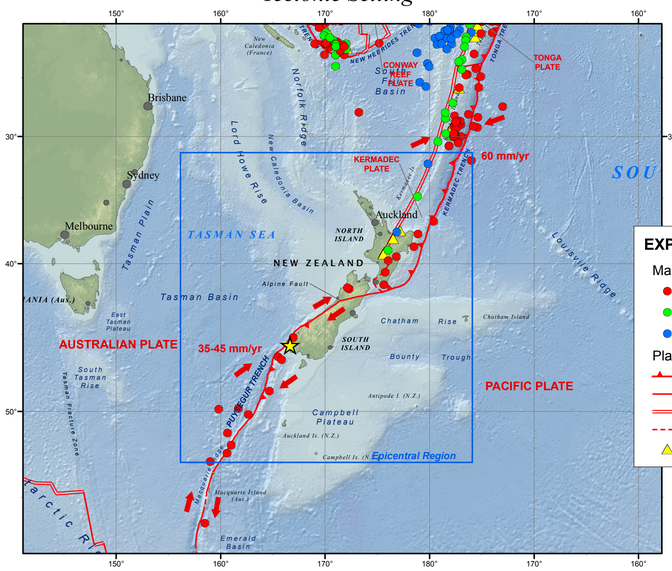
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

EARTHQUAKE SUMMARY MAP

Prepared in cooperation with the Global Seismographic Network

M7.8 South Island, New Zealand Earthquake of 15 July 2009

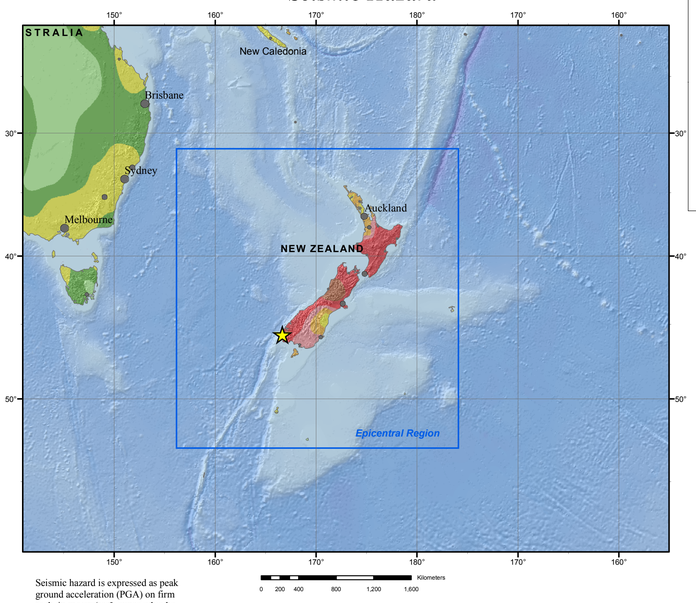
Tectonic Setting



RELATIVE PLATE MOTIONS

The broad red vectors represent the motion of tectonic plates relative to the adjacent plate. In the vicinity of this earthquake, the Australia Plate and Pacific Plate are converging at about 35-45 mm/yr along the Puysegur Trench.

Seismic Hazard

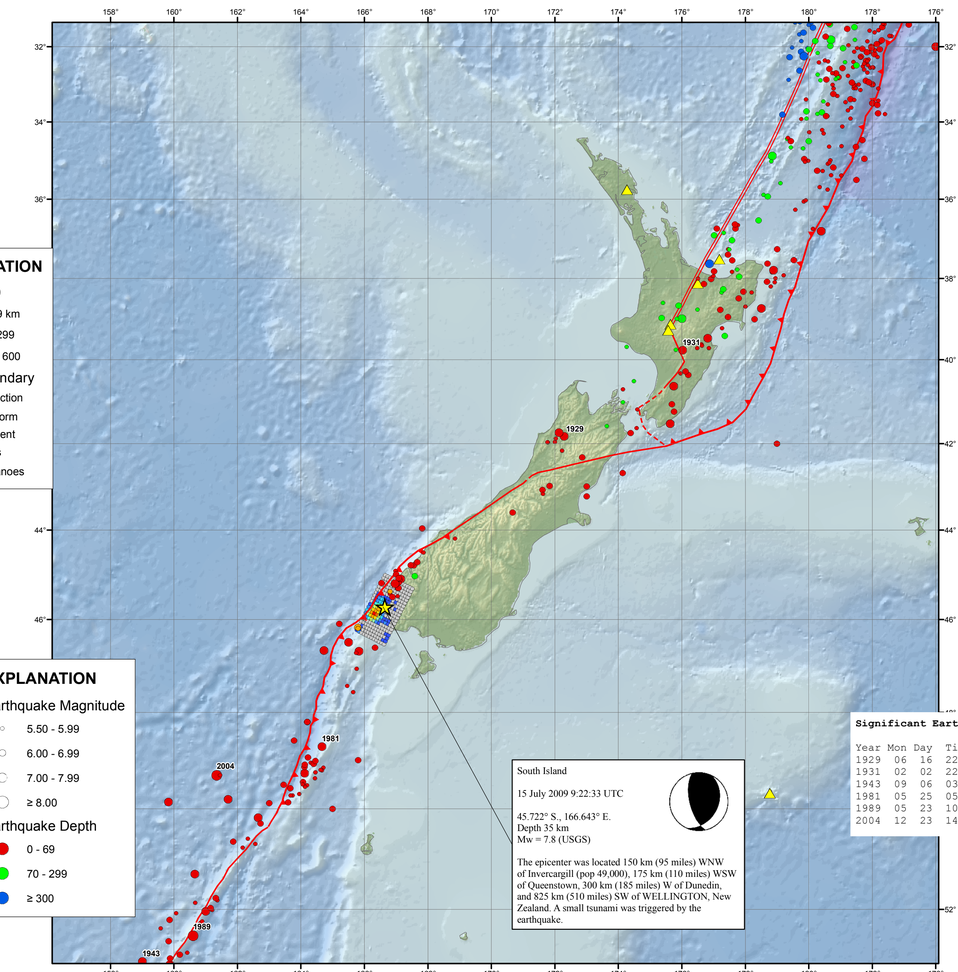


Peak Ground Acceleration in m/sec**2

.2 .4 .8 1.6 2.4 3.2 4.0 4.8

Seismic hazard is expressed as peak ground acceleration (PGA) on firm rock, in meters/sec^2, expected to be exceeded in a 50-yr period with a probability of 10 percent.

Epicentral Region



EXPLANATION

Mag ≥ 7.0
- 0 - 69 km
- 70 - 299
- 300 - 600

Plate Boundary
- Subduction
- Transform
- Divergent
- Others
- Volcanoes

EXPLANATION

Earthquake Magnitude
- 5.50 - 5.99
- 6.00 - 6.99
- 7.00 - 7.99
- ≥ 8.00

Earthquake Depth
- 0 - 69
- 70 - 299
- ≥ 300

South Island

15 July 2009 9:22:33 UTC

45.722° S., 166.643° E.
Depth 35 km
Mw = 7.8 (USGS)

The epicenter was located 150 km (95 miles) WNW of Invercargill (pop 49,000), 175 km (110 miles) WSW of Queenstown, 300 km (185 miles) W of Dunedin, and 825 km (510 miles) SW of WELLINGTON, New Zealand. A small tsunami was triggered by the earthquake.

Mercator Projection
0 100 200 400 Kilometers

Significant Earthquakes Mag >= 7.5

Year	Mon	Day	Time	Lat	Long	Dep	Mag
1929	06	16	2247	-41.831	172.292	35	7.5
1931	02	02	2246	-39.772	176.025	35	7.7
1943	09	06	0341	-53.000	159.000	0	7.6
1981	05	25	0525	-48.721	164.658	8.6	7.6
1989	05	23	1054	-52.507	160.602	4.3	8.1
2004	12	23	1459	-49.312	161.345	10	8.1

DISCUSSION

The North and South Islands of New Zealand straddle the boundary between the Australian and Pacific plates. Along this boundary through southern New Zealand, the Australian Plate moves to the northeast at a rate of 35-45 mm/yr relative to the Pacific plate. In Southwestern South Island, this motion is accommodated by oblique convergence at the Puysegur Trench, where the Australian Plate subducts beneath the Pacific Plate. Further north along the South Islands' west coast, relative motion is accommodated via oblique strike-slip movement along the Alpine Fault, driving the uplift of the Southern Alps.

The recent (09/07/15) thrust earthquake occurred near the southern tip of South Island in a region known as Fiordland, in a complex area of transition in plate boundary structure from Puysegur subduction to Alpine fault strike-slip motion. The preliminary location, depth, and estimate of fault orientation of this event are consistent with the earthquake having resulted from slip on the subduction thrust interface between the Pacific and Australian plates. The deformed Australian plate beneath Fiordland is highly active both along its interface with the Pacific plate and internal to the subducted Australian plate. Over the past two decades, several large earthquakes have occurred in Fiordland, predominantly in a cluster to the northwest of today's earthquake. Though the faulting mechanisms of those events are similar to today's earthquake, their slip vectors are rotated clockwise with respect to plate motions, and thus may not represent exactly the same style of faulting.

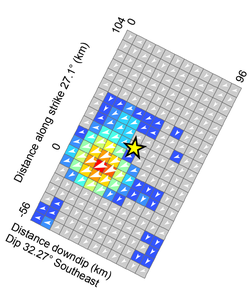
The most recent of these previous large events occurred in August of 2003 when a magnitude 7.2 earthquake approximately 100 km to the northeast caused minor damage in Otago and Southland, and numerous landslides across the Fiordland region. A magnitude 7.0 event on August 10, 1993 caused power outages in the Te Anau area and was felt throughout South Island and as far away as Sydney, Australia. A magnitude 6.4 earthquake struck on May 31, 1989 and was felt strongly in the southwestern part of South Island and a magnitude 6.7 quake struck on June 3, 1988.

Finite Fault Model for M7.8 Earthquake

FINITE FAULT MODEL
Contributed by
Gavin Hayes, NEIC

Distribution of the amplitude and direction of slip for subfault elements (small rectangles) of the fault rupture model are determined from the inversion of teleseismic body waveforms. Arrows indicate the amplitude and direction of slip (of the hanging wall with respect to the foot wall); the slip amount is also color-coded as shown. The view of the rupture plane is from above.

The strike of the fault rupture plane is N27.1°E and the dip is 32.27° SE. The dimensions of the subfault elements are 8 km in the strike direction and 8 km in the dip direction. The seismic moment released based on the plane is 4.59E+027 dyne.cm.



Slip (cm)
- 0 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- 200 - 250
- 250 - 300
- 300 - 350
- 350 - 400
- 400 - 450
- 450 - 500
- 500 - 550
- 550 - 600

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USAID from the American people

M 7.6, OFF WEST COAST OF THE SOUTH ISLAND, N.Z. **PAGER**
Origin Time: Wed 2009-07-15 09:22:29 UTC **Version 4**
Location: 45.75°S 166.58°E Depth: 12 km
Created: 7 hrs, 5 min after earthquake

Estimated Population Exposed to Earthquake Shaking

ESTIMATED POPULATION EXPOSURE (k = x1000)	-	-	88k*	40k	1k	0	0	0	0
ESTIMATED MODIFIED MERCALLI INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE: Historical Structures	none	none	none	V. Light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy
POTENTIAL DAMAGE: Vulnerable Structures	none	none	none	none	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy

*Estimated exposure only includes populations within the map area.

Population Exposure population per ~1 sq. km from Landscan 2006

0 1 50 100 500 1000 5000 10000

Selected City Exposure

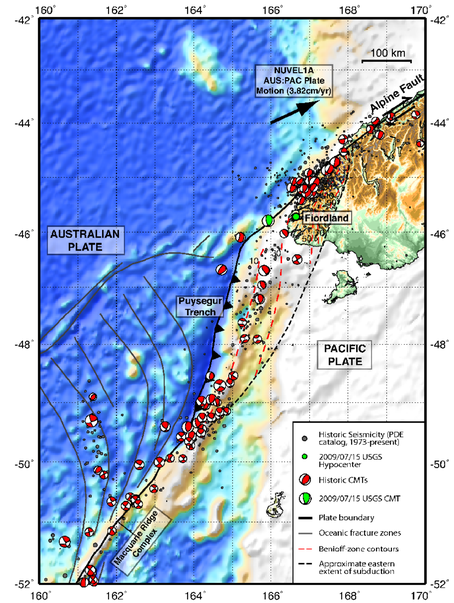
MMI	City	Population
V	Te Anau	2k
V	Bluff	1k
V	Riverton	1k
V	Winton	2k
IV	Invercargill	47k
IV	Wanaka	4k

bold cities appear on map (k = x1000)

Shaking Intensity MMI

Population exposure estimates are NOT a direct estimate of earthquake damage; comparable shaking will result in significantly lower losses in regions with well built structures than in regions with vulnerable structures.

This information was automatically generated and has not been reviewed by a seismologist.
http://earthquake.usgs.gov/pager Event ID: us2009jcap



DATA SOURCES and REFERENCES

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NOAA, National Geophysical Data Center
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HDF (unpublished earthquake catalog) (Engdahl, 2003)
Global Seismic Hazard Assessment Program
http://www.seismo.ethz.ch/GSHAP/

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Bird, P., 2003, An updated digital model of plate boundaries; Geochem. Geophys. Geosyst., v. 4, no. 3, pp. 1027- 80.

BASE MAP
NIMA and ESRI, Digital Chart of the World
USGS, EROS Data Center
NOAA GEBCO and GLOBE Elevation Models

Map prepared by U.S. Geological Survey National Earthquake Information Center
16 July 2009
http://earthquake.usgs.gov/
Map not approved for release by Director USGS