



This map shows global earthquakes of magnitude 4.0 and above for the 10-year period of 1998 – 2009. Some important and interesting historical earthquakes dating back to 1700 are also shown. These events are of note for their magnitude, their societal interest, or their scientific interest. Because earthquake catalogs are generally incomplete below magnitude 5.5 before 2000, it is not possible to show all the earthquakes below this magnitude. Areas with better seismic monitoring instrumentation have more complete catalogs for the magnitude range of 4.0 to 5.5. As a result, there are some areas in which more magnitude 4.0 to 5.5 earthquakes occurred than are seen on this map. For all the earthquakes below magnitude 9, the color of the earthquake indicates the depth of its hypocenter – where the earthquake rupture started.

• **Earthquakes and Plate Boundaries:** Note that most earthquakes are clustered along the active plate boundaries seen in the previous two maps. Mid-ocean ridges generally have no earthquakes – the newly-formed crust in these ridges is too hot. The transform boundaries that connect the ridges have shallow and generally small earthquakes. Although there are some exceptions, the crust in these transform boundaries usually is thin and weak, and unable to build up the stress needed to produce large earthquakes. The largest and deepest earthquakes occur in convergent boundaries that also are subduction zones. The crust in subduction zones generally is very old, dense and cold, making it stiff and resistant to movement. This resistance allows great stresses to build up in the crust, leading to large earthquakes when the stress is released. Earthquakes also occur away from the plate boundaries, within the stable portion of plates, but often with much less frequency and lower magnitude.

GLOBAL BACKGROUND SEISMICITY 1998 - 2009

NOTABLE HISTORIC EARTHQUAKES

• **Pacific Ring of Fire:** The most prominent band of earthquakes defines the Pacific Ring of Fire. The Ring of Fire starts on the west coast of South America, runs north along the continental coasts to Alaska, west along the Aleutian Islands to Russia, south along Japan and both sides of the Philippine Sea Plate, branches west into Indonesia and east towards Tonga and Fiji, and finally heads south to end in New Zealand. This ring of earthquakes is produced primarily by subduction of the Pacific Plate. Subduction also often produces volcanoes: the subducted crust is partially melted by the high temperatures inside the Earth, and the melted material rises back to the surface, erupting into volcanoes. Though not shown on this map, a majority of the Earth's volcanoes are located on the Pacific Ring of Fire, giving it its name.

As this map shows, smaller earthquakes occur in greater numbers than larger earthquakes. There are far more earthquakes of magnitude 4.0 to 6.9 than there are earthquakes of magnitude 7.0 and larger. As earthquake magnitude increases, the frequency of occurrence decreases: Global observation of earthquakes has shown that, on average, each year we can expect an estimated 1.3 million earthquakes of magnitude 2 – 2.9; 130,000 earthquakes of magnitude 3 – 3.9; 13,000 earthquakes of magnitude 4 – 4.9; 1,319 earthquakes of magnitude 5 – 5.9; 134 earthquakes of magnitude 6 – 6.9; 17 earthquakes of magnitude 7 – 7.9; and only 1 earthquake of magnitude 8 and higher (source: USGS). Although more than 99% of the earthquakes which occur each year are magnitude 4.9 or smaller, these are the earthquakes which generally cause little or no damage. All of the global annual earthquake damage and destruction is caused by 0.1% of earthquakes.

Historical Earthquakes - Published by USGS National Earthquake Information Center
Plate Boundary - Referenced from Bird, Pater (2003) An updated digital model of plate boundaries. (Circum boundaries omitted.)
Plate Convergence Vectors - Referenced from United States Geological Survey. Convergence data are shown by arrows describing direction and speed, relative to the plate across the boundary.
Plate Divergence Vectors - Referenced from Digital Tectonic Activity Map. Divergence data are shown by double arrows describing direction and speed.
World WorldSat Color Shaded Relief Image - Published by Environmental Systems Research Institute, Inc
Projection: Robinson (World)
Produced by California Institute of Technology Seismological Laboratory
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