P- and S-wave seismic tomography of landslide LS40 at Lawrence Berkeley National Laboratory

PI: Sebastian Uhlemann, Lawrence Berkeley National Laboratory

The main campus of Berkeley Lab is known for its elevated landslide hazard, and comprises multiple paleo and active shallow and deep landslides. One of them, LS40, is a deep-seated landslide, affecting with its movement a road bridge. To better understand the internal structure of this landslide and its relation to observed movements, we conducted a P- and S-wave seismic refraction survey on January 24, 2021. Having both P- and S-wave velocities allows us to calculate the Poisson's ratio, which has been shown to be beneficial for landslide studies (Uhlemann et al., 2016).

The P-wave survey comprised 48 geophones (4.5 Hz) at 1.5 m spacing. The source was a 4.5kg (10lb) sledgehammer hitting a horizontal metallic plate. Shot spacing was 4.5 m (every third geophone). For the S-wave survey, we used 33 horizontal geophones (oriented perpendicular to the survey line), which were moved during the survey (shot 2028) to cover all previous P-wave locations. As a source, we used a 4.5kg (10lb) sledgehammer, hitting a metal prism at a 45° angle. At each location, the prism was hit 3 times from one side, followed by 3 times from the other side. Hence, each shot location has two data files. By subtracting one file from the other, a "pure" S-wave signal is obtained (for details see Uhlemann et al., 2016). The results of this survey are published in Fiolleau et al. (2023).

References:

S. Fiolleau, B. Dafflon, S. Wielandt, and S. Uhlemann. *Understanding Slow-moving Landslide Triggering Processes Using Low-cost Passive Seismic and Inclinometer Monitoring*. Journal of Applied Geophysics, submitted, 2023. DOI: https://doi.org/10.31223/X5H638.

S. Uhlemann, S. Hagedorn, B. Dashwood, H. Maurer, D. Gunn, T. Dijkstra, and J. Chambers. *Landslide characterization using P- and S-wave seismic refraction tomography – The importance of elastic moduli*. Journal of Applied Geophysics 134 (2016), pp. 64–76. DOI: 10.1016/j.jappgeo.2016.08.014.

GPS locations

ID	Easting	Northing	Elevation
Shot-17m	566810.9	4192332	252.103
Shot-12m	566803.9	4192333	253.5257
Shot-7m	566800.9	4192336	252.0694
Shot-2m	566796.7	4192338	252.925
GP1	566794.9	4192339	253.2742
GP2	566793.1	4192339	253.9347
GP3	566791.3	4192340	254.4997
GP4	566789.5	4192341	255.0272
GP5	566787.7	4192342	255.4701
GP6	566785.9	4192342	255.9809
GP7	566784.1	4192343	256.4166
GP8	566782.4	4192344	257.0418
GP9	566780.6	4192345	257.5538
GP10	566778.9	4192345	258.1128
GP11	566777.1	4192346	258.5935
GP12	566775.3	4192347	259.1202
GP13	566773.6	4192348	259.5771
GP14	566771.7	4192348	260.1705
GP15	566769.9	4192349	260.7684
GP16	566768.3	4192350	261.4177
GP17	566766.4	4192350	261.8774
GP18	566764.7	4192351	263.3732
GP19	566762.8	4192352	262.7666
GP20	566761	4192353	263.1228
GP21	566759.2	4192353	263.6311
GP22	566757.4	4192354	263.9757
GP23	566755.5	4192355	264.4491
GP24	566753.7	4192356	264.9555

ID	Easting	Northing	Elevation
GP25	566752	4192356	265.4347
GP26	566750.2	4192357	265.9328
GP27	566748.2	4192358	269.3336
GP28	566746.6	4192358	266.9736
GP29	566744.8	4192359	267.3058
GP30	566743	4192360	267.8239
GP31	566741.2	4192361	268.4825
GP32	566739.5	4192361	268.6507
GP33	566737.6	4192362	269.6341
GP34	566735.8	4192363	270.3318
GP35	566734.1	4192364	270.9605
GP36	566732.4	4192364	271.4423
GP37	566730.6	4192365	272.0112
GP38	566728.9	4192366	272.6081
GP39	566727.1	4192366	273.3448
GP40	566725.5	4192367	274.1055
GP41	566723.8	4192368	274.8816
GP42	566722	4192369	275.7288
GP43	566720.3	4192369	276.6318
GP44	566718.6	4192370	277.4191
GP45	566716.9	4192370	278.2527
GP46	566715.1	4192371	278.8287
GP47	566713.3	4192372	278.906
Shot+5m	566708.4	4192373	280.0598