

# Cultivating Citizen Scientists with seismic monitoring in Texas and New England using an affordable seismograph



Poster SPET P3

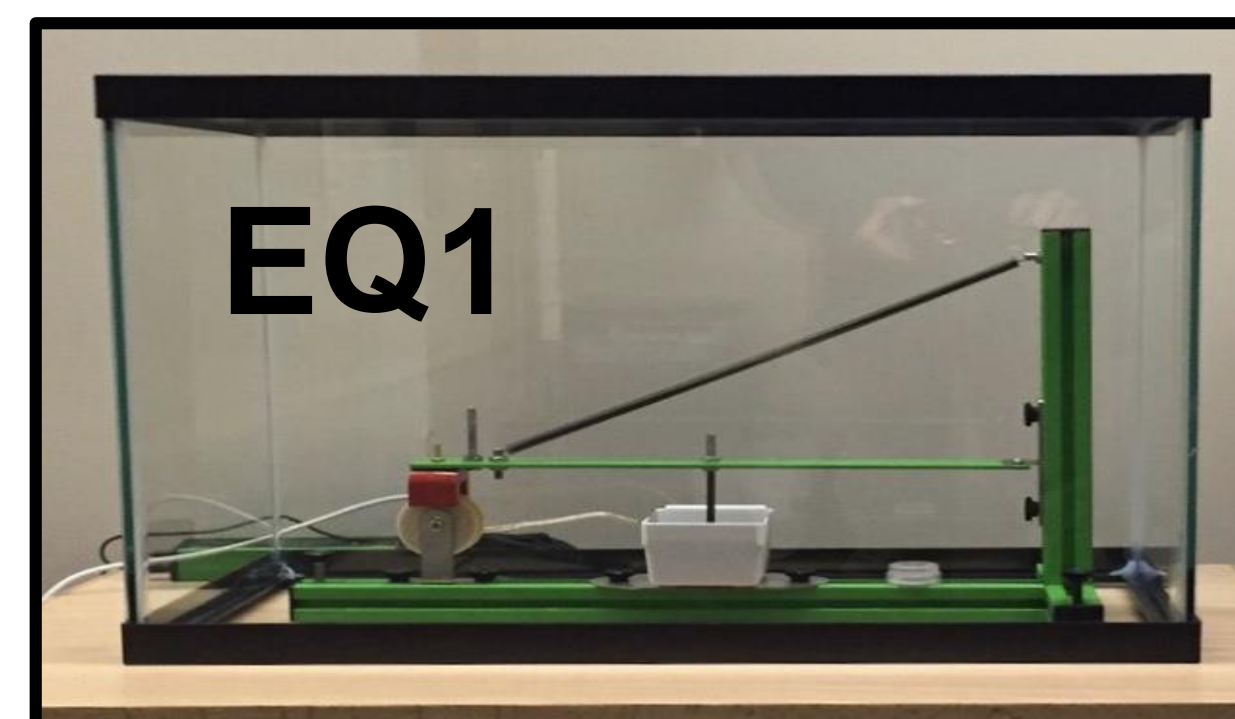
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## Educational Seismology Programs

Texas Educational Seismic Project (TXESP), together with the Boston College Educational Seismological Project (BCESP), share a mission to take real world events and turn them into "Teachable Moments". In pursuit of our mission, both TXESP and BCESP use seismology as an exciting medium for inviting students into the world of scientific monitoring; we are highly motivated to promote inquiry-based learning through investigation of earthquakes recorded by seismographs in classrooms. It is truly fascinating that it is possible to record earthquakes that occur across the globe and are recorded in Texas and New England using a new, simple seismograph - the "Raspberry Shake". Historically, real-time earthquake monitoring and analysis required very high cost, and research-quality instruments. However, very recently the Raspberry Shake seismograph revolutionized citizen science capabilities. The question we ask is "Can the Raspberry Shake seismograph provide high quality data comparable to educational and research-quality seismographs?" Affordability and flexibility expands opportunities for all students - giving them research experiences investigating what is recorded on their classroom seismograph and promoting a valuable positive step in the direction of inquiry-based science education and college readiness.

## Seismic Instrumentation

RIGHT: Ward's vertical educational seismograph uses oil as a damping mechanism.



BELOW: Raspberry Shake seismographs are available in a number of configurations: 1-C, 3-C, Strong Motion, Infrasonic

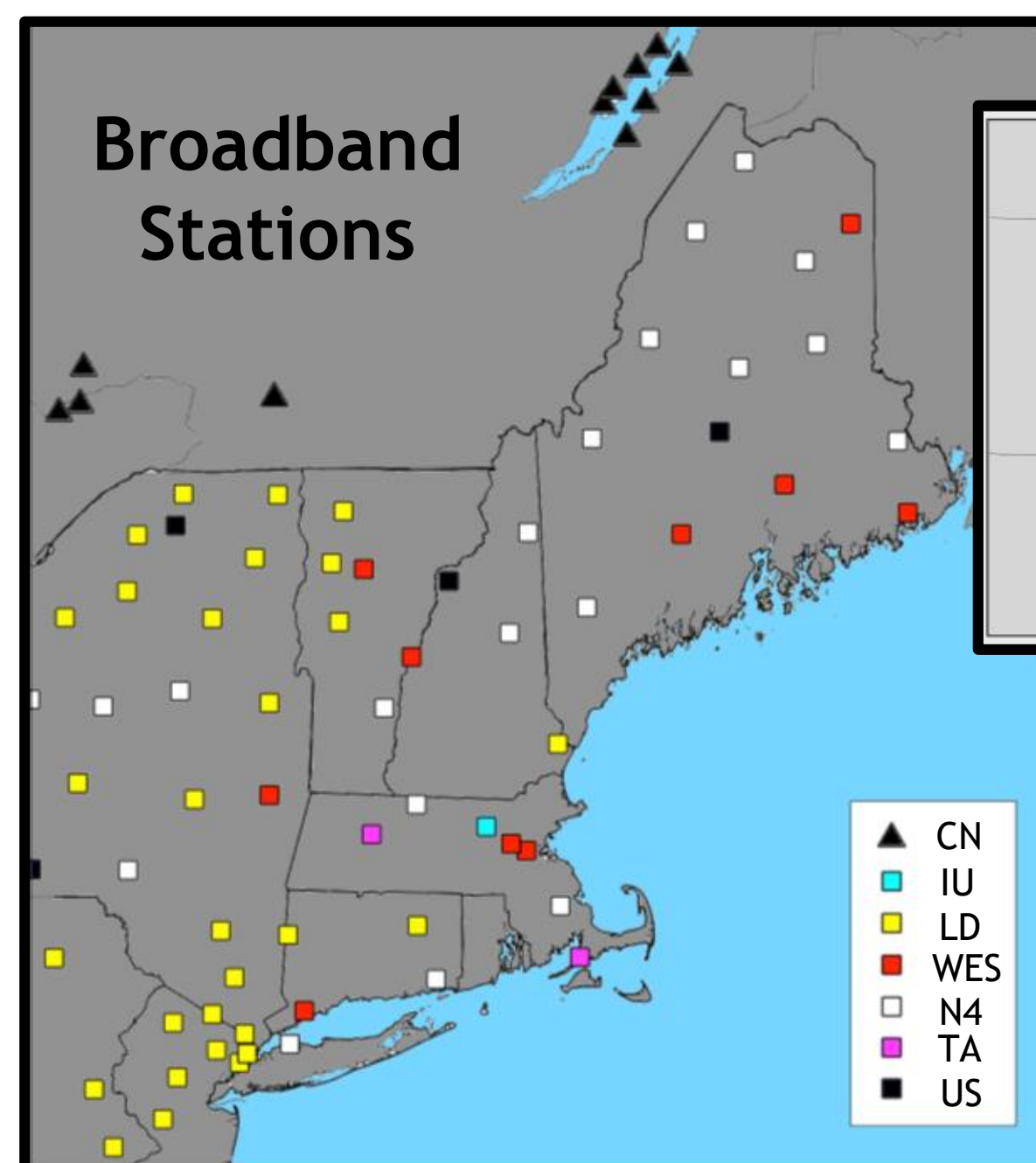


Raspberry Shake seismographs include self-contained Raspberry Pi computers

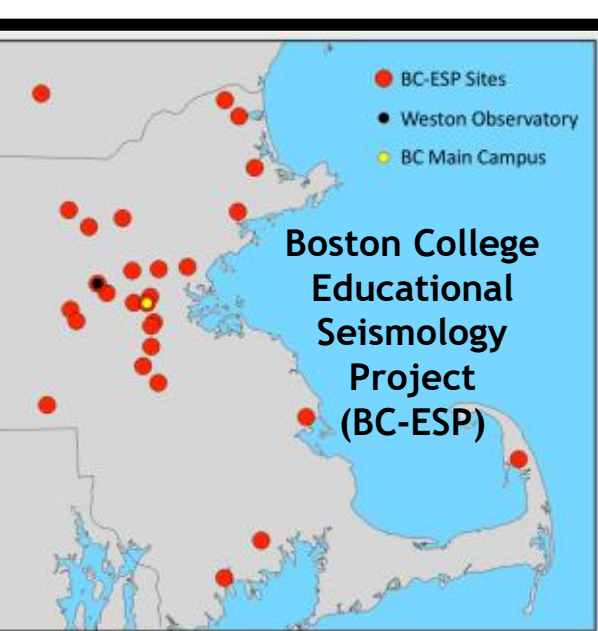


LEFT: Historical (and still operating) World-Wide Standardized Seismograph Network seismographs at Boston College's Weston Observatory in Weston, MA. Weston Observatory also operates modern research-quality seismographs as part of its New England Seismic Network (NESN Broadband).

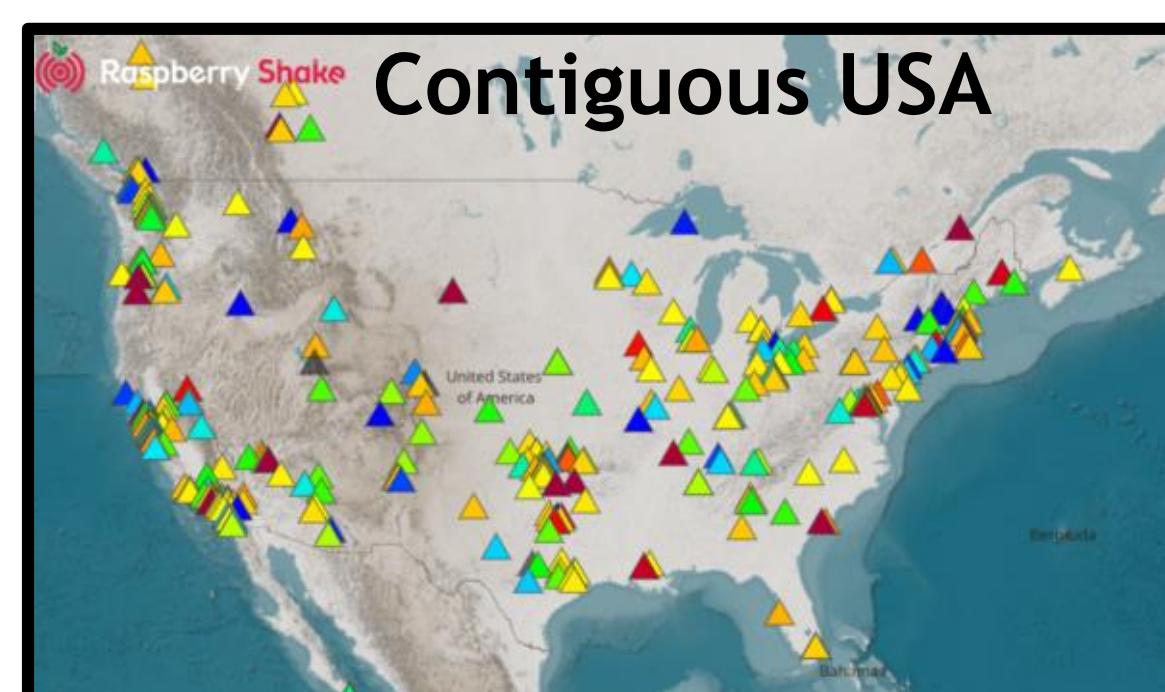
## Networks and Partnerships



Seismic Stations in New England Region



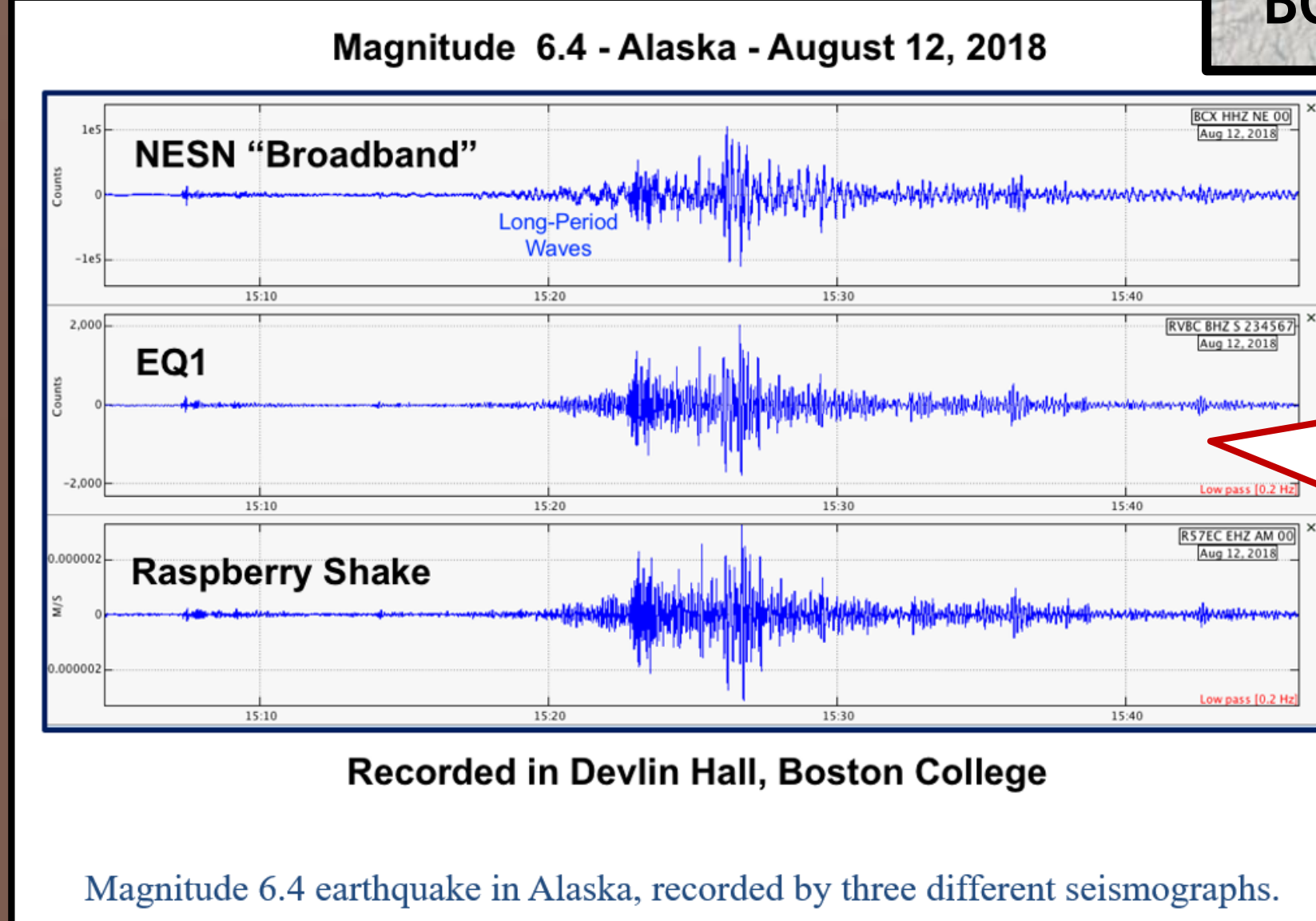
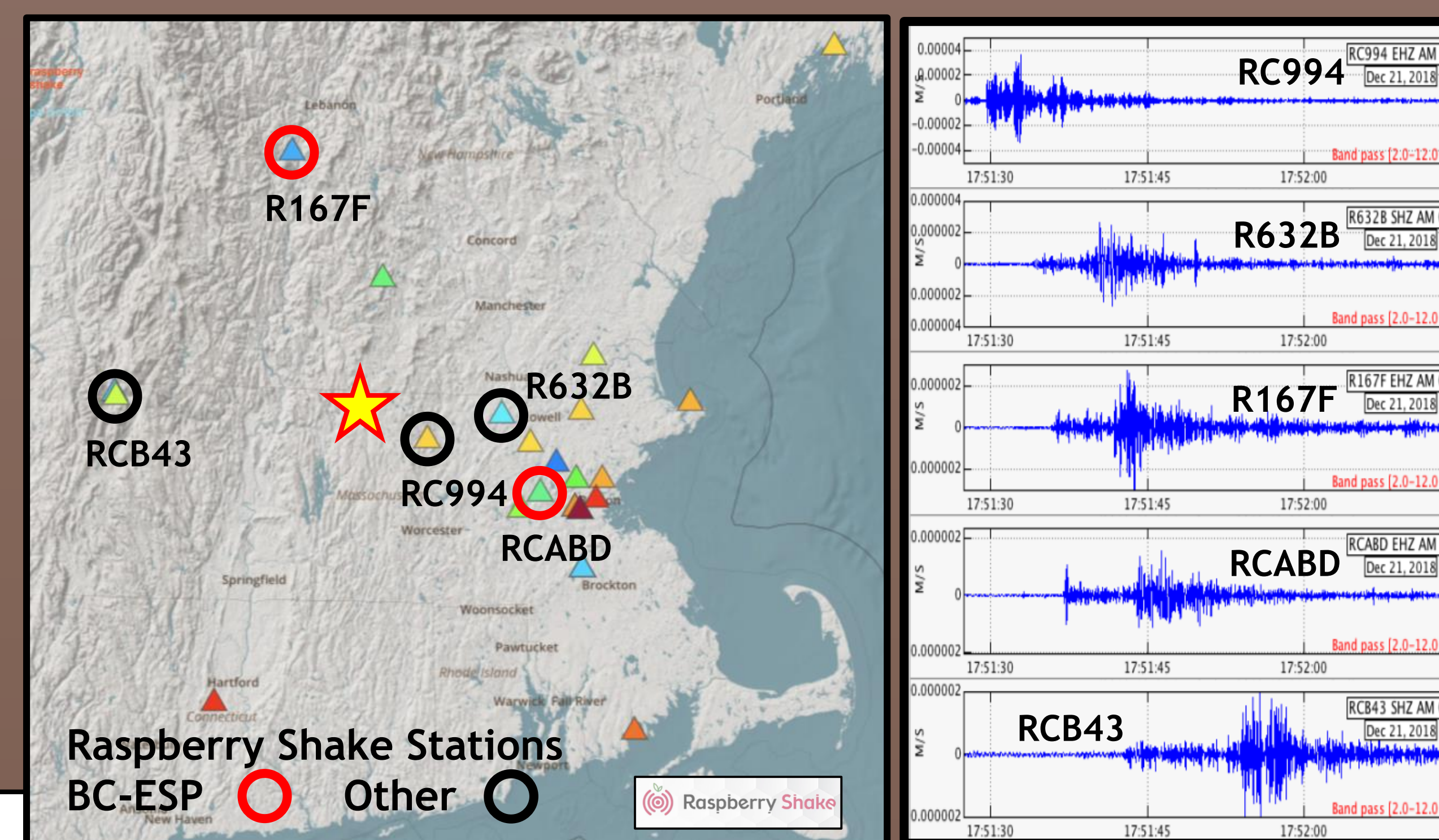
ESPs leverage existing seismic networks and their mapping software to introduce citizen scientists to the world of seismology.



## Testing Technology and Seismology Concepts

"How well can the Raspberry Shake seismograph detect earthquakes and provide high quality data comparable to other educational and research-quality seismographs?"

Magnitude 2.1 Gardner, MA, December 21, 2018 at 17:51hrs UTC



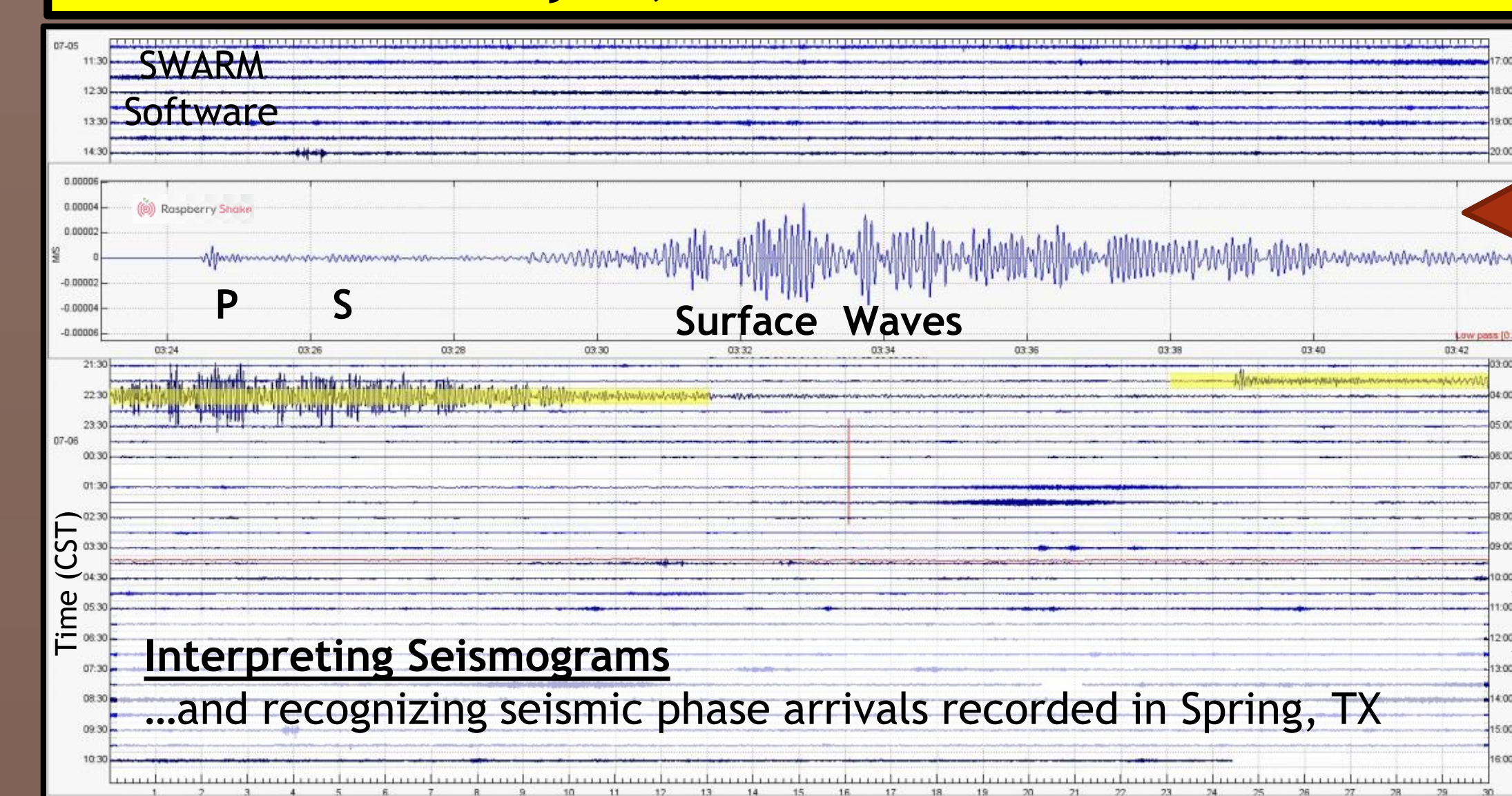
Magnitude 6.4 earthquake in Alaska, recorded by three different seismographs.

## Comparing Technology

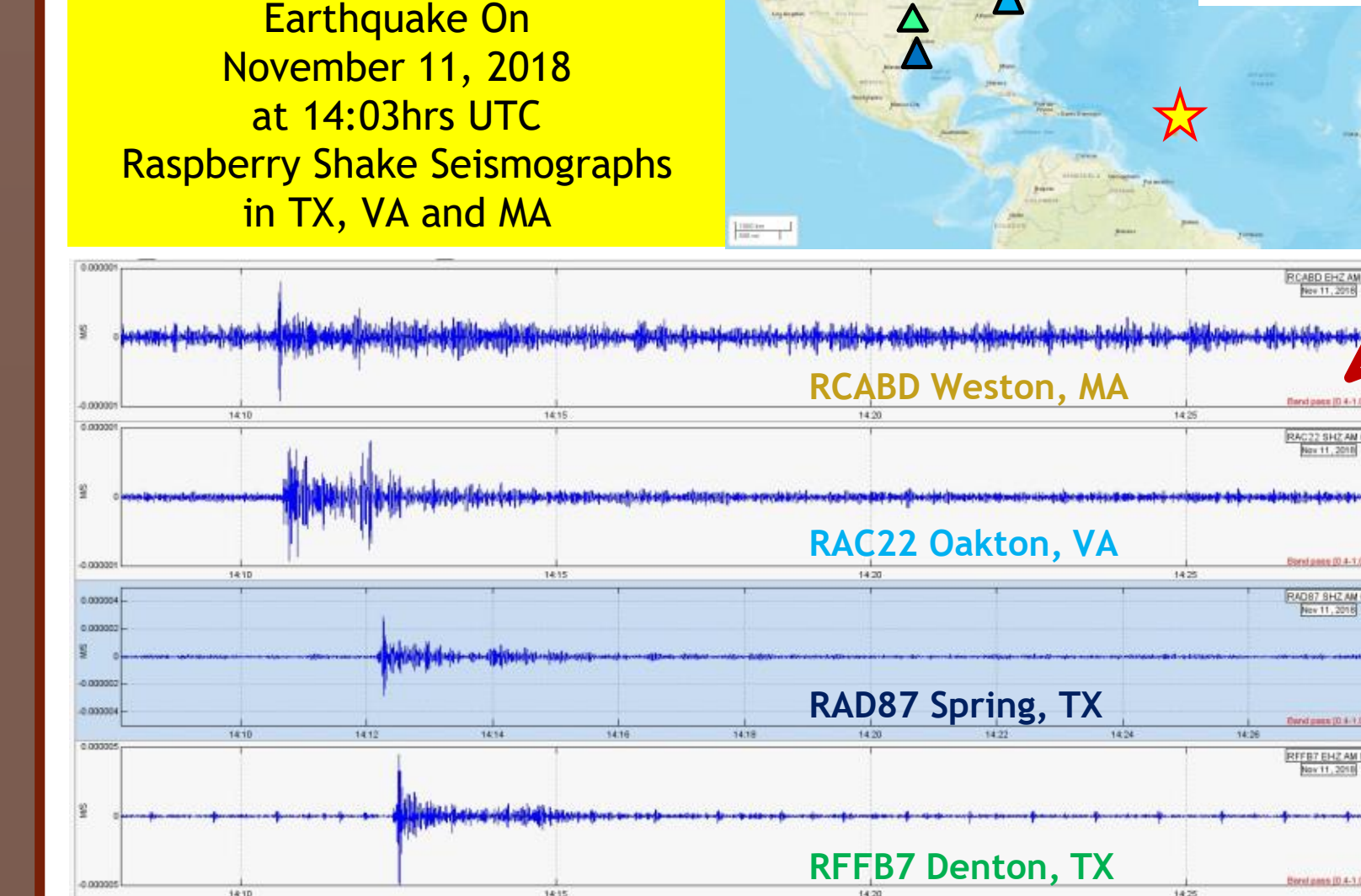
After significant earthquakes, Boston College's Weston Observatory compares seismograms recorded by expensive, research-quality seismographs with seismograms of the same earthquakes recorded by low-cost educational instruments. Raspberry Shake seismographs offer reasonable quality seismograms for conducting citizen science research (See LEFT). This enables open-ended, inquiry-based discussions about the effectiveness of different seismic technologies.

## Examples of Wave Interpretation, Propagation and Attenuation

Magnitude 7.1 Ridgecrest, California Earthquake On July 06, 2019 at 03:19hrs UTC



Magnitude 6.2 North Atlantic Earthquake On November 11, 2018 at 14:03hrs UTC



Comparing seismograms at multiple locations provides teachable moments for TXESP and BCESP students to investigate seismic wave propagation and attenuation.

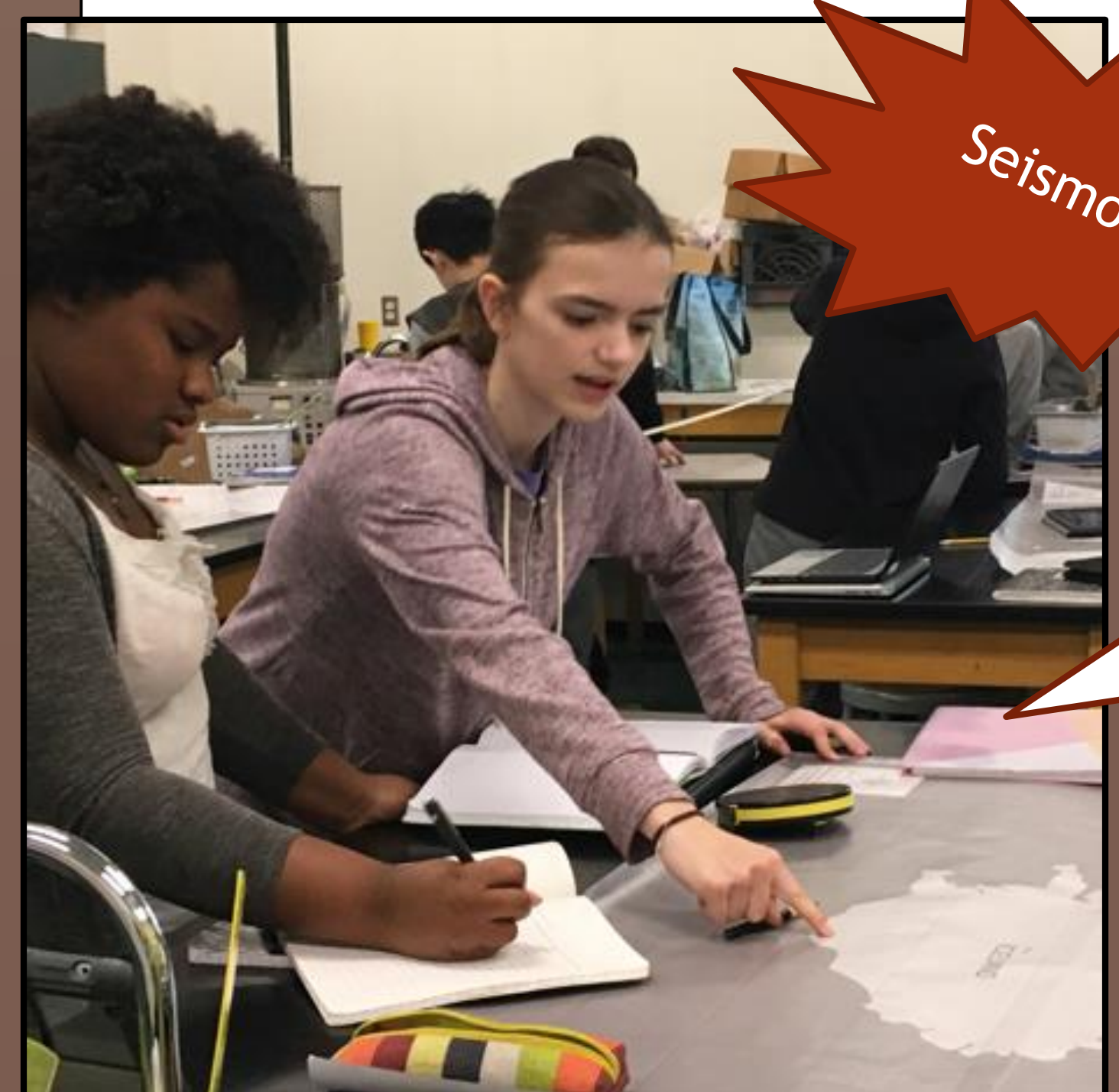


Fault Scarp

## ESPs Grow New Citizen Scientists

Through TX/BC ESP's educational partnerships, we make a difference in the lives of citizens and students of all ages and in differing socio-economic circumstances by engaging them in hands-on learning opportunities and teaching science as it is actually practiced.

Overseen by our science-education and monitoring team, students study, record, and interpret natural geologic phenomena through visual experiences and hands-on activities, explore and test student-led inquiries, and ultimately develop critical peer-to-peer communication skills. The science of seismology forms an excellent foundation for this endeavor because: (1) it is an interdisciplinary science that requires integration of many STEM concepts, and (2) it teaches how the natural environment impacts our everyday lives (see BELOW).



Seismology

LEFT: Exploring how earthquakes are located enables students to transcend passive learning and move towards active learning.

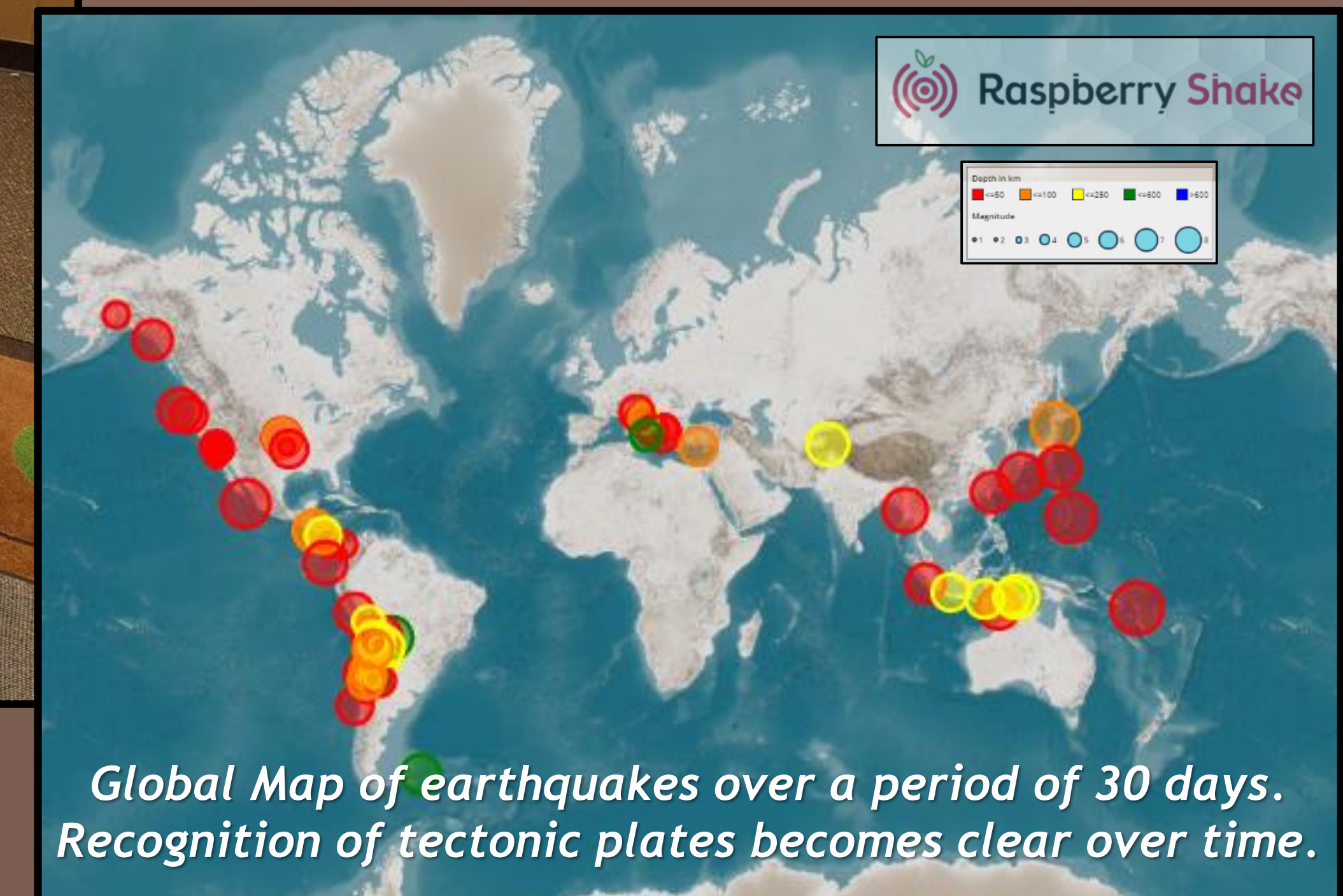
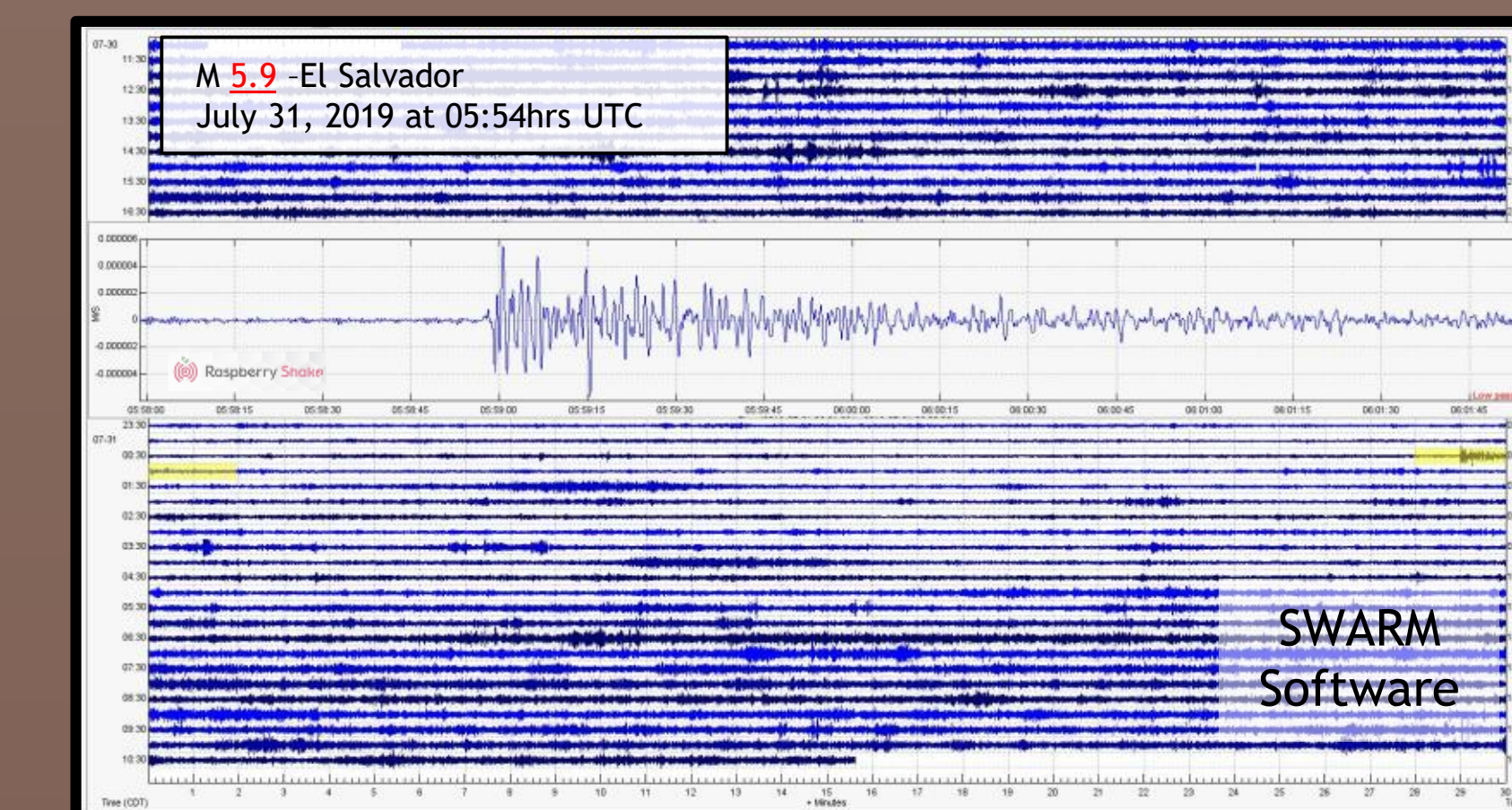


Making Our Own "Earthquakes" ...and experimenting with wave attenuation

## Collaboration Across the Nation

Raspberry Shake offers a simple "plug-and-play" affordable seismograph which offers great flexibility for users. Affordability and flexibility expands opportunities for low to median income students - giving them research experiences investigating what is recorded on their classroom seismograph and promoting a valuable positive step in the direction of inquiry-based science education and college readiness. With one classroom Raspberry Shake seismograph, all students at a school may benefit from multiple, large monitors (computer screens) across a campus. Required viewing software is available for free online, and any user can begin "watching the ground move" immediately once the software is installed.

Students utilize the internet to gather global information about the dynamic Earth (BELOW). Specific seismic events can be reviewed (RIGHT) and events can also be studied cumulatively over a period of time (LOWER RIGHT).



Global Map of earthquakes over a period of 30 days. Recognition of tectonic plates becomes clear over time.