PRF#: 56247-DNI8
Project Title: Seismicity-Enhanced Compaction in Deepwater Fine-Grained Sediments
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Co-PI name (if any), Affiliation: none

PROGRESS OF RESEARCH

The report describes the progress during grant period (09/01/2017 to 10/1/2018). The project objectives are to understand the influence of seismic energy generated by earthquakes on the compaction of fine-grained seafloor sediments. A major achievement in this period is the publication of a second journal article that has been produced under this grant: "*Submarine landslide and tsunami hazards offshore southern Alaska: Seismic strengthening versus rapid sedimentation*," published in Geophysical Research Letters, 44, doi: 10.1002/2017GL074537. The specific problem that we addressed in this article is the slope stability of the continental margin offshore southern Alaska (see Figure 1). This is a particularly vulnerable location due to the high seismicity and the very high sedimentation rates caused by glacial erosion of the coastal mountain range (St. Elias Mountains). This essentially means a large swath of loose seafloor sediments exposed to seismic shaking. Submarine slope failures can induce and/or amplify tsunamis. Tsunamis generated here can affect local areas but also locations around the entire Pacific as evidenced by the 1964 Great Alaska event. Up until recently, there were no data on the shear strength of the marine sediments to assess slope stability. We use new measurements of shear strength collected on Integrated Ocean Drilling Expedition Leg 341. Co-author Sean Gulick was a co-chief scientist on that expedition. The results reveal a lower-than-expected sediment shear strength offshore southern Alaska and thus a higher vulnerability to submarine landslide hazards (see Figure 2). The exceptional sedimentation rates in these locations are interpreted to be the primary reason for the low shear strengths.

A second key finding is more broadly that the shear strength of sediment offshore southern Alaska plots in line with a passive margin trend despite of course being on an active margin. This is surprising and important because it indicates that sedimentation rate is counteracting seismic strengthening.

Given that the Alaskan margin is capable of hosting large-magnitude earthquakes, these factors combine to make offshore Alaska one of the most susceptible regions to submarine landsliding hazards. It implies that other large fans on active margins should be expected to have similar vulnerability (e.g. Indus and Bengal fans).

During this grant period, the project has supported a graduate student to successfully complete all of Part 1 and make initial progress on Part 2. This has directly resulted in a scientific journal article, a conference paper, and 2 professional presentations.

IMPACT OF RESEARCH

This grant has been very valuable for the beginning stages of my academic career. It has given me the financial resources to support a graduate student thesis (personnel) and undergraduate student thesis. We have turned those two student thesis into peer-reviewed scientific articles in a top journal in the field. I have also presented results of the project at the Fall American Geophysical Union Meeting in Dec. 2017: Sawyer, D.E., R. Reece, S.P.S. Gulick, and B. Lenz, (2017, December), Submarine Landslide Hazards Offshore Southern Alaska: Seismic Strengthening Versus Rapid Sedimentation, abstract # NH53B-0148, American Geophysical Union Fall Meeting, New Orleans, LA, December 11-15, 2017, (Poster). I also presented a seminar at Ohio University in March, 2018: Sawyer, D.E., (2018, March), Earthquakes and Submarine Landslides on Continental Margins, seminar presented to Department of Geological Sciences, Ohio University, March 30, Athens, Ohio (Invited, Oral).This work continues to spawn follow-on work. In particular my new graduate student is working on a project that extends the original articles into another margin. I expect this work to yield a third publication in alter 2018 or early 2019.

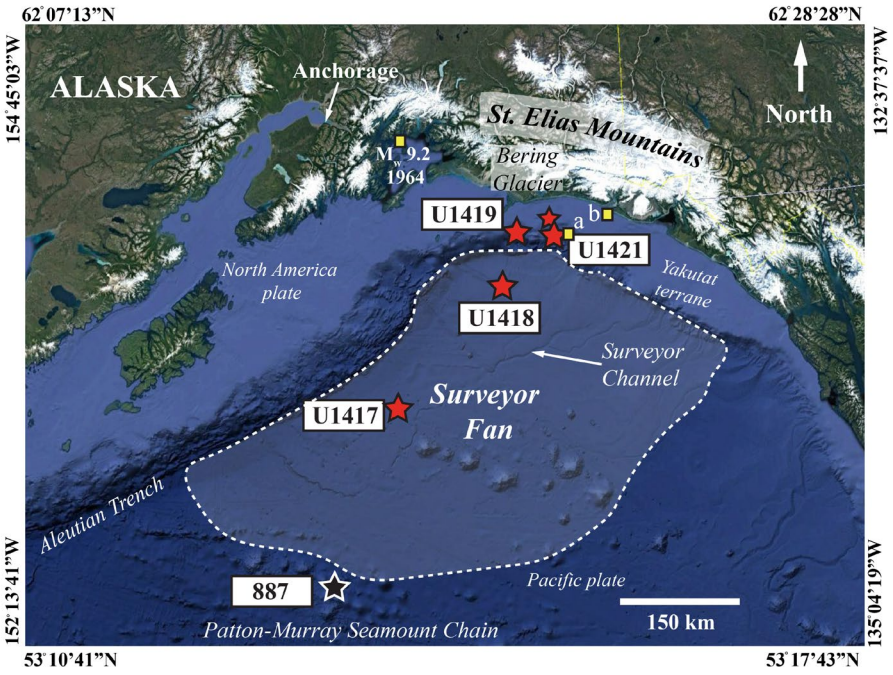

Figure 1(from Sawyer et al., 2017): Location map of study area offshore southern Alaska including the Surveyor Fan and the site locations of IODP Expedition 341 (red stars) and ODP Site 887 (black star).

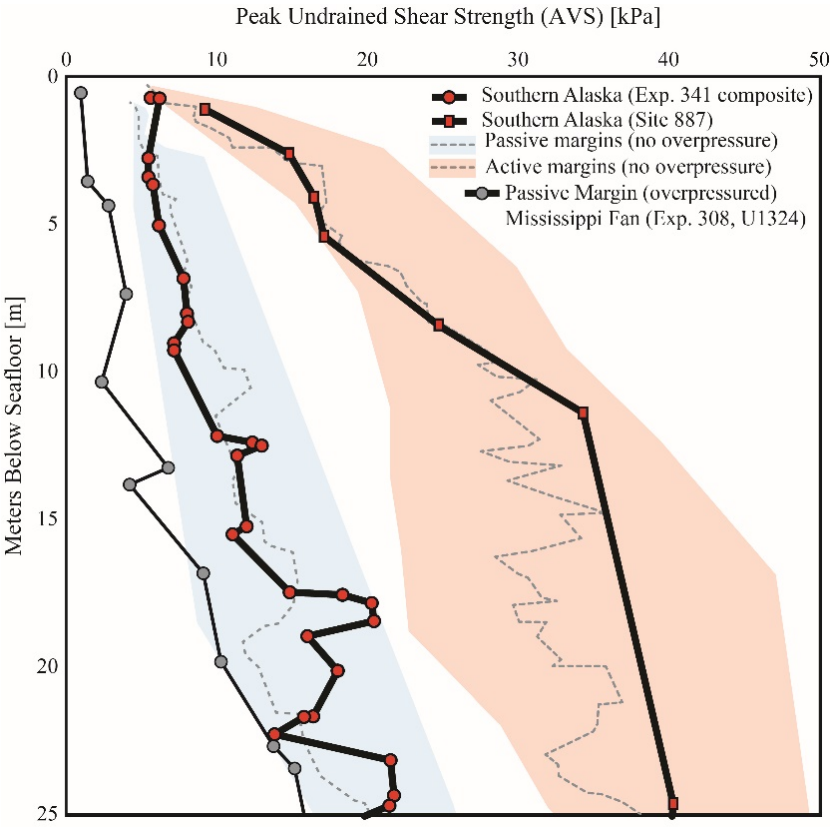

Figure 2 (from Sawyer et al., 2017): Compilation of shear strength data that shows the Surveyor Fan has lower-than-expected shear strength than other active margins. This makes the fan weaker-than-expected.