Sunda-Java

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

The Sunda-Java SZI event might have re-started subduction at the southern margin of Sundaland with the Indo-Australian plate sinking below the Eurasian plate at **around 60-40 Ma** (50 Ma is taken as the approximate average of the below timings). This subduction zone eventually evolved into the presently active Sunda-Java subduction system (Hall, 2012; Heine et al., 2004; Zahirovic et al., 2016).

It is generally agreed that the earlier accretion of the Woyla arc to Sundaland was followed by a hiatus in subduction along the margin. However, the absolute timings are debated. Hall (2012) initiate subduction along Sundaland (Sunda-Java described here) at 45 Ma (hiatus between 90-45 Ma) whereas the reconstruction of Zahirovic et al. (2016) suggest only a 10 Myr long hiatus with subduction initiating after 62 Ma (hiatus ~75-62 Ma). Nonetheless, the SZI event might have restarted subduction along the temporarily distinct destructive boundary by an **episodic SZI mechanism**. The general northward motion of the Indo-Australian plate driven by the surrounding northward directed subduction zones might have induced significant North-South directed compression and thereby fostered the new subduction zone. It is, however, also possible that the subduction zone re-initiated by a lateral progression of still active surrounding subduction systems.

Direct evidence (based on direct measurements)

One age constraint suggesting already ongoing subduction comes from the 42.7 Ma SHRIMP U-Pb date on volcanoclastic zircons (Smyth et al., 2008). In favour of the earlier SZI timings, a magmatic gap in arc volcanics related to Woyla accretion on Sumatra from ~75-62 Ma (McCourt et al., 1996) was implemented into the reconstruction of Zahirovic et al. (2016).

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

In the model of Müller et al. (2016), the Sunda-Java SZI event ostensibly occurs at 65 Ma, with the initiation of northeast-dipping subduction of the India Plate beneath Eurasia. However, that SZI event effectively occurs in name only, as it does not appear to be kinematically distinguishable. Starting in Jurassic time, a 'Sunda' subduction zone was operating along the southwest margin of the Woyla terranes (where the younger Sunda-Java subduction zone formed), and this subduction was already consuming Indian Plate oceanic lithosphere by Early Cretaceous time. In the model, it is indicated that this 'Sunda' subduction zone ceased at 75 Ma, and the boundary became an orogenic belt, named 'Woyla accretion', from 75-65 Ma. At 65 Ma, subduction re-initiates as the Sunda-Java subduction zone along that orogenic boundary. According to those evolving boundary descriptions, subduction ceased along that margin for ~10 Ma. However, there is no clear change in the relative convergence rates of the India and Eurasia plates during the ~10 Myr that subduction is supposed to have ceased; and in that 10 Myr interval, >1000 km of relative convergence between those plates occurred along the 'Woyla accretion' boundary. In addition to that possible continuation of subduction along the Sunda-Java subduction zone proper, immediately to the southeast of the Sunda-Java subduction zone lies the Kalimantan subduction zone which was also active prior to 65 Ma.

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

A SZI event along the South of Sundaland at around 60 Ma would place the Sunda slab at about the same depth as it is currently observed in P- and S-wave seismic tomography models (Zahirovic et al., 2016). The Atlas of Underworld catalogues an anomaly until 1100 km depth (van der Meer et al., 2018). However, it is stated that the slab is at variable depths along strike of the trench. The western section of the anomaly reaches the bottom of the upper mantle and is clearly separated from the underlying lower mantle anomaly. However, to the east the two anomalies overlap. Based on the vote map, we see an agreement of the models imaging a fast anomaly until 1450-1500 km depth. It is worth noting, though, that the thickness of the slab based on the vote map is over 700 km, which suggests that it could be two overlapping anomalies.

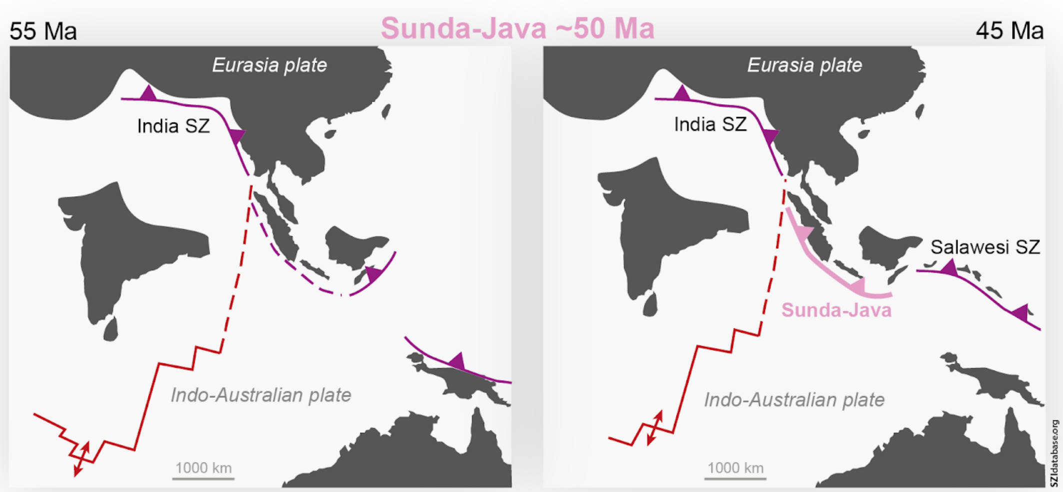

Figure. Schematic tectonic reconstruction of the Sunda-Java SZI event (modified from Hall, 2012). Subduction of the Indo-Australian plate at the Sundaland margin has been episodically ongoing since >100 Ma. The most recent episode occurred at ca. 40-60 Ma and it initiated the new Sunda-Java subduction zone. Shown are the new subduction zone (pink line), other active (solid purple lines) and inactive (dashed purple lines) subduction zones, spreading ridges (solid red lines), and transform faults (red dashed lines).

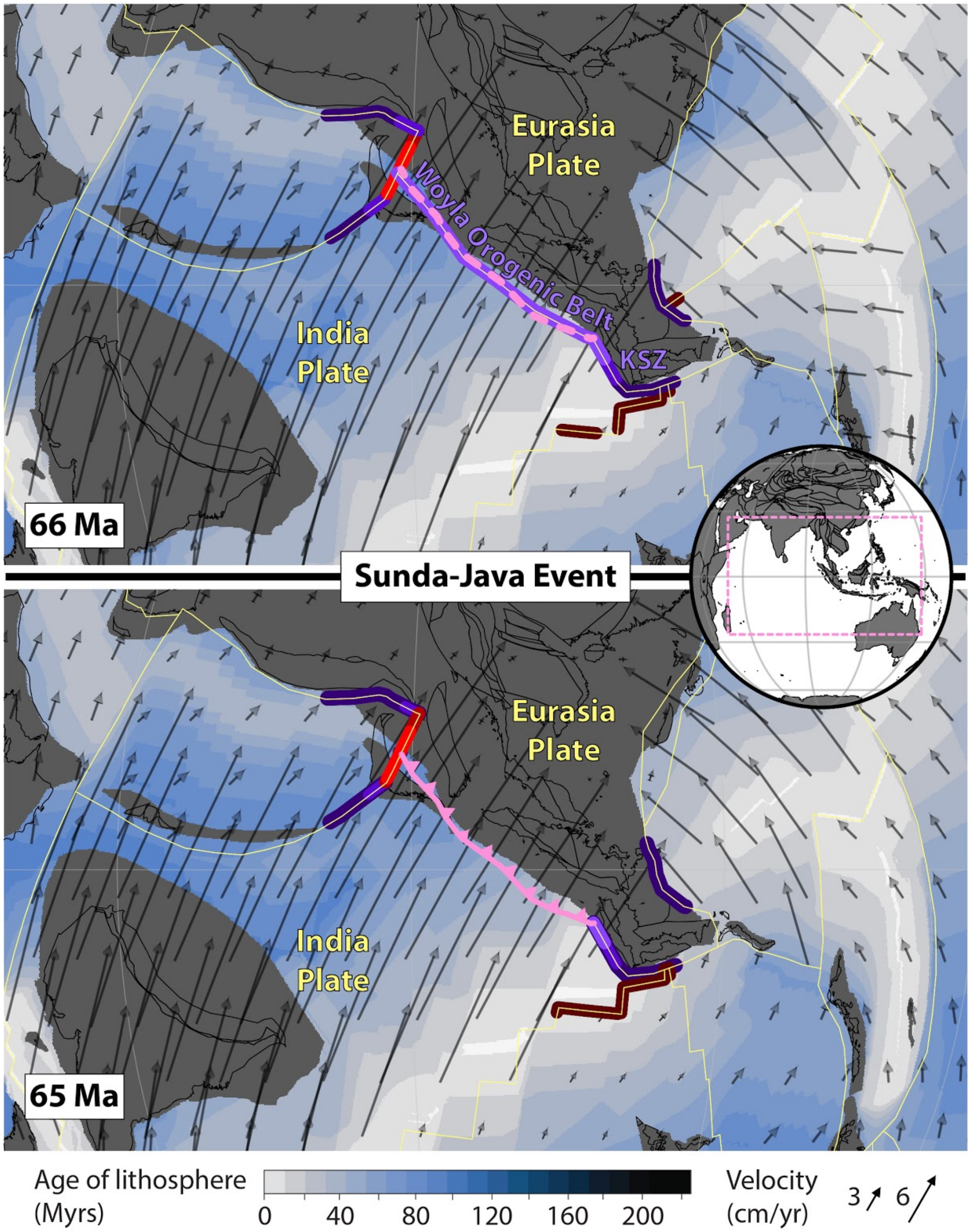

Figure. Sunda-Java SZI event as reconstructed in the model of Müller et al. (2016). Pink dashed (solid with teeth) line shows the Sunda-Java trench 1 Myr before (at) SZI time in the model. Purple (red) lines show segments of neighbouring subduction zones (ridges and transforms) that lie within some radius of the Izu-Bonin-Mariana trench (pink line); the brightness of the colours reflects 3 different distance thresholds of 250, 500 and 1000 km. KSZ: Kalimantan subduction zone.

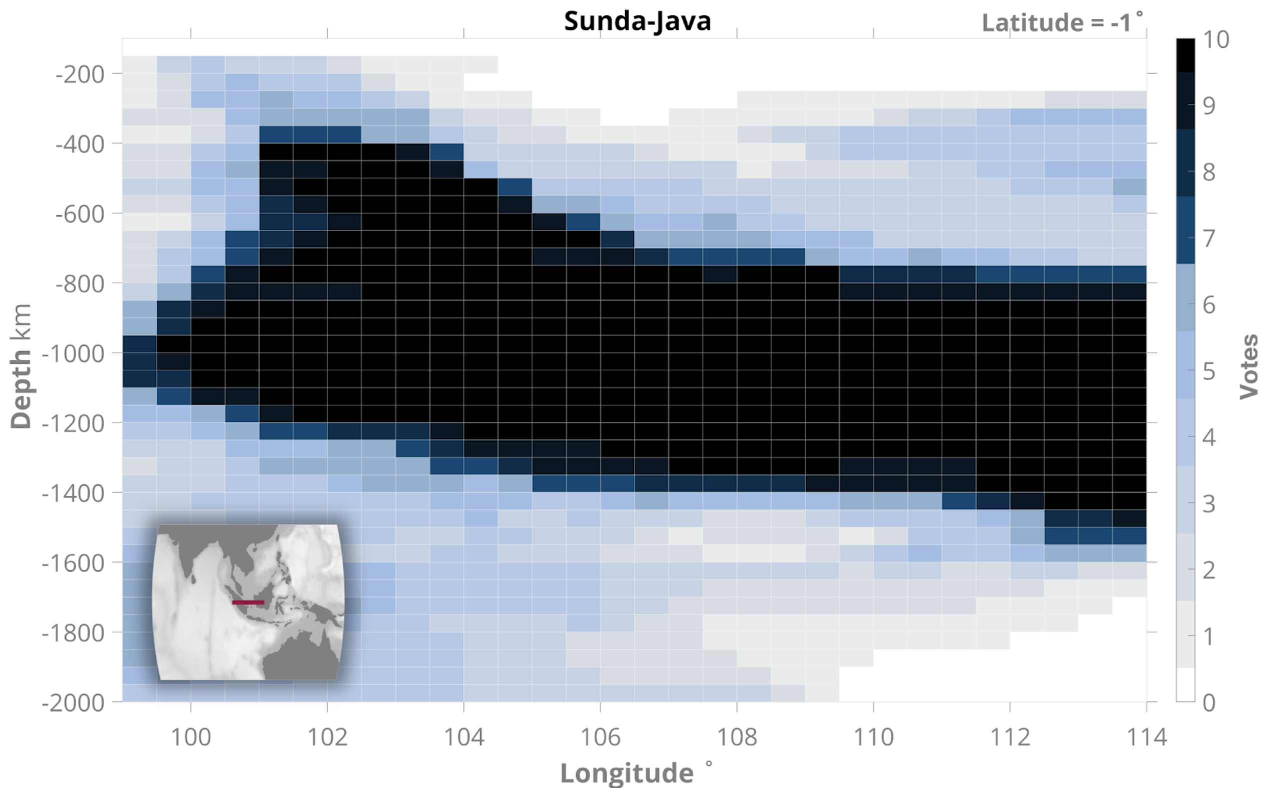

Figure. Seismic tomography VoteMap (Shephard et al., 2017) analysis of the Sunda-Java SZI event.

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