

A strong magnitude 7.7 earthquake has occurred near the Mariana Islands. The earthquake was located about 366 km (227 miles) north of Saipan and approximately 30 km (18 miles) southwest of Agrihan, Northern Mariana Islands, at a depth of 212.4 km (132 miles).

The closest island, Agrihan, is an unpopulated stratovolcano.





Image courtesy NASA



The Modified-Mercalli Intensity scale is a twelve-stage scale, from I to XII, that indicates the severity of ground shaking.

The islands nearest the epicenter experienced strong shaking.

Iodified Mercalli Intensity		
	х	l l
	DX	]
	VIII	
	VII	
	VI	1
	v	
	N	1
	II-III	
	1	Ĵ

Perceived Shaking Extreme 18<sup>°</sup> Violent Severe Very Strong Moderate Light 16<sup>°</sup> Weak Not Felt



Image courtesy of the US Geological Survey

USGS Estimated shaking Intensity from M 7.7 Earthquake



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

This earthquake was not widely felt because the area is sparsely populated.

MMI	Shaking	Pop.
I	Not Felt	*
II-III	Weak	*
IV	Light	*
V	Moderate	0 k
VI	Strong	0 k
VII	Very Strong	0 k
VIII	Severe	0 k
IX	Violent	0 k
Х	Extreme	0 k

#### USGS PAGER Population Exposed to Earthquake Shaking



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



The epicenter of the July 29, 2016 earthquake is labeled on this seismicity map showing the most recent 1000 earthquakes in the surrounding area.

The subduction zone between the Pacific and Philippine Plates has frequent earthquakes with depths increasing from east-to-west across the convergent plate boundary.

The rectangle shows the location of the cross section in the next slide.



Map created with the IRIS Earthquake Browser



The hypocenter of the July 29 earthquake is shown on this East – West cross section of seismicity. Earthquakes below 50 km depth are within the subducting Pacific Plate. To produce earthquakes, rocks must be brittle with temperatures below ~600 °C. With the exception of subducting oceanic plates, rock in Earth's mantle below about 100 km depth is viscoelastic and cannot rupture to produce earthquakes. However,



Cross section created with the IRIS Earthquake Browser

rapidly subducting cool oceanic plates can reach depths up to about 700 km into the hot mantle and continue to produce earthquakes.



The Pacific Plate is over 150 million years old at the Marianas Trench. This part of the Pacific Plate is some of the oldest oceanic plate on Earth. As an oceanic plate moves away from the spreading center at which it formed, it cools because its top surface is in contact with cold deep-ocean water. As the plate ages and cools, it shrinks and therefore becomes

#### Age of Oceanic Lithosphere (m.y.)

Muller, R.D., M. Sdrolias, C. Gaina, and W.R. Roest 2008. Age, spreading rates and spreading symmetry of the world's ocean crust, Geochem. Geophys. Geosyst., 9, Q04006, doi:10.1029/2007GC001743.



more dense. The 150 million year age and resulting high density of the Pacific Plate at the Mariana Trench accounts for its steep angle of subduction as it dives beneath the Philippine Plate.



Locations of earthquakes occurring between 1900 and 2014 are shown on this plate tectonic map of the Mariana Trench region in the western Pacific Ocean.

The Pacific Plate subducts beneath the Philippine Plate at the Mariana Trench, the deepest ocean trench. At the location of the July 29 earthquake, the convergence rate between the Pacific and Philippine Plates is about 40 mm/yr (4 cm/yr).

The colored contours show the depth to the top of the subducting Pacific Plate. The July 29 earthquake occurred at 212 km depth, within the subducting Pacific Plate.



Image courtesy of the US Geological Survey



According to the USGS, the focal mechanism solution indicates oblique rupture on a reverse fault. This is consistent with intraplate compressional tectonics implied by the faulting mechanism and earthquake depth. The earthquake likely represents the release of stress resulting from the distortion of the Pacific plate at depth.



#### USGS W-phase Moment Tensor Solution



Exploring earthquakes in oceanocean subduction zones.

According to the USGS, earthquakes like this event, with focal depths between 70 and 300 km, are commonly termed "intermediate-depth" earthquakes. Intermediate-depth earthquakes represent deformation within subducted slabs rather than at the shallow plate interface between subducting and overriding tectonic plates. They typically cause less damage on the ground surface above their foci than is the case with similar magnitude shallow-focus earthquakes.

Excerpt from IRIS animation on ocean-ocean subduction ("Subduction zone— Kermedec Trench & Vanuatu Islands"(



To see entire video url is at the end of this short.

The record of the earthquake in Bend, Oregon (BNOR) is illustrated below. Bend is 8801 km (5468 miles, 79.29°) from the location of this earthquake.



**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 <u>www.iris.edu/hq/retm</u>





University of Portland

www.iris.edu/earthquake