9th FTSES 2024 Penghu, Taiwan

9th France-Taiwan Symposium in Earth Sciences
Session: General Session

Investigating the temporal seismic velocity variations in the mud volcano area of SW Taiwan

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The autocorrelation functions of observed ambient noise signals can be treated as a zero-offset reflection response beneath the seismic station, providing local subsurface structural information. This technique utilizes the seismometer as both a virtual seismic source and receiver, eliminating the need for seismic events or artificial sources, saving exploration costs, and is also effective in aseismic zones. Previous studies have already used autocorrelation to analyze the reflected response of body waves, revealing the distribution of different structural boundaries such as fracture zones, mineral veins, bedrock, and Moho discontinuity. Additionally, the method is also applied to monitor temporal changes in seismic velocity (dv/v). In the orogenic front of SW Taiwan, the development of active structures has two interpretations, including the development of mud diapirs and the pop-up structure caused by thrust and back-thrust faults. However, the presence of mud diapirs in this region is highly debatable. To investigate the complex structure in this area, portable three-component seismometers were deployed in the mud volcano area of SW Taiwan, surrounded by the Chishan and Chegualin faults. The results of dv/v estimation show a sudden velocity drop right after the earthquake which occurred on September 17th, 2022, in Taitung—suggesting that the velocity variation may related to the temporal opening of the fractures or the changes in pore pressure, caused by the strong ground motion. However, due to the lower impedance between the mud diapirs and the mudstone layer, it's challenging to retrieve the reflection signals from the mud diapirs. A further series of investigations are needed to enhance our understanding of this dynamic region.

Keywords: autocorrelation function, temporal velocity variation, ambient noise