Strainmeters observations at the Rochefort karstic underground laboratory

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In order to monitor the hydrological strain forces of the karst micro fissure networks and local fault activities, six capacitive extensometers were installed inside a karstic cave near the midi-fault in Belgium. From 2004 to 2008, the nearby Lomme River experienced several heavy rains, leading to flooding inside the Rochefort cave. The highest water level rose more than thirteen meters, the karstic fissure networks were filled with water, which altered the pore pressure of the cave. The strain response to the hydrological induced pore pressure changes are separately deduced from fifteen events when the water level exceeded six meters. The strain measured from the extensometer show a linear contraction during the water recharge and a nonlinear exponential extension releasing during the water discharge. The sensitivity and stability of the sensor are constrained by comparing continuously observed tidal strain waves with a theoretical model. Finally, a local fault deformation rate around 0.03 ± 0.002mm/yr is estimated from more than four years' records.

The Rochefort karstic cave is located at a relatively stable continental region where the seismicity and the risk of seismic hazard are low. Palaeoseismology studies indicate that a maximum 0.3mm/yr deformation rate could account for coseismic effects from three large earthquakes during the Pleistocene and Holocene. However, the recently growing stalagmite and falling rocks inside the cave, strongly evidence that the identified faults are active and expending in the NW-SE direction which are driven by the regional tectonic force. But the continuous GPS measurements show motions less than 1mm/yr which is still inside the error bar. Hence, to constrain the results provided by the geological investigations, an in-situ strain measurement experiment was conducted since 1999.

Beyond the 14 interesting about the local faults activities, the experiment is also focusing on providing information about the hydrological impact on the formations process of micro fissure networks and karstification. There are two kinds of water flux which contribute to the process, the slow seepage and fast flow drainage. To monitor the strain inside a cave can help improving the understanding the of the karst structure, especially it's porosity and fissure networks. Six self designed extensometers were set up near two identified faults inside the Rochefort cave, two aluminum extensometers No.1 (E1) and No.2 (E2) in 1997 and four Pyrex aluminum extensometers No.3 (E3), No.4 (E4), No.5 (E5), and No.6 (E6) in 2000. The hydrological strain forces, local faults activity, and the secular earth strain were detected from the recording of the extensometers.