Tectonic landform and rock-controlled landform along fault trace of the Aceh segment, the northernmost Sumatran Fault

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The Sumatran fault is a major arc-parallel strike-slip fault that accommodates much of the right-lateral component of oblique subduction of the Indian-Australian plate beneath the Sunda plate. The 1,900-km-long fault is divided into 19 segments (Sieh and Natawidaja, 2000). The Aceh and Seulimeum segments, which are the northernmost segments of the Sumatran fault with a high slip rate (Natawidjaja and Triyoso, 2007; Natawidjaja, 2018), have not ruptured in the past 120 years (Hurukawa et al., 2014). Although the seismic potential of the Aceh and Seulimeum segments is considered to be high, fundamental geologic data on the northernmost Sumatran fault, such as detailed fault trace, late Quaternary slip rate, etc. are poorly documented.

Since 2012, we have conducted tectonic geomorphologic and paleoseismic studies in the northernmost Sumatran fault in Aceh Province. In 2015, we conducted a trenching survey on the Seulimeum segment at Lamtamot where the fault cuts a fluvial terrace. We identified geologic evidence of three seismic events after AD1280 (Tsutsumi et al., 2018).

In the northwestern portion of the Aceh segment, the tectonic geomorphic features are not well documented. In 2019, we carried out the survey in this area. We first conducted topographic interpretation to identify tectonic geomorphic features using stereoscopic images prepared from ALOS PRISM images with a spatial resolution of 2.5 m, and the stereoscopic images prepared from AW3D30, with a spatial resolution of 30 m DEM. We then conducted field geologic observations. During the filed survey, we utilized drone to confirm the topographic features at the sites where the accessibility for field observations was limited.

The Aceh segment with a general strike of N50°W in the study area is the direct northwestern extension of the main fault trace. The active fault line is traced in the lowland (Banda Aceh plain) from south of Jantho toward the northwest until reaching latitude 5°25’ N. The down-to-the southwest scarp and linear troughs are observed in the lowland. From the latitude 5°25’ N to the coastline toward the northwestern direction, active faulted geomorphic features are obscured, though the topographic boundary of the lowland and the Barisan Mountains is apparent.

Along the topographic boundary of the lowland and the Barisan Mountains, alignment of saddles, topographic lineaments and systematic right-lateral offsets of the streams were identified. We observed fracture zones and lithological boundaries of calcareous sand stone and mud stone at the locations of these geomorphic features. We also found an exposure of share zone in the silt-sand stone. The fault in the silt-sand stone do not extend upward to the overlying calcareous sand stone. These geomorphic features identified at the topographic boundary are interpreted to be rock-controlled landform, not active tectonic landform. Although fault lies along the topographic boundary, this fault is interpreted to be inactive in the northwestern portion of the Aceh segment. The active fault is found on the basin side of the topographic boundary of this area.

From the latitude 5°25’ N to the coastline toward the northwestern direction, active faulted geomorphic features are obscured. Ghosal et al. (2012) pointed out that based on marine geophysical data the active fault of the Aceh segment extends toward the northwestern direction offshore. These infers a possibility that the active fault trace of the Aceh segment lies in Banda Aceh plain as a concealed fault. In order to obtain a better understanding of the seismic hazard of the Sumatran fault in Aceh Province, further geoscientific investigations are desirable such as tectonic geomorphology, paleoseismology, and

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