Sundaland's subsidence requires revisiting its biogeography

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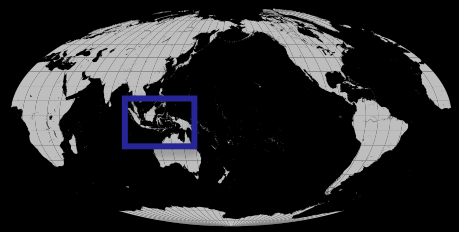
Sundaland biodiversity hotspot

- Sundaland has more a very high biodiversity, but it is unclear why

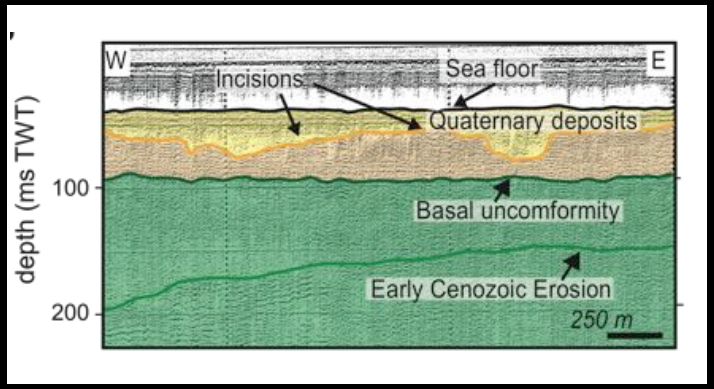
- General wisdom says that:
  - Sundaland is tectonically stable
  - Biodiversification and dispersal routes are solely reliant on sea level oscillations



But Sundaland subsides

We know this because:

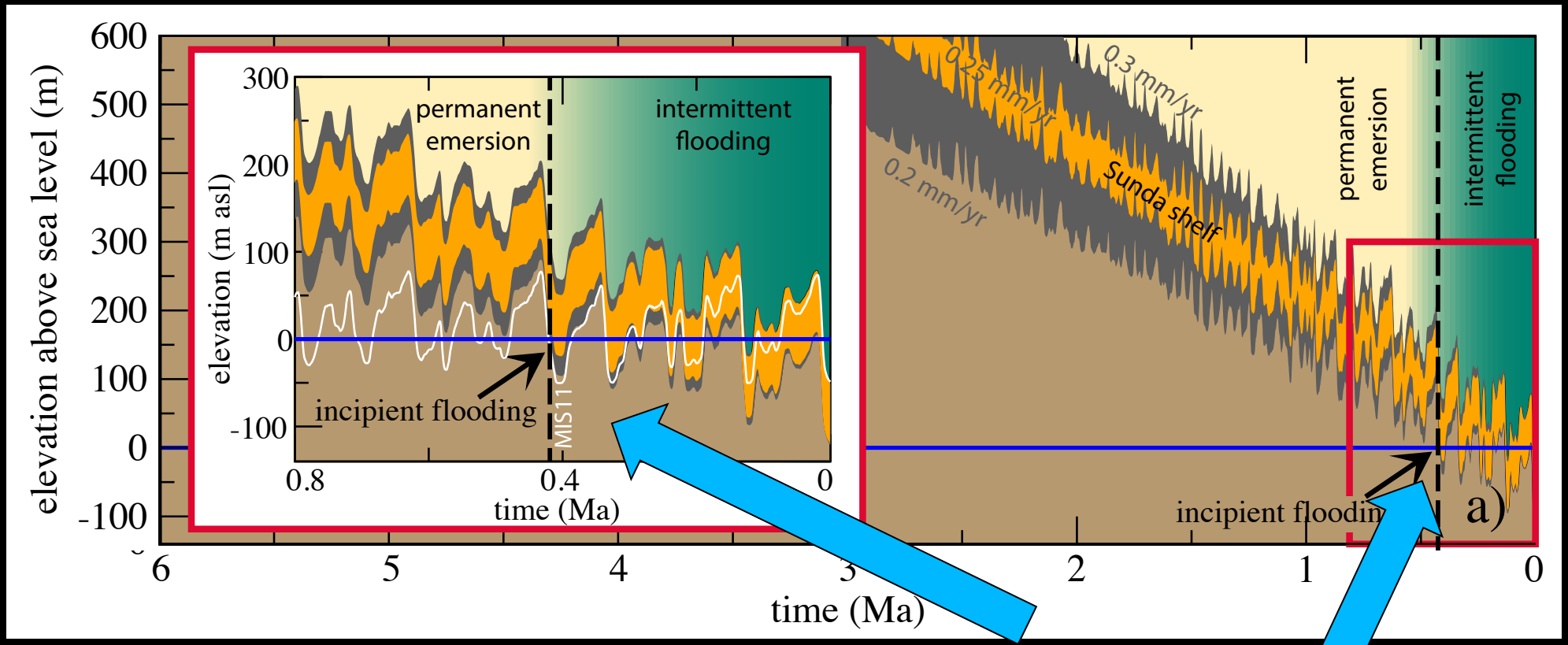
- Landforms suggest subsidence: alluvial plains, mangroves…
- No marine sediments lay above sea level, indicating no-uplift
- Seismic data indicate Late Pleistocene flooding
- Only narrow fringing coral reefs festoon the shorelines (and not a gigantic platform)
- Modeling coral reef growth yield a subsidence rate of ~0.2 mm/yr



[Husson et al., 2018, G3; Pastier et al., 2019, G3; Sarr et al., 2019, Geology]

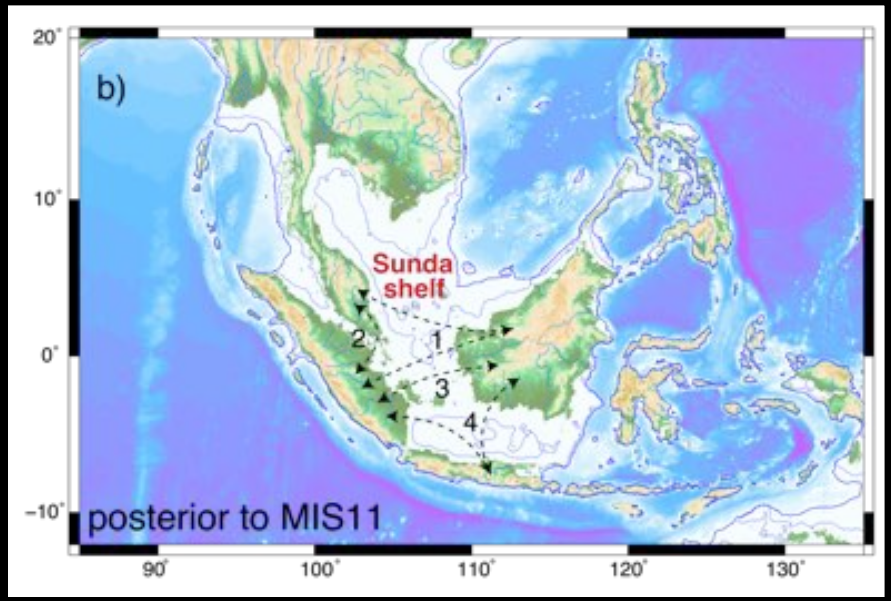
Subsidence has paleogeographic implications

- Because Sundaland is extremely shallow (<100 m deep),
- Because Sudaland subsides
- Then, Sundaland was permanently subaerial before 400 ka (MIS 11)



Relative sea level: Sundaland is above sea level (blue) until 400 ka, and gets inundated during highstands afterwards

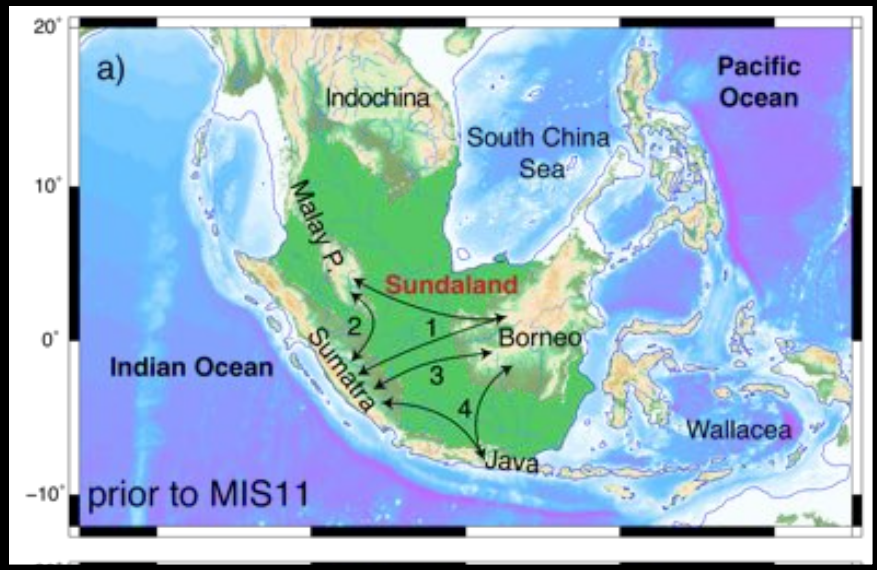
Paleogeographic implications



0 Ma

Before 400 ka:
- Sundaland was not looking like today

- But was more looking like this

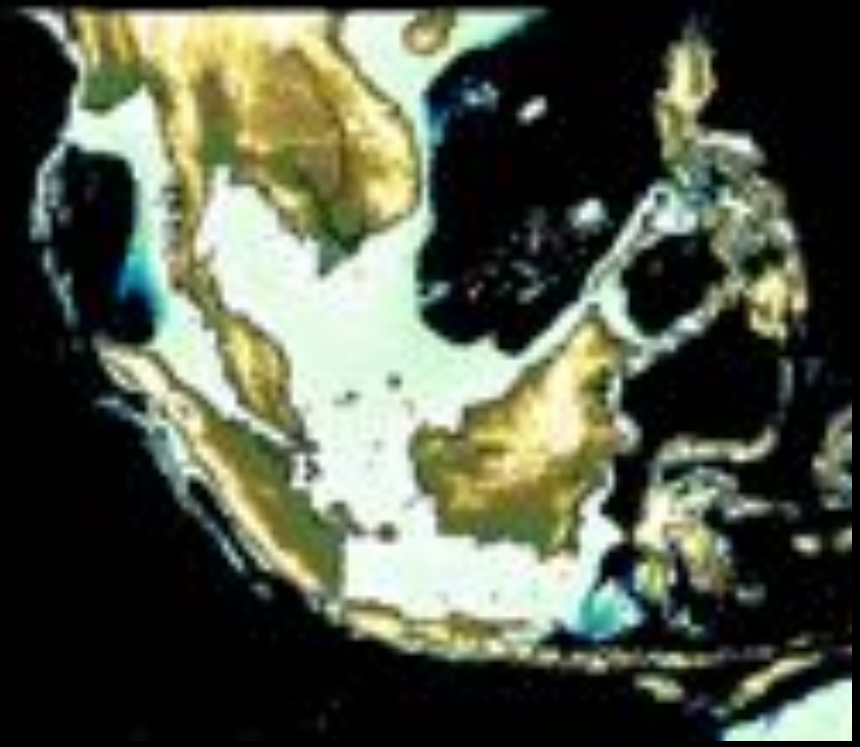


Pleistocene

[Sarr et al., 2019, Geology
Husson et al., 2019, J. Biogeography]

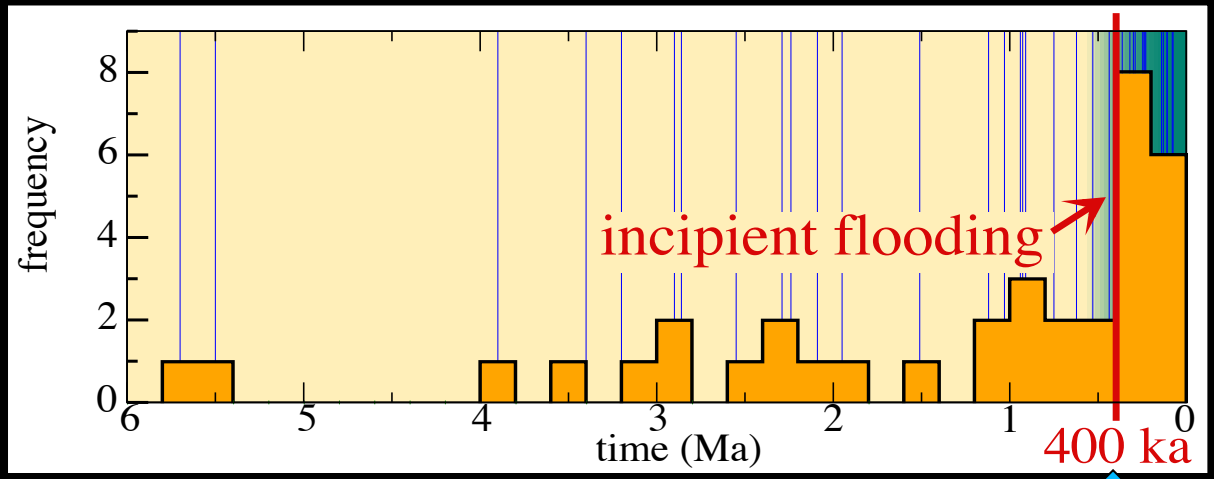
Paleogeographic changes yield biogeographic changes

- Because Sundaland was permanently subaerial before 400 ka
- Then land connections were open until 400 ka
- Then, terrestrial vertebrates freely migrated across Sundaland until 400 ka and only afterwards became isolated

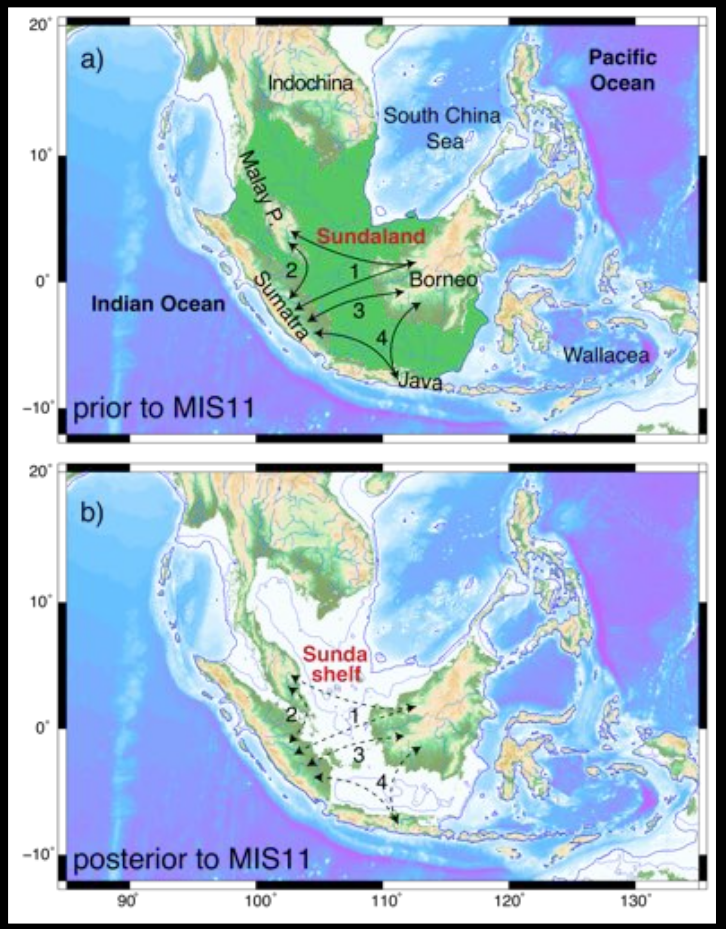


Phylogenetics confirm

- We compiled the timing of vicariance for 36 pairs of species
- We find that not much happens until… ~400 ka
- And that divergence increases 8-fold at ~400 ka



Divergence time estimated from molecular data
[data from Leonard et al., 2009, and others]



[Husson et al,. 2019, J. Biogeography]

Timing of divergence matches the timing of the first flooding event of Sundaland

Conclusions

- Because Sundaland subsides
- It was permanently subaerial until 400 ka
- Dispersal routes closed after 400 ka
- Species became isolated and genetically speciated after 400 ka
- Dispersal routes were open until 400 ka,
- including for H. erectus, who traveled dry-shod to Java at ~1.5 Ma