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ON SHAKY GROUND

Morell at Esquimalt Lagoon. UVIC PHOTO SERVICES

UVic-led research reveals a new earthquake risk lurking beneath the Victoria region

by Vimala Jeevanandam

No one was expecting the earthquake that shook Christchurch, New Zealand, in September 2010. The fault that ran just 10 kilometres from the city's centre had never been identified. And while there were other active faults in the area, the Greendale fault had shown no detectable seismic activity.

But the earthquake it created, along with subsequent aftershocks, caused 185 casualties and as much as $37 billion dollars in damage.

University of Victoria geologist Kristin Morell and her colleagues have now discovered a similar active fault that runs about two kilometres near downtown Victoria, including the Esquimalt Lagoon area and just offshore from James Bay and Clover Point.

Until recently, this Leech River fault was believed to be inactive. But Morell and her team have discovered that it has caused at least two major earthquakes since the last glaciation over 15,000 years ago, making it an active fault and a potential hazard.

The Greendale fault in New Zealand and the Leech River fault in Victoria's back yard create a unique challenge for researchers like Morell. Unlike the better-known Cascadia megathrust fault predicted to cause the earthquake referred to as the "Big One"—which is active every 300 to 500 years—crustal faults can display no detectable seismic activity for thousands of years.

Instead, Morell and her colleagues must read the trail of clues that earthquakes leave behind long after they've ended.

"Landscapes hold the accumulation of effects of earthquakes over thousands of years," says Morell. "By looking at topographic features, we can see how past earthquakes have shaped rivers or mountains. We can use this information to uncover how big past earthquakes were and how long ago they happened."

But the lush plant life that makes Vancouver Island uniquely beautiful also obscures much of the topography. Morell selects the sites for extensive field data collection using a mapping system—known as Light Detection and Ranging (LiDAR)—that emits laser pulses from helicopters. It can be used to visually strip away vegetation and reveal precise topographical features.

"Now that we've identified that the Leech River fault is active, the next step is for us to nail down exactly when and how big the most recent earthquakes were," says Morell, whose initial study was supported by the Natural Sciences and Engineering Research Council. She now hopes to collect more extensive LiDAR information to determine the history of similar faults throughout Vancouver Island, and the hazards they may present.

In another similar project, Morell is identifying faults in the northwest Himalayas, an area that is home to over 10 million people. She's looking for faults that could cause big earthquakes, similar to or larger than the one in Nepal in April 2015 that killed nearly 9,000 people. With some of the tallest mountains in the world and large swaths of land inaccessible for field data collection, Morell must rely heavily on remote sensing satellite data to analyze the landscape.

Whether in the Himalayas or in Victoria, communities must decide how to respond to the hazards Morell uncovers. In New Zealand, nearly all of the fatalities happened when three office buildings that didn't meet modern seismic standards collapsed during an aftershock.

"My hope is that this information will allow us to be informed, rather than alarmed," says Morell. "When we better understand the risk posed, there's a lot we can do to keep our communities safe."

EDGEWISE

Victoria is the second city in BC to commission a report detailing the seismic vulnerabilities of the area. The recently released report maps out the risks and hazards in the city's infrastructure, including the risk posed by the Leech River fault. The study also provides a number of recommendations for preparing Victoria for earthquakes. *bit.ly/2n75EUd*

Ocean Networks Canada, a UVic initiative, is developing an earthquake early warning system that would detect a Cascadia subduction earthquake as it begins and communicate a warning moments before shaking arrives. The system will link into networks of land-based sensors from other agencies including those owned by the Ministry of Transportation and Infrastructure, Natural Resources Canada and the University of British Columbia.

Morell teaches a number of undergraduate courses, including the Earth Science Field School, a 12-day summer field course that takes students around southern Vancouver Island, introducing them to mapping, traversing, sampling and familiarization with the regional geology and tectonics of the island.

To prepare yourself and your family or business for an earthquake, have an emergency kit prepared. Kits should include supplies for at least seven days without outside assistance. Learn more at *bit.ly/2mRIf6U*

UVic's School of Earth and Ocean Sciences is a pioneer and leader in an interdisciplinary approach to Earth system science in Canada, using tools and methods from a variety of core disciplines—geology, geochemistry, geophysics, oceanography and atmospheric science—to answer vital questions about the Earth and its environment.