9th FTSES 2024 Penghu, Taiwan

9th France-Taiwan Symposium in Earth Sciences
Session: Earthquake and Seismotectonics

Mud volcanoes monitoring in SW Taiwan to investigate possible relationship with transient tectonic deformations

Agnes Helmstetter[1], **Erwan Pathier[1]**, Maryline Le Béon[2], Wen Strong[3], Laurent Metral[4], Kai-Feng Chen[2], Yen-Hiang Gao[3], Chia-Nan Lai[3], Jean Vandemeulebrouck[4]

[1] Univ. Grenoble Alpes, CNRS, ISTerre
[2] NCU, Applied Geology
[3] NCCU, Department of Earth and Environmental Sciences
[4] Univ. Savoie Mont Blanc, CNRS, ISTerre

The South-Western part of Taiwan is a fold-and-thrust belt with a high surface deformation rate (centimetric relative displacements within a few km per year) but a very weak seismic activity at shallow depth (< 8km) in the sedimentary cover. The presence of a clayey formation (Gutingkeng formation), a few kilometers thick with overpressured fluids attested by the presence of active mud volcanoes, raises the question of whether, in this region, part of the fold-and-thrust belt growth could be dominated by aseismic deformation rather than seismic increments. This question is addressed by the French-Taiwan project Active-SW "Active tectonics and deformation mechanisms in fold-and-thrust belts: learning from Southwestern Taiwan", which is funded by the French national Research Agency (ANR) and NSTC National Science and Technology Council from Taiwan (NSTC).

Here we present one approach to address this problem which is to continuously monitor the activity of some mud volcanoes to determine whether fluids circulation might be associated with transient deformations measurable by geodesy. Indeed, in this area tens of mud volcanoes often located near active faults traces are known to be active. Previous geochemistry studies have suggested a fluid source several km deep in the Gutingkeng formation. Fluid circulation toward the surface probably takes place along active faults and could therefore be correlated with their activity that is predominantly aseismic. A first step is to establish sufficiently long timeseries of activity on several mud volcanoes, and to try, by comparing volcanoes far enough apart, to distinguish local variations in the dynamics of these volcanoes from possible variations of deeper origin.

The SW Taiwan mud volcanoes have vents with diameter typically between 0.1 meters and a few meters and depth up to a few meters. They have more or less regular "eruption" phases with bubbling activity associated with the collapse of rising bubbles with methane rich gas. The recurrence interval varies between about 15 s and 1 hr between volcanoes and also show progressive temporal changes at each site. We have instrumented some of these mud volcanoes with different types of instruments: seismometers, inclinometer, cameras, piezometer, hydrophone. Our objective is to monitor the temporal changes in eruption energy and recurrence time and to understand the influence of external factors such as earthquakes, slow slip events, precipitations, atmospheric pressure and tides on the dynamics of eruptions.

Both seismometers and hydrophones allow the detection of bubbling phases that produce ground vibrations with a broad spectrum (3-20000 Hz). Bubbling phases are preceded by an increase in mud level in the crater that can be detected by a piezometer. We will present a method to quantify the mud volcanoes activity based on results obtained at one mud volcano (Hsiao Gun Shui) that has been instrumented for more than one year with a seismometer. The

results show temporal fluctuations between time periods with rather regular inter-eruptions phases and short recurrence time (about 17 s) and times with more irregular and less energetic eruptions separated by a longer inter-event time of about 35 seconds.

Keywords: SW Taiwan, mud volcanos, aseismic deformation, active faults