GEOMORPHOLOGY, STRUCTURAL GEOLOGY AND PALEOSEISMOLOGY OF THE MIDDLE PORTION OF THE SAGAING FAULT, BETWEEN SINGU AND WUNDWIN, CENTRAL MYANMAR

PhD DISSERTATION

SAW NGWE KAHING

DEPARTMENT OF GEOLOGY
UNIVERSITY OF YANGON
MYANMAR

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ABSTRACT

The Sagaing Fault, a well-known N-S trending dextral strike-slip fault, passes through Myanmar for a distance of about 1200 km. It has been seismically active, and has generated many major earthquakes in Myanmar.

In the Singu–Tada-U area, there are five types of geomorphic units: (1) Meandering and flood plain area, (2) Alluvial fan, (3) Rolling hills and semi-badland areas, (4) Isolated hillock areas, and (5) Linear mountain ridges. Four fault segments can be recognized on the basis of right step-over patterns along the Sagaing Fault between Singu and Thazi. These are: (1) Singu–Kanbyu Segment, (2) Sheinmaga–Sagaing Segment, (3) Tada-U–Shwedaung Segment, and (4) Wundwin–Thazi Segment. There are 21 stream offsets in the study area, and they range from 6 m to 370 m.

Surface depression features are observed along the Sagaing Fault as sag ponds. The Khule-In, Yega-In, Hanza-In and Minhla-Kan are typical sag ponds along the Sagaing Fault zone in the study area. Kule-In, Yega-In and Minhla-Kan areas mark the terminations of the fault segments. The Yega-In area is a more active area due to the normal faulting and right step-over of the Sagaing Fault.

The Tada-U–Shwedaung and Wundwin–Thazi segments are observed as pressure ridges. These ridges are sharp restraining bends of the Sagaing Fault. The Ayeyarwady River is more braided on the eastern side of Sagaing ridge. The slip rate of the Sagaing Fault at Singu lava field is determined to be 14 mm per year.

There generally are high-angle dips in most rock units along the Sagaing Fault zone. The Pleistocene gravel units are steeply tilted. However, in the Wundwin–Thazi segment, the Sagaing Fault bends at two localities, one at the middle portion and the other at the southern end. The main Sagaing Fault dips over 60° towards the west (260°-270°). At east of Shawbin village, it dips 62°/262°. In the Sagaing area, three fracture systems were observed in the Sagaing metomorphics: (1) NE-SW, (2) NW-SE and (3) N-S.

Three main types of deformation are observed. These are semi-brittle, brittle-ductile and brittle. The Sagaing metamorphic rocks were subjected to all these three deformations. The Tertiary sandstones along the Sagaing Fault zone show brittle deformation characters. Field observations indicate that the progressive deformation

history of the Sagaing metamorphics can be concluded as, first btittle-ductile deformation of layer-parallel shearing at the upper crustal level, and then brittle deformation in which there was fracturing in two directions. The older fractures are in NE-SW direction, and the younger in N-S direction. The second is related to the dextral shearing of the Sagaing Fault. The fault-related brittle deformation resulted in open fractures during seismic events, and then these were filled with clay sediments. These features are well developed between the Tada-U and Wundwin areas. The open fractures filled with clays trend 165°, and the fracture-filled width is wider in the Wundwin area. Silicified hard bands are of semi-recrystallized quartz grains which were coated. The veins and quartz grains indicate that the semi-recrystallized stage and grains movement are at the time of deformation. All these features were caused by the intense shear deformation during past earthquakes.

The 1839 earthquake caused considerable damage to the massively built Mingun Pagoda, northeastern corner of Innwa ancient city wall, tilting of Nanmyintmyawsin (watch tower) and Layhtatgyi Pagoda, and these damages are still visible today in the form of large cracks and collapsed sections of the walls. On the basis of stream offsets (6 m) that was thought to be caused by 1839 earthquake, the earthquake magnitude was probably more than 7.5 and the surface rupture length was ~130 km. On the basis of observation on damaged structures and personal interviews with local people, the main ground shaking of 1839 and 1956 earthquakes were in the north-south direction. The Samon River was shifted to the east at SE of Tada-U. This area was uplifted about 1 m probably during Innwa earthquake of 1839.

In the Kaingma trench dug for this study, the fracture filled with soil and fragments of brick at the trench site trends 50°, and is 10 cm wide. This is indicative of a paleoseismic event most probably 1839 Innwa earthquake. The fracture filling was later affected by 1956 earthquake at the middle part. The fracture trends nearly 100°. In the HtutKaung trench dug for this study, the colluvium wedge deposits were observed as three different layers. This indicates that the Sagaing–Tada-U area was affected by at least three major earthquakes.

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