Fault rupture in Baribis Fault possibly related to the 1847 major earthquake event in the Cirebon area

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Abstract. Baribis Fault is a recently identified active fault known to have thrust movement which located along the northern part of the West Java area. This E-W striking fault runs across high-populated areas, including Cirebon, Indramayu, Sumedang, and Subang area (with a probability of continuing to Jakarta and Banten areas). The last major historical earthquake occurred on November 16th, 1847 around the fault line with a radius of shaking area up to 400 km. The available high-resolution Digital Elevation Model from Geospatial Information Agency, called DEMNAS, has about 7.5-m grid data resolution but still not adequate to be used for identifying fault ruptures of this event. Hence, we conducted an Unmanned Aerial Vehicle (UAV) 3D Photogrammetry survey flown in the lower latitude (~100-m high) in the suspected sites. This study identified clear fault scarp associated with stream-valley offsets indicating strike-slip movement in the Ujung Jaya subdistrict, Sumedang. The trace of fault rupture has a 5±1-meter sinistral offset. This sharp fault deformation feature is possibly related to the 1847 earthquake in this area. This fact is different from regional morphology, which shows that the Baribis Fault is a thrust. Further study is necessary to get more detailed and precise information.

1. Introduction

Baribis Fault is located in the northern part of the West Java area. The Fault is the result of the subduction of the Hindia-Australia Plate with Eurasia Plate with movement about 57 mm/yr. In Sumatra the boundary between the sliver accommodated by the Sumatran Fault. However, in Java the movement of the Sunda Megathrust could be transferred into inland faults in Java such as Cimandiri Fault, Lembang Fault, and this Baribis Fault in Western Java (Figure 1).

On November 16th, 1847 major earthquake occurred around Cirebon city with a radius of shaken up to 400 km [1]. However, there are still many questions about the evidence from the earthquake geology point of view, as the fault rupture line, recent surface deformation, and displacement are also unknown.

We use the Digital Elevation Model of DEMNAS with a 7.5 resolution grid combined the Lower latitude (~100-m high) 3D photogrammetry of the Unmanned Aerial Vehicle (UAV) image to get the 1847 earthquake evidence in this area. The hillshade analysis and coloring technic help improve the topographic scarp view of the suspected fault. We did the Digital Elevation Models’ (DEM) surface analysis under the Geographic Information System (GIS) [2].
2. Result and Discussion

Our observation of the DEMNAS image shows a clear NW-SE oriented fault scarp on the hills area. On the Ujung Jaya area has an NW-SE orientation lineament of the fault scarp. This part/segment has a 22 km length until the scarp feature is not existed (Figure 2).

In this area, we identified a left-movement/sinistral river offset. In the eastern area of this part/segment, the fault scarp’s trace not clear on the 7.5m DEM images. Hence, we fly a UAV drone to better view the area’s topography around Ujung Jaya subdistrict, Sumedang. Our observation produces a 0.3 m resolution of the DEM. With this high resolution DEM, we identified obvious fresh fault scarp deformation. We measure the offset of the river is about 5±1 m left-movement / sinistral (Figure 3). This sense movement is in agreement with earthquake geology study in Lembang Fault [3] and Cimandiri Fault [4]; and geodetic study [5]. Further geodetic research shows a large strain rate related to the strike-slip fault movement in this area (Gunawan & Widyantoro, 2020).

This size of 5±1 m sinistral movement possible correlated to the latest earthquake event in this area since the offset size is capable produce by Mw 7+ class earthquake [6]. The distribution of damage area shows by a line is focus to this area with a shaken radius up to 400 km [1]. A recent historical earthquake study shows that the shake radius is 700 km and possible produce by Mw 7.6 [7].

The regional scale of the Baribis Fault is thrust fault [8, 9]. Here we show the local scale of the sinistral river offset. The 5±1m sinistral river offset possibly related to the 1847 earthquake. Further study is necessary to get more detailed and precise information.
Figure 2. A 22 Km length of part/segment of Baribis Fault. This fault part/segment identified as a fault scrap lineament. The right rectangle is best fresh deformation of this segment.

Figure 3. Obvious fresh surface deformation of the last earthquake rupture in this fault part/segment of Baribis Fault. (Left) Drone DEM image original and (right) with fault interpretation and detail site of next figure.
Conclusion Remark
Baribis Fault is a recently identified active fault known to have thrust movement which located along the northern part of the West Java area. The last major historical earthquake occurred on November 16th, 1847 around the fault line with a radius of shaking area up to 400 km. Unmanned Aerial Vehicle (UAV) 3D Photogrammetry survey flown in the lower latitude (~100-m high) identified clear fault scarp associated with stream-valley offsets indicating strike-slip movement in the Ujung Jaya subdistrict, Sumedang. The trace of fault rupture has a 5±1-meter sinistral offset. This sharp fault deformation feature is agree with the Mw 7+ intensity historical study and possibly related to the 1847 earthquake in this area.

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