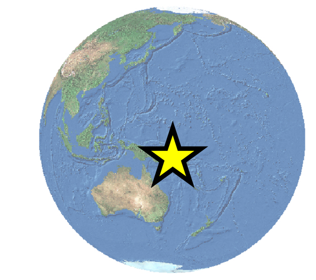
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

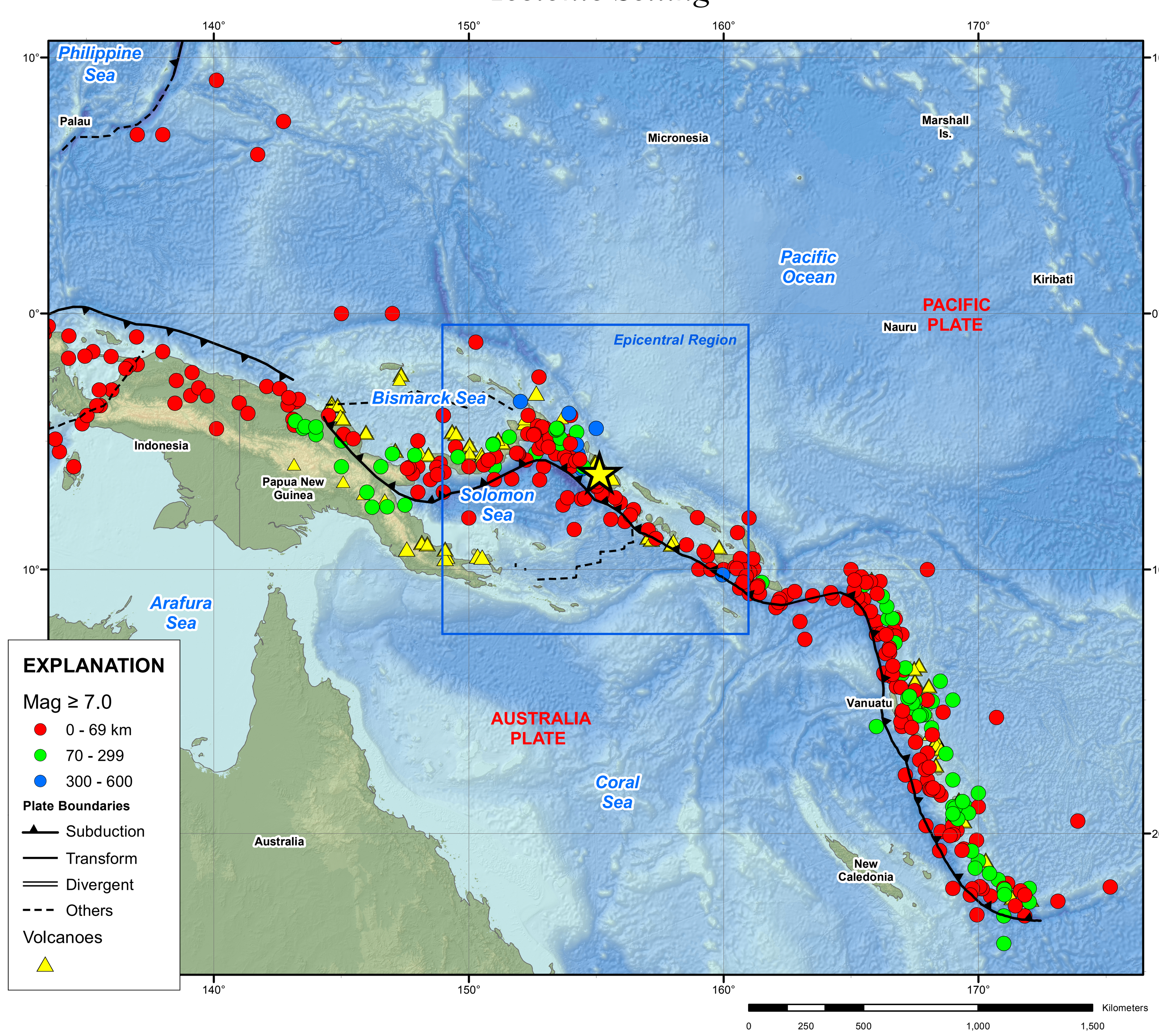
M7.9 Papua New Guinea Earthquake of 22 January 2017



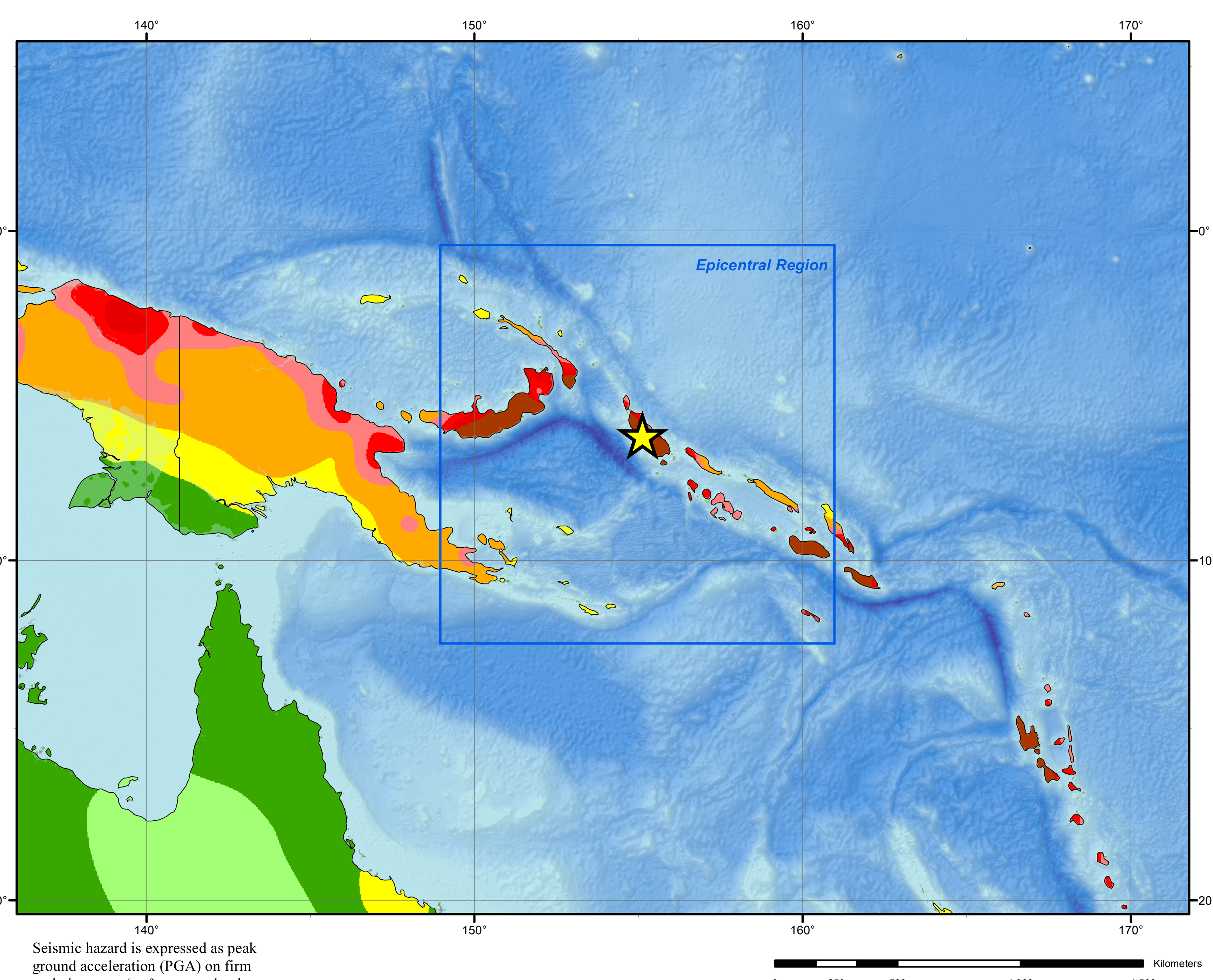
EARTHQUAKE SUMMARY MAP

Prepared in cooperation with the Global Seismographic Network

Tectonic Setting



Seismic Hazard

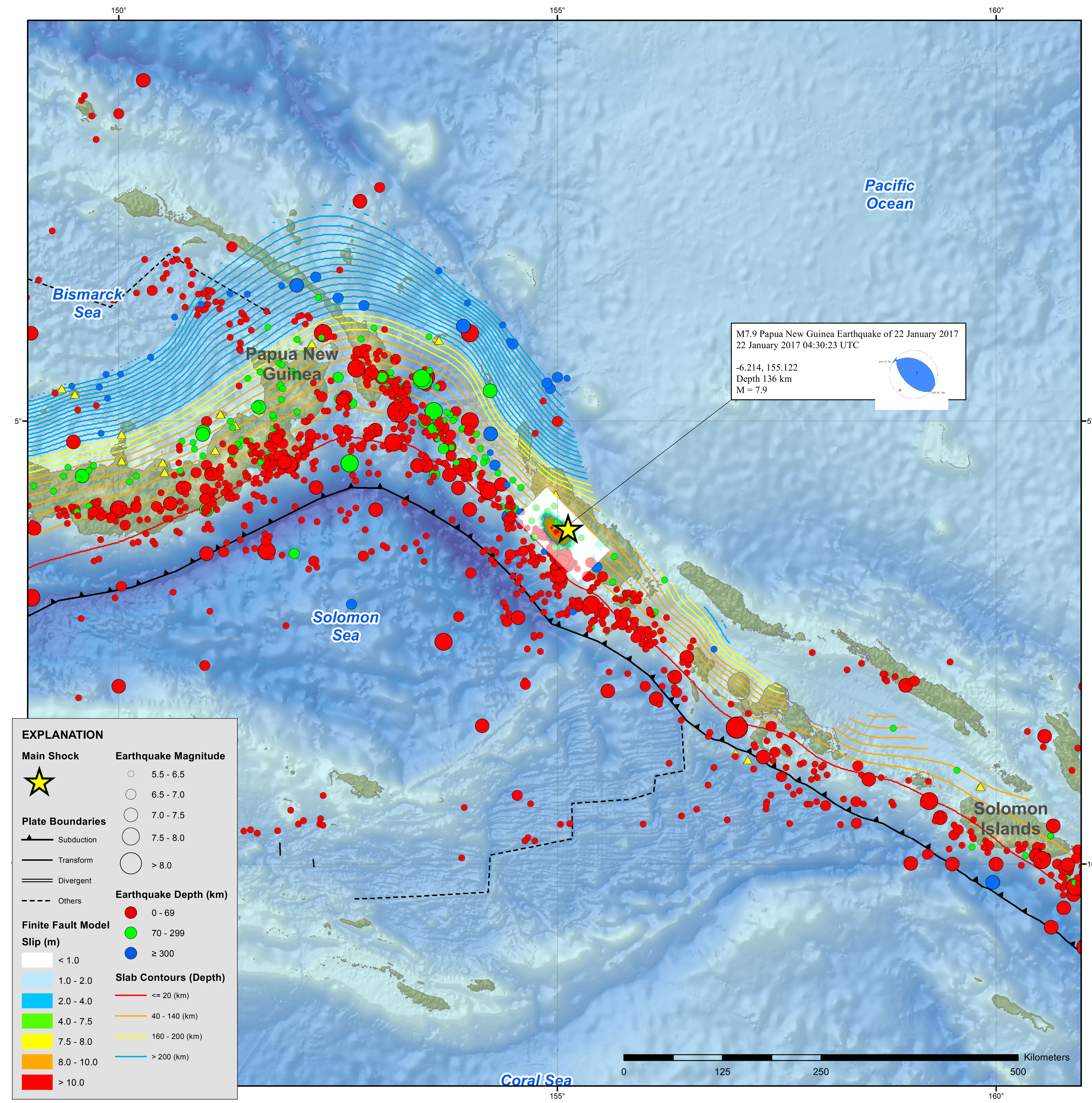


Seismic hazard is expressed as peak ground acceleration (PGA) on firm rock, in meters/sec², expected to be exceeded in a 50-yr period with a probability of 10 percent.

Peak Ground Acceleration in m/sec**2

.2 .4 .8 1.6 2.4 3.2 4.0 4.8

Epicentral Region



PAGER

Earthquake Shaking — Yellow Alert

M 7.9, BOUGAINVILLE REGION, PAPUA NEW GUINEA
Origin Time: Sun 2017-01-22 04:30:23 UTC (14:30:23 local)
Location: 6.21°S 155.12°E Depth: 136 km

PAGER Version 4
Created: 12 hours, 4 minutes after earthquake

Estimated Fatalities

39% 35% 20% 5% 1% — Fatalities: 1, 10, 100, 1,000, 10,000, 100,000

Yellow alert level for shaking-related fatalities. Some casualties are possible and the impact should be relatively localized. Past events with this alert level have required a local or regional level response.

Green alert level for economic losses. There is a low likelihood of damage.

Estimated Economic Losses

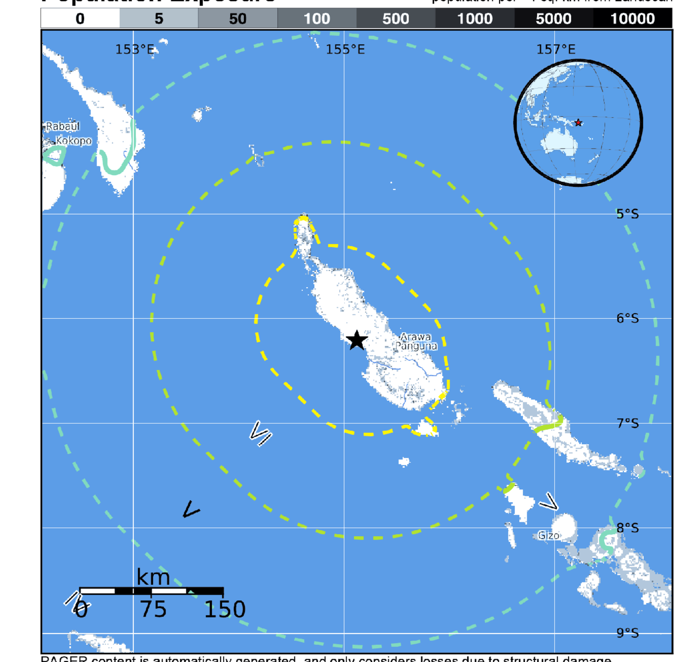
65% 30% 4% — USD (Millions): 1, 10, 100, 1,000, 10,000, 100,000

Estimated Population Exposed to Earthquake Shaking

ESTIMATED POPULATION EXPOSURE (k = x1000)		- -*	- -*	192k*	118k	42k	210k	2k	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	Resistant Structures	none	none	none	V. Light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy
	Vulnerable Structures	none	none	none	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy	V. Heavy

*Estimated exposure only includes population within the map area.

Population Exposure population per ~1 sq. km from Landscan



Structures:
Overall, the population in this region resides in structures that are vulnerable to earthquake shaking, though some resistant structures exist. The predominant vulnerable building types are unreinforced brick masonry and informal (metal, timber, GI etc.) construction.

Historical Earthquakes (with MMI levels):

Date (UTC)	Dist. (km)	Mag.	Max MMI(#)	Shaking Deaths
1975-07-20	38	7.9	VIII(48k)	0
1996-04-29	30	7.2	VIII(601)	1
1983-12-21	368	6.2	VII(5k)	10

Recent earthquakes in this area have caused secondary hazards such as tsunamis and landslides that might have contributed to losses.

Selected City Exposure
from GeoNames.org

MMI	City	Population
VII	Kieta	4k
VII	Panguna	3k
VII	Arawa	40k
V	Gizo	6k
IV	Kokopo	26k
IV	Namatanai	1k
IV	Rabaul	8k

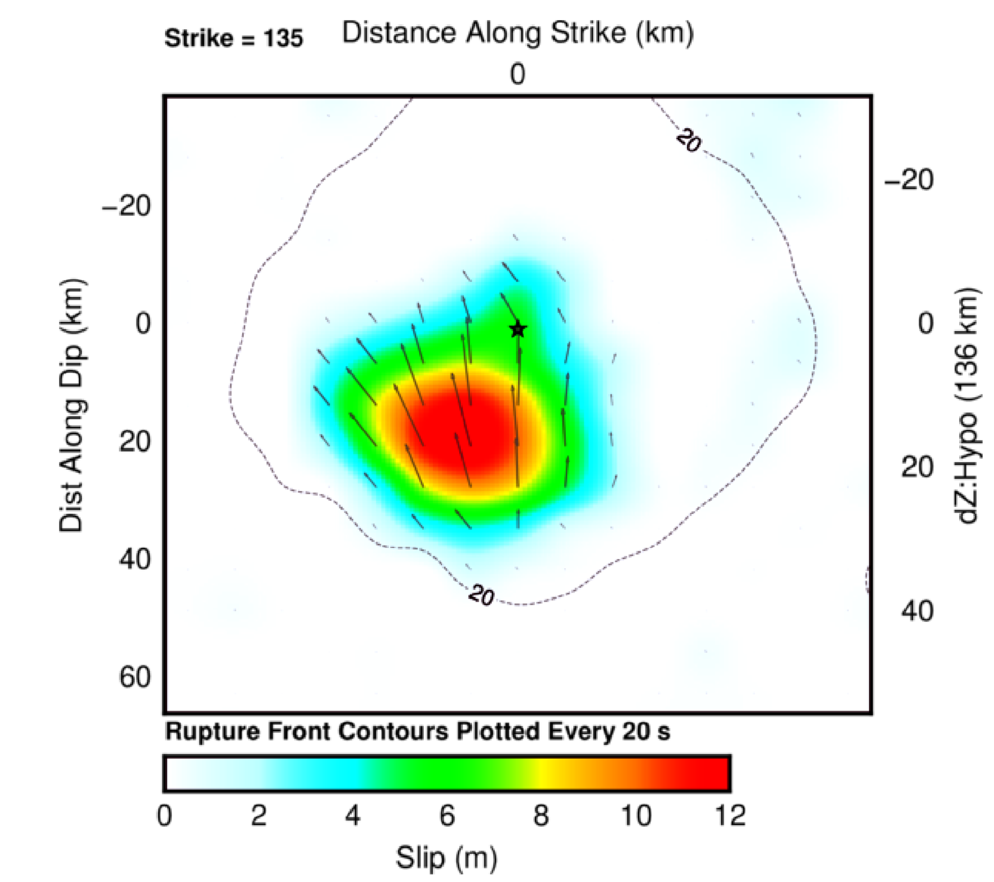
bold cities appear on map (k = x1000)

PAGER content is automatically generated, and only considers losses due to structural damage. Limitations of input data, shaking estimates, and loss models may add uncertainty.
http://earthquake.usgs.gov/earthquakes/eventpage/us10007uph

Event ID: us10007uph

Finite Fault Model

Distribution of the amplitude and direction of slip for subfault elements of the fault rupture model are determined from the inversion of teleseismic body waveforms and long period surface waves. Arrows indicate the amplitude and direction of slip (of the hanging wall with respect to the foot wall); the slip is also colored by magnitude. The view of the rupture plane is from above. The strike of the fault rupture plane is 135° and the dip is 55°SW. The dimensions of the subfault elements are 8 km in the strike direction and 7 km in the dip direction. The rupture surface is approximately 50 km along strike and 50 km along downdip. The seismic moment release based upon this plane is 8.79e+27 dyne.cm.



TECTONIC SUMMARY

The January 22nd, 2017, M 7.9 earthquake west of Panguna, Papua New Guinea, occurred as the result of reverse faulting at an intermediate depth (~150 km) beneath the island of Bougainville (North Solomons). At the location of the earthquake, the Australia plate is converging with and subducting beneath the Pacific plate in an east-northeast direction at a rate of approximately 103 mm/yr. At the location of the earthquake, some researchers consider the edges of the Australia and Pacific plates to be divided into several microplates that take up the overall convergence between Australia and the Pacific, including the Solomon Sea, South Bismarck and Manus microplates local to this event. In this context, the January 22nd event occurred along the boundary between the Solomon Sea microplate and the Pacific plate. The Solomon Sea microplate moves slightly faster and more northeasterly with respect to the Pacific plate (and South Bismarck and Manus microplates) than does the Australia plate due to sea-floor spreading in the Woodlark Basin to the southeast of the January 22nd earthquake, facilitating the classic subduction evident beneath New Britain and New Ireland. Focal mechanism solutions for the January 22nd event indicate the earthquake occurred on a moderately dipping fault striking either northwest or southeast. The location, depth and focal mechanism solution all indicate the earthquake occurred as a result of intraplate faulting within the subducting lithosphere of the Australia plate (Solomon Sea microplate), rather than on the overlying plate interface.

While commonly plotted as points on maps, earthquakes of this size are more appropriately described as slip over a larger fault area. Reverse-faulting events of the size of the January 22, 2017, M 7.9 earthquake are typically about 135x60 km (length x width).

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, but large intermediate-depth earthquakes may be felt at great distance from their epicenters. "Deep-focus" earthquakes, those with focal depths greater than 300 km, also occur in the subducted Australia plate. Earthquakes have been reliably located to depths of about 500 km in this region.

The Papua New Guinea region frequently hosts large earthquakes. Over the preceding century, 29 other earthquakes with M 7+ occurred within 250 km of the January 22nd event. One of these occurred at intermediate (70-300 km) - the March 1983 M 7.6 earthquake, over 200 km northwest of the January 22nd event - while two others occurred at deep (>300 km) depths. The December 17, 2016, M 7.9 intermediate earthquake occurred just under 300 km to the northwest of the January 22nd event.

DATA SOURCES

EARTHQUAKES AND SEISMIC HAZARD
USGS, National Earthquake Information Center
NOAA, National Geophysical Data Center
IASPEI, Centennial Catalog (1900 - 1999) and extensions (Engdahl and Villaseñor, 2002)
EHB catalog (Engdahl et al., 1998)
HDF (unpublished earthquake catalog, Engdahl, 2003)
Global Seismic Hazard Assessment Program
Volcanoes of the World (Siebert and Simkin, 2002)

PLATE TECTONICS AND FAULT MODEL
PB2002 (Bird, 2003)
Ji, C., D.J. Wald, and D.V. Helmberger, Source description of the 1999 Hector Mine, California earthquake; Part I: Wavelet domain inversion theory and resolution analysis, Bull. Seism. Soc. Am., Vol 92, No. 4. pp. 1192-1207, 2002.
DeMets, C., Gordon, R.G., Argus, D.F., 2010. Geologically current plate motions, Geophys. J. Int. 181, 1-80.

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

REFERENCES

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

Engdahl, E.R., and Villasenor, A., 2002, Global Seismicity: 1900-1999, chap. 41 of Lee, W.H.K., and others, eds., International Earthquake and Engineering Seismology, Part A: New York, N.Y., Elsevier Academic Press, 932 p.

Engdahl, E.R., Van der Hilst, R.D., and Buland, R.P., 1998, Global teleseismic earthquake relocation with improved travel times and procedures for depth determination;Bull. Seism. Soc. Amer., v. 88, p. 722-743.

DISCLAIMER

Map updated by U.S. Geological Survey National Earthquake Information Center
23 January 2017
http://earthquake.usgs.gov/
Map not approved for release by Director USGS