

Extensional Fracture Spatial Distribution of Samui Granite Using CorrCount Software

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Abstract

Fracture networks are crucial for understanding tectonics history and fluid flow characteristics. This study analyzed fracture distributions in granitic rock at five waterfalls consisting of Na Muang2, Hin Lat, Mountain, Lat Wa Non, and Khun Sri waterfall on Koh Samui, Surat Thani province, using the Normalized Correlation Count (NCC) technique through systematic scanline survey and the CorrCount software. Three distinct spatial fracture patterns were identified as clustered (NCC > 1), anti-clustered (NCC < 1), and regularly spaced (NCC ≈ 1). Clustered patterns predominantly occurred near major NE-SW and NW-SE lineaments with faulting features, such as slicken-line and pseudo-tachylyte, mainly observed at the Lat Wa Non and Khun Sri waterfalls. Anti-clustered and regularly spaced patterns appeared away from the major structures, particularly at the Mountain waterfall and central section of Lat Wa Non. Spatial correlation analysis revealed power-law decay decreasing trend in clustered regions and periodic spacing in regularly spaced zones. These patterns reflect the tectonic evolution of Koh Samui, indicating areas of concentrated deformation that might have influenced by the Khlong Marui and Ranong Fault systems, while regularly spaced patterns suggest uniform stress distribution. This quantitative analysis offers new insights into the structural evolution of the Gulf of Thailand region and serves as a framework for future studies on fluid flow in crystalline rock.

Introduction

Rock fractures play a vital role in Earth's processes, influencing plate boundaries, earthquakes, volcanic activity, and fluid movement. Their spatial arrangement affects permeability and structural stability, impacting resource extraction, environmental protection, and hazardous material storage. However, direct subsurface fracture data is costly and complex to obtain, requiring advanced techniques like borehole imaging and geophysical surveys. Surface methods, such as outcrop analysis and drone photogrammetry, offer cost-effective alternatives but are limited to surface observations.

The Normalized Correlation Count (NCC) method, implemented via the CorrCount program, provides an approach to analyzing fracture distributions by quantifying clustering and spacing in existing datasets. This method reduces the need for extensive data collection while enhancing interpretations of subsurface structures, tectonic histories, and fluid pathways. This study applies NCC to compare fracture distributions in Doi Suthep (northern granite) and southern Thailand, aiming to expand datasets, refine methodologies, and deepen insights into regional geology.

Study Area



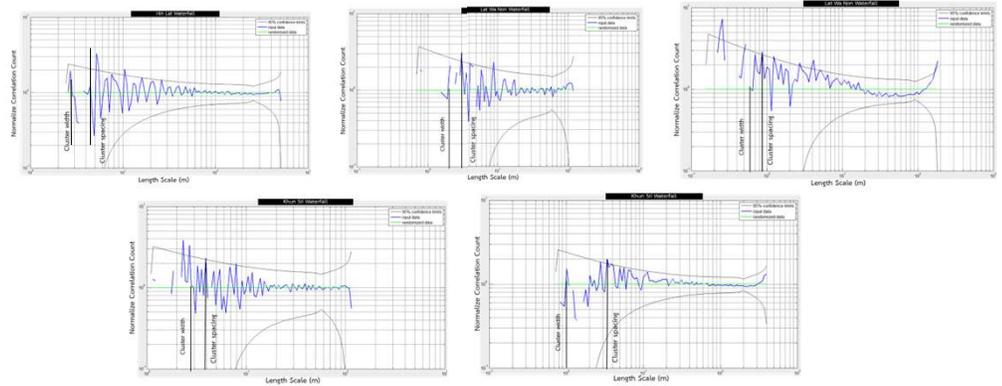
Results

Geological Observation

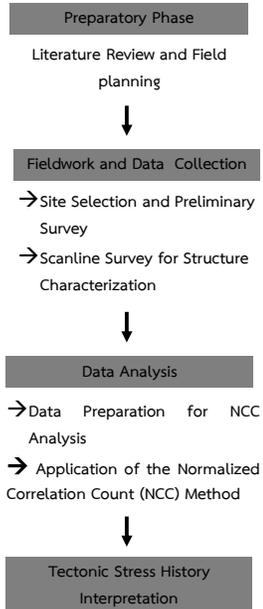


Structural features documented during field investigations reveal a complex deformation history, characterized by brittle deformation with multiple joint sets-oriented ESE-WNW (~145°), SE-NW, and N-S (~170°), and ductile deformation evidenced by shear zones, mineral-filled fractures, asymmetric structures indicating shear sense, and curved or offset quartz veins, highlighting their implications for regional tectonic evolution

CorrCount Software



Methodology



Normalize Correlation Count

Input Data

- ❖ Fracture Position (x)
- ❖ Fracture kinematic aperture (y)
- ❖ Scanline Length (L)
- ❖ Number of Fractures (N)

Key Calculations

Correlation Sum

$$C(\lambda_h) = \frac{2}{N(N-1)} \sum_{k=1}^{N-1} \sum_{j=k+1}^N H[\lambda_h - (x_k - x_j - y_j)]$$

λ_h is the length scale
 x_k and x_j are the positions of fractures k and j
 y_j is the kinematic aperture of fracture j
 H is the Heaviside step function

Correlation Count

$$c(\lambda_h) = C(\lambda_h) - c(\lambda_{h-1})$$

Random Correlation Count

$$c_{random}(\lambda_h) = \frac{\lambda_h - \lambda_{h-1}}{L} (2 - \frac{\lambda_h + \lambda_{h-1}}{L})$$

Final NCC

$$NCC = \frac{c(\lambda_h)}{c_{random}(\lambda_h)}$$

NCC > 1 : positive correlation (more clustered than random)
 NCC < 1 : anti-correlation (less clustered than random)
 NCC = 1 : random arrangements

Conclusion

This study applied the Normalized Correlation Count (NCC) technique and CorrCount software to analyze the fracture distribution in Samui Granite. Three primary fracture patterns were identified: clustered, predominantly near major fault structures such as Lat Wa Non and Khun Sri waterfalls; anti-clustered; and regularly spaced, found in areas farther from major structures.

The results highlight the tectonic evolution of Koh Samui, where clustered fractures indicate deformation influenced by the Khlong Marui and Ranong Fault systems, while regularly spaced patterns suggest uniform stress distribution. This study enhances the understanding of the geological structure of the Gulf of Thailand and provides a framework for future research on fluid flow in crystalline rock formations.

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