Morphotectonic Analysis Along Eastern and Western Fault Segments of Phrae Basin, Phrae Province

Author : Ms. Choltida Jaichalao 650510405
Advisor : Asst. Prof. Dr. Pichawut Manopkawee
Independent study in geology 205499
Department of Geological Sciences, Faculty of Science, Chiang Mai University

Abstract

The Thoen Fault Zone (TFZ) is a series of normal faults trending in a northeast-southwest that extends through Phrae and Lampang Provinces, with a total length of approximately 180 km. While the overall tectonic activity of the TFZ is categorized as moderate to high, its activity varies spatially, as evidenced by seismic events and distinct topographical features. This study evaluates the relative tectonic activity along the eastern and western fault segments of the Phrae Basin and its impact on geomorphic evolution. The assessment was conducted across 23 sub-basins using five geomorphic indices: Stream Length-Gradient Index (SL), Mountain Front Sinuosity (Smf), Basin Shape Index (Bs), Asymmetry Factor (Af), and Valley Floor Width-to-Height Ratio (Vf). By controlling lithology and precipitation variables, the Relative Index of Tectonic Activity (RIAT) was calculated to classify the tectonic activity levels within the study area. The results indicate varied tectonic activity across the sub-basins: Class 1 (Very Low) accounts for 26.09%, Class 2 (Low) for 43.48%, Class 3 (Moderate) for 17.39%, Class 4 (High) for 8.70%, and Class 5 (Very High) for 4.35%. The RIAT values range from 4.20 in the Nam Mae Thang sub-basin to 1.60 in the Huai Rong Pha sub-basin, with an overall average of 2.48. While many areas exhibit low to moderate activity, significantly high-activity zones were identified, particularly along the Nam Mae Thang and Nam Mae Man fault segments. Conversely, segments such as Huai Hom, Huai Bo Thong, Doi Pha Klong, and Huai Nam Mae Sang show lower activity levels. The observed spatial inconsistency in tectonic activity between the eastern and western fault segments is attributed to differences in fault types and slip rates across the region. This study provides a critical framework for assessing fault activity and as a model for morphotectonic analysis in other intermontane basin environments.

Objectives

- To assess the relative tectonic activity of the eastern and western fault segments of the Phrae Basin using geomorphic indices.
- To examine the relationship between tectonic activity and landscape susceptibility in the eastern and western fault segments of the Phrae Basin
- To develop a tectonic hazard susceptibility map for the study area.

Study Area

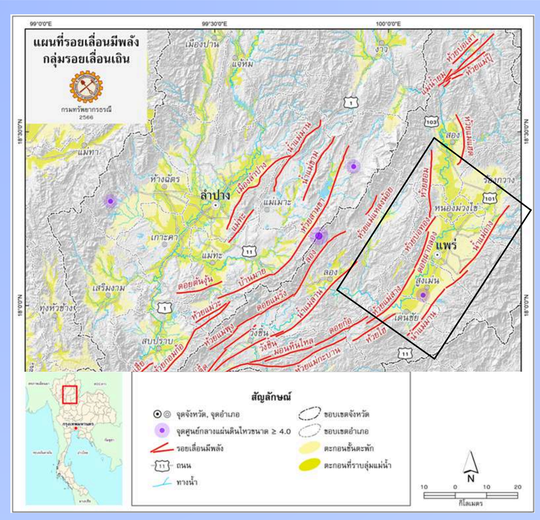


Fig 1. Map of the active Thoen Fault Zone in the Phrae Basin (Department of Mineral Resources, 2023)

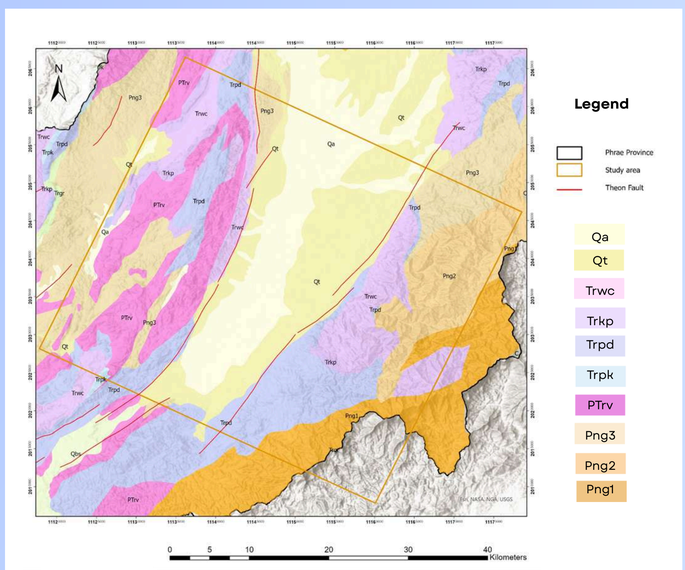
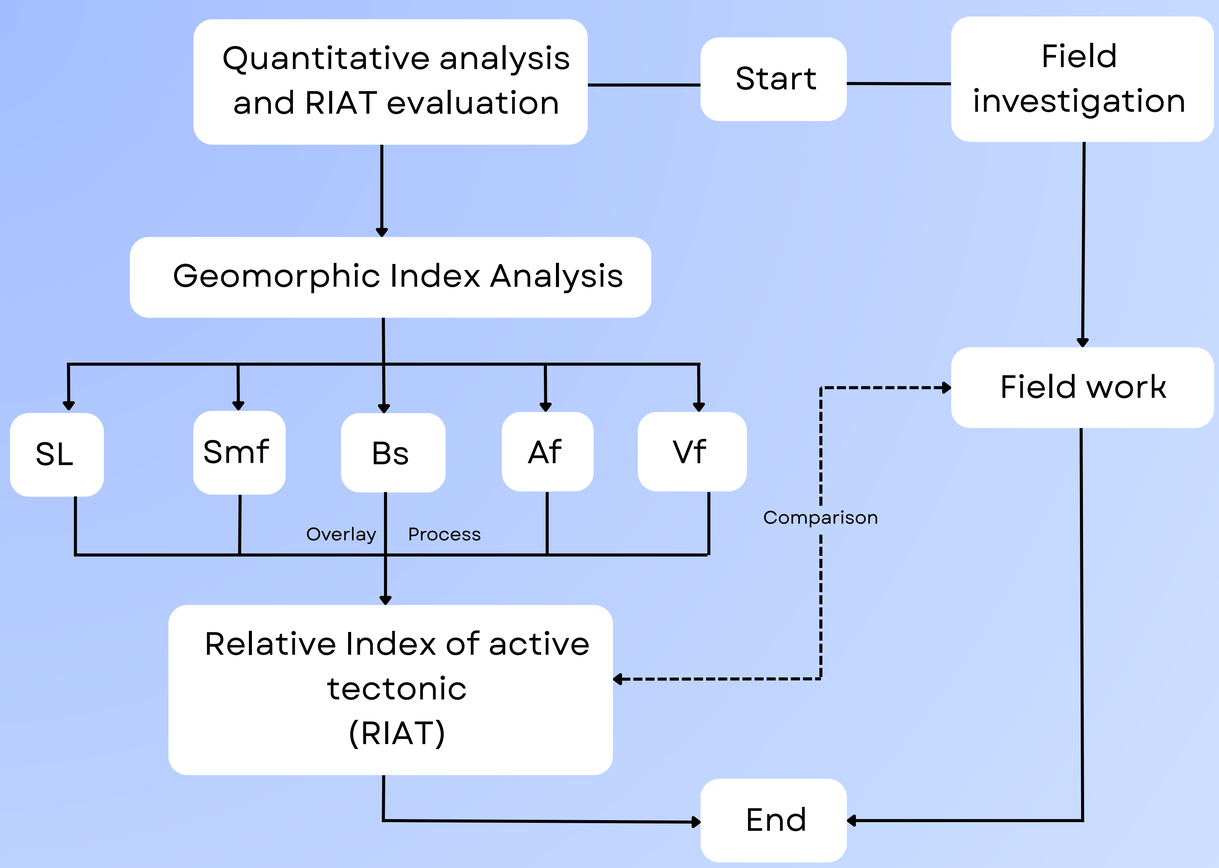
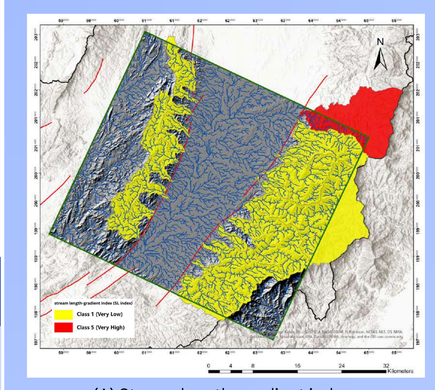


Fig 2. Geological map of the study area (Department of Mineral Resources, 2020)

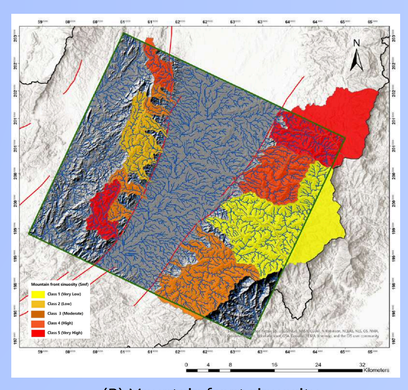
Methodology



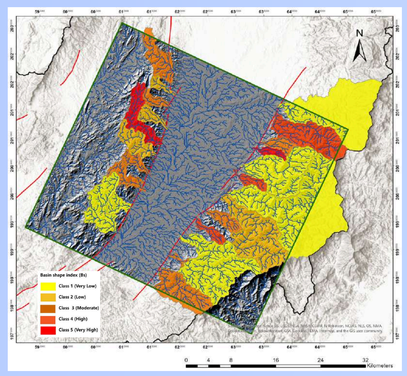
Results



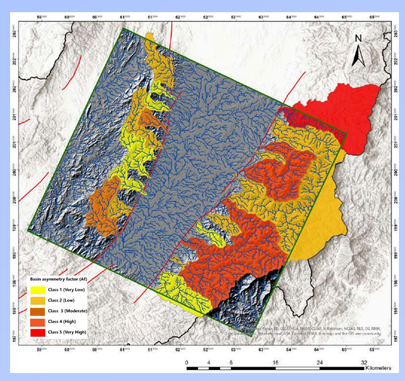
(A) Stream length-gradient index



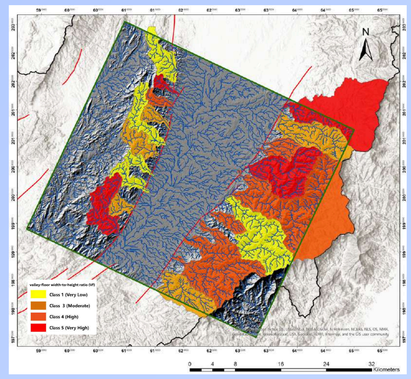
(B) Mountain front sinuosity



(C) Basin shape index



(D) basin asymmetry factor



(E) Valley-floor width-to-height ratio

Fig 3. Class of geomorphic indices in study area

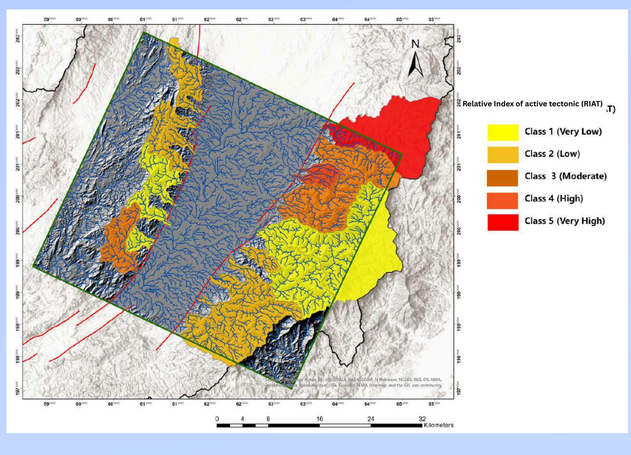


Fig 4. Class of RIAT in study area

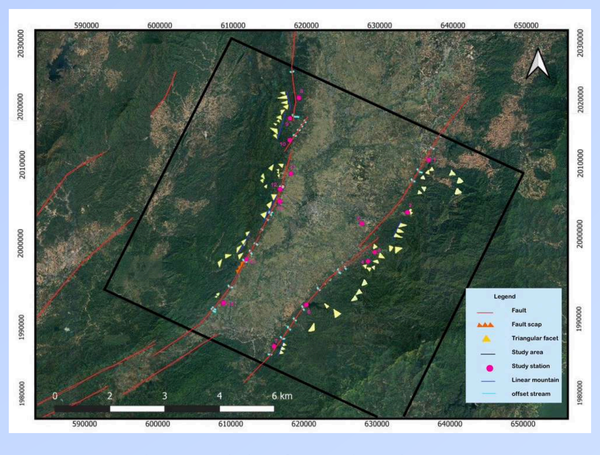


Fig 5. Morphology features in study area

Conclusion

- Most sub-basins in the study area show low to moderate tectonic activity based on geomorphic index analysis.
- The western segment generally exhibits tectonic activity ranging from moderate to very low.
- The eastern segment shows a wider range of tectonic activity, from very high to very low.
- These variations correspond to the distribution, number, and morphology of geomorphic features observed in the basin.
- This approach can be applied to morphotectonic studies in other regions with similar geomorphic characteristics

References

- Pourali, M., Hosseinzadeh, S. R., & Akbari, M. (2020). Quantitative analysis of relative active tectonics using geomorphic indices in Band-Golestan basin, northeastern Iran. Spatial Information Research, 28(3), 419–429.
- Keller, E. A., & Pinter, N. (2002). Geomorphic Indices of Active Tectonic. In McConnin, R. (Ed), Active tectonic Earthquakes, Uplift, and Landscape. (p. 121-147). United States of America: Prentice - Hall, Inc.