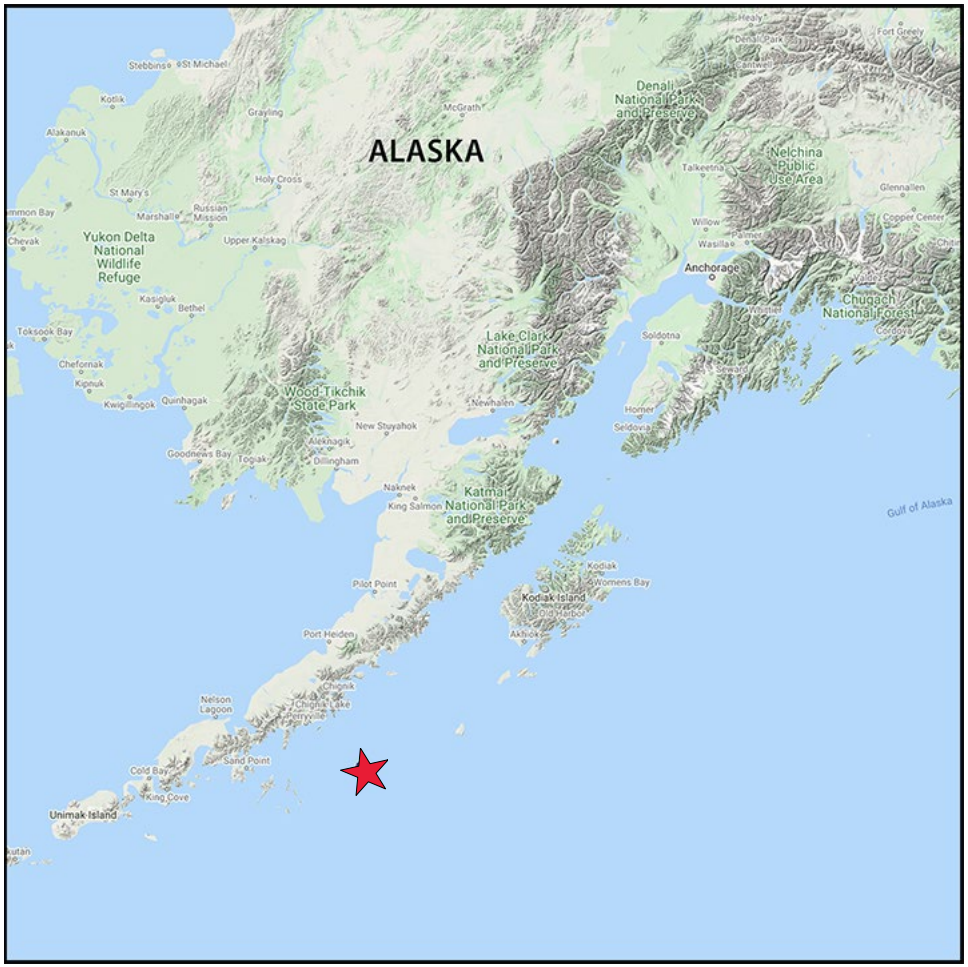
Magnitude 8.2 ALASKA

Thursday, July 29, 2021 at 06:15:47 UTC

At 10:15pm Alaska time on July 28, a magnitude 8.2 earthquake struck offshore of the Alaska Peninsula at a depth of 32 km. This was the largest U.S. earthquake in 50 years.

No major damage was reported.

The National Tsunami Warning Center issued a tsunami warning for much of coastal Alaska. Several communities issued evacuations. Recorded wave heights were under a foot, however, and the warning was downgraded a couple of hours after the earthquake.



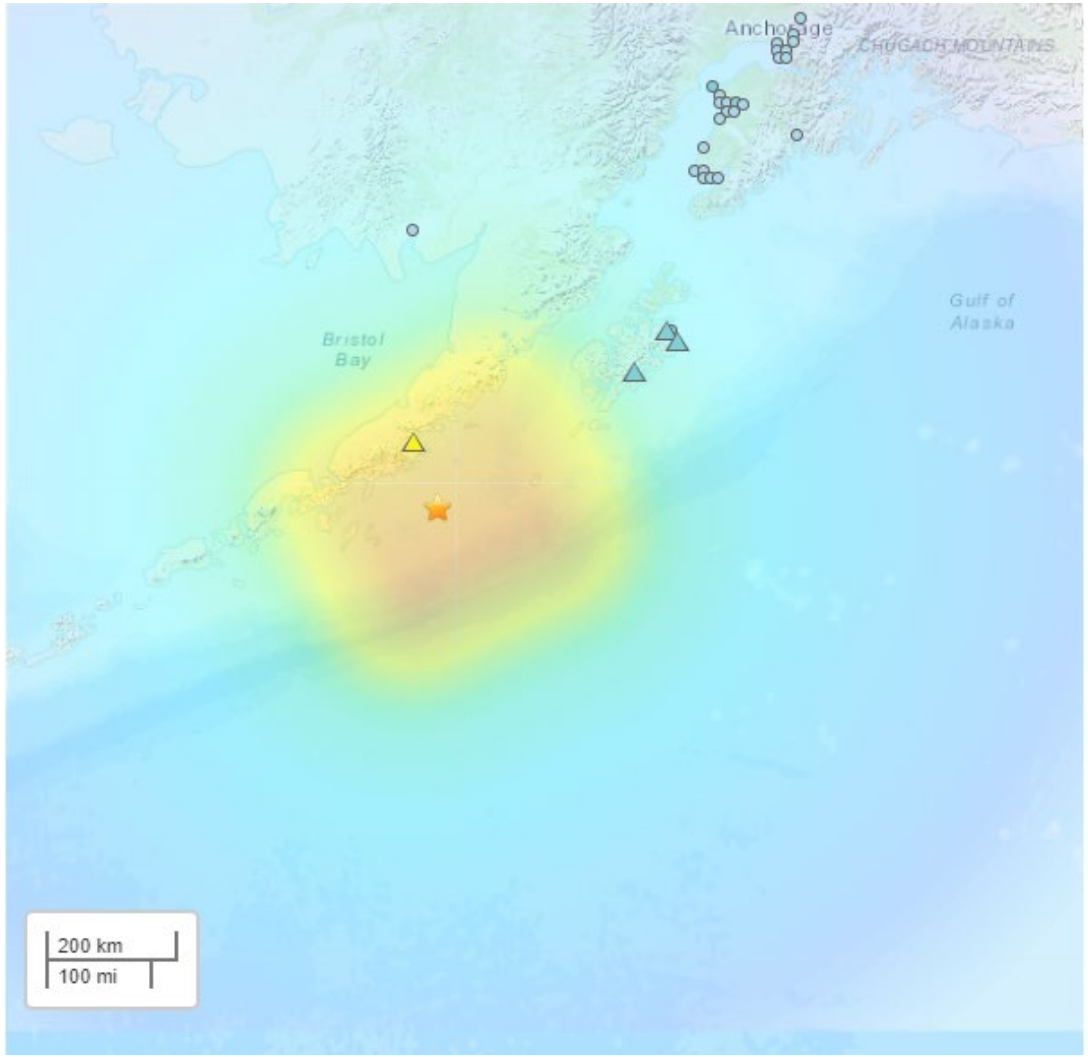
Magnitude 8.2 ALASKA
Thursday, July 29, 2021 at 06:15:47 UTC

The Modified-Mercalli Intensity scale is a twelve-stage scale, from I to XII, that indicates the severity of ground shaking. Intensity is dependent on the magnitude, depth, bedrock, and location.

Very strong shaking was felt from this earthquake.

Modified Mercalli Intensity	Perceived Shaking
X	Extreme
IX	Violent
VIII	Severe
VII	Very Strong
VI	Strong
V	Moderate
IV	Light
II-III	Weak
I	Not Felt

Image courtesy of the US Geological Survey



USGS Estimated shaking intensity from M 8.2 Earthquake

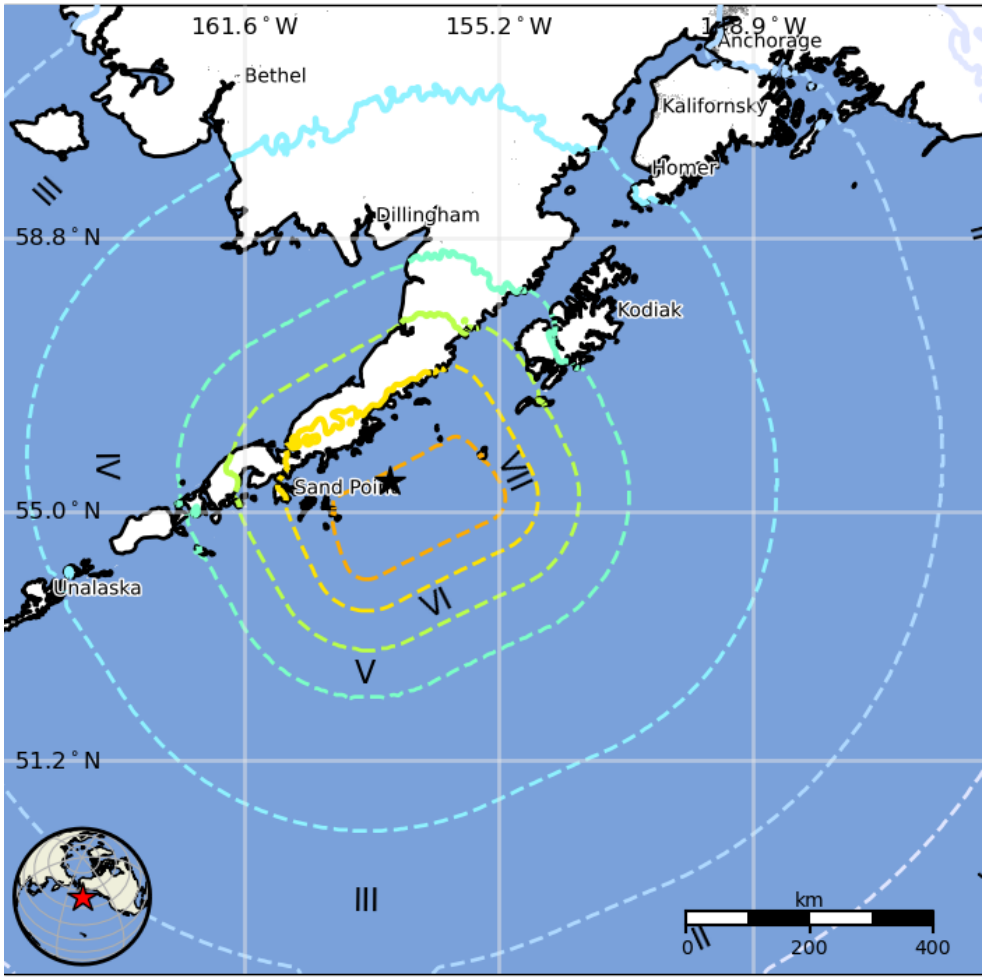
IRIS Teachable Moments

Magnitude 8.2 ALASKA
Thursday, July 29, 2021 at 06:15:47 UTC

The USGS PAGER map shows the population exposed to different Modified Mercalli Intensity (MMI) levels.

The USGS estimates that two thousand people felt very strong shaking from this earthquake.

I	Not Felt	0 k*
II-III	Weak	482 k*
IV	Light	25 k
V	Moderate	1 k
VI	Strong	0 k
VII	Very Strong	2 k
VIII	Severe	0 k
IX	Violent	0 k
X	Extreme	0 k

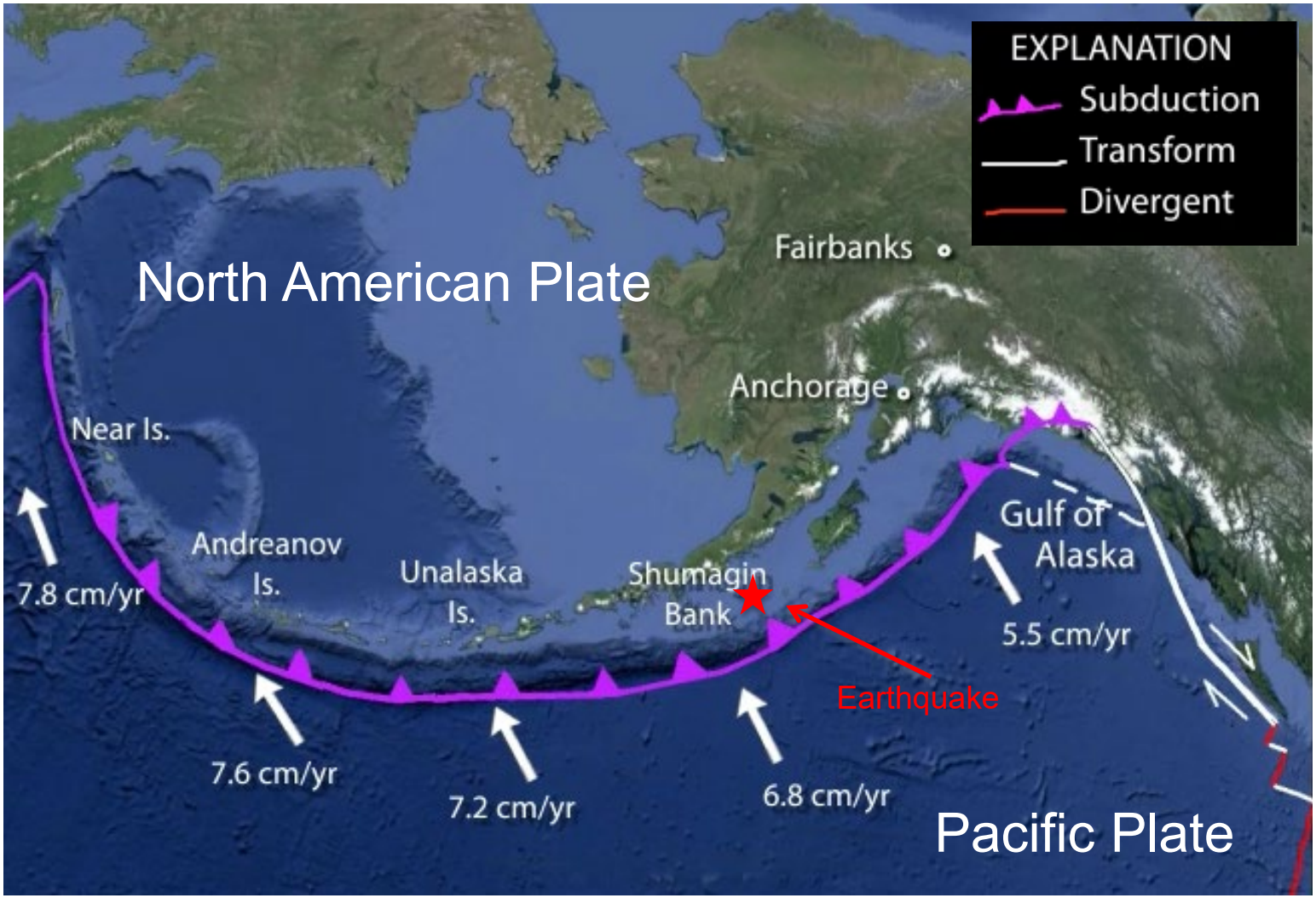


The color-coded contour lines outline regions of MMI intensity. The total population exposure to a given MMI value is obtained by summing the population between the contour lines. The estimated population exposure to each MMI Intensity is shown in the table.

Image courtesy of the US Geological Survey

Magnitude 8.2 ALASKA

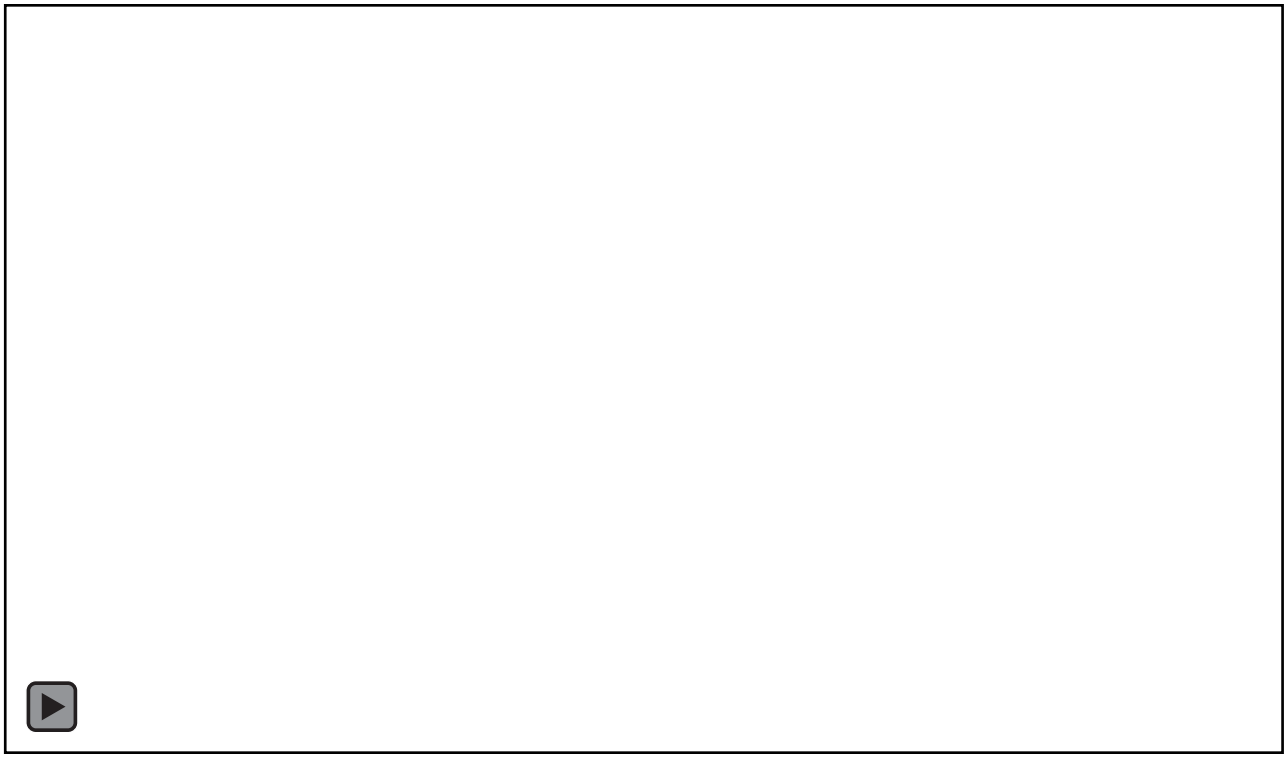
Thursday, July 29, 2021 at 06:15:47 UTC



The Pacific Plate converges with, and subducts beneath the North American Plate and begins its decent into the mantle at the Alaska - Aleutian Trench just south of this earthquake. The rates of relative plate motion range from 5.5 cm/yr in the Gulf of Alaska to 7.8 cm/yr at the western end of the Aleutian Island chain. The rate of subduction in the location of this earthquake is about 6.5 cm/yr.

Magnitude 8.2 ALASKA
Thursday, July 29, 2021 at 06:15:47 UTC

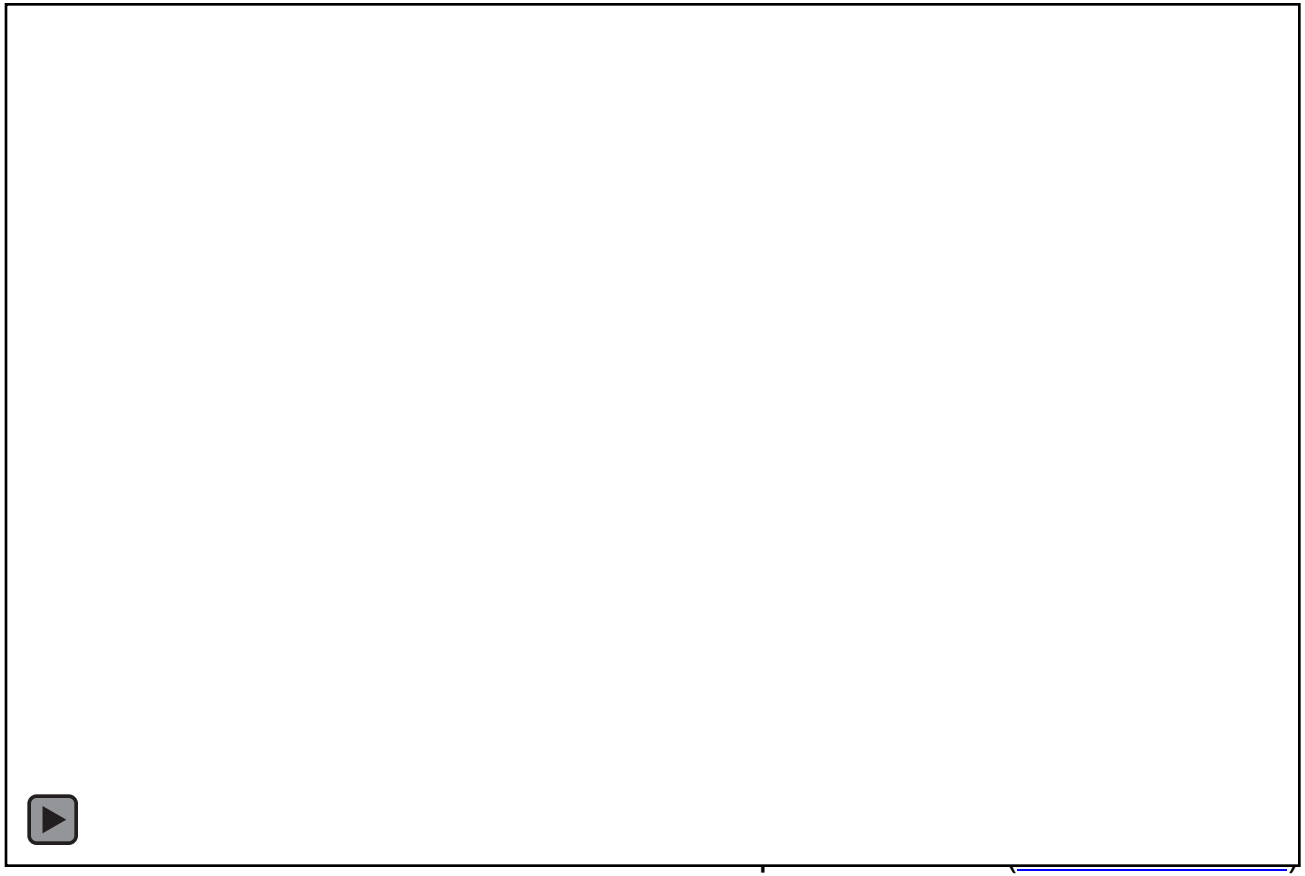
Large earthquakes are common in Alaska. This earthquake was on the subduction zone megathrust boundary between the Pacific and North American Plates. Since 1900, 8 other earthquakes M 7 and larger have occurred within 250 km of this earthquake.



Animation exploring plate tectonics and earthquakes of the Pacific – North American Plate boundary region.

Magnitude 8.2 ALASKA
Thursday, July 29, 2021 at 06:15:47 UTC

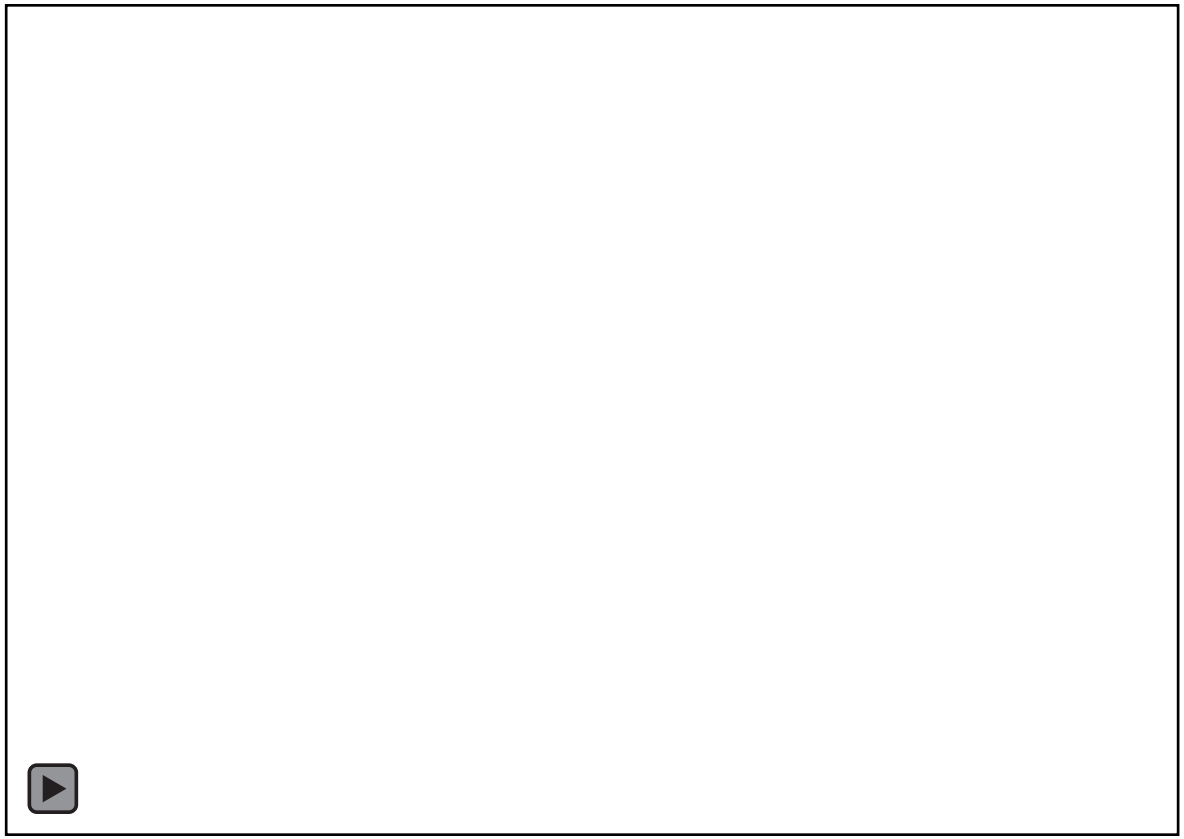
This animation from IRIS's Earthquake Browser explores the mainshock and aftershocks of this M8.2 earthquake.



Data from IRIS's Earthquake Browser (www.iris.edu/ieb)

Magnitude 8.2 ALASKA
Thursday, July 29, 2021 at 06:15:47 UTC

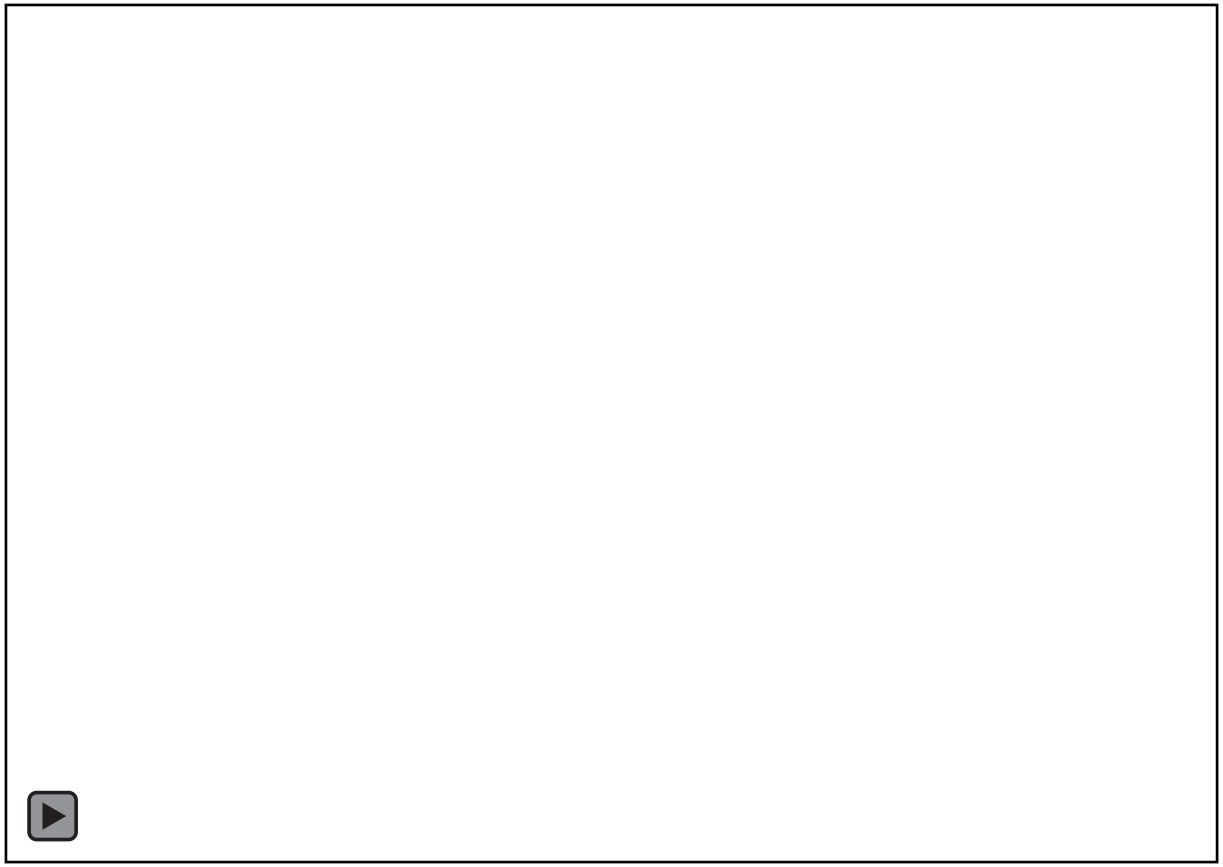
Earthquakes happen frequently in the Aleutians and fill in almost the entire arc. This animation shows the biggest earthquakes in a 15-year period along with all the M>4 events.



Magnitude 8.2 ALASKA

Thursday, July 29, 2021 at 06:15:47 UTC

Plotted in this animation, M8+ earthquakes have ruptured nearly the entire Aleutian arc in the past 85 years except for a small segment near the Shumagin Islands, commonly referred to as the Shumagin Gap.



Magnitude 8.2 ALASKA
Thursday, July 29, 2021 at 06:15:47 UTC

From the previous animation, this map shows rupture zones from earthquakes along the Aleutian megathrust from 1938-1996. The “Shumagin Gap” is a section of the plate boundary that had not ruptured in a major or great earthquake during this time range. The M 7.8 July 2020 earthquake initiated on the eastern edge of the Shumagin Gap and aftershocks reveal it ruptured westward into the Shumagin Gap.

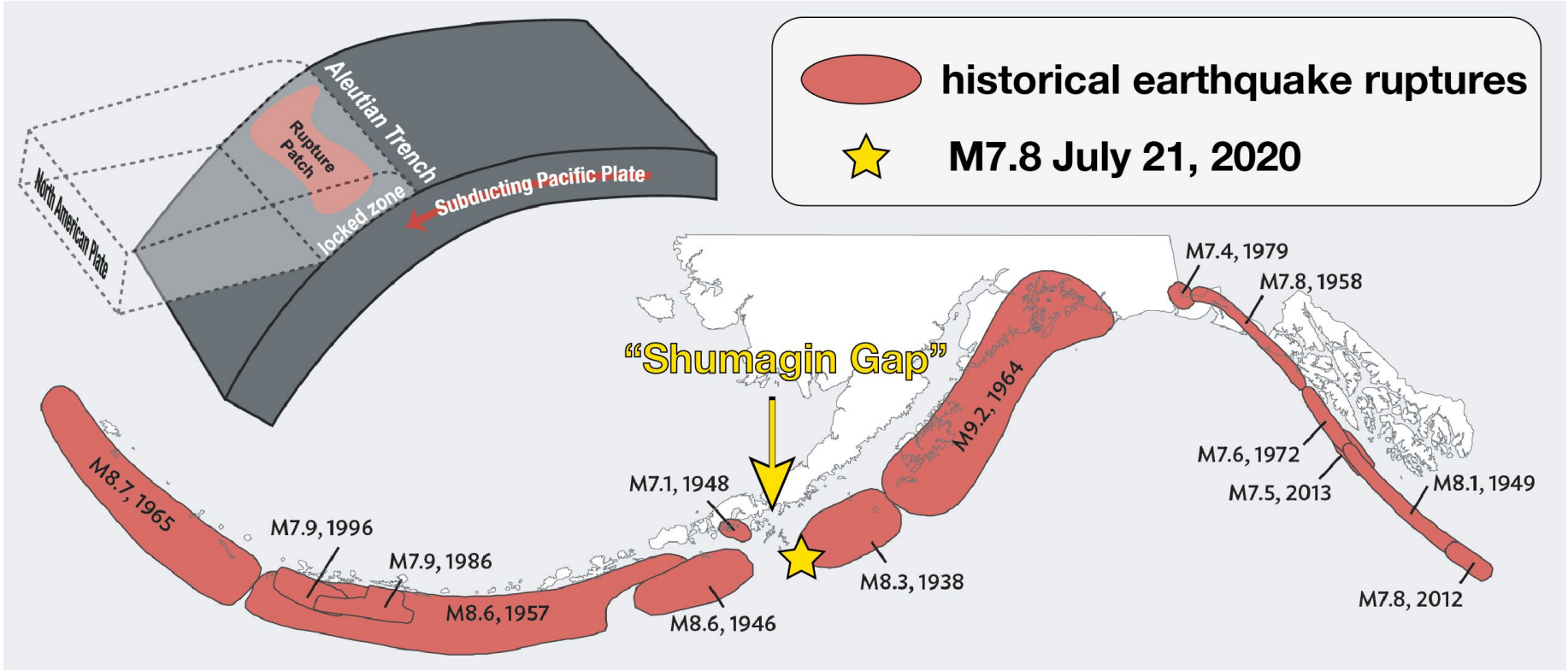


Image courtesy of the Alaska Earthquake Center

Magnitude 8.2 ALASKA
Thursday, July 29, 2021 at 06:15:47 UTC

This M8.2 earthquake occurred relatively close (about 62 km) from the location of the M7.8 earthquake that ruptured July 22, 2020, and about 145 km from a M7.6 on October 19, 2020.

Given the temporal and spatial proximity of this M8.2 earthquake to the two previous large earthquakes, which increased the stress on the 1938 region, those previous events can be considered foreshocks of this earthquake.

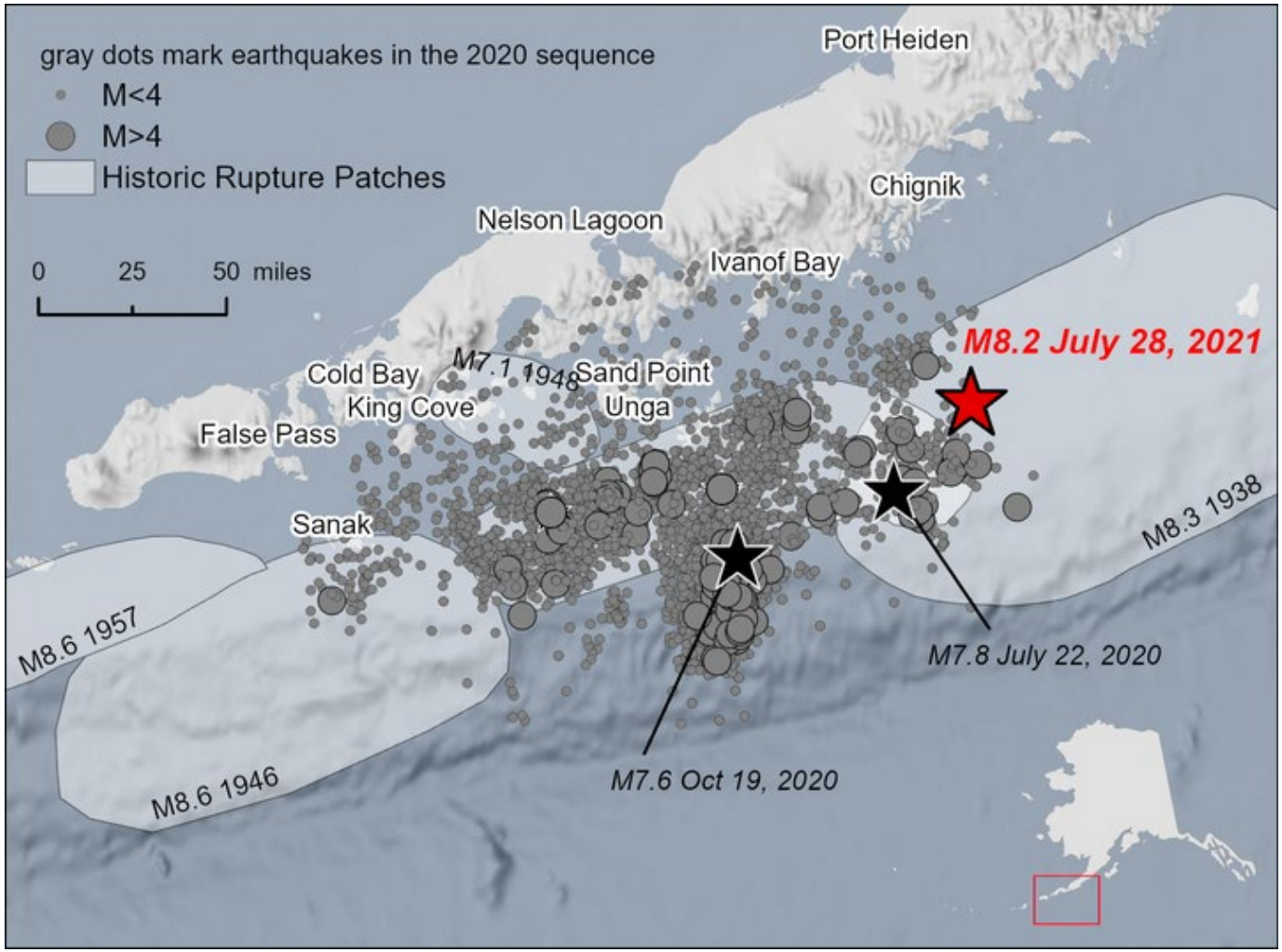


Image courtesy of the Alaska Earthquake Center

Magnitude 8.2 ALASKA
Thursday, July 29, 2021 at 06:15:47 UTC

On this map, the first 12 hours of aftershocks are plotted in red, aftershocks of the two earthquakes in 2020 are plotted in gray. The rupture areas of the most recent adjacent earthquakes in 1938, 1946 and 1964 are the light grey regions.

Today's earthquake appears to have ruptured the segment previously ruptured in the 1938 M8.3 earthquake.

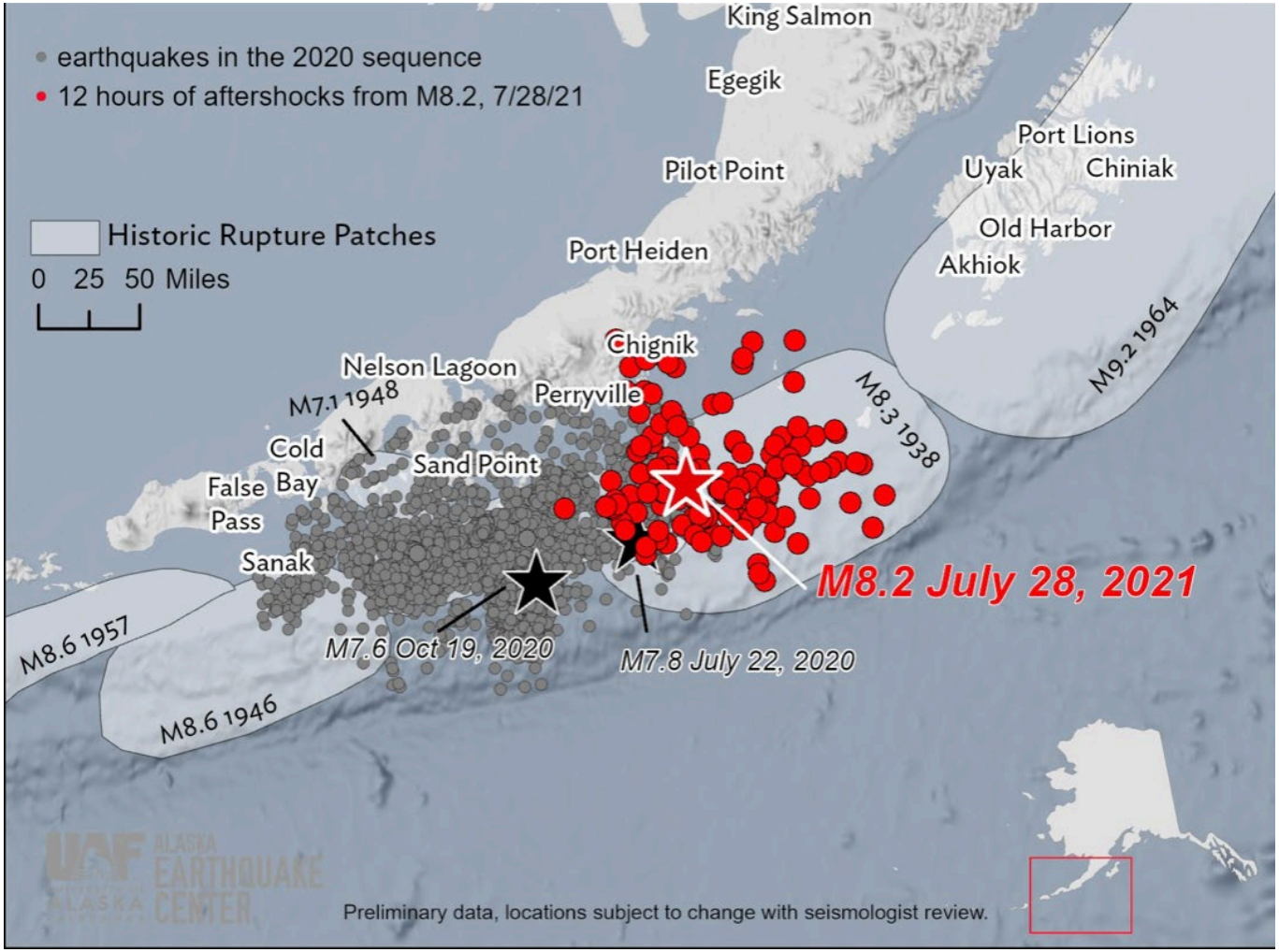
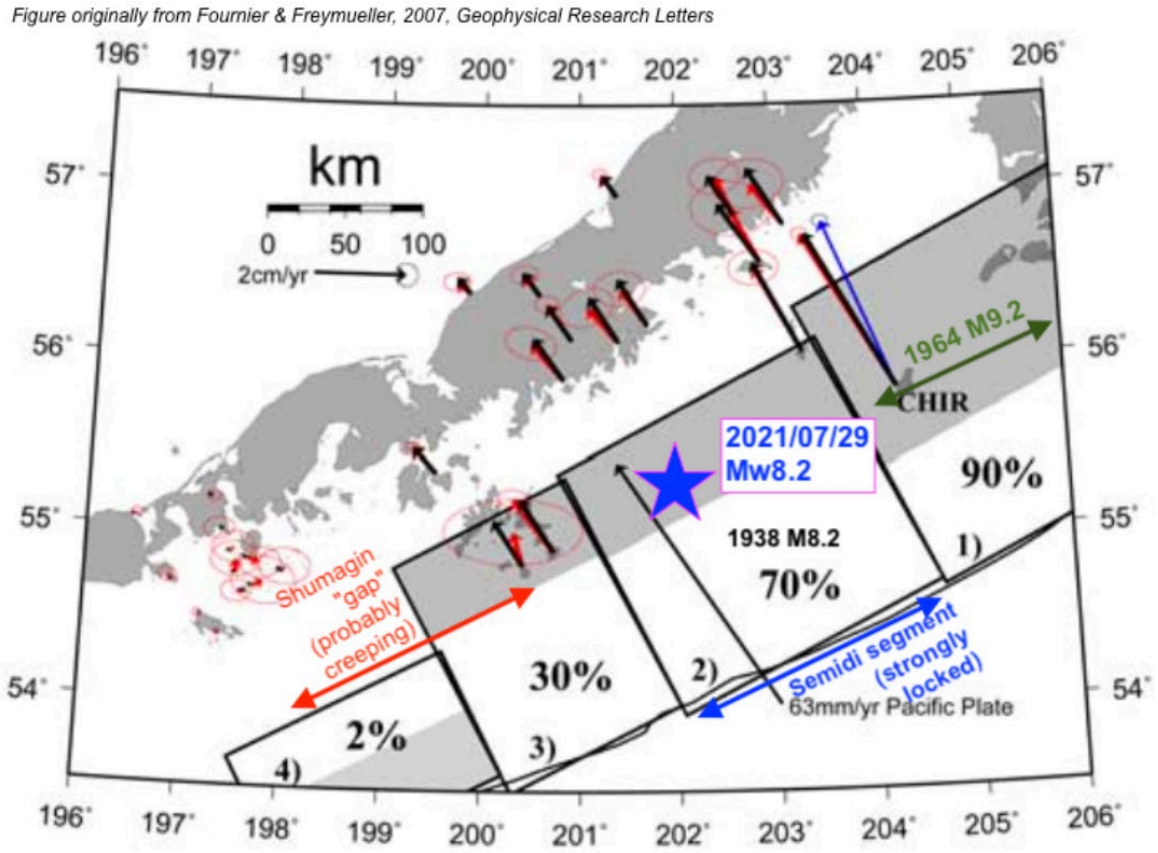


Image courtesy of the Alaska Earthquake Center

Magnitude 8.2 ALASKA
Thursday, July 29, 2021 at 06:15:47 UTC

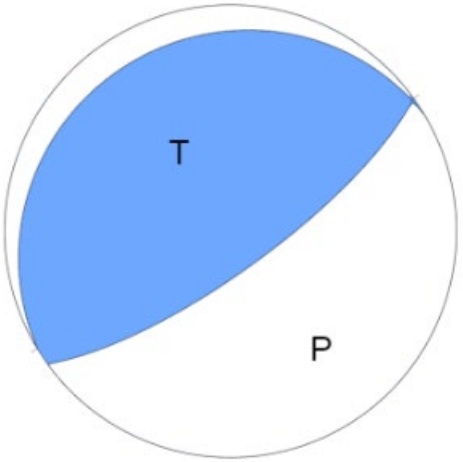
Plate coupling varies along the arc. On this map, arrows show rates of motion with respect to interior Alaska determined by GPS observations. The segment of the fault that ruptured in the July 29 earthquake is an area where the coupling between the subducting Pacific and overriding North American plates is high. So, the adjacent part of the Alaska Peninsula is pushed toward the northwest, the direction of motion of the Pacific Plate towards the North American Plate. In contrast, coupling in the Shumagin Gap is low.



From Fournier and Freymueller, 2007 with annotation from Stephan Hicks

Magnitude 8.2 ALASKA
Thursday, July 29, 2021 at 06:15:47 UTC

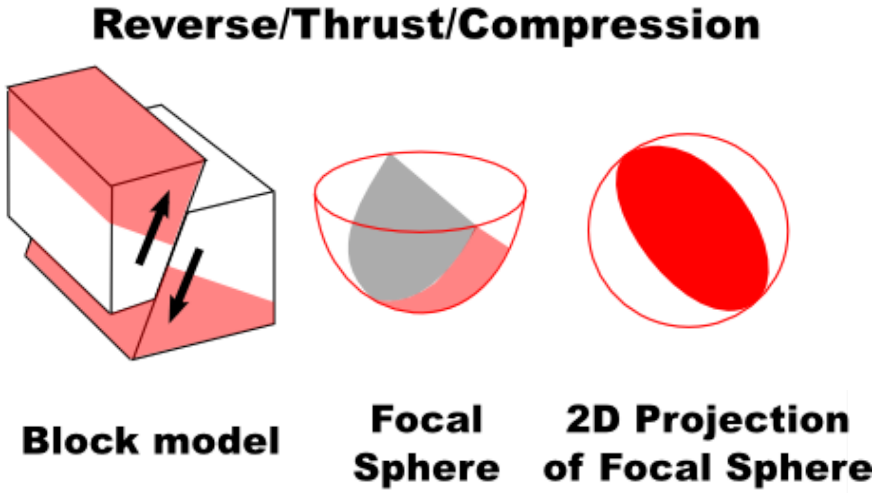
The focal mechanism is how seismologists plot the 3-D stress orientations of an earthquake. Because an earthquake occurs as slip on a fault, it generates primary (P) waves in quadrants where the first pulse is compressional (shaded) and quadrants where the first pulse is extensional (white). The orientation of these quadrants calculated from recorded seismic waves determines the type of fault that produced the earthquake.



USGS W-phase Moment Tensor Solution

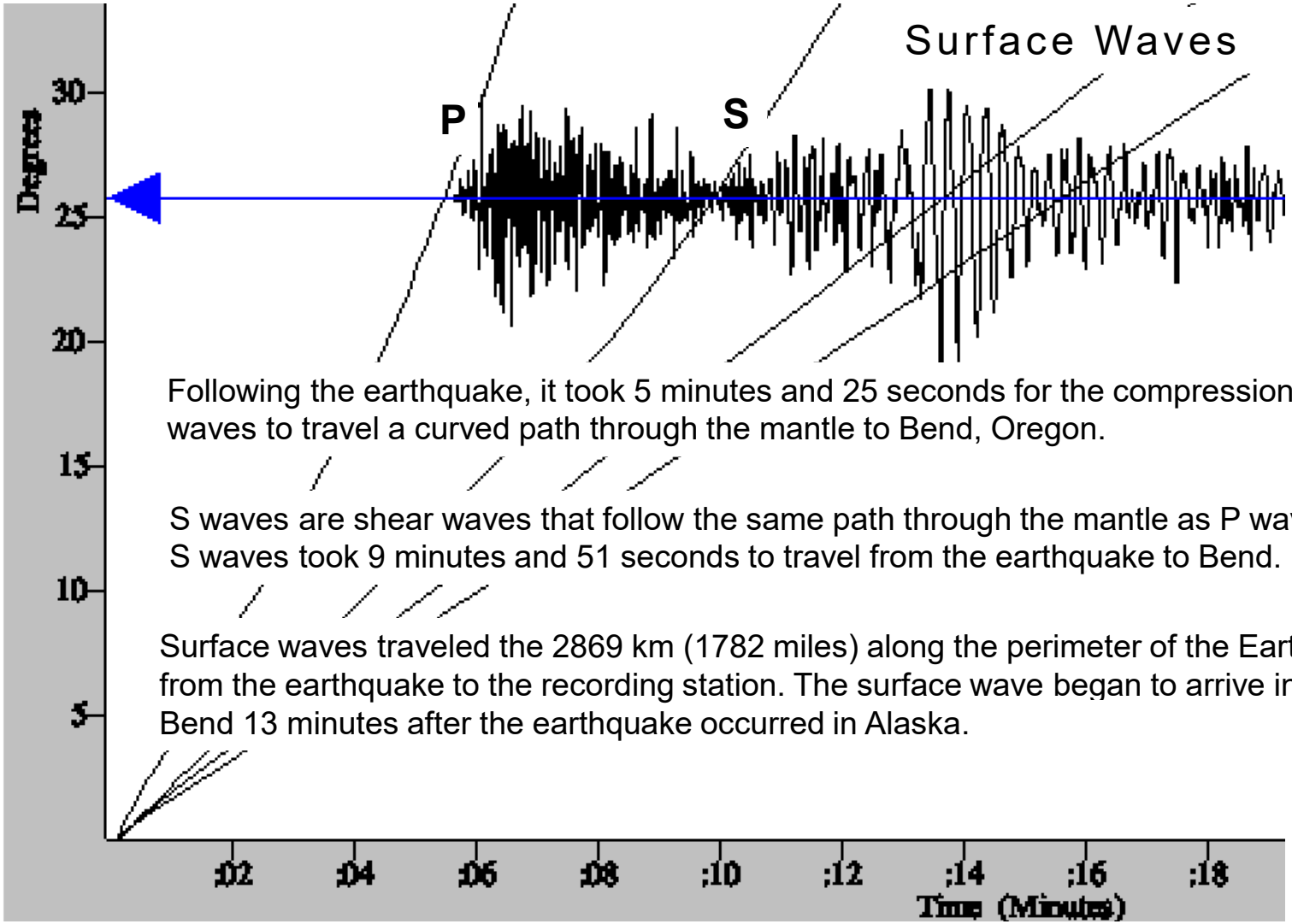
The tension axis (T) reflects the minimum compressive stress direction. The pressure axis (P) reflects the maximum compressive stress direction.

In this case, the earthquake location and focal mechanism indicate it was due to thrust faulting on the megathrust boundary between the subducting Pacific Plate and the overriding North American Plate.



Magnitude 8.2 ALASKA
Thursday, July 29, 2021 at 06:15:47 UTC

The record of the earthquake in Bend, Oregon (BNOR) is illustrated below. Bend is 2869 km (1782 miles, 25.5˚) from the location of this earthquake.



Following the earthquake, it took 5 minutes and 25 seconds for the compressional P waves to travel a curved path through the mantle to Bend, Oregon.

S waves are shear waves that follow the same path through the mantle as P waves. S waves took 9 minutes and 51 seconds to travel from the earthquake to Bend.

Surface waves traveled the 2869 km (1782 miles) along the perimeter of the Earth from the earthquake to the recording station. The surface wave began to arrive in Bend 13 minutes after the earthquake occurred in Alaska.

Teachable Moments are a service of

The Incorporated Research Institutions for Seismology
Education & Public Outreach
and
The University of Portland

Please send feedback to tkb@iris.edu

To receive automatic notifications of new Teachable Moments
subscribe at www.iris.edu/hq/retm

www.iris.edu/earthquake