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SUPPLEMENTARY INFORMATION

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Earthquakes and tsunamis caused by low-angle normal faulting in the Banda Sea, Indonesia

Phil R. Cummins[1,2,3] ✉, Ignatius R. Pranantyo[1], Jonathan M. Pownall[1,4], Jonathan D. Griffin[3,5], Irwan Meilano[6] and Siyuan Zhao[1]

[1]Research School of Earth Sciences, Australian National University, Canberra, Australian Capital Territory, Australia. [2]Global Geophysics Research Group, Institut Teknologi Bandung, Bandung, Indonesia. [3]Community Safety Branch, Geoscience Australia, Canberra, Australian Capital Territory, Australia. [4]Department of Geography, Geology, and Environment, University of Hull, Hull, UK. [5]Department of Geology, University of Otago, Dunedin, New Zealand. [6]Geodesy Research Group, Faculty of Earth Science and Technology, Institut Teknologi Bandung, Bandung, Indonesia. ✉e-mail: phil.cummins@anu.edu.au

Supplementary Material

Table ST1: GPS observations from analysis of Indonesian Agency for Geospatial Information CORS stations in the Banda Sea region.

Station	longitude $^\circ$	latitude $^\circ$	$v_{east}(\sigma_{east})$ (mm/yr)	$v_{north}(\sigma_{north})$ (mm/yr)	$v_{up}(\sigma_{up})$ (mm/yr)
BANI	129.905	-4.522	29.9(0.3)	35.5(0.3)	1.4(0.7)
CAMB	128.185	-3.696	10.3(0.3)	23.7(0.3)	-0.7(1.0)
CBLA	130.488	-3.104	-6.3(1.0)	40.8(1.0)	2.0(4.0)
CFAK	132.304	-2.924	-23.8(0.4)	44.3(0.3)	0.6(0.9)
CSAU	131.298	-7.984	34.8(0.4)	54.9(0.3)	-2.3(0.7)
CUAL	132.745	-5.632	19.7(0.2)	58.3(0.2)	-1.6(0.7)

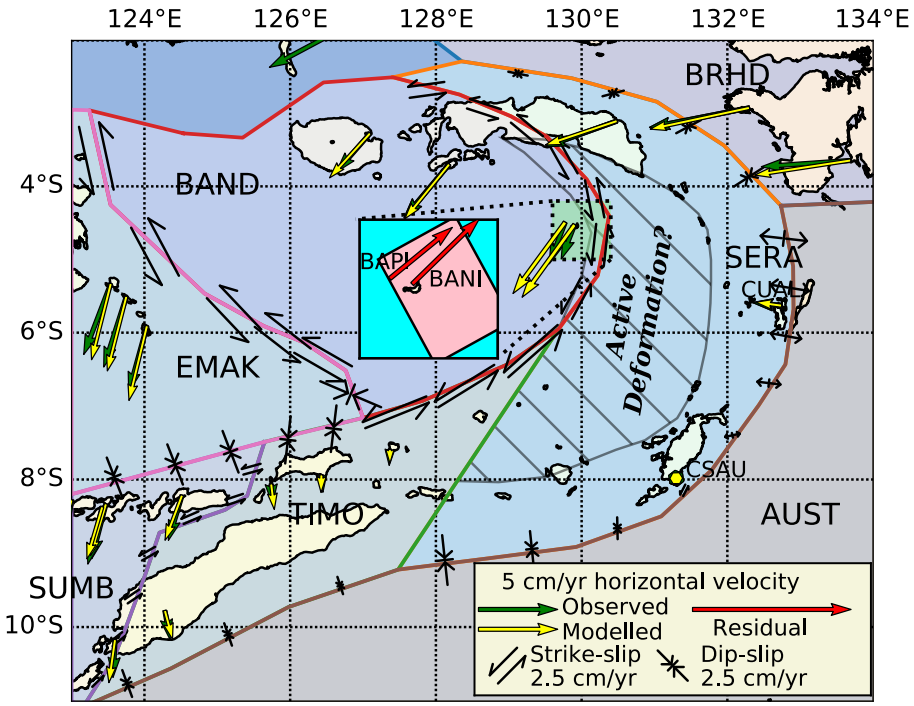

Figure S1: Analysis of GPS measurements of crustal motion in the Banda Sea region, modelled as the interaction the Australian Plate (AUST) with five crustal blocks - East Maluku (EMAK), Banda (BAND), Timor (TIMO), Sumba (SUMB) and Seram (SERA). Arrows depict observed (green) and modelled (yellow) velocities referenced to a fixed AUST, and the dominant slip regime on each block boundary is indicated by a symbol whose size scales with total relative velocity, including any oblique component. Oblique motion is indicated by the skewed directions of the symbols with respect to the respective block boundary. The inset shows the residual - observed minus calculated - velocity for the two stations BAPI and BANDI closest to the Banda Detachment, along with the geometry of the normal fault used to model them. Locations of stations CAUL and CSAU in the outer arc that are referred to in Figure 2 are also indicated.

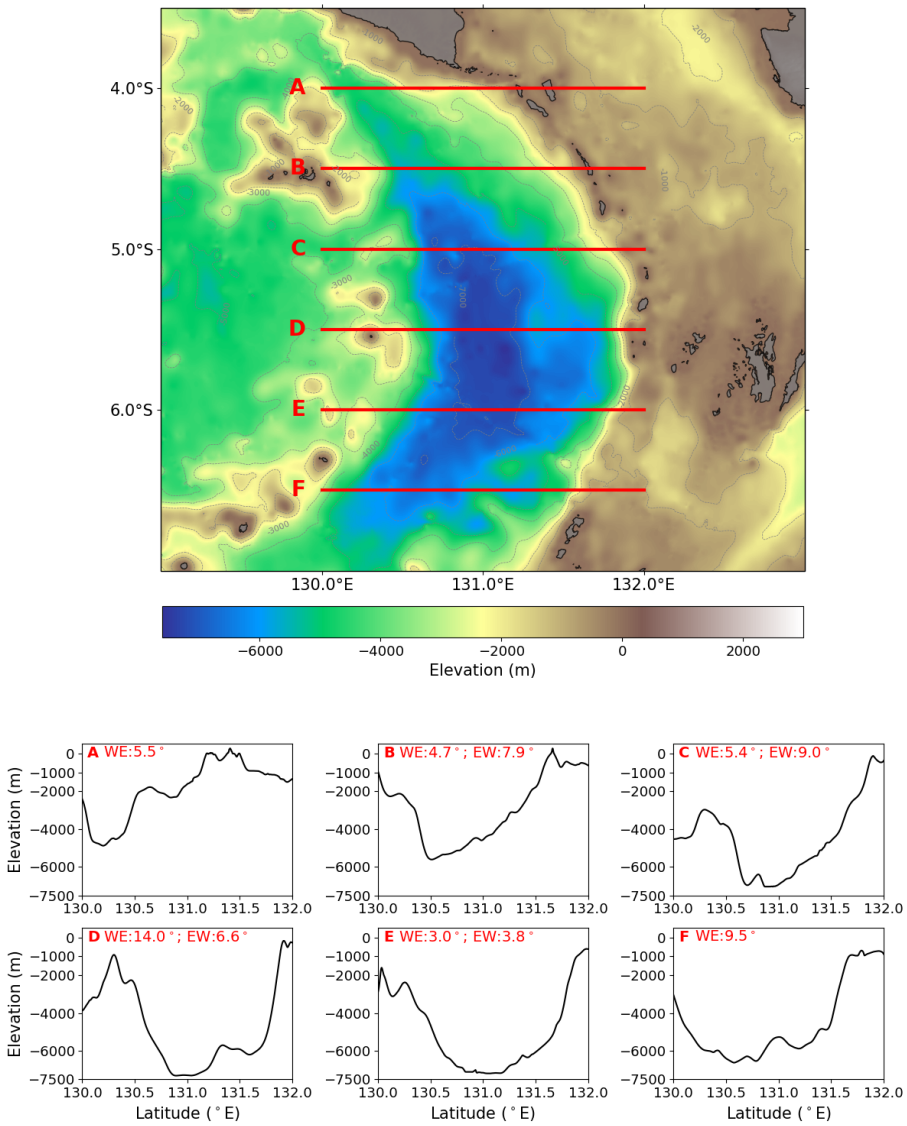

Figure S2: Elevation profiles in the Weber Deep. (above) Contours show the elevation at every 1,000 m depth, and the red lines indicate the locations of the corresponding elevation profiles shown below. (below) Elevation profiles along the lines shown above. The number on top of the profile shows maximum slope angle from west to east (WE) and east to west (EW) along the profile.

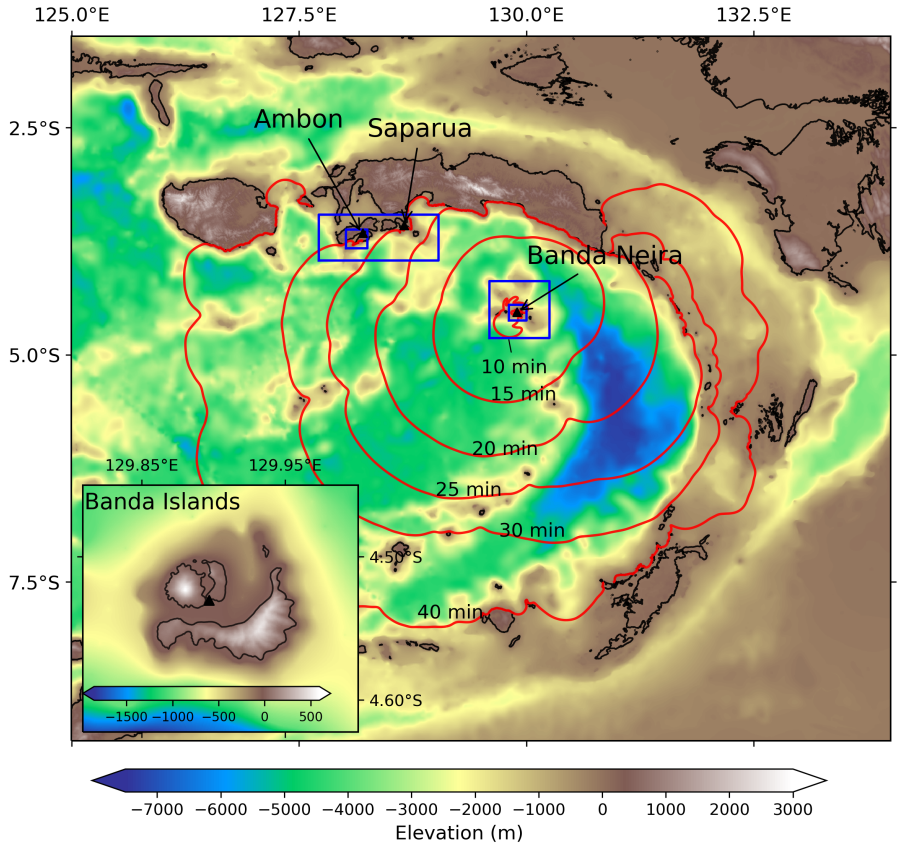

Figure S3: Computational domain used in the tsunami simulations. The outermost domain uses a 450 m gird spacing, while the domain in the first level nested grid (outermost blue rectangles) uses 150 m grid pacing, and the innermost gird (innermost blue rectangles) uses 50 m. Red curves are the tsunami inverse travel time contours from Banda Neira, and the inset shows the bathymetry used in Banda Neira based on a historical document[57].

Table ST2: Ground motion and tsunami accounts of the 1852 Banda Sea event

Location (Region)	**Description**	**MMI**[1]	**TH**[2]
Banda Islands: Banda Neira and Banda Besar	7:50 am earthquake with a duration of 5 minutes. Majority of the buildings were destroyed and ground cracking appeared around the island. Then it was followed by at least 9 aftershocks during the day. A flood wave surged into the bay fifteen minutes later. The seawater rose as high as the foot wall of Fort Belgica and the foot mountains at Banda Besar (Lonthor) (approx. 8.2 m). The north coast of Banda Neira and the southern shore of Banda Besar noticed minor tsunamis only.	$8+^{b}$ (10)	8.2^{a}
Banda Islands: Rosengain and Ai	Strong earthquake was felt at the islands of Rosengain and Ai. Seawater rose but only a few feet above the usual level.	8 (8)	$< 1^{a}$
Ambon: Ambon Town, Hila, Larike	7:30 am, the town of Ambon felt violent ground motion lasting for 5 minutes. Shortly after, the water in the bay rose and oscillated until 2:00 pm. It reached up 1.8 m in the first five times. The ground motion was also felt at Hila and Larike without causing any damage.	5 (Ambon: 7; others: 6)	1.8^{a} (Ambon Bay)
Saparua: Tijau, Hatuana, Porto, Kulor, Siri Sori, Boi	7:30 am, island of Saparua felt an earthquake. A flood wave surged into Saparua Bay, oscillated between 8:30 and 11:00 am, rose up to 3 m, and inundated about 127 inland at settlements around the bay and Tijau. Villages of Porto,Kulor, Siri Sori noticed a weak flood. A village of Boi, where was located in the bay, heard rumble sound from southeast direction.	7 (5)	3.0^{a} (Saparua Bay)
Haruku: Fort Zeelandia (Haruku), Hulaliu, Oma, Wasu	7:30 am, island of Haruku felt vibration causing cracks at Fort Zeelandia. Villages of Hulaliu, Oma, and Wasu noticed a flood wave together with a rumble sound.	7 (6)	$< 2^{a}$

Continuation of Table ST2

Location (Region)	**Description**	**MMI**[1]	**TH**[2] **(m)**
Nusa Laut: Amet, Akoon, Leinitu	Earthquake was felt and instantaneous flooding noted at Amet, Akoon, and Leinitu.	7 (5)	$< 2^a$
Buru	Earthquake was felt and followed by a flood wave without causing any damage.	5 (5)	$< 2^a$
Seram: Amahai	8:00 am violent shaking was felt at Amahai.	6 (6)	$< 2^a$
Halmahera: Ternate, Labuha	Ground motion was felt at Ternate and Labuha	6 (Labuha: 5; Ternate: 3)	–
Kai Islands and its surroundings	Two small risen islands were observed in 1853 had soft and yellow golden colour surface. Three smalls islands were discovered between Tayandu and Kaimer islands. Another new islands was discovered in 1854.	–	–
Java: Semarang, Pasuruan, Grati, Sumenep	6:45 am, a weak shock felt[3].		

[1] This study (Previous study[11])
[2] Estimated tsunami height (m)
[3] Caused by a different earthquake on the Pasuruan Fault in east Java[27]
a) From Previous study[11]
b) MMI 8+ denotes saturation since MMI 8 would likely result in collapse of most masonry built in 1852

End of Table ST2