Short Report on the Field Trip of Landslides at GSA2017, Seattle

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(November 3, 2017)

On the occasion of GSA2017 annual meeting at Seattle, WA, we attended one-day pre-meeting field trip on landslides to the north of Seattle, October 21, 2017. This trip was organized and lead by Scott Anderson (USGS), Doug Clark (Western Washington University), Alison Duvall (University of Washington), Sean Lahusen (University of Washington), Geoff Malick (Western Washington University), and Dave Montgomery (University of Washington).

This trip is called “The 2016 Kirk Bryan field trip: Exploring the mechanics, frequency, and impacts of deep seated landslides in Washington State”, and focused on the evolution, and landscape-scale denudation, and can pose a substantial hazard to human life and infrastructure.

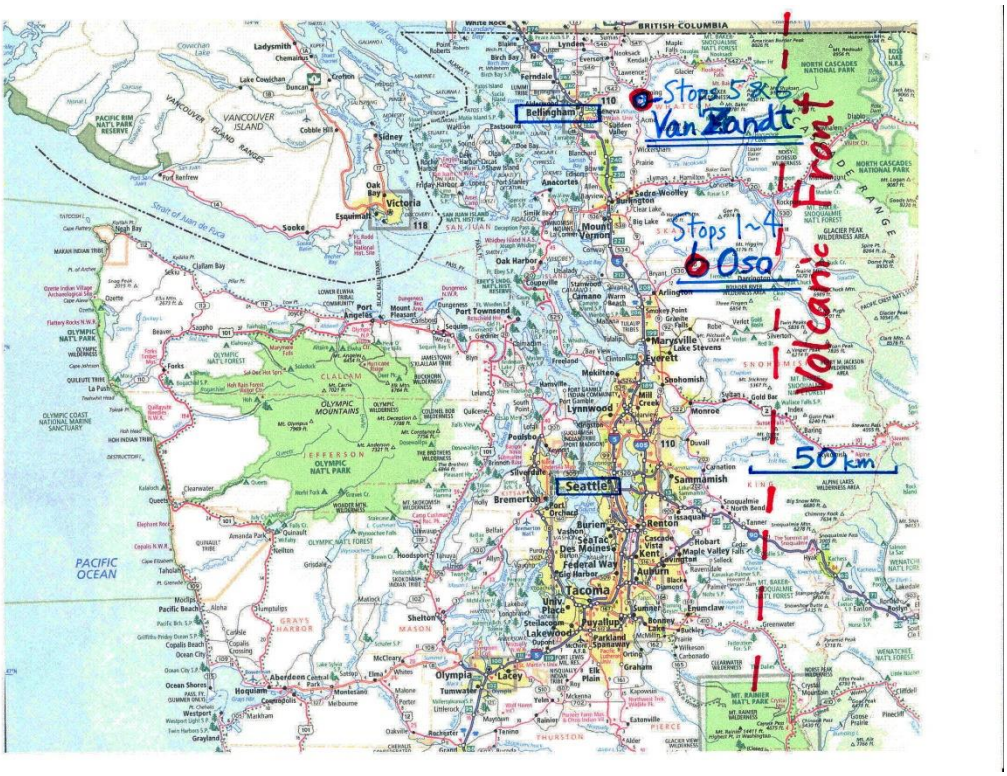

Fig. 1. Map showing Stops 1-4 at Oso landslide, and Stops 5 and 6 at Van Zandt landslide. Base map after Rand MacNally Atlas.

The followings are partly after the field guide (Anderson et al., 2017), which was published as GSA Field Guide No. 49. We visited two regions in Washington State where large landslides have been pervasive, and discussed the geologic and hydrologic conditions that promote deep-seated failures, their frequency, and the impacts of large landslides on natural and human landscapes. This area is known to be situated

in the Cascadia subduction zone, in front of the active volcanic arc chain (Fig. 1). The trip was composed of two regions, at the first series of stops (Stops 1 – 4) explored the North Fork Stillaguamish Basin, where deposits from the last glacial maximum have failed frequently over the Holocene, including the catastrophic 2014 Oso landslide. The attendees discussed the methods and results of a recently developed landslide chronology for the valley, possible mechanisms of failure and mobility of the 2014 landslide and the river response to that valley-spanning deposit. We understood that the glacier deposits (lacustrine deposits, advance outwash, till, and reccesional outwash in ascending order) of 200 m thickness of the hillslope of the last glacier period, was suddenly collapsed after rain of March 22, 2014. Observation indicated that silt and clay in the till must have worked as the sliding zone for large debris flow type landslide. Based on the seismic record, it is interpreted that the first period of landslide is of slow flow type, whereas the second period four minutes and a half later is rapid collapse though the latter is of smaller scale of mass flow. Tree (trunk) orientation with vectors is analyzed to show back-rotation of overstepping type (toe first, head last), and local sliding occurring separately to various directions.

Another landslide next to the west (Rowan landslide) is analyzed by C14 dating, which indicates the most recent one to be of 500 yBP, and some others 6000 yBP, 12000 yBP etc., suggesting rather continuous occurrence in the E-W lines of both north and south flanks of the river at hillslopes.

At the second series of stop region in the Nooksack Basin east of Bellingham (Stops 5 & 6), we observed an open pit at the latter stop, where collapsed of Eocene sedimentary rocks have produced numerous large slumps and high-mobility bedrock landslides, called Van Zandt landslide complex (VZLC) (Fig. 1). Bed rock avalanche might have occurred by collapse by cracking during 7th Century according to the C14 dating of trunks. This age merely coincides with a subduction type mega earthquake, and some lines of evidence of tsunamis in the Cascadia coasts. We inspected surface expressions in the runout zone of a particularly large, multi-lobe bedding-plane failure.

The leaders explained that the ongoing efforts are tried to monitor growing fractures in the head-scarp region of the complex. They further explained that given the high human cost of the Oso landslide, and the clear but poorly defined prehistoric sites like VZLC, they hope to foster discussions throughout this trip about how earth science is communicated to policy makers and the general public in the context of disaster avoidance, awareness, and response.

Thus during the trip, we examined two different types of landslides, either influenced (or triggered) by heavy rain or earthquake shake or both, and noticed that the glacier influenced areas like Washington State of the US must be hazardous by both climate, tectonic and also the basic bed rocks or sediments of the hillslopes. Also we need to consider how to avoid the loss of fatality by multiple causes of the coming disasters in subduction zones.

(Reference)
Anderson, S. et al., (2017) The 2016 Kirk Bryan field trip: Exploring the mechanics, frequency, and impacts of deep seated landslides in Washington State. In: Ralph A. Haugerud and Harvey M. Kelsey (eds), From the Puget Lowland to East of the Cascade Range: Geologic Excursions in the Pacific Northwest. GSA Field Guide 49.

Fig. 2. Dr. S. Anderson (USGS) explains the Oso landslides.

Fig. 3. Prof. A. Duvall (Univ. Washington) explains the Oso landslide that is in back of her.

Fig. 4. Van Zandt landslide (2 m thick) above the layer zone of trunks. Below is glacier deposits.

(The End)