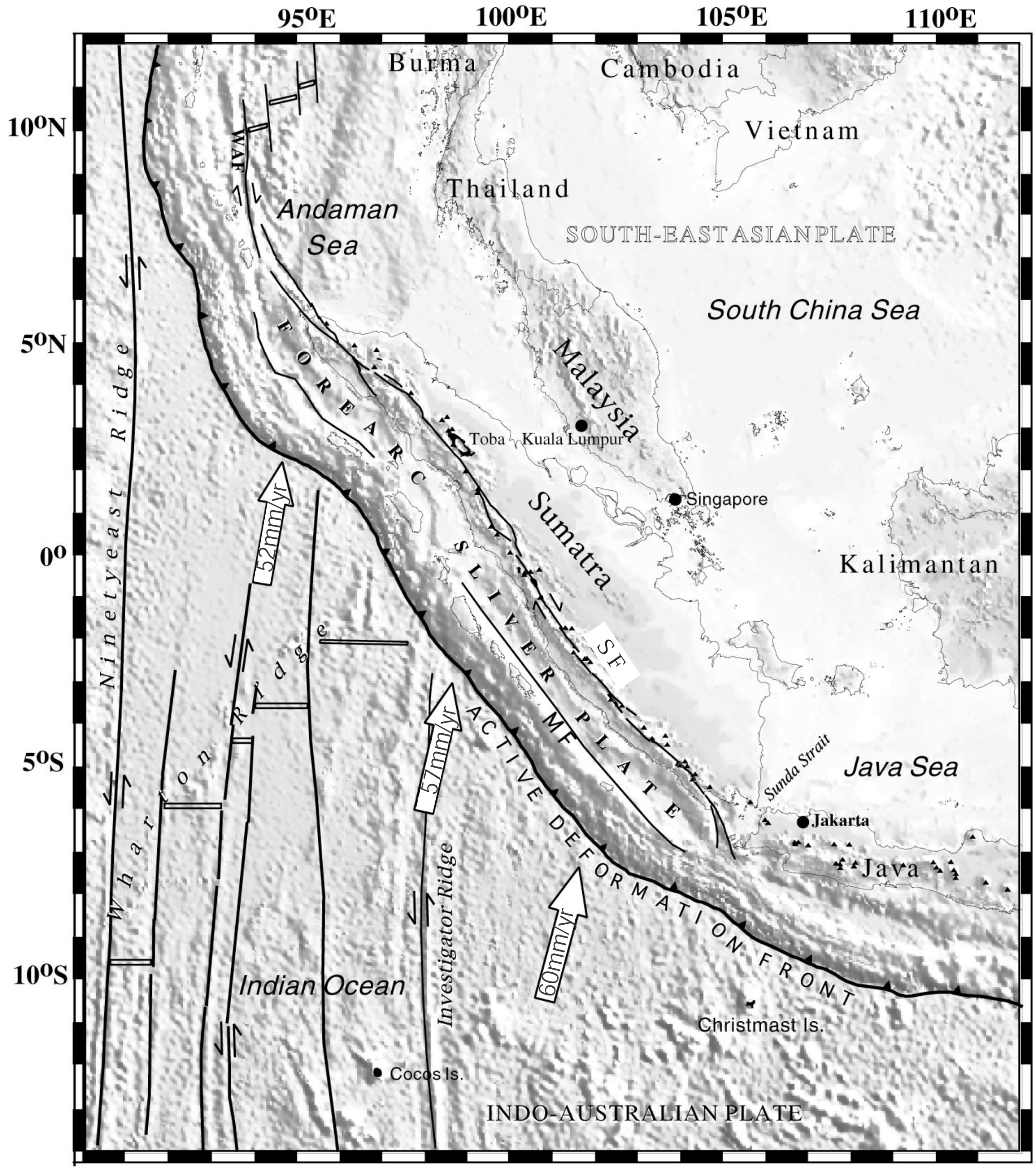

Figure 2.1. Regional tectonic setting of the Sumatran fault. The Sumatran fault (SF) is a trench-parallel, right-lateral strike-slip fault that traverses the hanging wall block of the Sumatran subduction zone from the Sunda Strait to the spreading centers of the Andaman Sea. It separates a forearc sliver plate from the southeast Asian plate. Triangles are active volcanoes of the Sunda arc. Arrows are relative plate motion vectors determined from GPS. Topography and bathymetry are from *Smith and Sandwell* [1997]. WAF is the West Andaman fault. MF is the Mentawai fault.

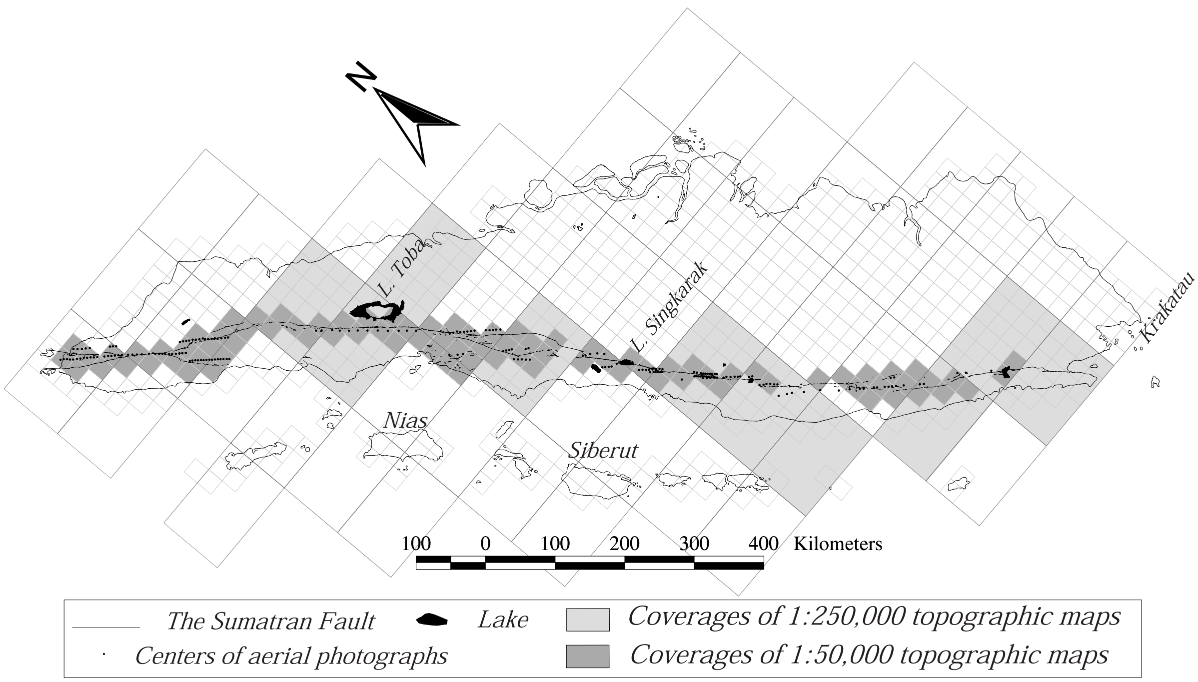

Figure 2.2 Data upon which our map compilation is based. Most of our mapping is based on inspection of 1:50,000-scale topographic maps and produced by BAKOSURTANAL & JANTOP, the national mapping agencies for Indonesia, and 1:100,000-scale aerial photographs. Other data sources include smaller-scale geologic and topographic maps.

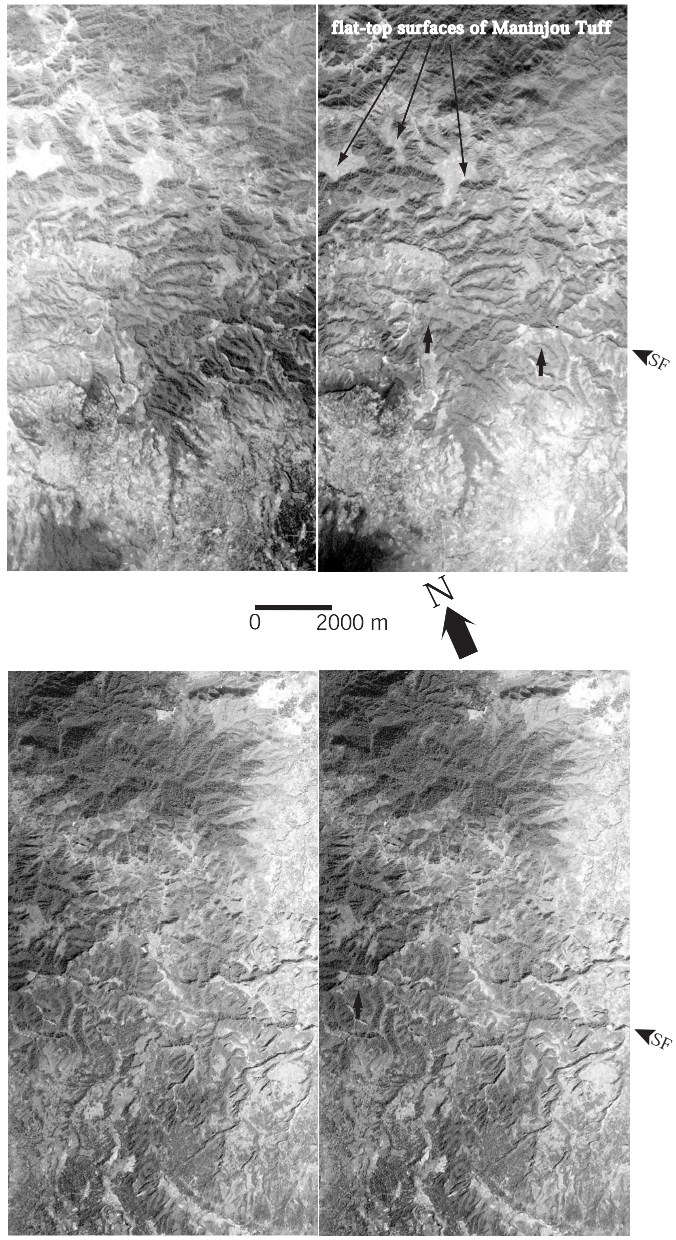

Figure 2.3. An example of the approximately 1:100,000-scale aerial photographs we used to compile most of our map of the Sumatran fault. These two sets of stereopairs show channel offsets of ~720 m. The channels cut a late Pleistocene pyroclastic flow deposit at about 0.3˚S. The flat upland surfaces are the unincised top of the flow. These offsets yield an average slip rate of ~11 mm/yr.

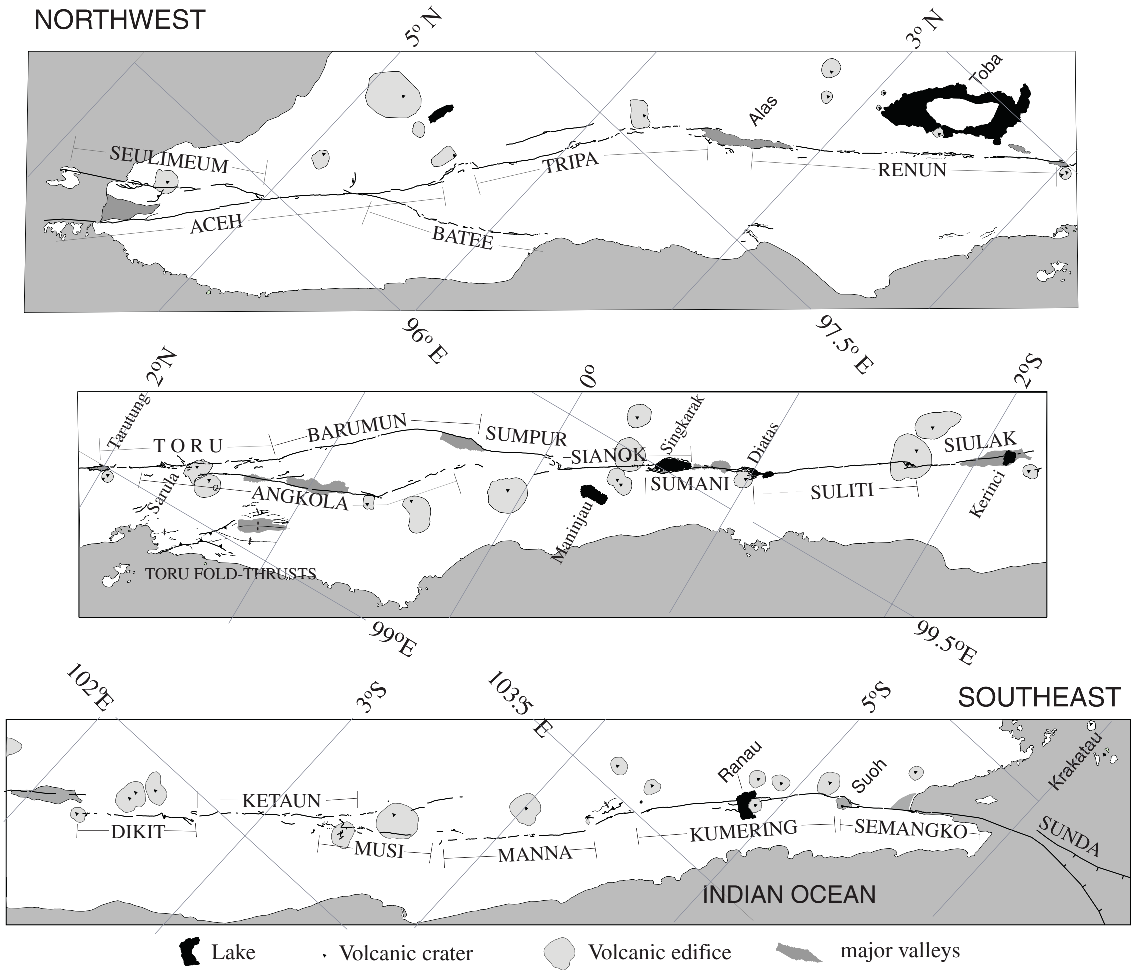

Figure 2.4. Map of 20 geometrically defined segments of the Sumatran fault system and their spatial relationships to active volcanoes, major graben, and lakes.

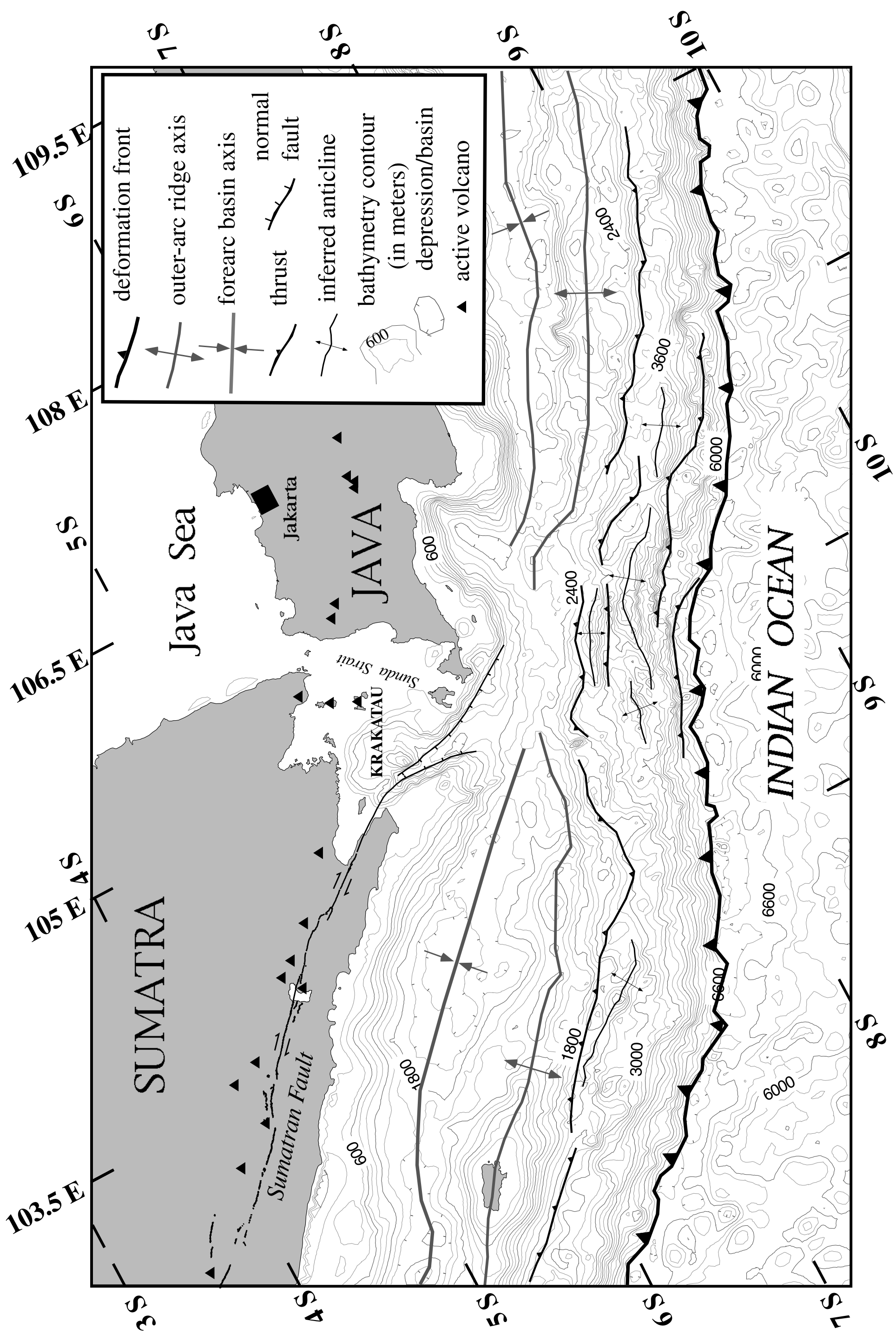

Figure 2.5. Sumatran fault and related structures near the Sunda Strait and bathymetric map of the portion of the Sunda Strait and surrounding seafloor. The Sunda segment of the Sumatran fault forms an 1800 m deep graben that widens southward, toward the deformation front. Northwestward movement of the forearc sliver plate along the Sumatran fault appears to have caused thinning of the region between the trench and the strait. Bathymetry is from Digital Elevation Model ETOPO02 and bathymetric surveys [*Smith and Sandwell*, 1997].

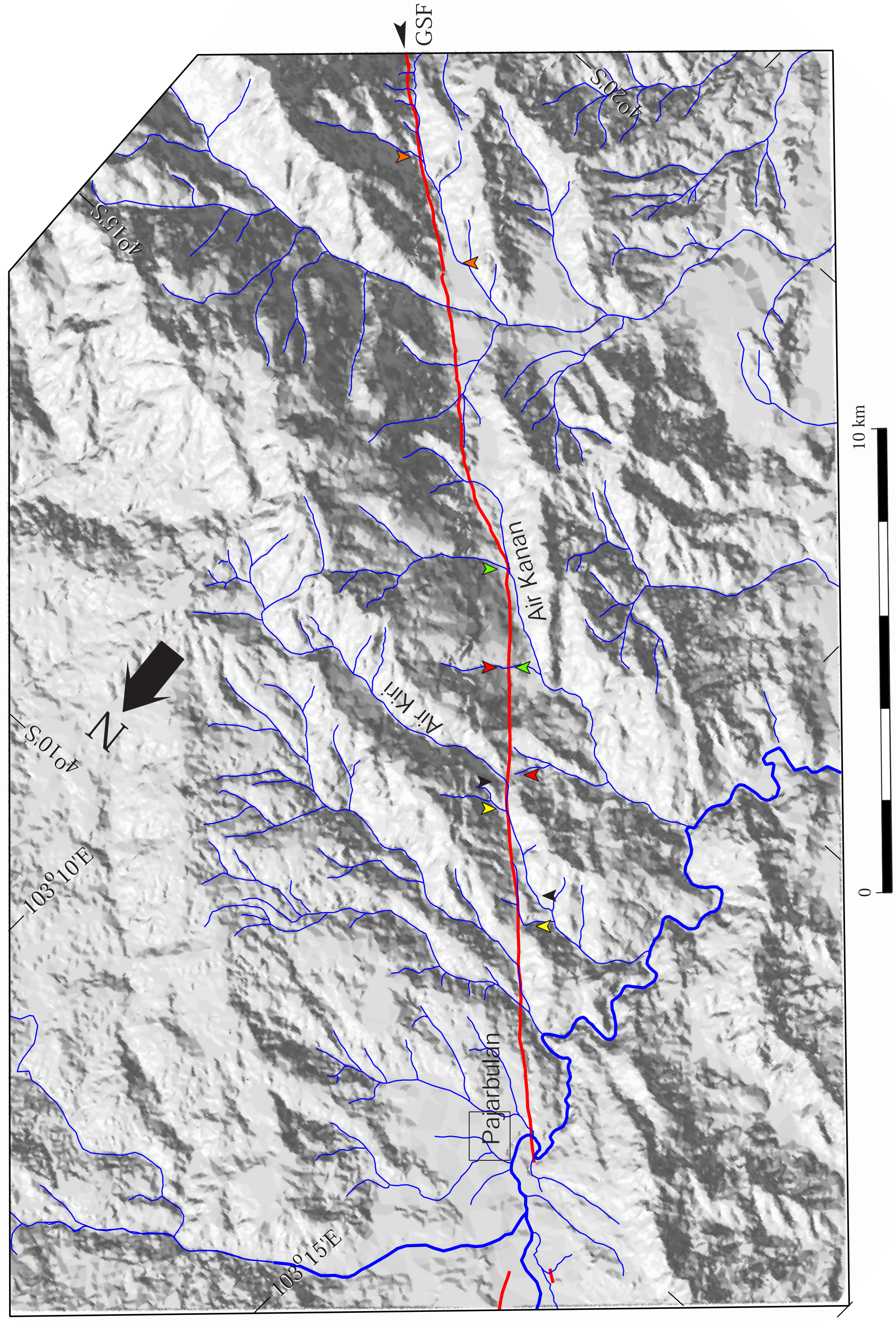

Plate 2-2. Shaded-relief map of the Sumatran fault where it crosses the western flank of a highly dissected volcano at about 4.2˚S. Colored arrows mark several offsets of the Air Kiri and Air Kanan ("river left" and "river right") of ~2.4 km. Created from 1:50,000-scale topographic map.

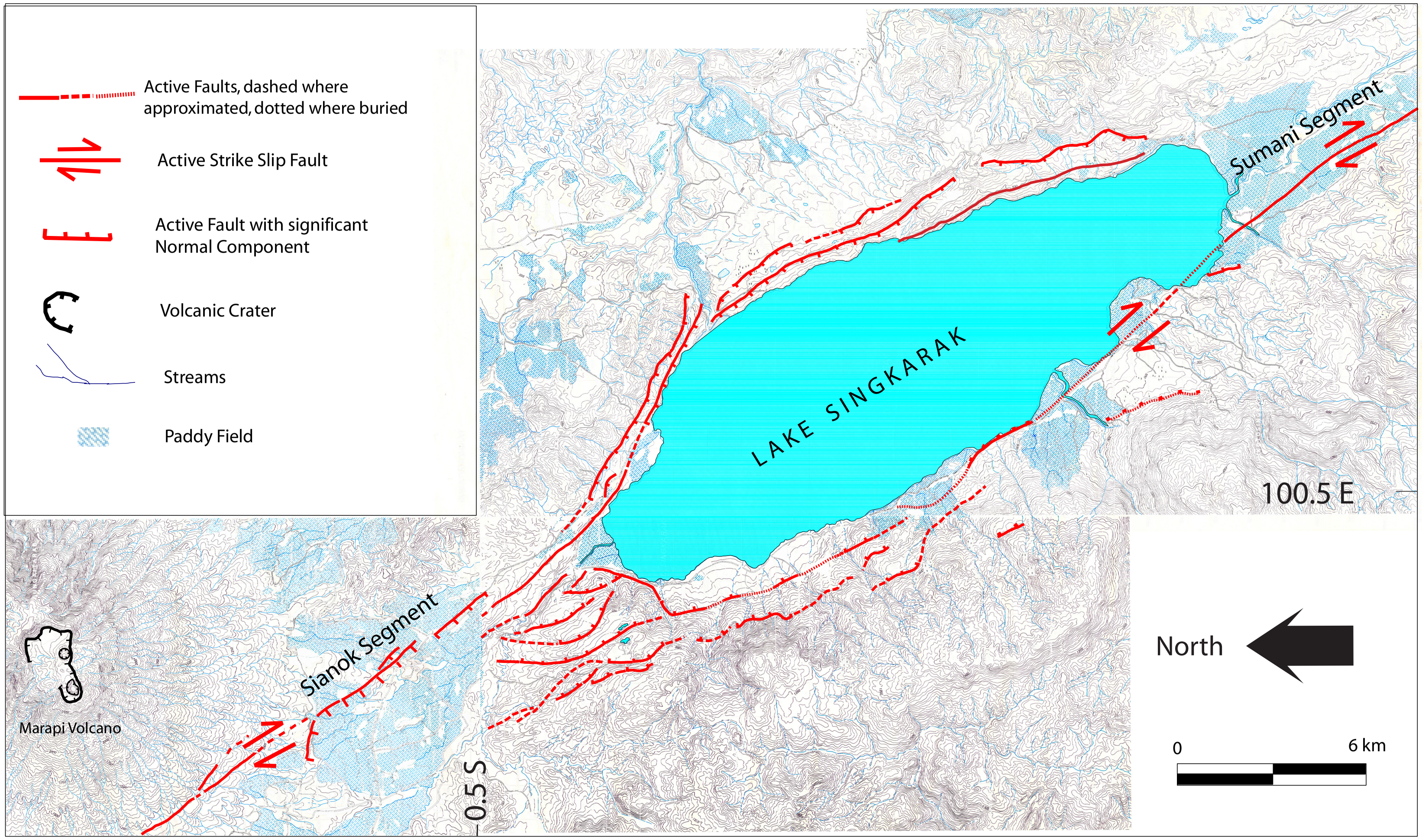

Plate 2-3. Map of the Sumani and Sianok segments near the Singkarak graben. The youthful appearance of the bounding normal faults suggests that accommodation space continues to form as the en echelon Sumani and Sianok segments accumulate dextral slip. Topography is from 1:50,000-scale quadrangles. The fault geometry was compiled from the topographic maps and stereo aerial photographs.

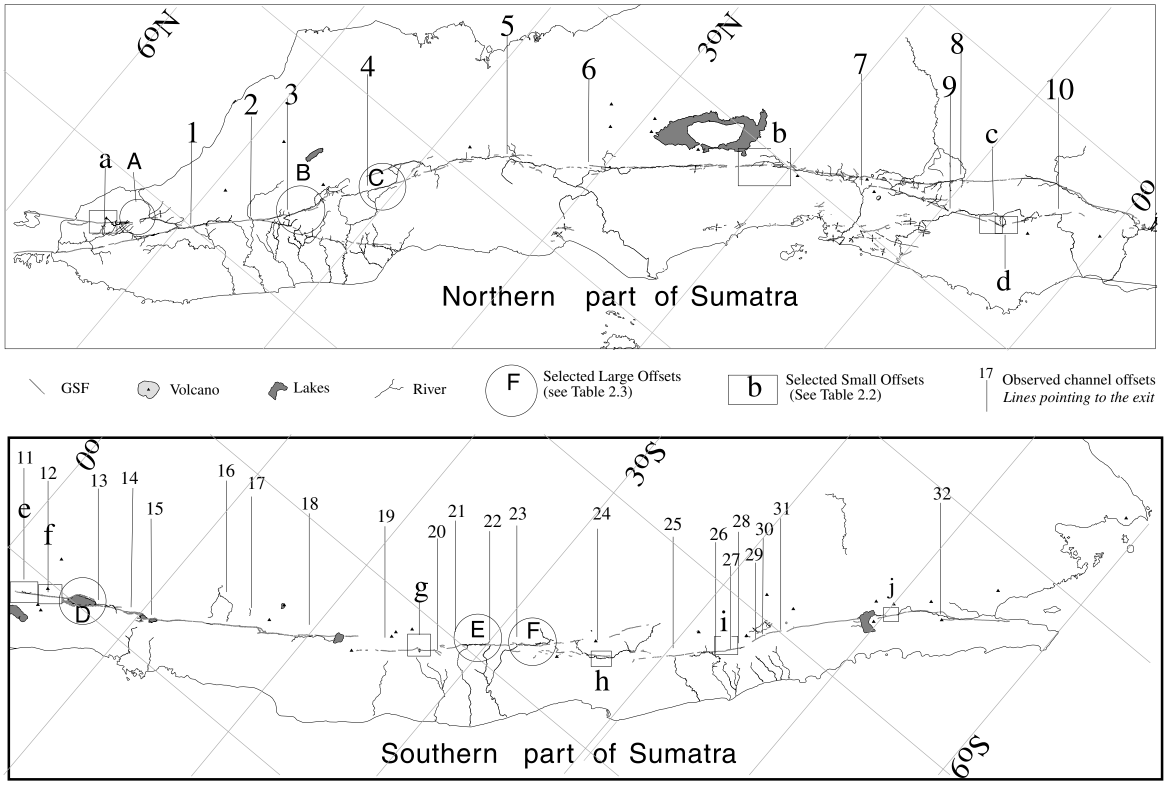

Figure 2.6. Map of small and large geomorphic offsets along the Sumatran fault. See Tables 2.2 and 2.3 for more information. The largest offsets indicate that total slip across the fault is at least 20 km.

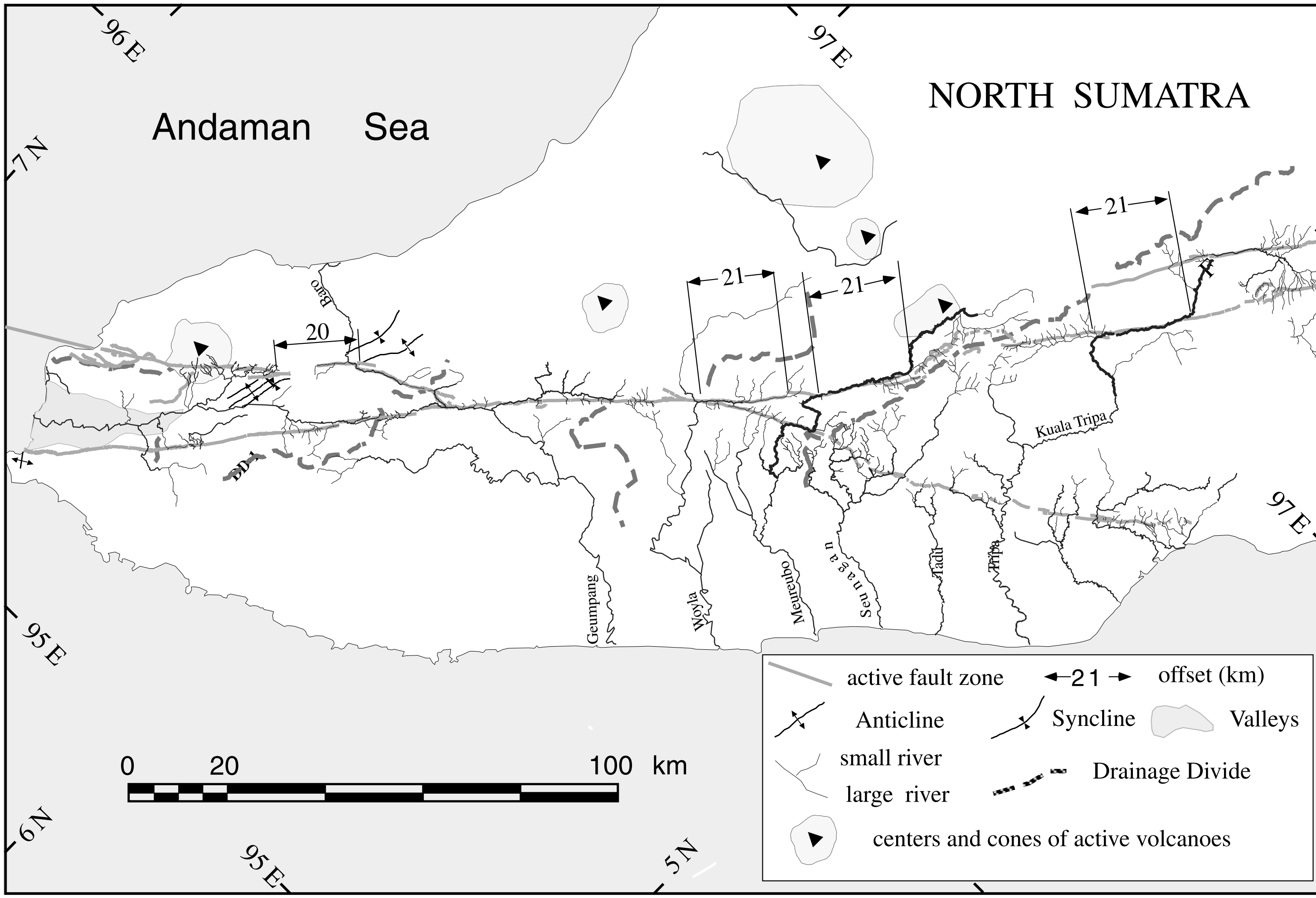

Figure 2.7. Two of the most compelling large geomorphic offsets along the Sumatran fault, the 21 km dextral offsets of the Tripa and Meureubo Rivers in north Sumatra. The headwaters of the nearby Woyla River and folded Quaternary sediments near 6°N also appear to be offset by this amount. These offsets appear to represent the total dextral offset since initial uplift of this part of the Barisan Mountains several million years ago.

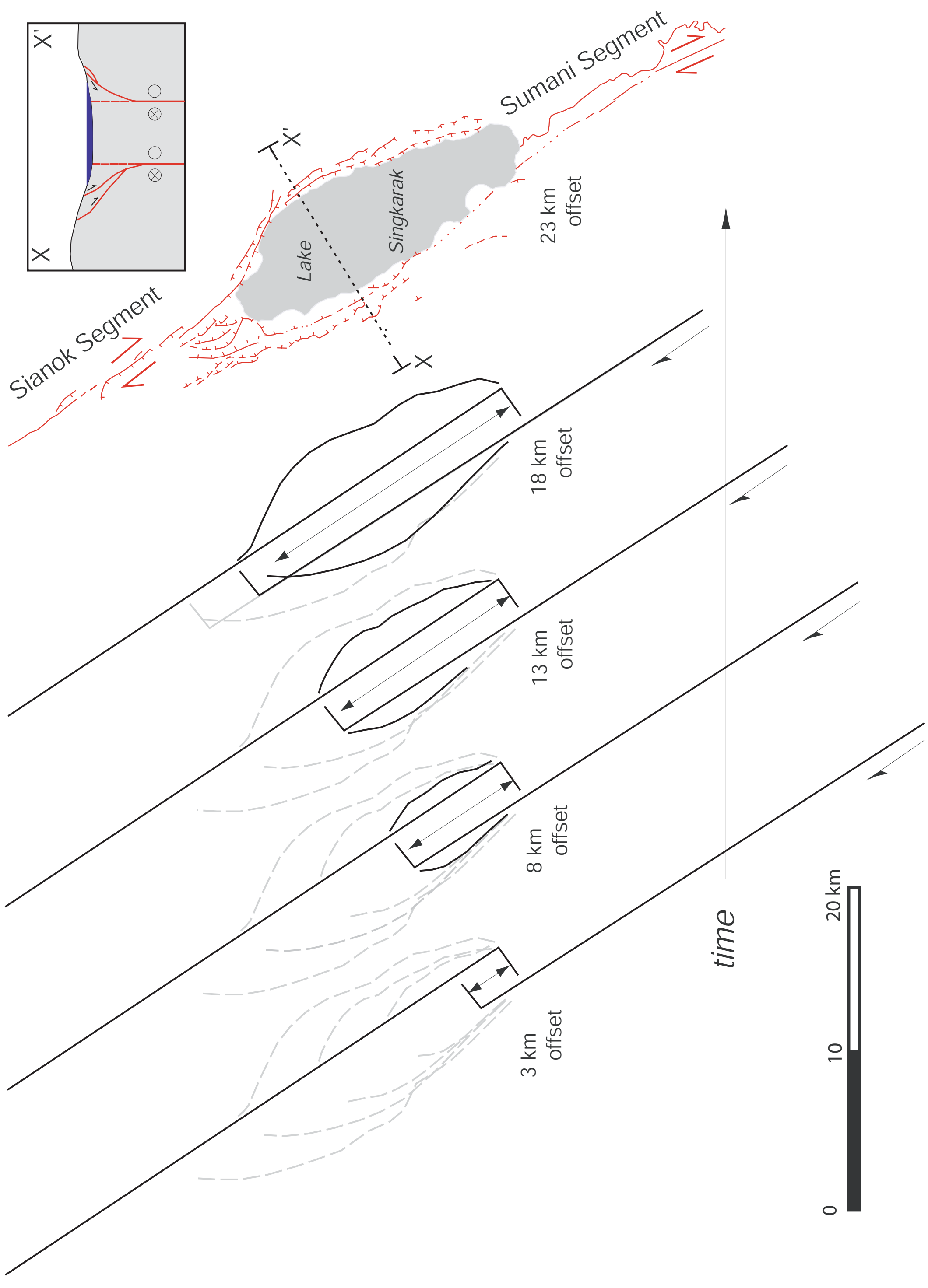

Figure 2.8. Hypothetical evolution of the Singkarak graben and bounding normal faults showing how the length of the normal-oblique faults might represent the total offset on the Sianok and Sumani segments. Profile E shows the current geometry of the graben.

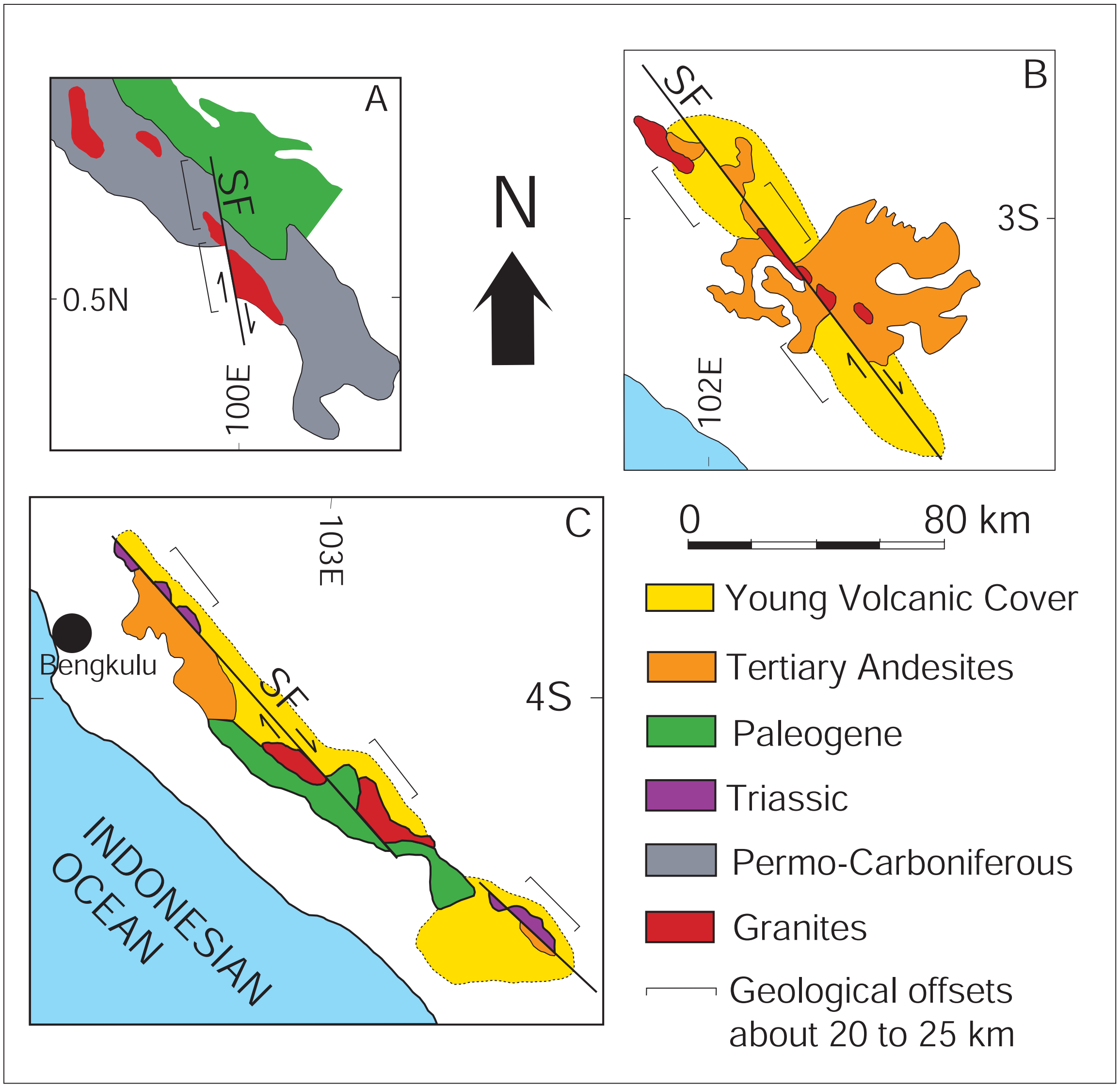

Plate 2-4. Geologic maps of offset bedrock units along three sections of the Sumatran fault suggesting that the total offset across the fault is only ~20 km. Reproduced from Katili and Hehuwat [1967].

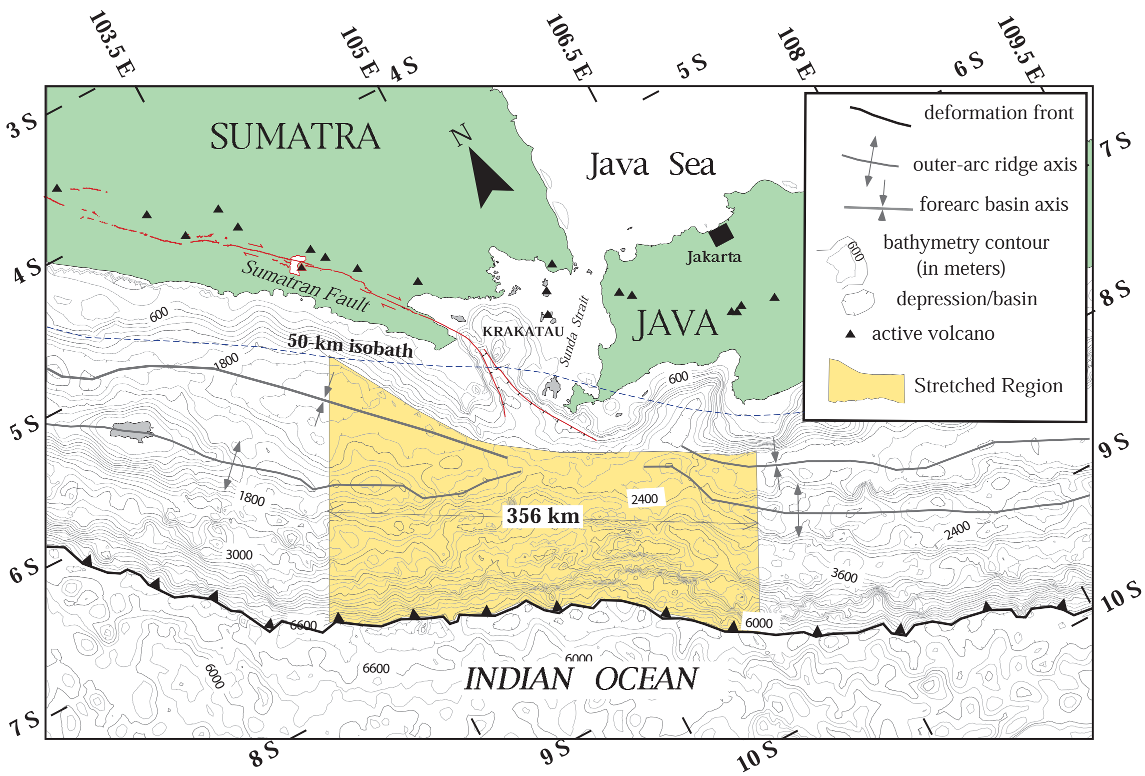

Figure 2.9. Stretching of the forearc sliver plate near the Sunda Strait, which appears to have thinned the forearc wedge perpendicular to the deformation front. By volumetric balancing, we calculate that ~100 km of stretching of the forearc sliver has occurred parallel to the Sumatran fault since formation of the outer-arc ridge and forearc basin. This would be a maximum value for northwestward translation of the part of the forearc sliver plate that is south of the equator.

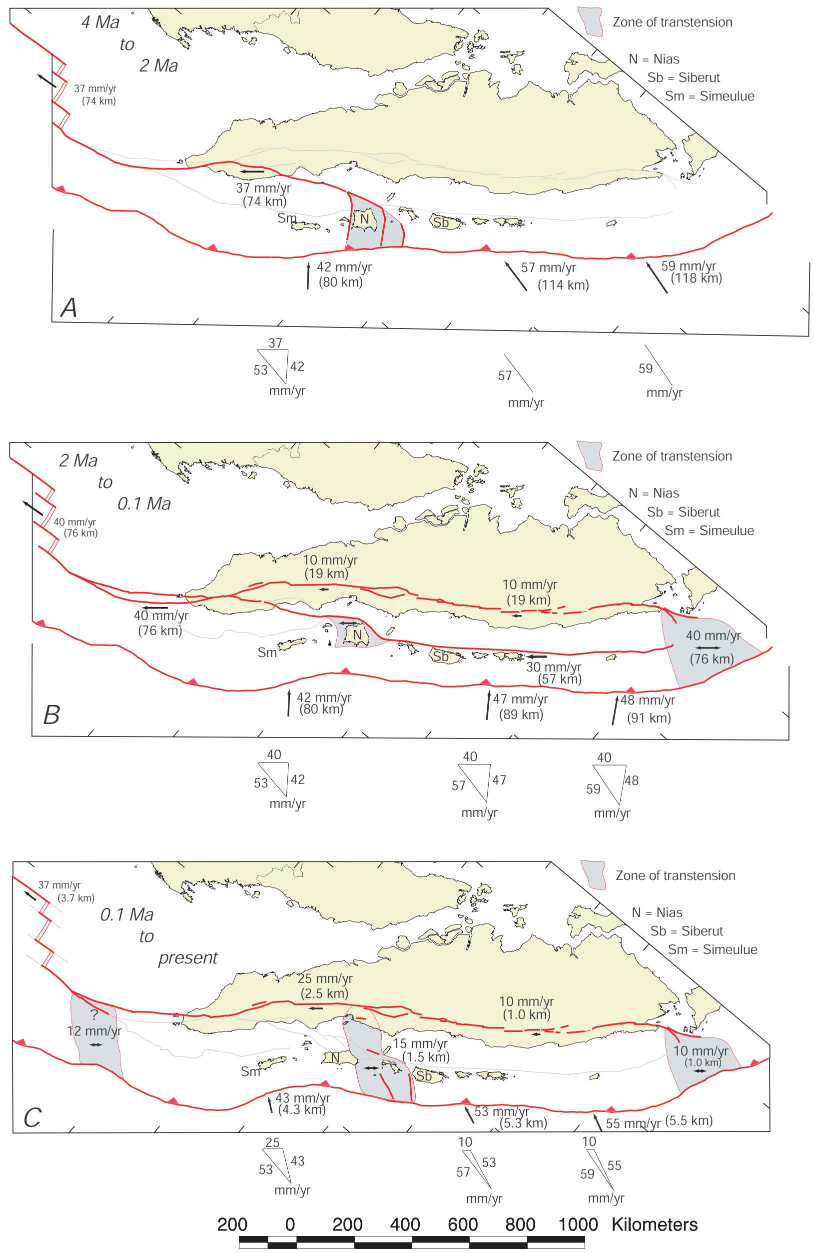

Figure 2.10. (opposite) A plausible (but nonunique) history of deformation along the obliquely convergent Sumatran plate margin, based upon our work and consistent with GPS results and the timing of deformation in the forearc region. (a) By about 4 Ma, the outer-arc ridge has formed. The former deformation front and the Mentawai homocline provide a set of reference features for assessing later deformations. From 4 to 2 Ma, partitioning of oblique plate convergence occurs only north of the equator. Dextral-slip faults on the northeast flank of the forearc sliver plate parallel the trench in northern Sumatra but swing south and disarticulate the forearc basin and outer-arc ridge north of the equator. (b) Slip partitioning begins south of the equator about 2 Ma, with the creation of the Mentawai and Sumatran faults. Transtension continues in the forearc north of the equator. (c) In perhaps just the past 100 yr, the Mentawai fault has become inactive, and the rate of slip on the Sumatran fault north of 2˚N has more than doubled. This difference in slip rate may be accommodated by a new zone of transtension between the Sumatran fault and the deformation front in the forearc and outer-arc regions.

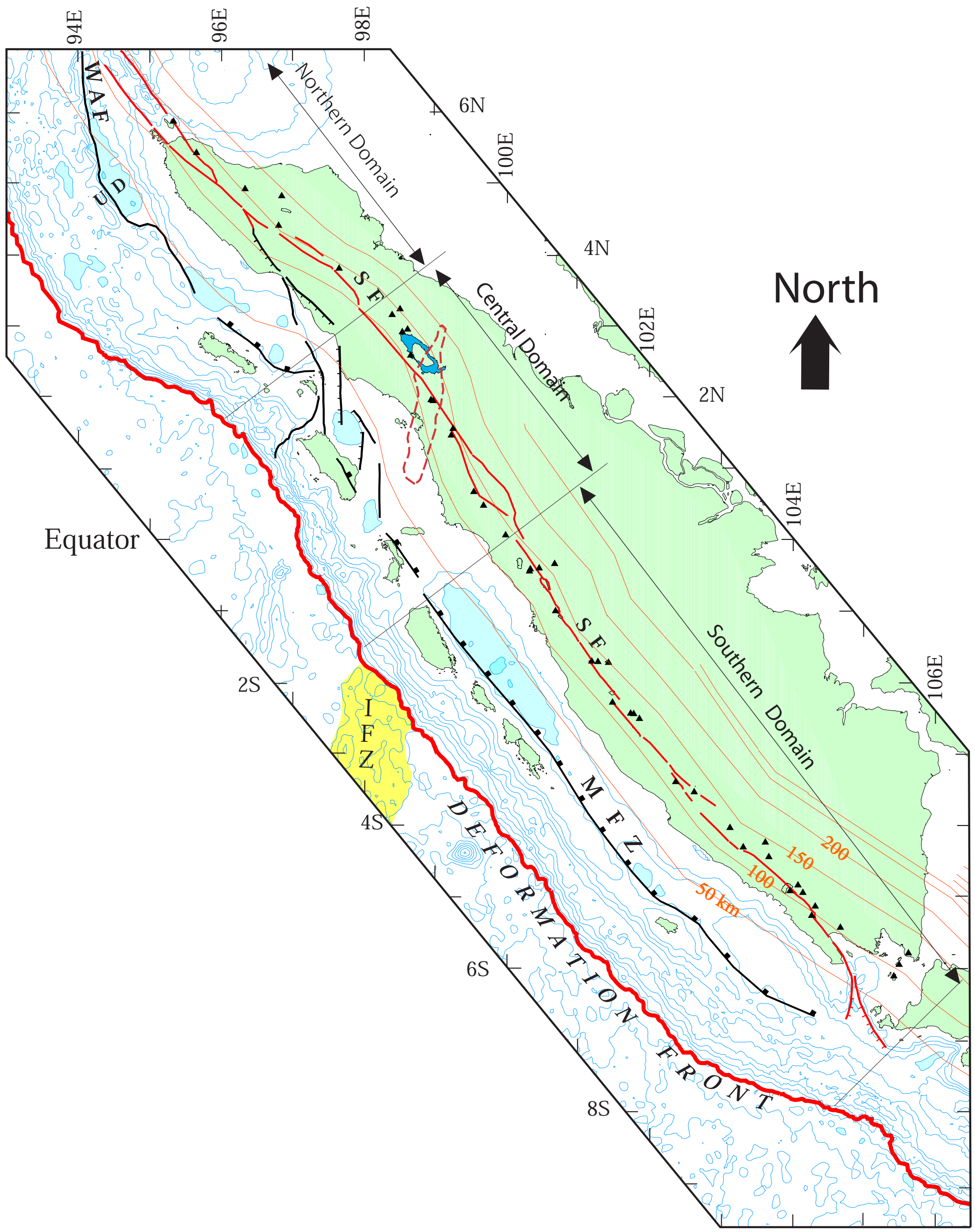

Plate 2-5. Geometric and structural details of the Sumatran fault, the forearc basin, outer-arc ridge, and volcanic arc, suggesting the division of the Sumatran plate margin into northern, central, and southern domains. The simplest outer arc, forearc, and Sumatran fault geometries are in the southern domain. The coincidence of this structural domain with the source region of the giant (Mw 9) subduction earthquake of 1833 suggests that geometrical simplicity encourages large ruptures. The central domain appears to have been the source region of the great (Mw 8.4) subduction earthquake of 1861. Fragmentation of the central domain appears to have been caused by subduction of the Investigator fracture zone during the past 5 Myr. The locus of impingement of the fracture zone on the deformation front was calculated by assuming the current relative plate motion vector and the forearc deformation history of Figure 10. Contours in red are the top of the Benioff-Wadati zone. Bathymetric contour interval is 200 m.

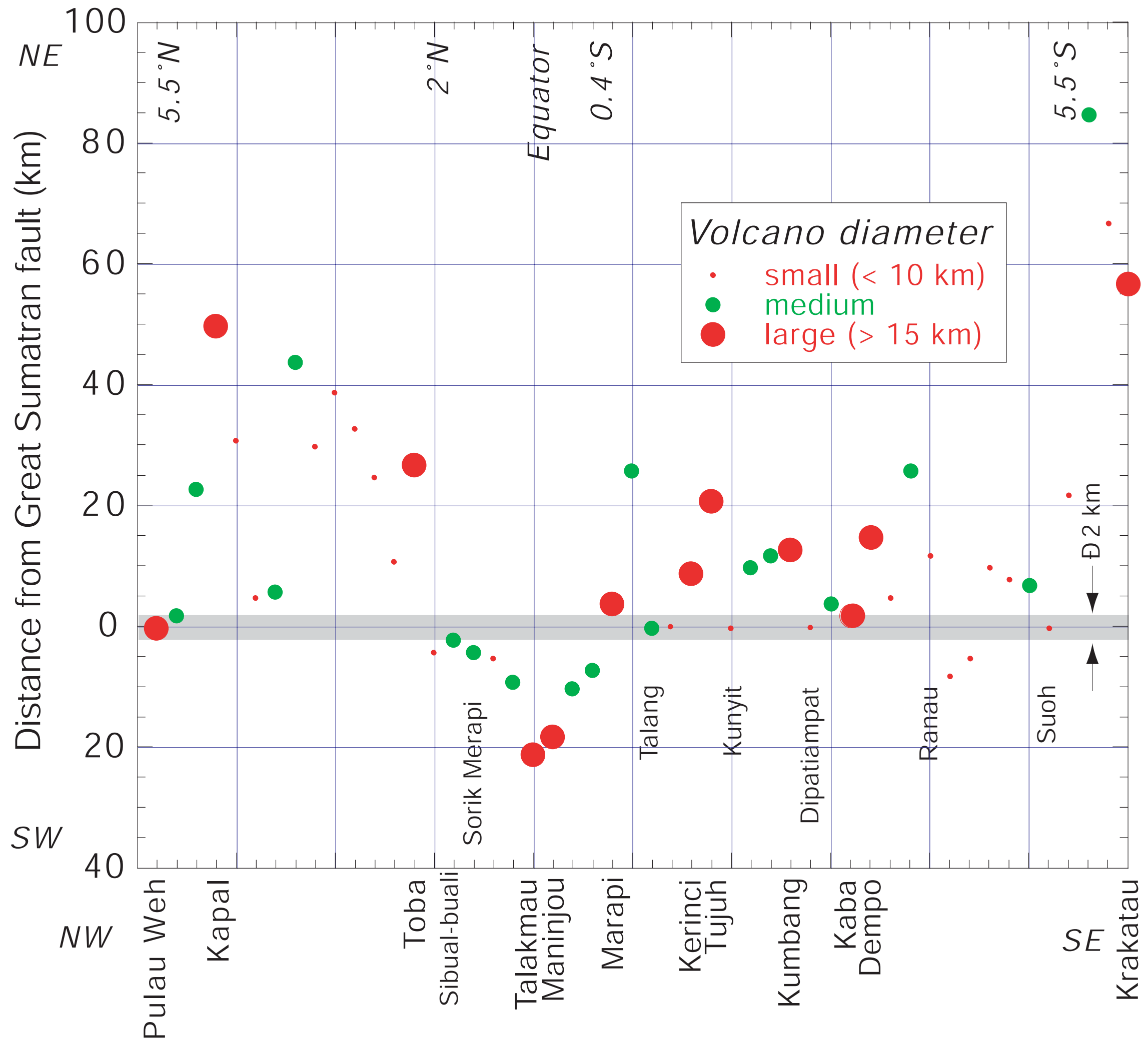

Figure 2.11. Plot of the distance of volcanic centers from the Sumatran fault showing that the volcanic arc has not influenced the location of the fault. However, 9 of the 50 volcanic centers are within 2 km of the fault. Most of these are associated with extensional (right) step overs in the fault. Large (15 km diameter) volcanic edifices are listed along the horizontal axis. Smaller volcanoes mentioned in the text are named.