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Application of unmanned aircraft system (UAS) for large paleo-landslide survey at Waian, Penghu Archipelago of Taiwan

Yu-Jui Tsai (1,3), Shyh-Jeng Chyi (1), and Cheng-Hao Lu (2)

(1) National Kaohsiung Normal University, Department of Geograghy, Taiwan, (2) National Penghu University of Science and Technology, Department of Tourism and Leisure, Taiwan, (3) stone840608@gmail.com

Paleo-landslide is an important issue not only for the study of sea cliff evolution, but also for the coastal hazard management. This study presents the applications of UAS and field investigations to identify a large late Pleistocene paleo-landslide in the basalt columnar coast of Penghu Archipelago.

The sea cliff at Wanan of Shiyu (Western Island in Chinese) is the highest sea cliff in Penghu Archipelago. The geological outcrop of the 55-meter high sea cliff shows an 8-meter thick dark grey siliceous basalt layer with vertical columnar joints on the top of the cliff. Beneath the siliceous basalt layer is a thick but weak sandstone and shale interbedded layer with black alkaline basalt bodies at the bottom of the cliff. Not only the joint characteristics but also the color of the alkaline basalt bodies are quite different from those of siliceous basalt in the upper part. We found that the landform profile of the sea cliffs shows a concave shape on the upper part of slope but a convex shape on the lower part. Many blocks of siliceous basalt are distributed on the lower part of the sea cliff, but their columnar joint directions are inclined or even horizontal, rather than vertical in their original attitude.

Based on the preliminary field observation, this study intends to investigate and analyze the shape and joint direction of the columnar basalt rock mass exposed on the cliff slope, in order to understand the integrity and deformation of the sea cliff. Meanwhile, we use the UAS to survey the suspected collapse areas and produce their digital surface model (DSM) for terrain analysis and monitoring their activeness.

Current field investigation results show that the sea cliff in Waian did occur a large rotational slide before, making the columnar basalt rock atop drop onto the coastal area. However, the feet and toes of the rotational slide should be located below the modern sea level. In other words, the large rotational slide should have occurred at the low sea-level during the late Pleistocene. Since the foot of the slide is merged into the sea in a stable state and the sea-level continuously rises in the future, we consider that the reactivation possibility of the landslide in the future is still low.