combining Seismic methods to characterize sensitive clays in the saguenay region, Quebec, canada

*Maxime Claprood, Université du Québec à Chicoutimi, Chicoutimi, QC, Canada*

*Jashia Islam, Université du Québec à Chicoutimi, Chicoutimi, QC, Canada*

*Antonin Montreuil, Université Laval, Québec City, QC, Canada*

*Martin Blouin, Geostack, Quebec City, QC, Canada*

*Ali Saeidi, Université du Québec à Chicoutimi, Chicoutimi, QC, Canada*

Sensitive and quick clays are common in Norway, Sweden and Eastern Canada. They are characterized by remoulded undrained shear strength much lower than their intact undisturbed shear strength. In the Saguenay region of Eastern Canada, sensitive clays related to the Laflamme Sea invasion are responsible of several retrogressive landslides and pose security issues in the region. Data from direct sampling, laboratory tests and seismic cone penetrating tests (sCPT) have been acquired over the years to study the nature and properties of sensitive clays in the Saguenay region. While these methods provide reliable quantification of the physical properties of clays at specific locations, they fail at characterizing the spatial variations of sensitive clays horizons. Seismic refraction, active and passive MASW, and high-resolution seismic reflection surveys have been completed in the summer of 2024 at 2 sites (La Baie and Saint-Jean-Vianney) in the Saguenay region to detect low shear-wave velocity zones associated with the presence of sensitive clays.

The La Baie site is located 500 meters away, and at the same topographic elevation, from the location of a landslide that occurred in 2021. A 175-meter-long seismic refraction and MASW surveys was acquired using 48 4.5Hz-geophones with a spacing of 1.5 meters. Preliminary interpretation of the seismic data at La Baie suggests the bedrock is located at a depth varying between 10 to 15 meters, and that the shear-wave velocity of clays can as low as 100 m/s. The Saint-Jean-Vianney site was home of a major landslide in 1971, causing the death of 31 persons and substantial material damages. The 1971 landslide scar is located within a larger and older scar evidenced by LIDAR data. The acquisition of a 140-meter-long seismic refraction and MASW data (48 4.5Hz-geophones with 1.5 meter spacing) was conducted at the limit of the oldest scar, approximately one kilometer away from the edge of the most recent landslide, for investigating the physical properties of undisturbed clays. A 2-kilometer-long seismic reflection survey was also recorded at the site to detect any variation in the elastic properties of clays with distance to the recent landslide scar. Initial interpretation of seismic refraction and MASW data suggests that the bedrock is not reach with the employed configuration and is located at depth greater than 30 meters. In depth interpretation of MASW data, using both passive and active data source, is needed to get a more detailed estimation of the variation of shear wave velocity with depth and position. In the next phase of the project, electrical resistivity tomography (ERT) and transient electromagnetic (TEM) data will be recorded to analyse if a decrease in electrical resistivity is induced by leaching of salt ions common in sensitive clays such as those present in the Saguenay region.