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# LAKE GENERATED MICROSEISMS AT YELLOWSTONE LAKE AS A RECORD OF ICE PHENOLOGY

**Aini Ashiqin Mohd Mokhdhari (Keith D. Koper and Relu Burlacu)**
**Department of Geology and Geophysics**

It has recently been shown that wave action in lakes produces microseisms, which generate noise peaks in the period range of 0.8-1.2 s as recorded by nearby seismic stations. Such noise peaks have been observed at seven seismic stations (H17A, LKWY, B208, B944, YTP, YLA, and YLT) located within 2 km of the Yellowstone Lake shoreline (Fig 1). Initial work using 2016 data shows that the variations in the microseism signals at Yellowstone Lake correspond with the freezing and thawing of lake ice: the seismic noise occurs more frequently in the spring, summer, and fall, and less commonly in the winter. If this can be confirmed, then lake-generated microseisms could provide a consistent measure of the freezing and melting dates of high-latitude lakes in remote areas. The seismic data would then be useful in assessing the effects of climate change on the ice phenology of those lakes. In this work, we analyze continuous seismic data recorded by the 39 seismic stations around Yellowstone Lake for the years of 2002 to 2017. We generate probability distribution functions of power spectral density for each station to observe the broad elevation of energy near a period of 1 s. The time dependence of this 1-s seismic noise energy is analyzed by extracting the power spectral density at 1 s from every processed hour (Fig 2). The seismic observations are compared to direct measurements of the dates of ice-out and freeze-up as reported by rangers at Yellowstone National Park. We examine how accurate the seismic data are in recording the freezing and melting of Yellowstone Lake, and how the accuracy changes as a function of the number of stations used. We also examine how sensitive the results are to the particular range of periods that are analyzed.

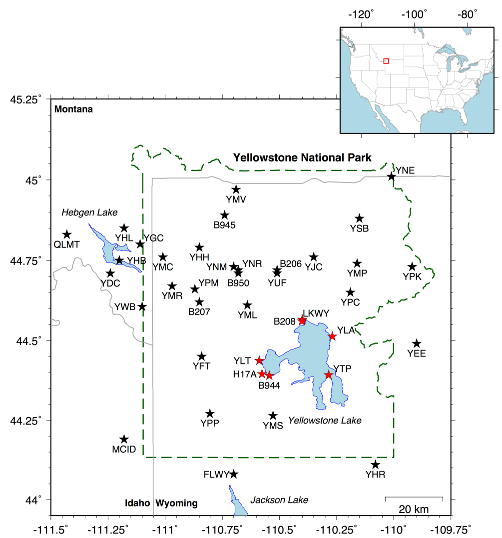


**Figure 1** Map of seismic stations deployed in the Yellowstone region.

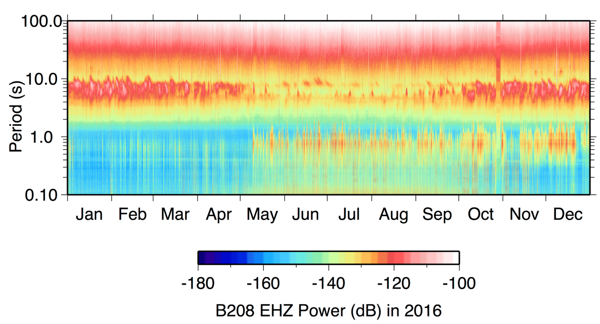


**Figure 2** Spectrogram of station B208 showing high energy during summer and fall, when Yellowstone Lake is unfrozen.