Presented to the Alaska Seismic Hazards Safety Commission
December 6, 2006

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EARTHQUAKE SCENARIO

AN APPROACH TO SEISMIC HAZARD MITIGATION FOR ALASKA

WHAT IS AN EARTHQUAKE SCENARIO?

Credible earthquake description

- Earthquake source characteristics
- Ground motions, surface faulting, ground failure, slope failure, tsunami
- Effects on lifelines, structures, infrastructure
- Casualties
- Economic impacts
- Societal impacts

California Earthquake Scenarios

Humboldt-Del Norte County

Cascadia Subduction Zone M9

San Francisco Bay Area

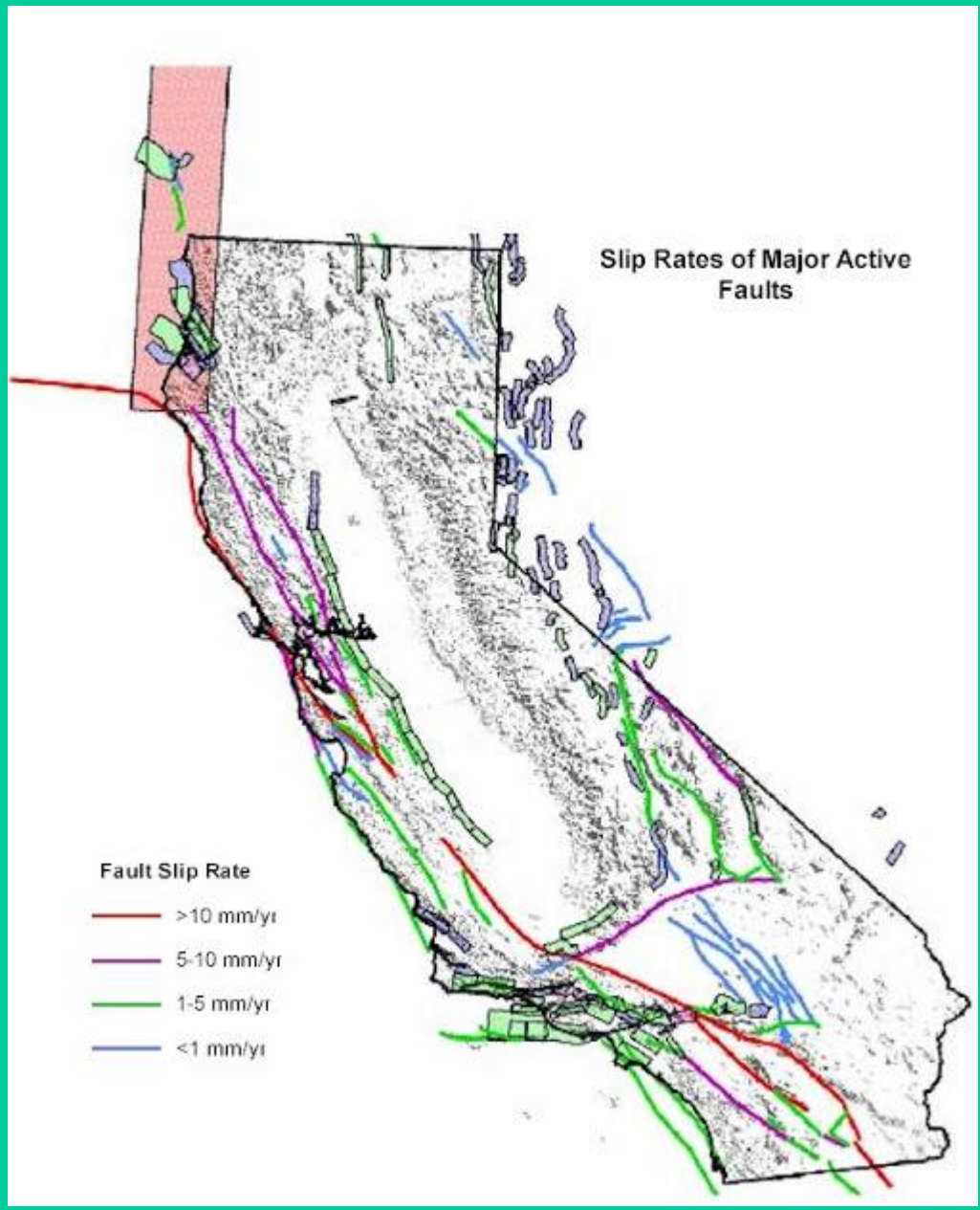
San Andreas Fault -various segments M7.0 to 7.9
Hayward-Rogers Creek Fault - various segments M6.5 to 7.3
Calaveras Fault - various segments M5.8 to 7.0
Concord-Green Valley Fault - various segments M6.2 to 6.7
San Gregorio Fault - various segments M7.0 to 7.4
Greenville Fault - various segments M6.6 to 6.9
Mt Diablo Fault - single segment M6.7

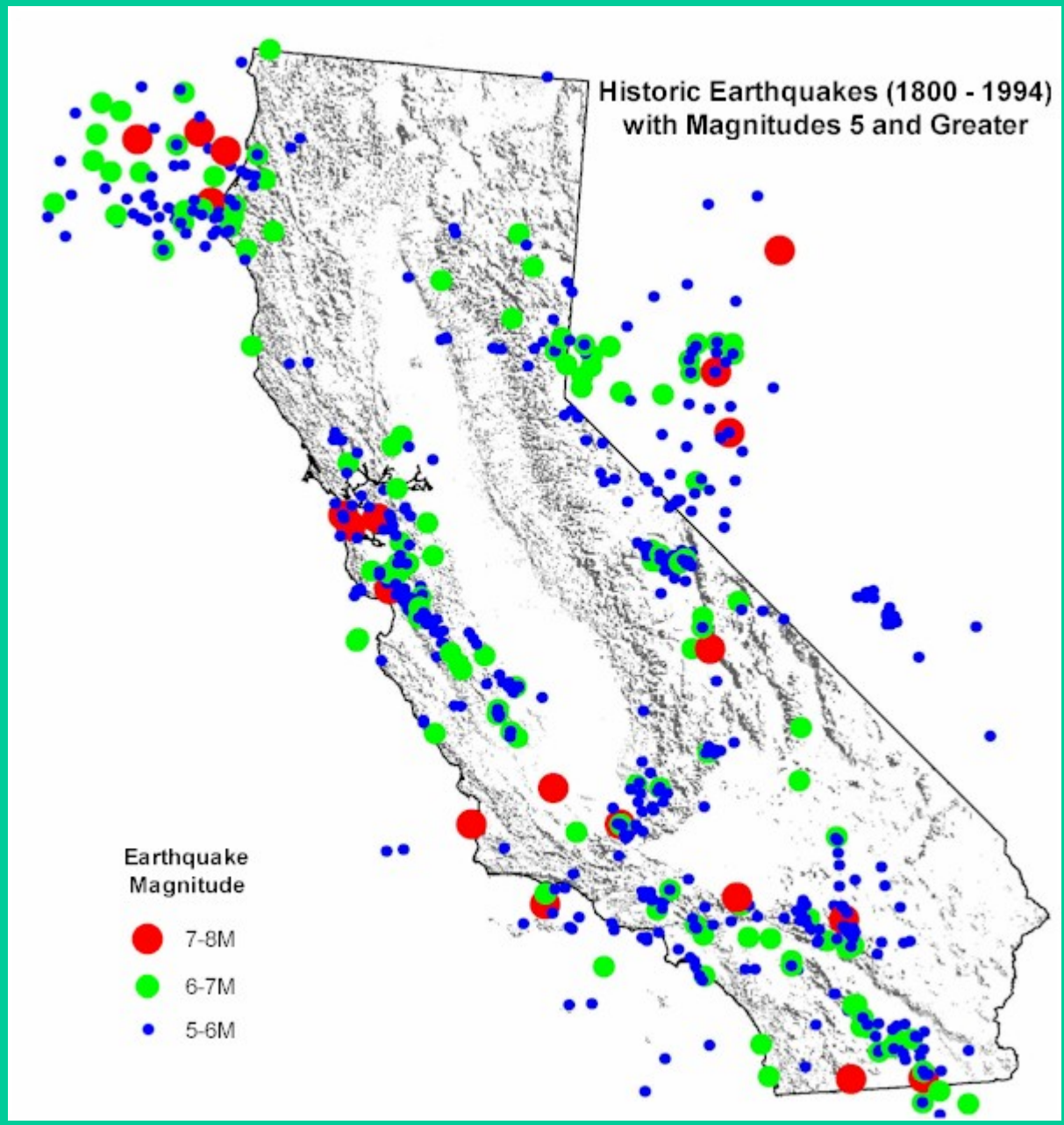
Los Angeles Area

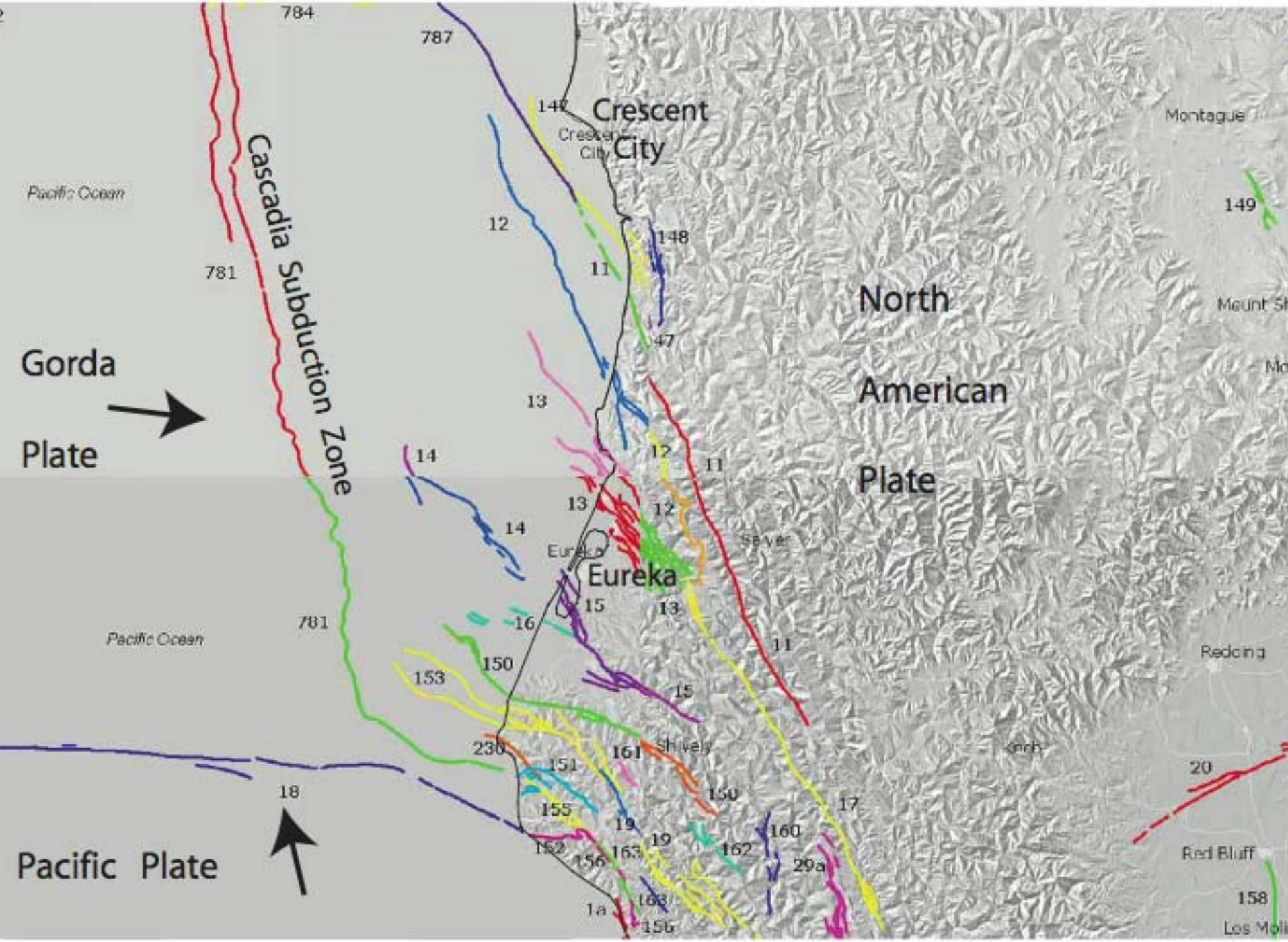
San Andreas Fault - various segments M7.1 to 7.9
San Jacinto Fault - single segment M6.9
Ellsinore Fault

San Diego

Rose Canyon Fault - single segment M 7.0


Slip Rates of Major Active Faults
Fault Slip Rate
>10 mm/yr
5-10 mm/yr
1-5 mm/yr
<1 mm/yr


Historic Earthquakes (1800 - 1994)
with Magnitudes 5 and Greater
Earthquake
Magnitude
7-8M
6-7M
5-6M


Cascadia Subduction Zone
Gorda
Plate
Pacific Ocean
Pacific Plate
North
American
Plate
Crescent
City
Eureka
Montague
Redding
Red Bluff
784
787
781
147
148
149
12
11
47
13
14
15
16
150
153
230
151
161
155
19
162
163
156
18
1a
20
17
29a
158

Humboldt-Del Norte County Scenario Elements:

Source Characterization

- Ground Motion
- Surface Faulting
- Ground Failure

Buildings and Structures

- Buildings
- Schools

Transportation Lifelines

- Highways
- Bridges
- Airports
- Marine Facilities

Utility Lifelines

- Electrical Power
- Natural Gas
- Water Supply Facilities
- Waste Water
- Petroleum Products

Humboldt - Del Norte Cascadia Scenario

Process:

Core Team - CDMG

Working Groups for each element

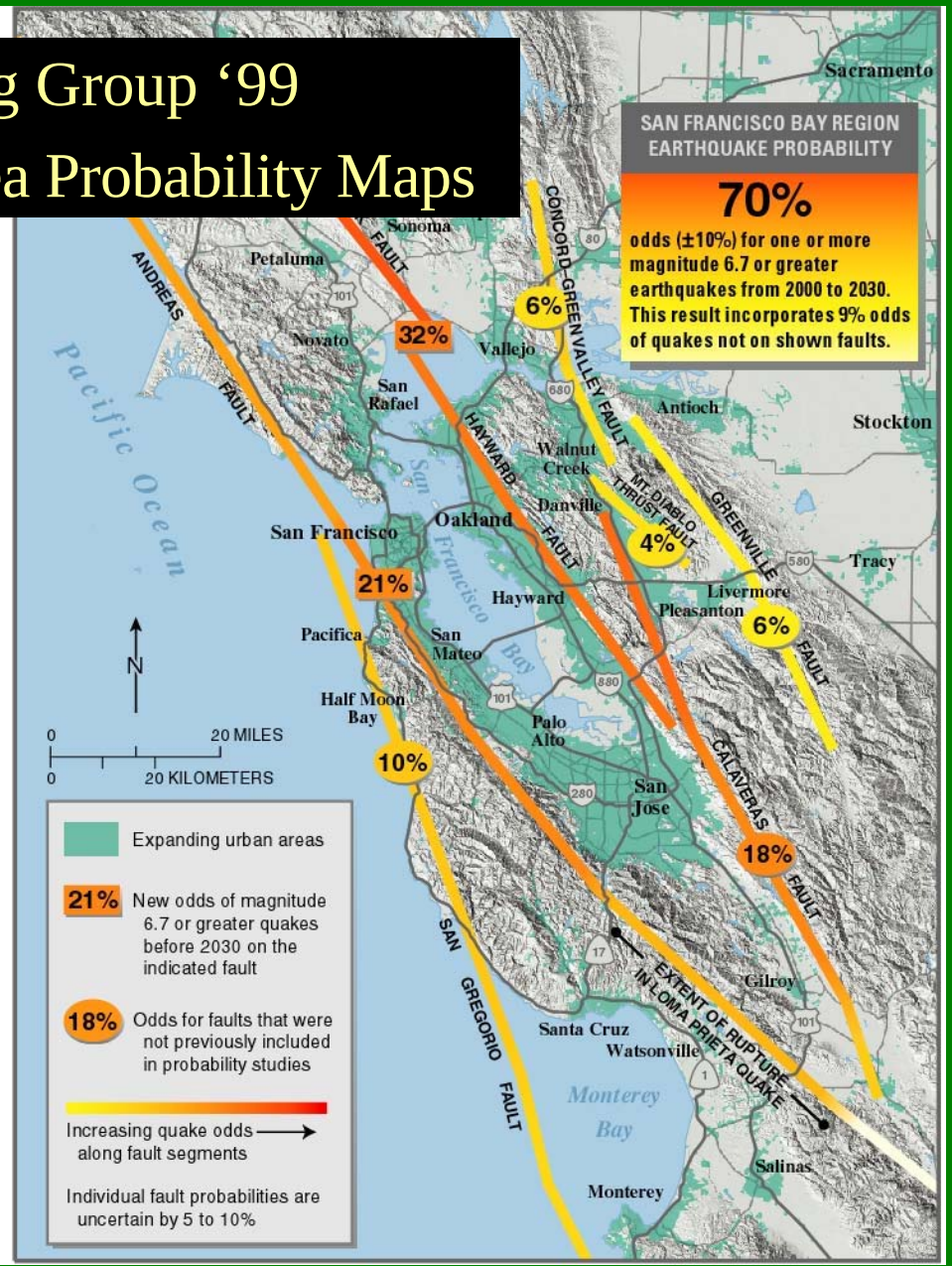
- CDGM
- Universities, USGS,
- Industry, Government Agencies

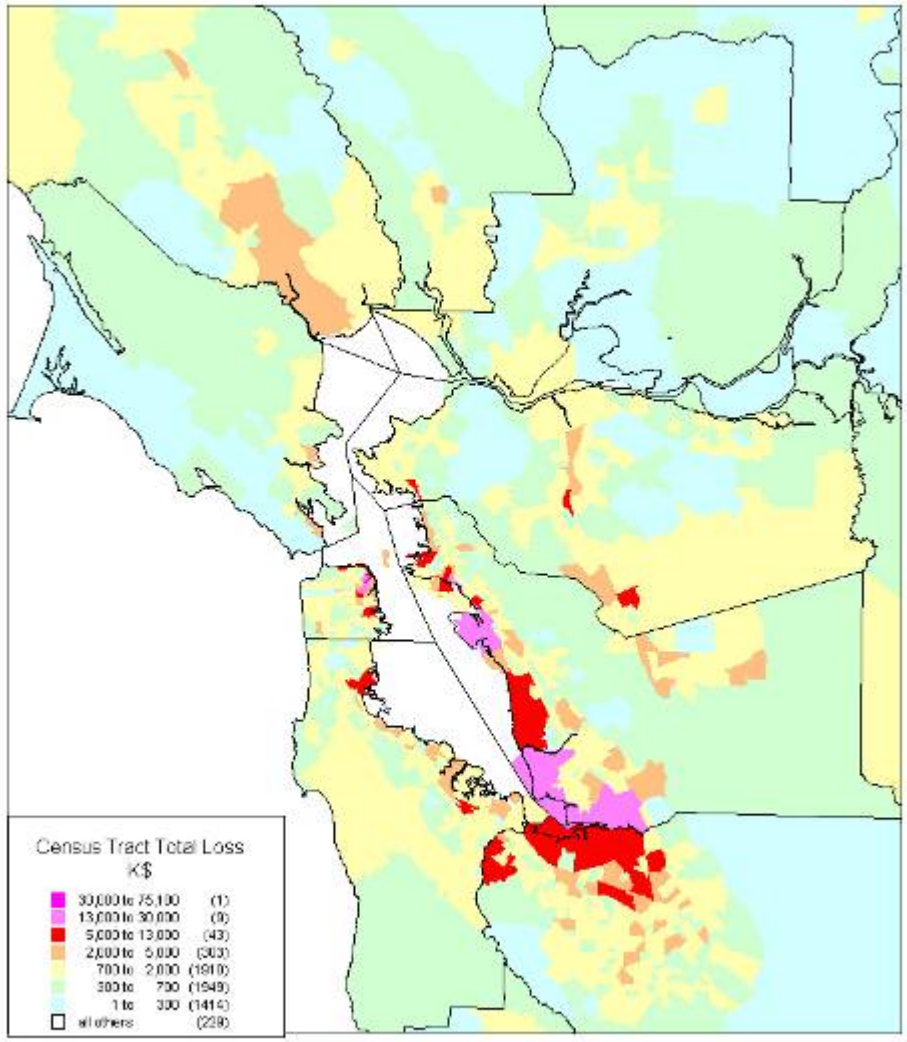
Workshops for each element

- CDMG
- Working Groups
- Local Government,
- Public, Media

USGS Working Group ‘99
San Francisco Bay Area Probability Maps

Figure 0.1, Dashed rectangle (Working Group 1999 box) shows the region included for calculation of earthquake probability and seismic moment. Bold solid lines indicate major faults for which probabilities were calculated. *MTD*, Mount Diablo Thrust; *Con*, Concord Fault.





For each census tract we calculated the ground motion for each soil type & the proportion of each soil type within the area. We then used those ground motion in those proportions in HAZUS to calculate the expected loss.

HAZUS

HAZUS is recently developed software and methodology for developing loss estimates from earthquakes.

CDMG role in use of HAZUS

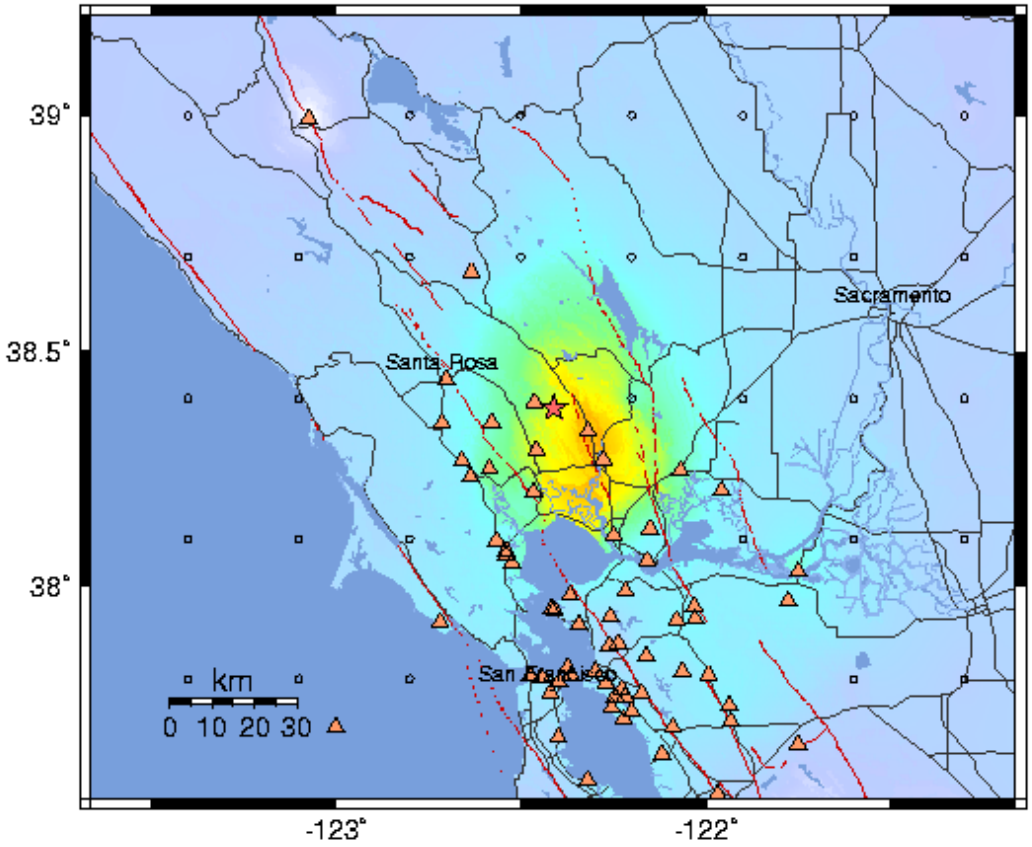
1. Uniform statewide consensus-based PSHA & HAZUS Loss estimate.

2. Post-earthquake advise to OES and local governments.

3. Cooperative work with Bay Area HAZUS users group and Working Group on Bay Area earthquake probabilities.

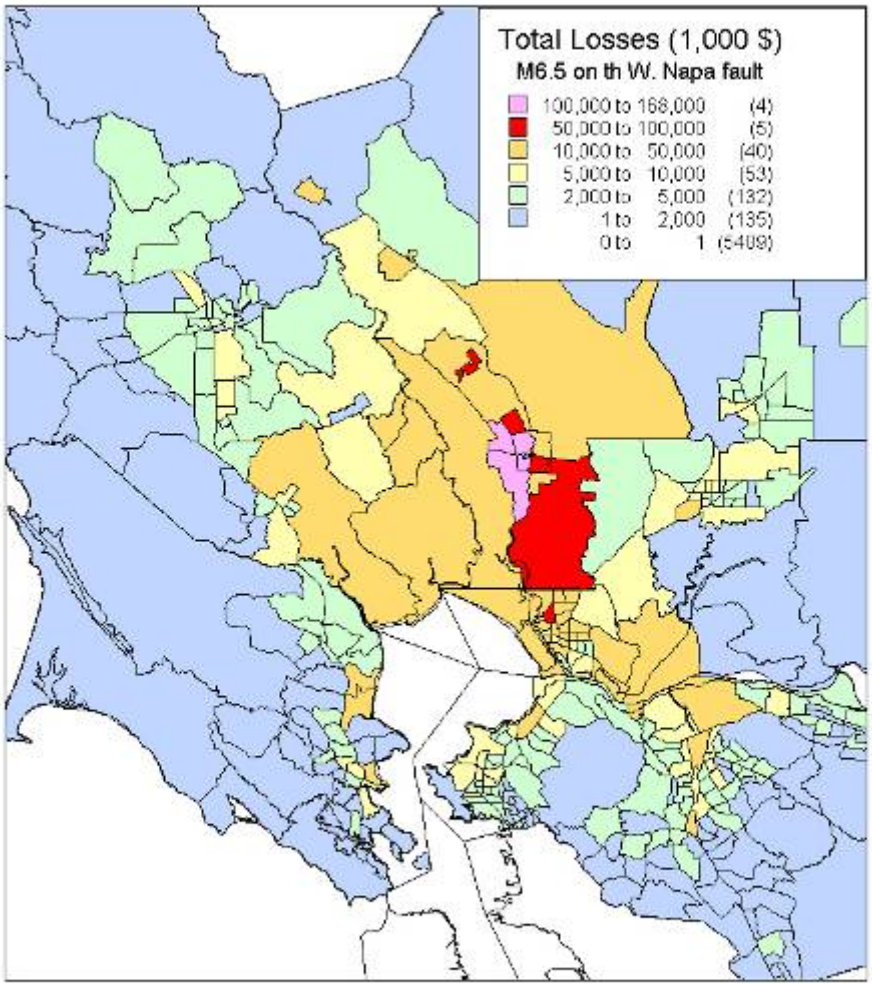
USGS/UCB/CDMG Rapid Instrumental Intensity Map for Yountville Earthquake

Sun Sep 3, 2000 01:36:30 AM PDT M 5.1 N38.38 W122.41 ID:51101203



PROCESSED: Mon Dec 4, 2000 12:14:30 PM PST,

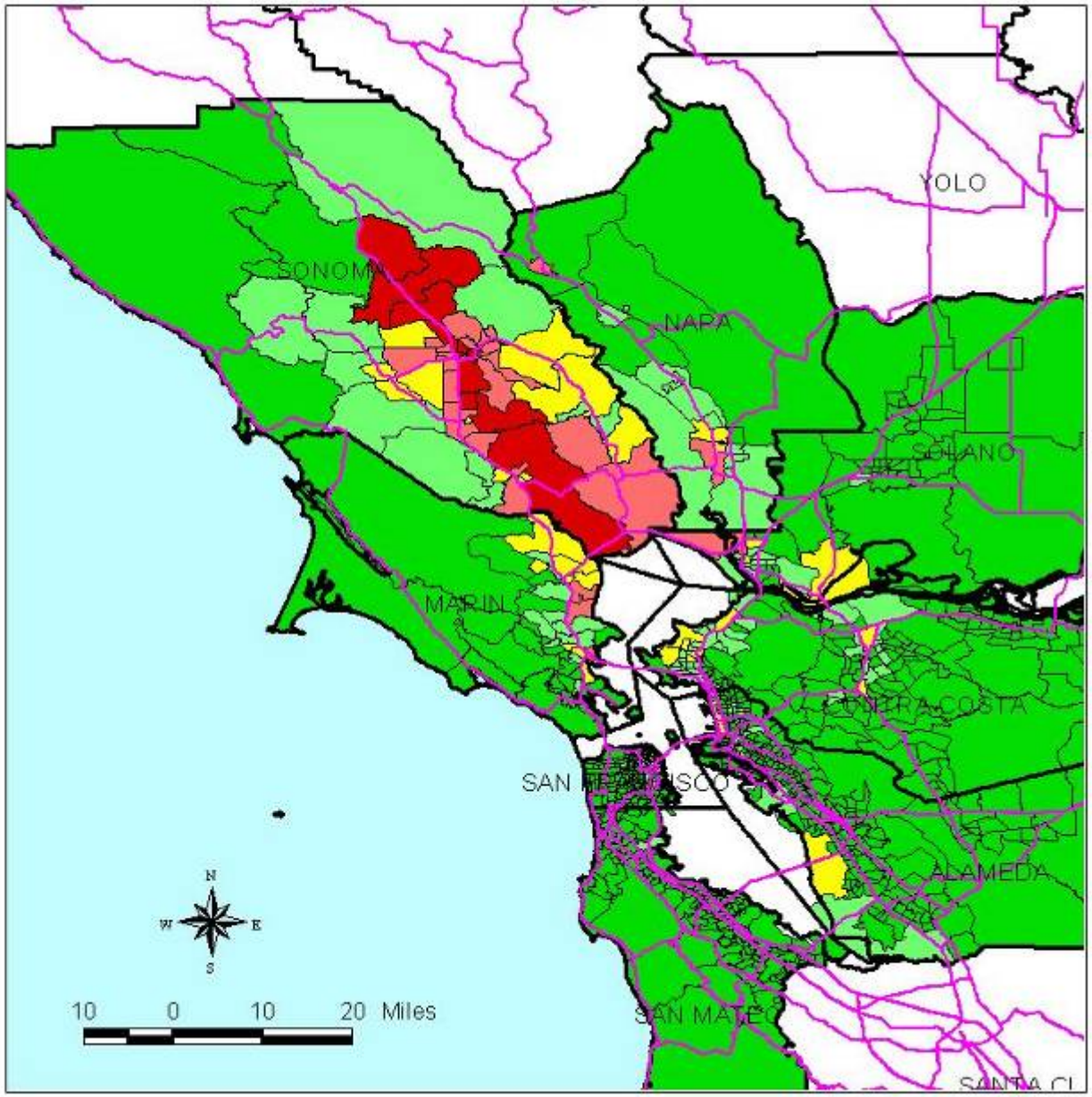
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+


Total Losses (1,000 $)
M6.5 on th W. Napa fault
100,000 to 168,000 (4)
50,000 to 100,000 (5)
10,000 to 50,000 (40)
5,000 to 10,000 (53)
2,000 to 5,000 (132)
1 to 2,000 (135)
0 to 1 (5409)

Direct Economic Losses for Buildings

Bay Area Risk Assessment
Magnitude 7.06 Earthquake
Rodgers Creek Fault

January 17, 2001



Total Building Loss
in Thousands of Dollars
(By Occupancy
for Census Tract)

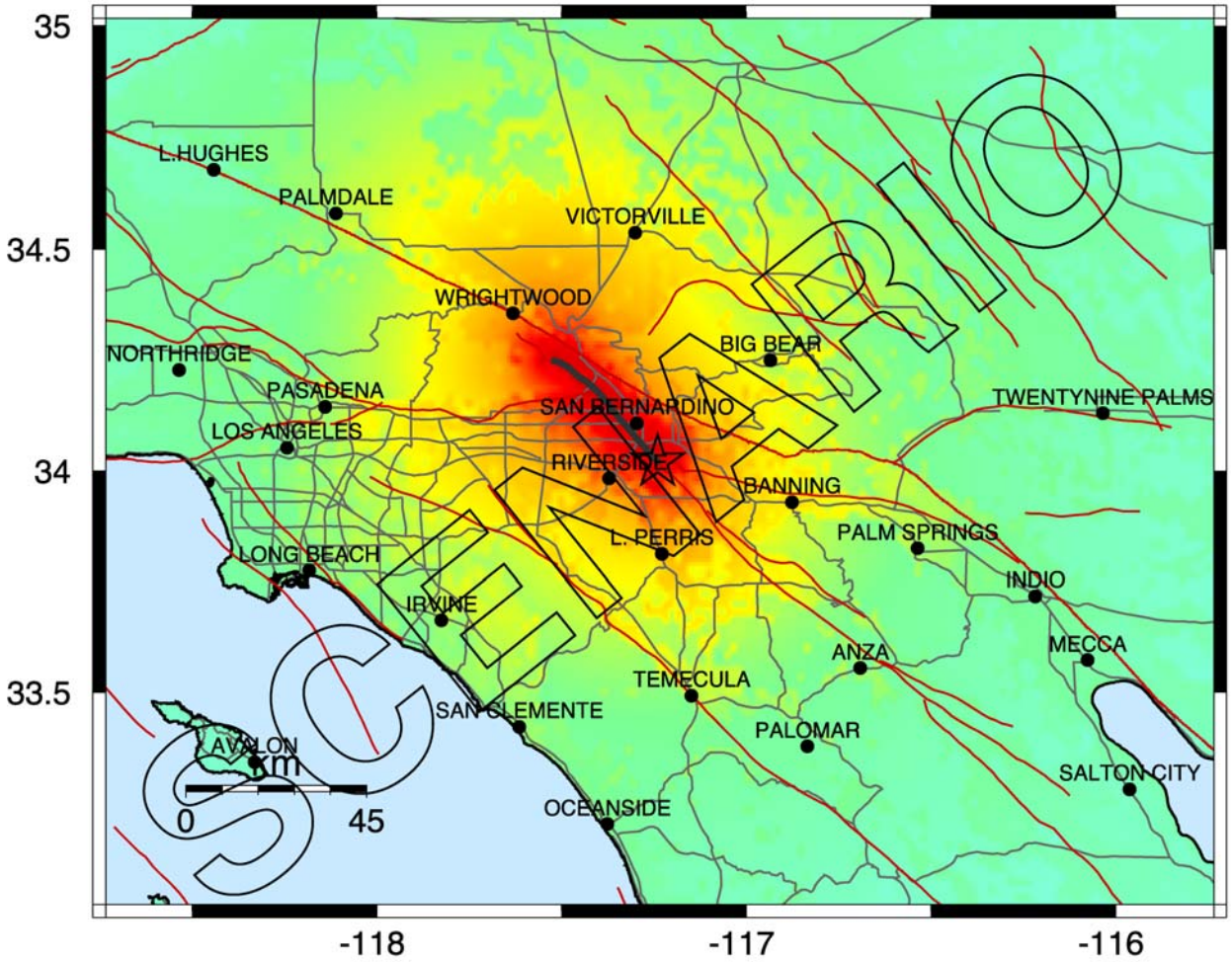
- 0 - 9448
- 9449 - 27486
- 27487 - 67184
- 67185 - 153701
- 153702 - 361976
- Cnty_dd.shp

OES CALIFORNIA
Governor's Office of Emergency Services

-- Earthquake Planning Scenario --

Rapid Instrumental Intensity Map for San Jacinto M6.9 Scenario

Scenario Date: Thu Nov 30, 2000 06:00:00 AM PST M 6.9 N34.02 W117.24



PLANNING SCENARIO ONLY

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
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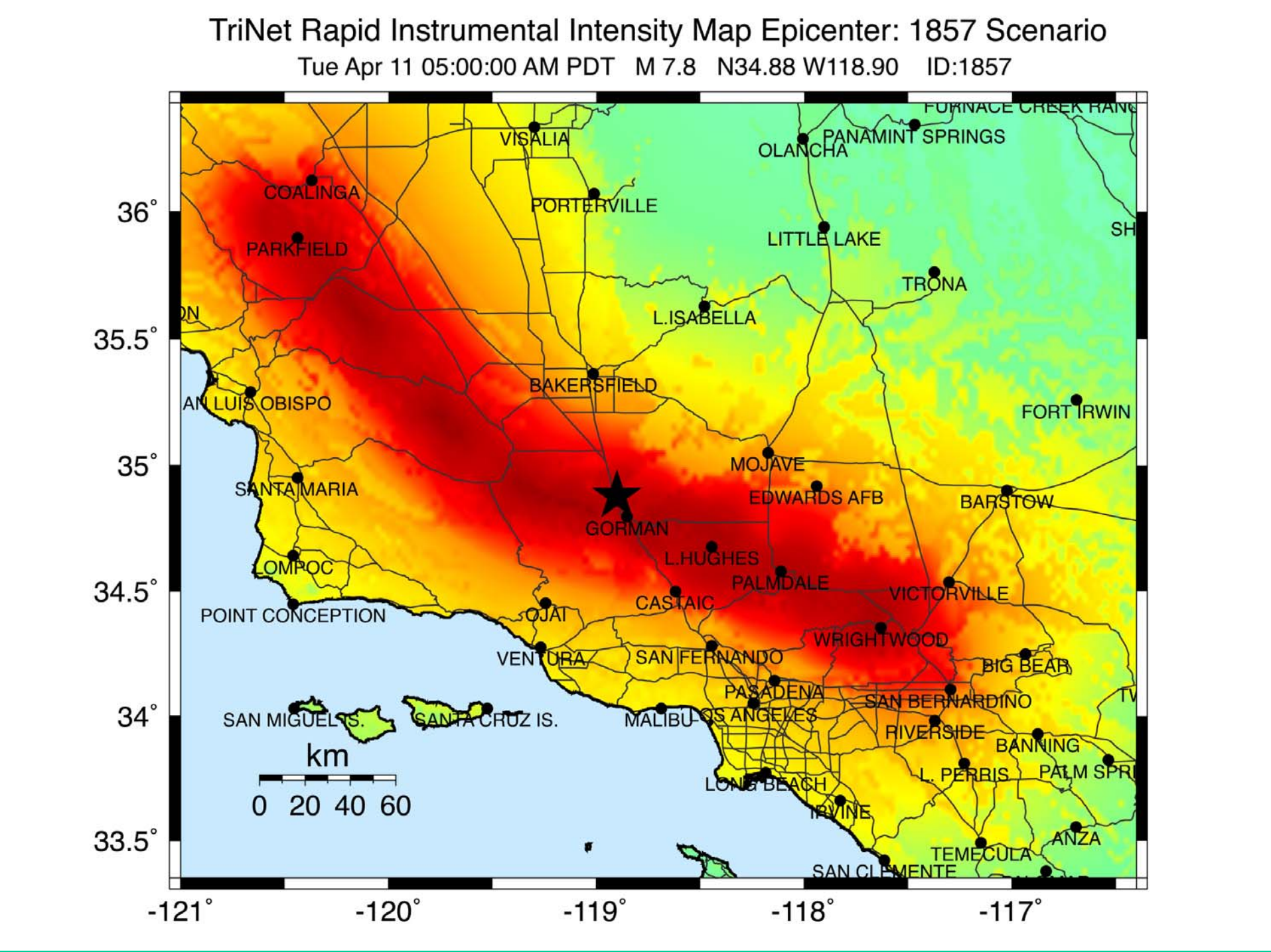
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+


TriNet Rapid Instrumental Intensity Map Epicenter: 1857 Scenario
Tue Apr 11 05:00:00 AM PDT M 7.8 N34.88 W118.90 ID:1857
VISALIA
PANAMINT SPRINGS
OLANCHA
COALINGA
PORTERVILLE
LITTLE LAKE
PARKFIELD
TRONA
L.ISABELLA
BAKERSFIELD
FORT IRWIN
MOJAVE
SANTA MARIA
EDWARDS AFB
BARSTOW
GORMAN
L.HUGHES
PALMDALE
VICTORVILLE
CASTAIC
POINT CONCEPTION
OJAI
WRIGHTWOOD
VENTURA
SAN FERNANDO
BIG BEAR
PASADENA
SAN BERNARDINO
SAN MIGUEL IS.
SANTA CRUZ IS.
MALIBU
LOS ANGELES
RIVERSIDE
BANNING
L. PERRIS
LONG BEACH
IRVINE
ANZA
TEMECULA
km
0 20 40 60
36°
35.5°
35°
34.5°
34°
33.5°
-121°
-120°
-119°
-118°
-117°

Accurate Earthquake-Loss Estimates Require Successful Partnerships

Geographic Information System Professionals

Earth Scientists

Earthquake Engineers

Risk Managers
- Local
- Regional
- Corporate

The HAZUS User Group
PUBLIC ĞPRIVATE PARTNERSHIP

- 600 Members
- 175 Organizations
- GIS Professionals
- Risk Managers
- Business Resumption Planners
- Emergency Managers
- Earthquake Experts
- Media Representatives

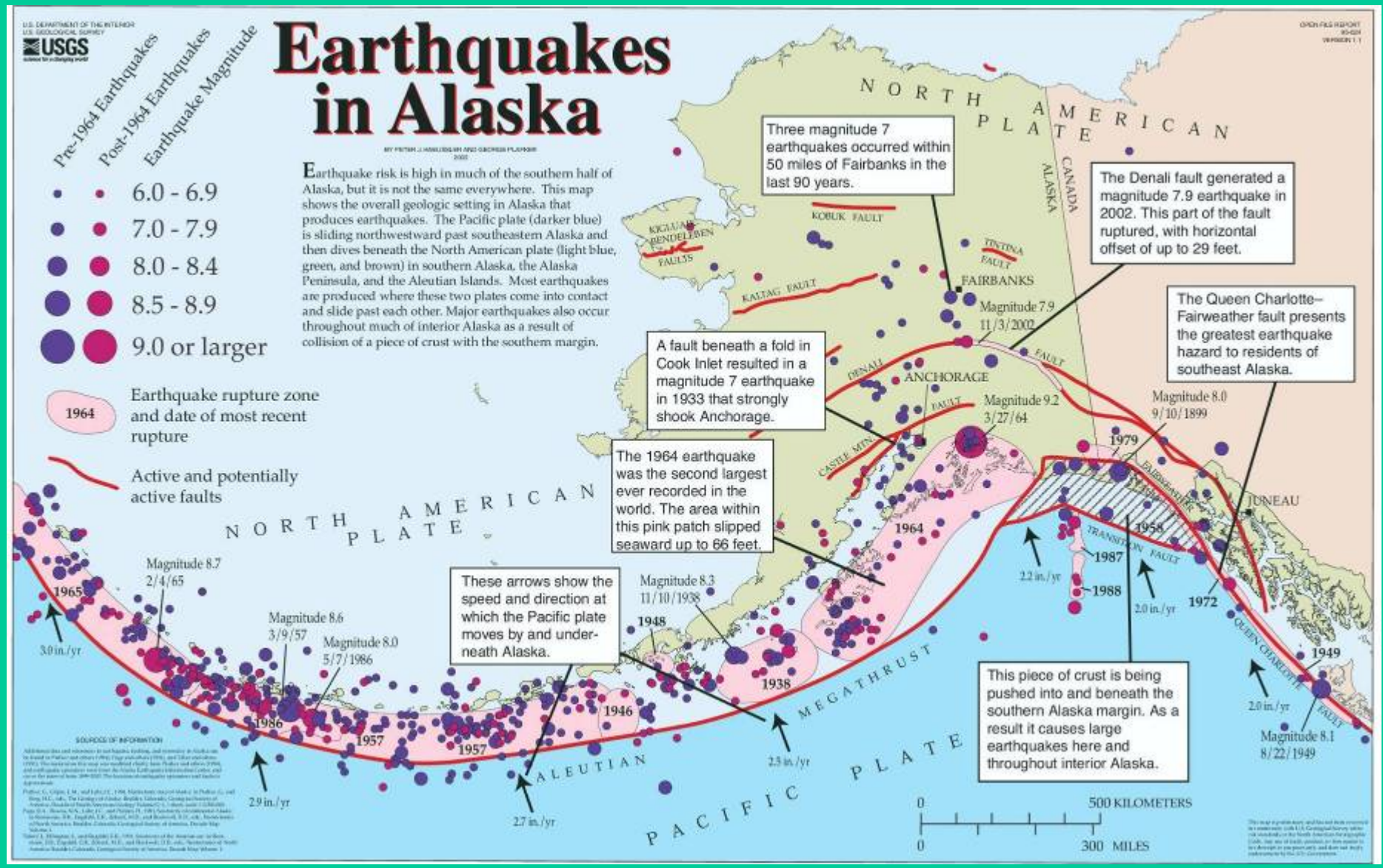
WELLS FARGO

USGS science for a changing world

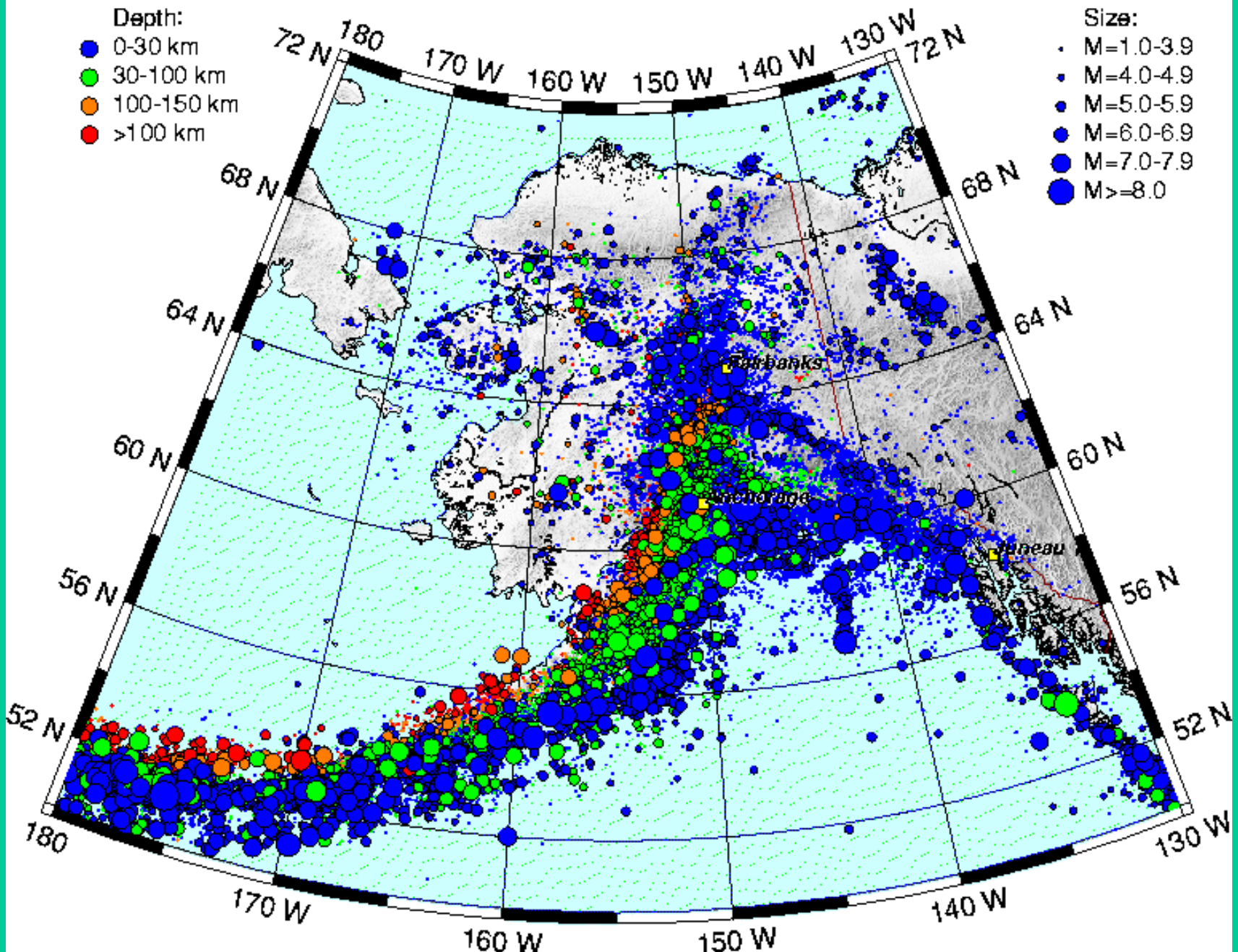
OES CALIFORNIA California Office of Emergency Services

COMPAQ

CALIFORNIA CONSERVATION


U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
USGS
Earthquakes in Alaska
Pre-1964 Earthquakes
Post-1964 Earthquakes
Earthquake Magnitude
6.0 - 6.9
7.0 - 7.9
8.0 - 8.4
8.5 - 8.9
9.0 or larger
1964
Earthquake rupture zone and date of most recent rupture
Active and potentially active faults
Earthquake risk is high in much of the southern half of Alaska, but it is not the same everywhere. This map shows the overall geologic setting in Alaska that produces earthquakes. The Pacific plate (darker blue) is sliding northwestward past southeastern Alaska and then dives beneath the North American plate (light blue, green, and brown) in southern Alaska, the Alaska Peninsula, and the Aleutian Islands. Most earthquakes are produced where these two plates come into contact and slide past each other. Major earthquakes also occur throughout much of interior Alaska as a result of collision of a piece of crust with the southern margin.
Three magnitude 7 earthquakes occurred within 50 miles of Fairbanks in the last 90 years.
The Denali fault generated a magnitude 7.9 earthquake in 2002. This part of the fault ruptured, with horizontal offset of up to 29 feet.
The Queen Charlotte–Fairweather fault presents the greatest earthquake hazard to residents of southeast Alaska.
A fault beneath a fold in Cook Inlet resulted in a magnitude 7 earthquake in 1933 that strongly shook Anchorage.
The 1964 earthquake was the second largest ever recorded in the world. The area within this pink patch slipped seaward up to 66 feet.
These arrows show the speed and direction at which the Pacific plate moves by and underneath Alaska.
This piece of crust is being pushed into and beneath the southern Alaska margin. As a result it causes large earthquakes here and throughout interior Alaska.
NORTH AMERICAN PLATE
PACIFIC PLATE
ALEUTIAN MEGATHRUST
CANADA
ALASKA
KOBUK FAULT
KIGLUAIK-PENDELETON FAULTS
TINTINA FAULT
KAITAG FAULT
DENALI FAULT
CASTLE MTN. FAULT
TRANSITION FAULT
QUEEN CHARLOTTE FAULT
FAIRBANKS
ANCHORAGE
JUNEAU
Magnitude 7.9 11/3/2002
Magnitude 9.2 3/27/64
Magnitude 8.0 9/10/1899
Magnitude 8.7 2/4/65
Magnitude 8.6 3/9/57
Magnitude 8.0 5/7/1986
Magnitude 8.3 11/10/1938
Magnitude 8.1 8/22/1949
1965
1986
1957
1957
1946
1948
1938
1964
1979
1958
1987
1988
1972
1949
3.0 in./yr
2.9 in./yr
2.7 in./yr
2.3 in./yr
2.2 in./yr
2.0 in./yr
2.0 in./yr
0
500 KILOMETERS
0
300 MILES
SOURCES OF INFORMATION

Earthquakes in Alaska 1898-2005



SUCCESSFUL SCENARIO

- Powerful tool if done right - offers mitigation options
- Ignored if not done right - overwhelming negative, too scary

Need to balance hazard identification and solution strategies

Lloyd Cluff 2006

DEVELOP PARTNERSHIPS

- Geologist/Seismologist
- Engineers
- Emergency Responders
- Business Community
- Local Government
- Public

“Craig Weaver 2006”