Destruction along the waterfront of Hilo, Hawaii from the Pacific-wide tsunami generated off the coast of Unimak Island, Alaska, USA on April 1, 1946.

Characteristics of the Tsunami Phenomena

A tsunami is a system of ocean gravity waves formed as a result of a large-scale disturbance of the sea that occurs in a relatively short duration of time. In the process of the sea water returning by the force of gravity to an equilibrium position, a series of oscillations both above and below sea level take place, and waves are generated which propagate outward from the source region. Most tsunamis are caused by earthquakes, with a vertical disruption of the water column generally caused by a vertical tectonic displacement of the sea bottom along a zone of fracture in the earth's crust which underlies or borders the ocean floor. For the largest tsunamigenic earthquakes, 100,000 km^2 or more of seafloor may be vertically displaced by up to several meters or even more. Other source mechanisms include volcanic eruptions next to or under the ocean, displacement of submarine sediments, coastal landslides that go into the water, or large-scale explosions in the ocean caused by manmade detonations or meteor impacts.

A tsunami travels outward from the source region as a series of waves. Its speed depends upon the depth of the water, and consequently the waves undergo accelerations or decelerations in passing respectively over an ocean bottom of increasing or decreasing depth. By this process the direction of wave propagation also changes, and the wave energy can become focused or defocused. In the deep ocean, tsunami waves can travel at speeds of 500 to 1000 kilometers per hour. Near shore, however, a tsunami slows down to just a few tens of kilometers per hour. The height of a tsunami also depends upon the water depth. A tsunami that is just a meter in height in the deep ocean can grow to tens of meters at the shoreline. Unlike familiar wind-driven ocean waves that are only a disturbance of the sea surface, the tsunami wave energy extends to the ocean bottom. Near shore, this energy is concentrated in the vertical direction by the reduction in water depth, and in the horizontal direction by a shortening of the wavelength due to the wave slowing down. Tsunamis have periods (the time for a single wave cycle) that