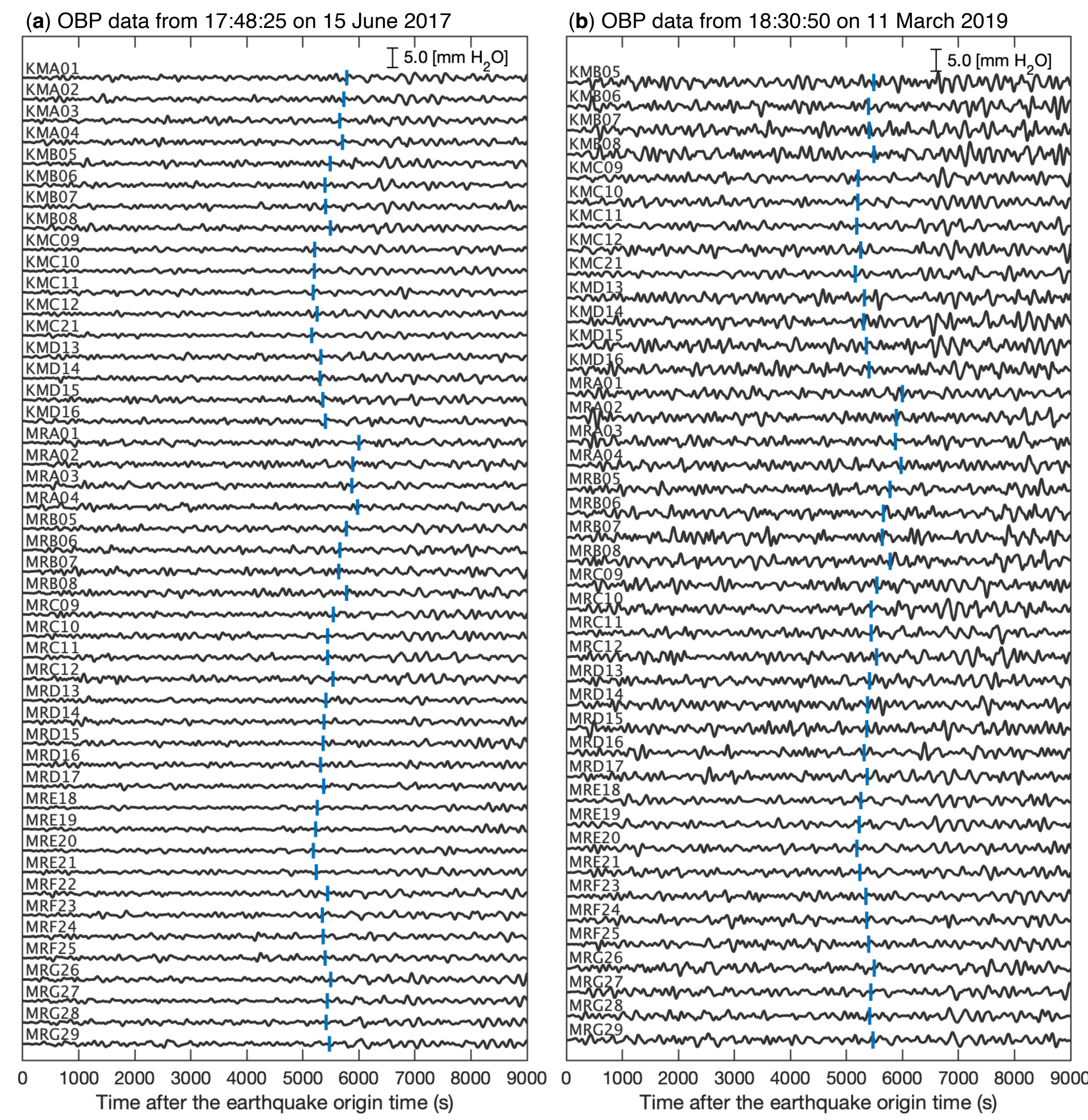


Fig. 3: Band-pass (100–500 s) filtered waveforms after the earthquakes in (**a**) 2017 and (**b**) 2019. Blue lines indicate the estimated tsunami arrival times.

3. Methods: Waveform stacking

To improve the S/N ratio of tsunami waves.

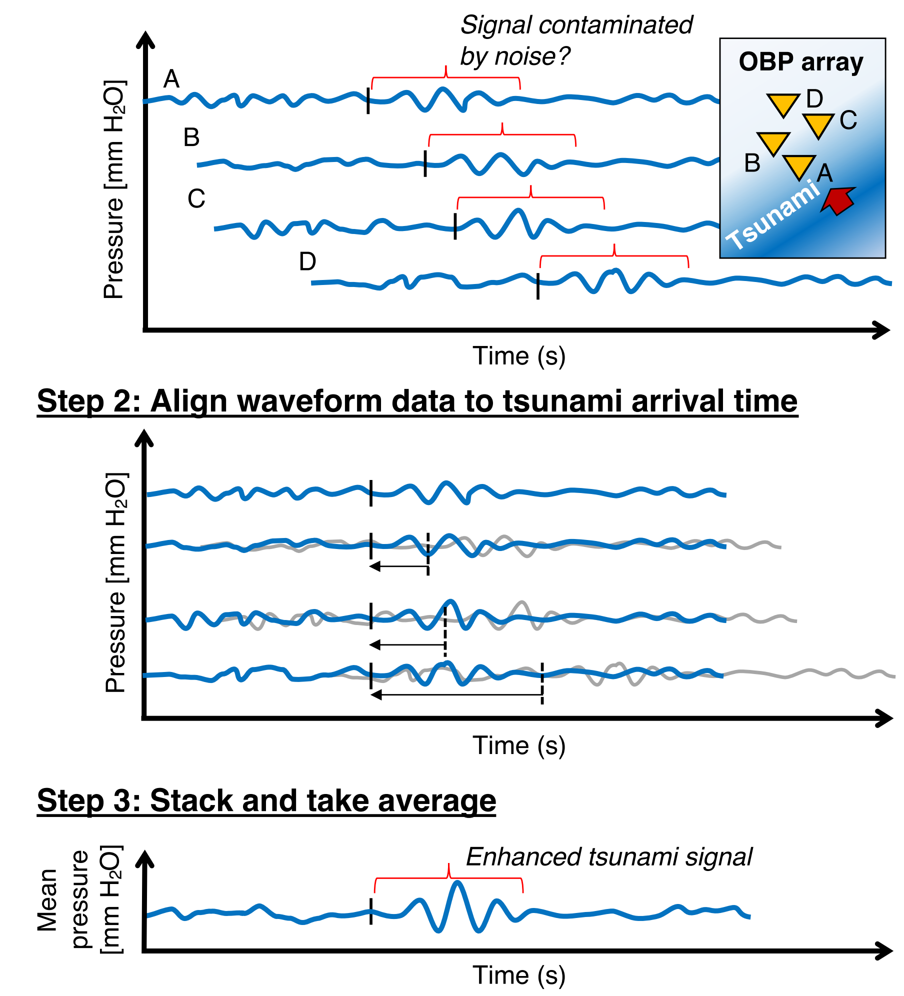
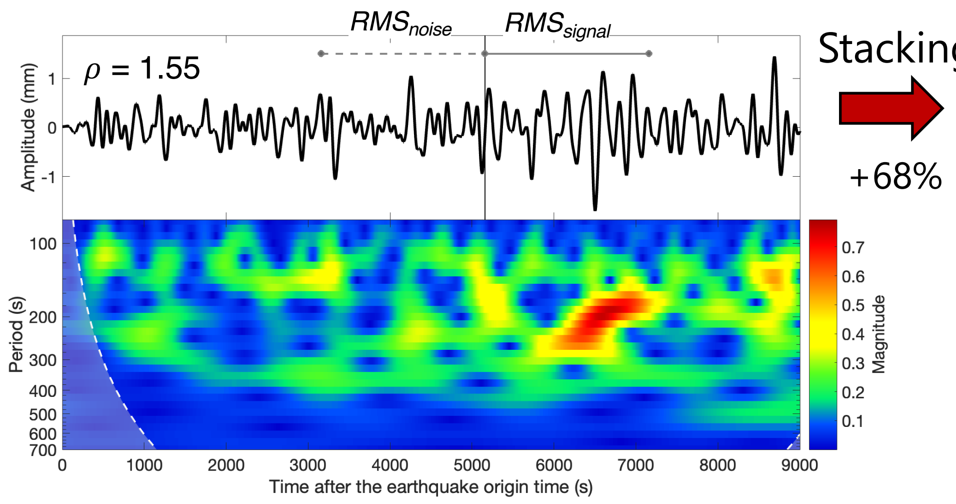


Fig. 4: Schematic illustration of waveform stacking.

4. Results *Tsunami signals of ~1.0 mm in average became evident*, with S/N-ratio increase by >~70%.

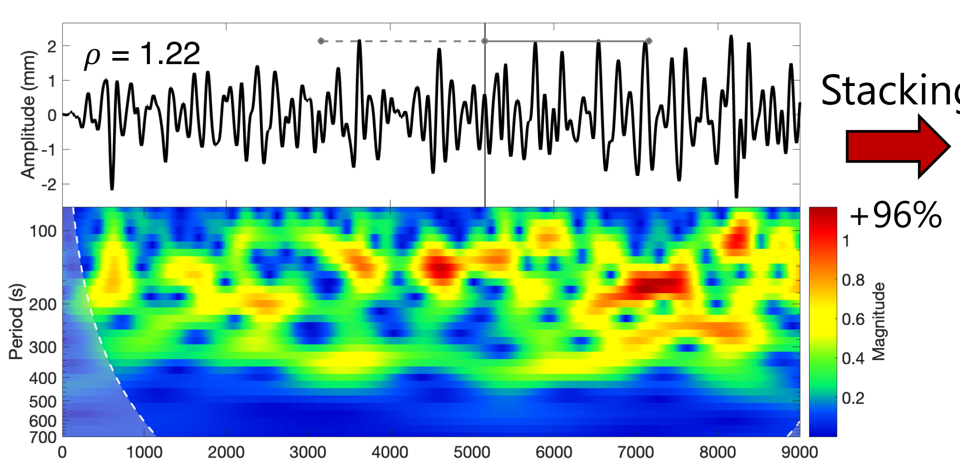
Before stacking *Signal/noise (S/N) ratio $\rho = \frac{RMS_{noise}}{RMS_{signal}}$

(**a**) Example OBP waveform of the 2017 EQ (@KMB07)



For the 2017 event, S/N ratio ρ = **1.65**±**0.63** (16 stations)

(**b**) Example OBP waveform of the 2019 EQ (@KMB07)

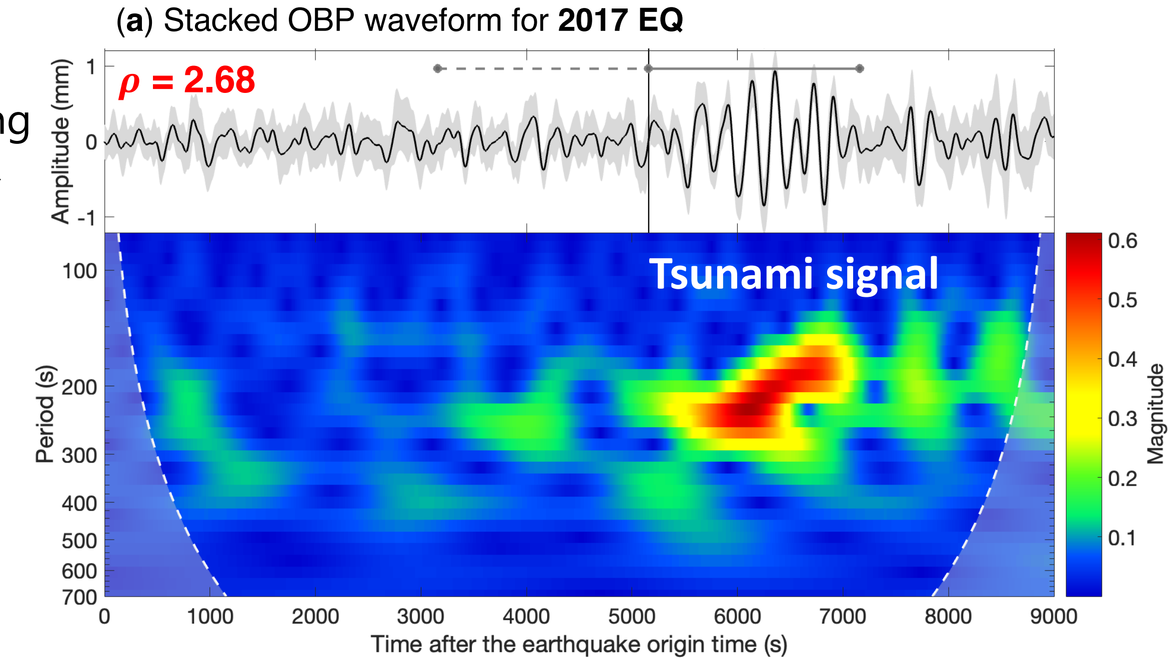


For the 2019 event, S/N ratio ρ = **1.26**±**0.49** (13 stations)

Fig. 5: An example of waveform & wavelet analysis result before stacking for the (**a**) 2017 & (**b**) 2019 EQs.

After stacking

(a) Stacked OBP waveform for **2017 EQ**



(b) Stacked OBP waveform for **2019 EQ**

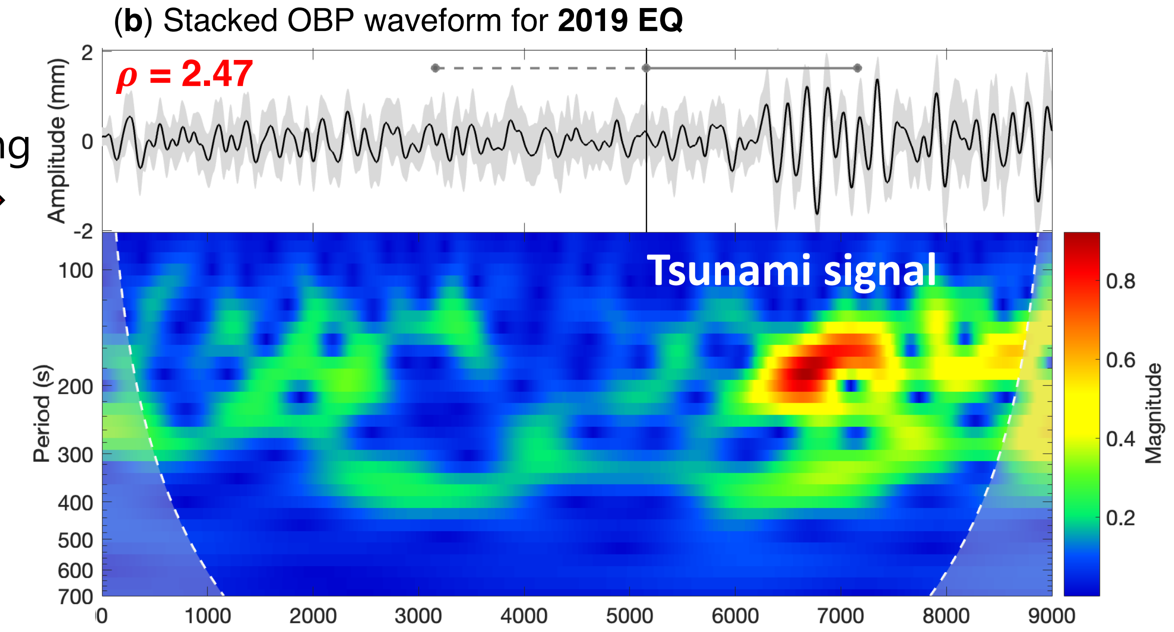
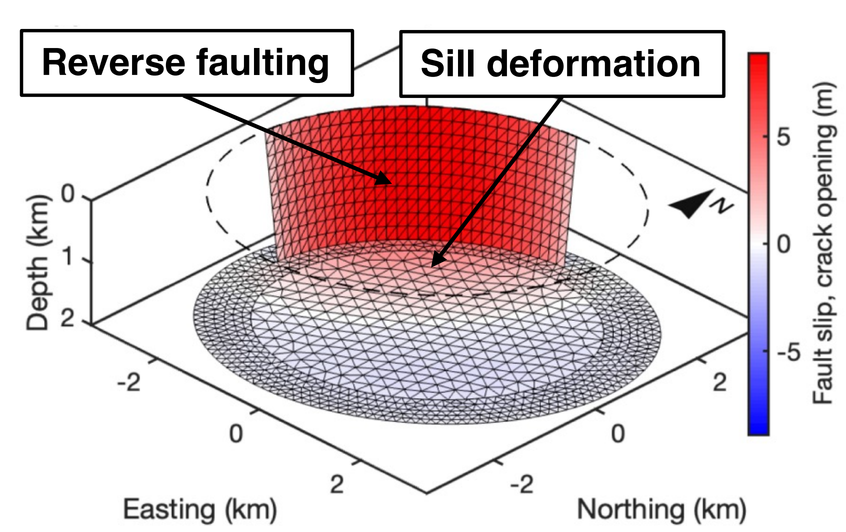


Fig. 6: Waveforms and wavelet analysis after stacking. Line & shade on top panel indicates the mean value & standard deviation, resp.

5. Discussion & Conclusions

Stacked tsunami waveforms help distinguish a difference in *the ruptured fault location*.

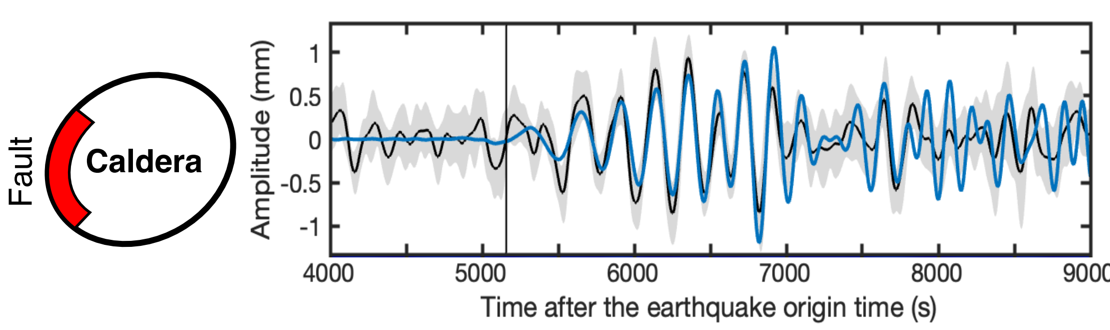
- The synthesis from "trapdoor faulting (TF)" model reproduces the stacked waveforms, which resolves the detailed locations of the ruptured fault for the 2017/2019 EQs.



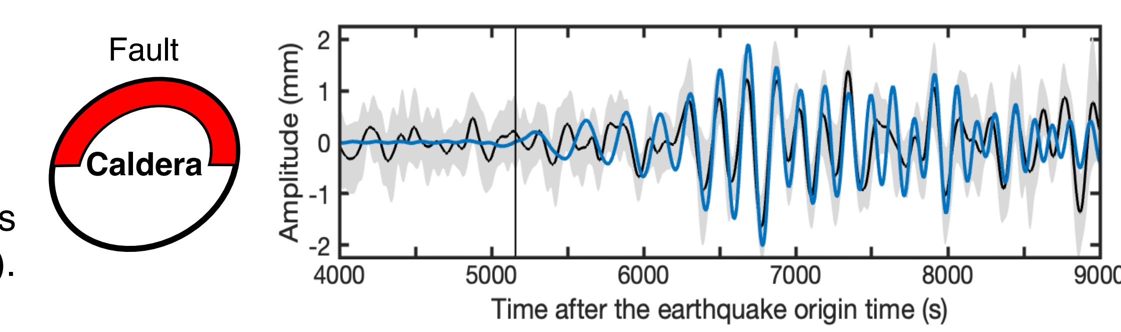
⬆**Fig. 7**: TF source model of the 2008 EQ. [Sandanbata & Saito, 2023, ESSOAr]

➡**Fig. 8**: Comparison between stacked waveforms of the model (blue) and the observed data (black).

■ **West-sided** trapdoor fault explains the 2017 tsunami.



■ **North-sided** trapdoor fault explains the 2019 tsunami.



- We suggest that ***successive fault rupture on segmented faults in the submarine caldera*** causes frequent trapdoor faulting recurrence, in an interval of 2–5 years, at Kita-Ioto caldera.

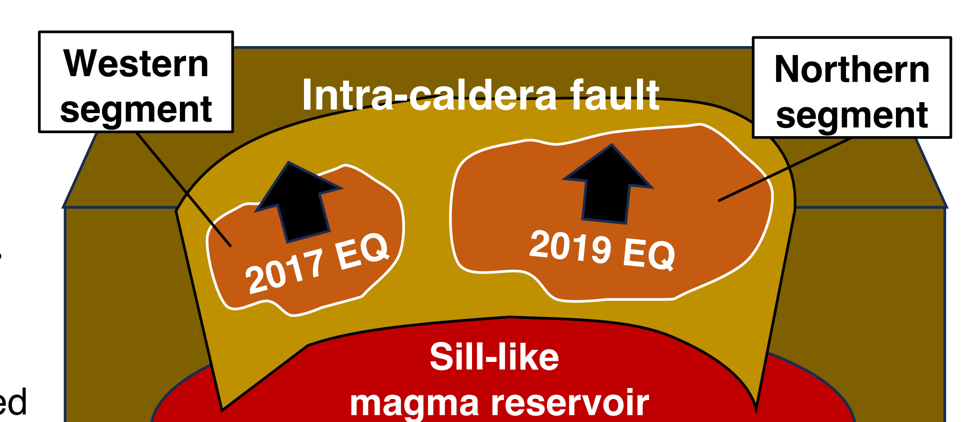


Fig. 9: Illustration of intra-caldera fault segmentations inferred from our analysis of stacked tsunami waveform data.