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*Editorial*

# Earthquake Geology of Plate Margins and Plate Interiors: Integrating Classical Methods with New Approaches

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Earthquakes are extremely complex natural phenomena that have been part of the Earth's tectonic history ever since the crustal plates were formed and started wandering with respect to each other. Earthquakes are one of the most destructive phenomena associated with the tectonic processes that mankind has encountered; it includes sudden violent shaking or rolling of the Earth's surface caused by a release of energy in the lithosphere such that it generates elastic waves with different frequency content and amplitudes. Seismic waves propagate through the Earth's crust; when they reach the surface with sufficient energy they can cause structural damage, casualties, and disruption to infrastructure. Human casualties and infrastructure damage are often exacerbated by poor building standards and a lack of seismic hazard planning, as demonstrated by the 2010 Haiti (M 7.0), 2015 Nepal (M 7.8), and 2026 Venezuela earthquakes (M 7.5), all of which admittedly occurred in challenging tectonic environments. Therefore, it is imperative to better understand the causes and occurrences of earthquakes to improve seismic hazard assessment. To achieve this, scientists and researchers combine multi-disciplinary tools across various spatial and temporal scales, focusing heavily on geological controls and local site effects. This Special Issue brings together key studies highlighting such contemporary practices and advancements with the objective of addressing enhanced earthquake monitoring, modeling, and regional hazard assessment. It comprises nine separate articles that capture the diversity in techniques applied across diverse tectonic domains, advancing current knowledge of earthquake and tectonic processes:

1. Geological Controls & Subduction: Namdarsehat et al. [1] review the Makran accretionary prism, created by the Arabian plate subducting under the Eurasian plate, emphasizing geological influences on seismicity.
2. Artificial Intelligence in Risk Reduction: Plevris [2] explores AI's transformative role in early warning systems, real-time structural health monitoring, dynamic multi-hazard risk assessments, resilient design, and personalized public preparedness.
3. Volcanic & Fault Monitoring: Karakonstantis and Vallianatos [3] highlight volcano-tectonic connections and the need for closer monitoring in the Santorini Island Volcanic Complex.
4. Archaeoseismology: Kázmér and Gaidzik [4] map historic high-intensity earthquake damage along a <400 km segment of the Periadriatic Fault system, confirming ongoing tectonic activity.
5. Spatiotemporal Patterns: Mantovani et al. [5] evaluate major earthquakes from 1600–2024 to trace short-term tectonic connections over decades to centuries.

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6. Fault Mechanics: Singh et al. [6] show how compressional step-overs concentrated stress during the 2022 Afghanistan earthquake (Mw 6.0–6.2) along the North Waziristan-Bannu fault system.
7. 3D Velocity Modeling: Liu et al. [7] construct a 3D shear-wave velocity model beneath Indonesia, detailing slab segmentation along the Sunda–Java Trench driven by lithospheric age and plate interactions.
8. Strain & Slip Rates: Geng et al. [8] analyze the Da-Liang-Shan Fault Zone, revealing heterogeneous deformation caused by the eastward extrusion of the Tibetan Plateau.
9. Unmapped Seismic Hazards: Buphu et al. [9] identify a previously unmapped strike-slip fault that triggered the 2019 ML4.9 Wang Nua earthquake in Thailand, underscoring the risks posed by unknown faults.

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