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Displacement patterns obtain from monitoring at the Gascons rockslide, Gaspé Peninsula, Canada

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Along the coast of the Gaspé Peninsula, in Quebec, Canada, a railroad runs directly across an active rockslide involving a volume of 0.5 Mm^3. First geotechnical studies in the early 1990's revealed an important fissures network and significant displacements of up to 13 mm/month. In July 1998, a moving rock compartment of approximately 500 m^3 fell down the cliff and caused damages to the railroad interrupting the traffic for several days. The failed rock mass and the railroad were situated approximately at the same elevation (60 m above sea level) as a result, the granular material supporting the tracks followed the block down the cliff.

A near real time monitoring system has been installed in 2009 and 2010 in order to develop an early-warning system. The instrumentation consists of 12 crackmeters, nine piezometers installed in three boreholes reaching a depth of 50m, one tiltmeter, two 50 m long accelerometers strings (Shape Accel Array, SAA) in vertical boreholes, one 60 m horizontal accelerometers string (SAA) and a weather station. Manual reading instruments are installed on site and consist of an extensometer network of 40 rods, an inclinometer tubing of 60 m and six targets to be surveyed with a total station. Moreover, the remote sensing technique PTA-InSAR is applied to monitor the displacement of the rock slope. For this purpose, 20 permanent reflectors have been installed. After more than a year of acquisition, some interesting trends are observed and some interpretation can be derived for the post-failure behaviour of this slow moving rockslide. The kinematic behaviour is complex. The slide is composed of multiple compartments that are individualised to a more or less important degree. They are delimited by sub-vertical fissures, with widths reaching 10 m. The slide can be separated into three parts: the lower part including the cliff area, the middle part which is the railroad cut and right-of-way, and the upper part above the railroad. As of now, there is a clear difference between movement patterns in the lower and upper part.

The upper part is showing mostly regular displacement patterns with displacement rates of 5 to 40 mm/year. Most of the instruments in this sector are read manually, so the frequency of reading might not be sufficient to detect short accelerations and decelerations. Nevertheless, one accelerometer string, read every 6 hours, shows a regular trend except for two episodes in fall 2010. Two step-like displacements of 7 and 5mm were detected by the sensors on an overall displacement of 40 mm in a year. In the lower part and in the railroad right-of-way the movements are not so regular and show episodic or chaotic patterns. The fissures are closing and opening, which is the result of unsynchronized movements from the blocks on each side of the fissure.

Although the main cause of sliding may be related to shore erosion, the actual higher rate of displacement takes place in the upper part of the slide. Piezometric results from the upper part are showing important pressure variations related to precipitation and snowmelt. This phenomenon is not observed in piezometers installed near the cliff. Even though the monitoring system is recent, the data set is giving surprising information and an overall seasonal trend can be defined, with slower rates in the summer months. Fine analysis of the kinematic behaviour of the slide will lead to a better evaluation of risk associated with this active rockslide.