Classification and Chronological Analysis of Alluvial deposits on the Western Margin of the Pai Basin, Mae Hong Son Province, Based on Geomorphic Indices and Field Observation

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Abstract

This study aims to classify and analyze the geomorphic evolution of alluvial deposits on the western margin of the Pai Basin, Mae Hong Son Province. By applying ten quantitative geomorphic indices through a Geographic Information System (GIS), the study identifies two primary alluvial deposits units with distinct physical characteristics: Fan 1, which exhibits a radial shape, and Fan 2, which displays a pie-shaped morphology. The relative age analysis indicates that Fan 1 is geomorphically older than Fan 2. Key supporting evidence includes a Hypsometric Integral (HI) value of 0.39 and a mean of the Relative Elevation Model (REM) of 562.97 meters. Both of which are significantly lower than those of Fan 2. These values reflect an "old stage" in the erosion cycle, where original sediments have been largely denuded, leaving a highly rugged, dissected surface. In contrast, Fan 2 is classified as the "mature stage," characterized by its ability to retain a thicker, denser sediment mass. However, the area also exhibits evidence of modern deep incision, resulting from geomorphic rejuvenation driven by the structural influence of active faults in the region.

Study area

The study area is located in the western part of the Pai Basin, Pai District, Mae Hong Son Province, covering an area of approximately 34 square kilometers.

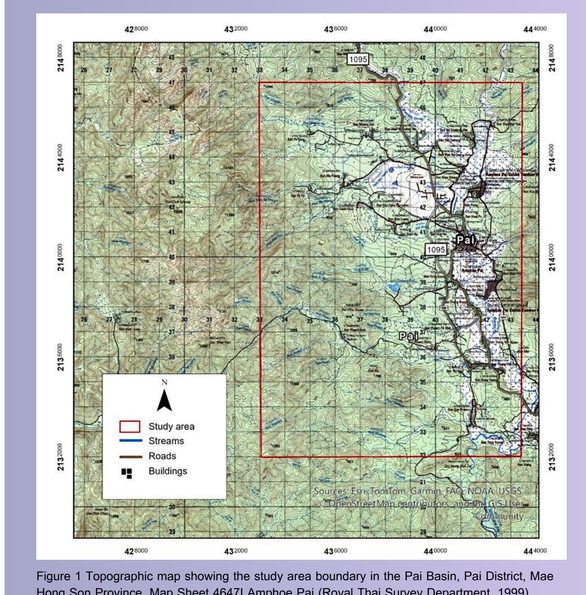


Figure 1 Topographic map showing the study area boundary in the Pai Basin, Pai District, Mae Hong Son Province, Map Sheet 4647I Amphoe Pai (Royal Thai Survey Department, 1999).

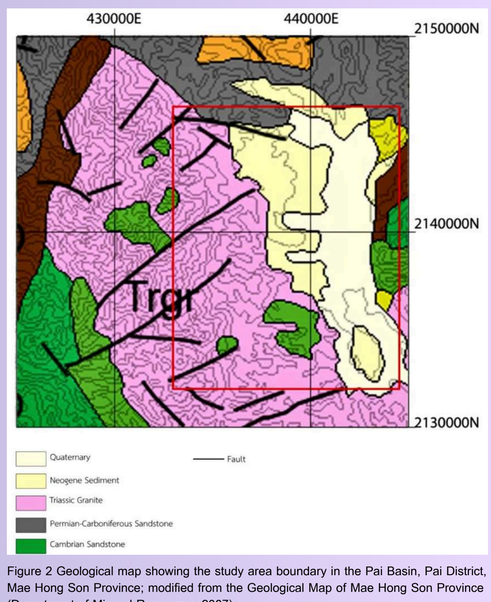


Figure 2 Geological map showing the study area boundary in the Pai Basin, Pai District, Mae Hong Son Province; modified from the Geological Map of Mae Hong Son Province (Department of Mineral Resources, 2007).

Objectives

1. To classify and analyze the depositional sequence of alluvial deposits along the western margin of the Pai Basin, Mae Hong Son Province.
2. To explain the geomorphological evolution of the landscape in the western part of the Pai Basin, Mae Hong Son Province.

Methodology

The study is divided into three main stages. The first stage involves data analysis using 10 Geomorphic indices: Hillshade, Slope, Geomorphons, Terrain Ruggedness Index (TRI), Topographic Position Index (TPI), Standard Deviation of Slope, Hypsometric Integral (HI), Drainage Density, Relative Elevation Model (REM), and Incision Depth. The second stage focuses on the analysis of results, and the final stage consists of field observation to validate the findings derived from the previous two stages.

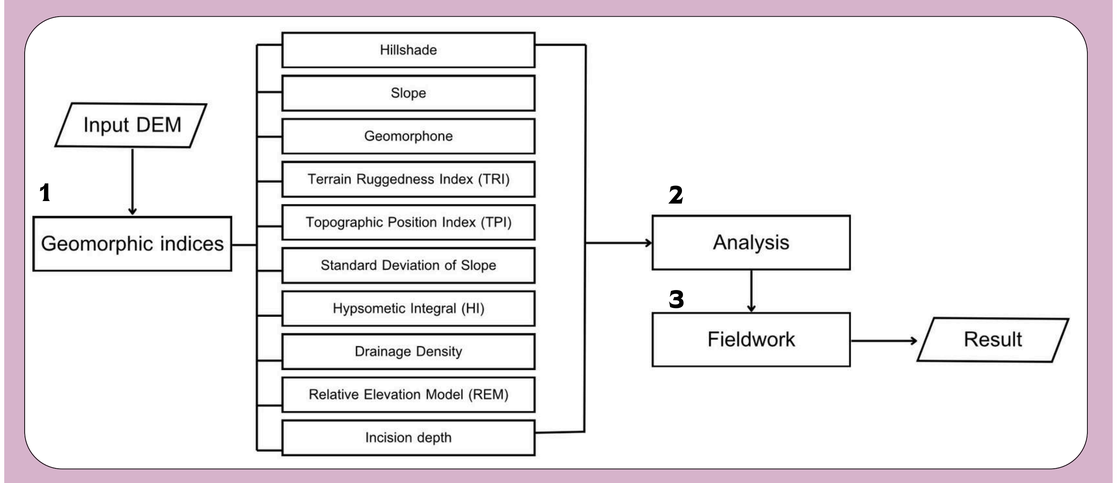


Figure 3 Flowchart showing the three operational procedures.

Results

Based on the analysis of 10 geomorphic indices combined with field morphology observation in the western Pai Basin, Pai District, Mae Hong Son Province, the evidence indicates that the first set of alluvial deposits (Set 1) exhibits a higher evolutionary sequence, or a more mature geomorphic age, compared to the second set (Set 2).

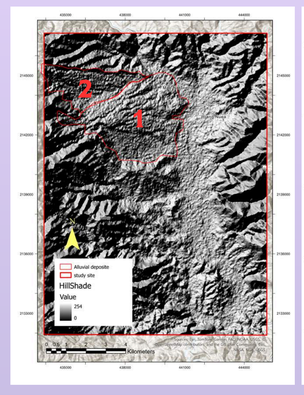


Figure 4 Analysis results using the Hillshade method

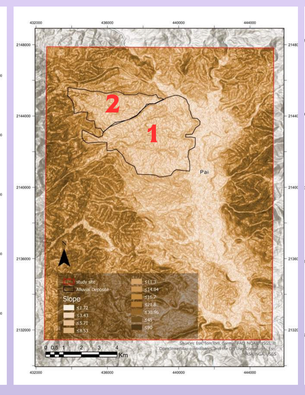


Figure 5 Analysis results using the Slope method

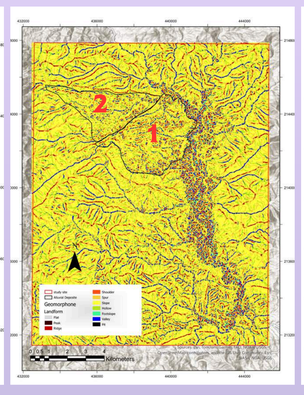


Figure 6 Analysis results using the Geomorphon method

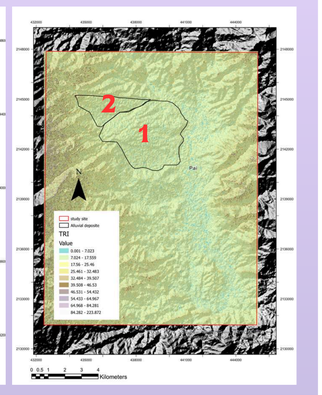


Figure 7 Analysis results using the TRI method

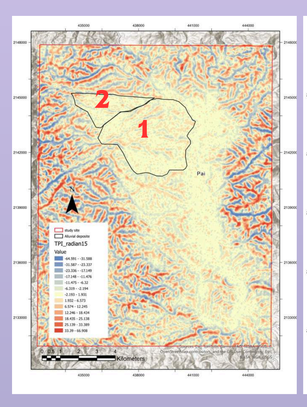


Figure 8 Analysis results using the TPI method

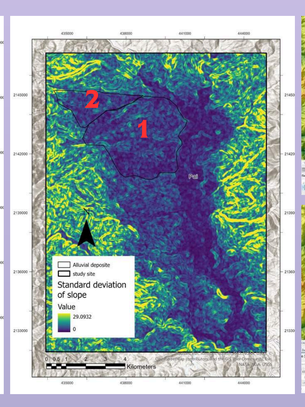


Figure 9 Analysis results using the Standard Deviation of Slope method

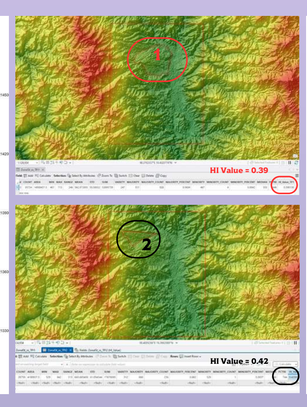


Figure 10 Analysis results using the HI method

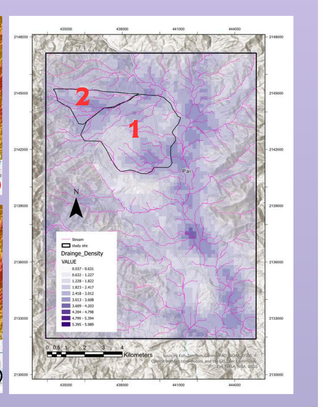


Figure 11 Analysis results using the Drainage density method

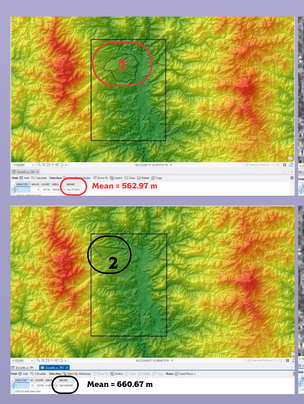


Figure 12 Analysis results using the REM method

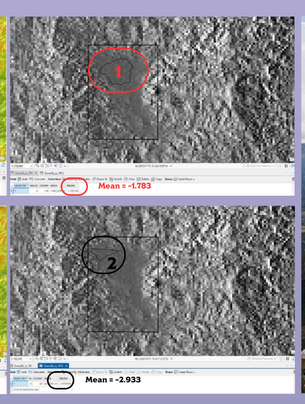


Figure 13 Analysis results using the Incision depth method



Figure 14 Wide-angle photograph of an alluvial deposit. UTM Coordinates: 47Q 442870 2139657, Wat Phra That Mae Yen, Mae Hi Sub-district, Pai District, Mae Hong Son Province (looking West)

Conclusions

- Identify two distinct types of alluvial deposits. The first type (Set 1) is characterized by a radial shape, while the second type (Set 2) exhibits a pie-shaped triangular morphology.
- Alluvial deposits Set 1, being radial-shaped, is geomorphically older than the pie-shaped Set 2.
- Set 1 is in the 'Old Stage' of development, where significant sediment mass has been eroded. This erosion is reflected in lower values of both the Relative Elevation Model (REM) and the Hypsometric Integral (HI), resulting in a highly dissected fan surface.
- Alluvial deposits Set 2 is in the 'Mature Stage,' retaining a thicker sediment mass than Set 1. However, it is currently experiencing deep incision triggered by active faulting.

References

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