Resource from animation found at: <http://www.iris.edu/hq/inclass/search>

**Narration from the animation:**

**Alaska: The Great Alaska Earthquake of 1964**

The 1964 Great Alaska Earthquake occurred on Good Friday and rocked the state with strong ground shaking that lasted four and a half minutes. At magnitude 9.2, it was the second largest quake *ever* recorded by seismometers. Its memory haunts those who lived through the shaking and experienced the tsunami that destroyed entire communities….. This earthquake *also* rocked the scientific community by confirming a major principle of plate tectonics with the observation that the oceanic Pacific Plate dives beneath the continental North American Plate at the Aleutian trench.

Alaska has over 24,000 measured earthquakes every year, more than the rest of the US combined. Shown here are only those above magnitude 6. On average, at least one strong magnitude seven occurs every year. Between 1899 and 1986 eight earthquakes of magnitude eight or greater impacted different areas of the Aleutian subduction zone. Red circles mark the epicenter above the site where fault rupture began, whereas yellow shows the fault-rupture area. How can we understand the *relative* energy released by a great earthquake of magnitude 9 compared to smaller yet still damaging earthquakes? *And* what is the rupture zone?

The energy released by earthquakes increases by a factor of 30 for each unit increase in magnitudeAs an anology, if breaking a single strand of pasta represents a magnitude *five* earthquake, then we need to break *30* strands to represent a six, 900 strands for a seven, and *27,000 noodles* to represent a magnitude eight. To represent the energy released in a magnitude nine earthquake, like the recent earthquake in Japan, we would need to break an immense bundle of 810,000 noodles! And the Alaska 1964 earthquake was even larger at magnitude 9.2.

To address the great-earthquake rupture process, let’s first examine the plate tectonics of the North Pacific region. The distribution of earthquake epicenters, shown earlier, roughly defines plate boundaries. The Aleutian trench marks *a 2 thousand One Hundred*-mile-long subduction boundary between the Pacific and North American plates, similar to the Nazca Plate diving beneath the South America Plate at the Peru-Chile Trench. Along southeast Alaska and western British Columbia, the Pacific Plate grinds against the North American Plate in strike-slip motion as it does along the San Andreas Fault in California.

The rate of subduction varies from **two point two** , to 3 inches per year.

We will animate the 1964 earthquake in four consecutive perspectives to understand what happened:

Most people think of an earthquake as a sudden release of energy at the epicenter. In reality, an earthquake is caused by sudden displacement of rock across a fault at a given depth within the earth at the hypocenter. For great earthquakes, the displacement at the hypocenter is just the beginning. The initial fault break in 1964 triggered a runaway rupture that displaced an area more than 500 miles long, The entire fault rupture elapsed over four and a half minutes releasing immense seismic energy equivalent to a cascade of 1,000 magnitude seven earthquakes.

Lets zoom in now to a cross section to view the plate interaction. The dense oceanic plate dives beneath the more-buoyant continental plate at a rate of about 2.5 inches per year. Because tectonic plates are elastic like a spring, converging plates build energy at the leading edge of the continent. Locked by friction, the upper plate is forced back and shortened, raising the land surface. GPS, not available in 1964, is now able to measure that strain. In 1964, the force of the converging plates overcame friction, and caused the leading edge to lurch seaward, uplifting the seafloor, forming a mound of seawater that spread out as a tsunami. As coastal areas near the trench were uplifted, areas inland dropped.

During the 1964 earthquake, the broad area at the leading edge of the overlying plate rose up as high as *nine* meters as the landward region subsided up to 2 meters, thus raising the shoreline barnacles well above sea level and dropping the inland shoreline below sea level killing trees, leaving its legacy in ghost forests. The ground shook relentlessly as the rupture progressed along the fault surface. Prolonged shaking served to liquefy underground water-saturated sediment. Liquefaction triggered the landslides that caused in major damage in Anchorage.

Deformation of the seafloor, especially uplift along the Patton Bay fault, produced a tsunami that spread across the Pacific Ocean. Astonishingly only nine people died from the earthquake itself, but *130* were killed by the subsequent tsunami that wreaked havoc across the northern Pacific region.

In the early 1960’s, Plate Tectonic Theory was in its infancy, and subduction was poorly understood. Measurements of land and seafloor deformation taken by U.S.G.S. geologist George Plafker & co-workers soon after the earthquake, led them to propose that under-thrusting of the Pacific Plate beneath Alaska caused the earthquake. This discovery helped establish subduction of oceanic plates beneath continental plates, and megathrust earthquakes as fundamental processes of plate tectonics.

Since 1964, when there were only two seismometers in Alaska, monitoring earthquakes and ground deformation to assess hazards and to mitigate future risk has greatly increased. Research that characterizes earthquakes and fault lines serves to reduce the possibility of casualties by better land-use planning and constructing earthquake resistant buildings, allowing us to live more safely in earthquake zones.