

# Ryukyu

## Interpretation (based on geologic data, plate reconstructions, seismic tomography, geodynamic modelling)

The Ryukyu SZI event reinitiated subduction of the Philippine Sea plate below the Eurasian plate, and is presently characterised by a northwest-dipping slab along the western boundary of the Philippine Sea plate. For Ryukyu, there seem to be **two SZI events** to consider, an older more enigmatic event and a subsequent, younger one. The first, older SZI event is unclear, as reconstruction models currently disagree (e.g., Faccenna et al., 2018 versus Müller et al. 2016) and geologic evidence is largely missing. The second, younger SZI event, which is considered and named here Ryukyu SZI event, might be classified as an **episodic SZI event** that occurred at around **6 Ma**. The two separated phases of ongoing subduction are interrupted by a **slab break-off event** (Lallemand et al. 2001; Malavieille et al. 2002), due to the arrival of the Gauge Ridge at the subduction trench (Deschamps and Lallemand, 2002).

## Direct evidence (based on direct measurements)

Ryukyu arc volcanism, indicating ongoing subduction, is observed to have occurred during two separate time periods, between 18-13 Ma and from 6 Ma until present day (Kizaki 1986; Shinjo 1999; Faccenna et al. 2018). For the youngest episode of magmatism, the oldest ages of arc rocks are reported to be about 6 Ma and are found in Kume Island and Aguni (Shinjo et al., 1991; Shinjo 1999).

## Reconstruction (based on reference model by Müller et al., 2016, AREPS)

The SZI event is not implemented into the current plate reconstruction model (Müller et al. 2016).

## Seismic tomography (based on Vote Maps of 10 seismic tomography models and the Atlas of the Underworld)

The Ryukyu slab is imaged by van der Meer et al. (2018) in the Atlas of the Underworld. It is represented by a fast anomaly from the surface until 350 km depth. The Ryukyu slab is underlain by the Pacific slab subducting at the Izu-Bonin-Mariana trench. Due to its shallow depth, this anomaly does not show on a vote map.

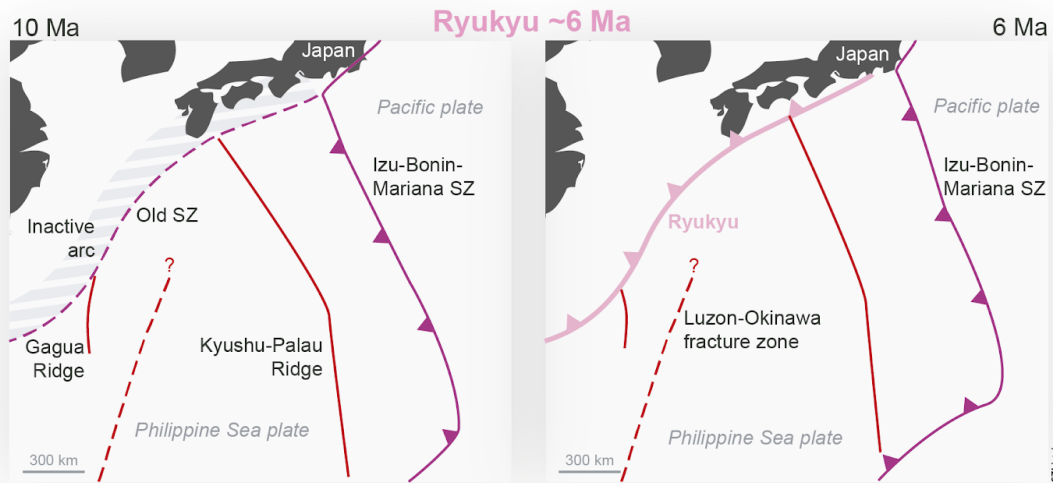


Figure. Schematic tectonic reconstruction of the Ryukyu SZI event (modified from Faccenna et al., 2018). A slab break-off event caused a pause in arc activity. Subduction of the Philippine Sea plate started again along the same margin, initiating the new Ryukyu subduction zone. Shown are the new subduction zone (pink line), other active (solid purple lines) and inactive (dashed purple lines) subduction zones, and spreading ridges (solid red lines).

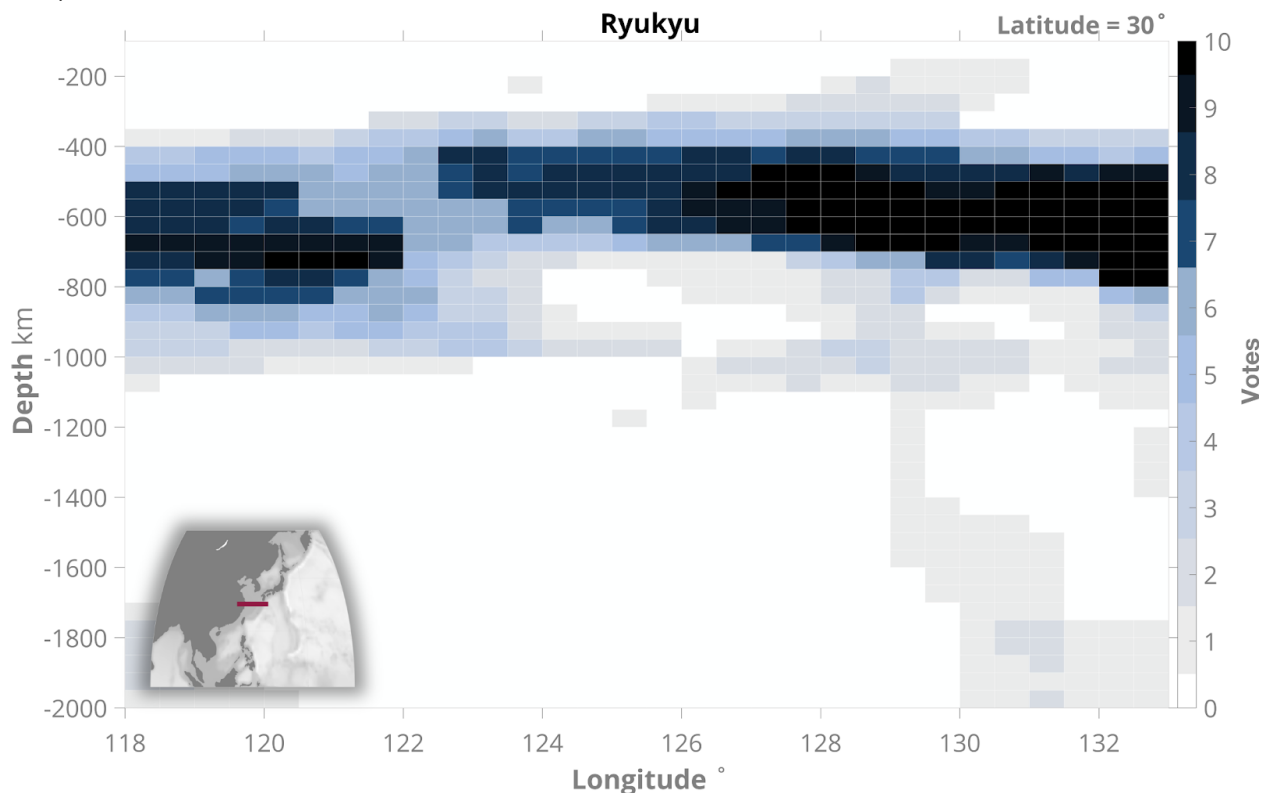


Figure. Seismic tomography VoteMap (Shephard et al., 2017) analysis of the Ryukyu SZI event.

## References

- Deschamps, A., & Lallemand, S. (2002). The West Philippine Basin: An Eocene to early Oligocene back arc basin opened between two opposed subduction zones. *Journal of Geophysical Research: Solid Earth*, 107(B12), EPM-1.
- Faccenna, C., Holt, A. F., Becker, T. W., Lallemand, S., & Royden, L. H. (2018). Dynamics of the Ryukyu/Izu-Bonin-Marianas double subduction system. *Tectonophysics*, 746, 229-238
- Kizaki, K. (1986). Geology and tectonics of the Ryukyu Islands. *Tectonophysics*, 125(1-3), 193-207.
- Lallemand, S., Font, Y., Bijwaard, H., & Kao, H. (2001). New insights on 3-D plates interaction near Taiwan from tomography and tectonic implications. *Tectonophysics*, 335(3-4), 229-253.
- Malavieille, J., Lallemand, S. E., Dominguez, S., Deschamps, A., Lu, C. Y., Liu, C. S., ... & Crew, A. S. (2002). Arc-continent collision in Taiwan: New marine observations and tectonic evolution. *Special Papers-Geological Society of America*, 187-211.
- Müller, R. D., Seton, M., Zahirovic, S., Williams, S. E., Matthews, K. J., Wright, N. M., ... & Bower, D. J. (2016). Ocean basin evolution and global-scale plate reorganization events since Pangea breakup. *Annual Review of Earth and Planetary Sciences*, 44, 107-138.
- Shephard, G.E., Matthews, K.J., Hosseini, K., Domeier, M. (2017). On the consistency of seismically imaged lower mantle slabs. *Scientific Reports* 7.
- Shinjo, R., Ban, M., Saito, K., & Kato, Y. (1991). K-Ar dating of the volcanic rocks in the Ryukyu arc. *Journal of Mineralogy, Petrology and Economic Geology*, 86(7), 323-328.
- Shinjo, R. (1999). Geochemistry of high Mg andesites and the tectonic evolution of the Okinawa Trough–Ryukyu arc system. *Chemical Geology*, 157(1-2), 69-88.