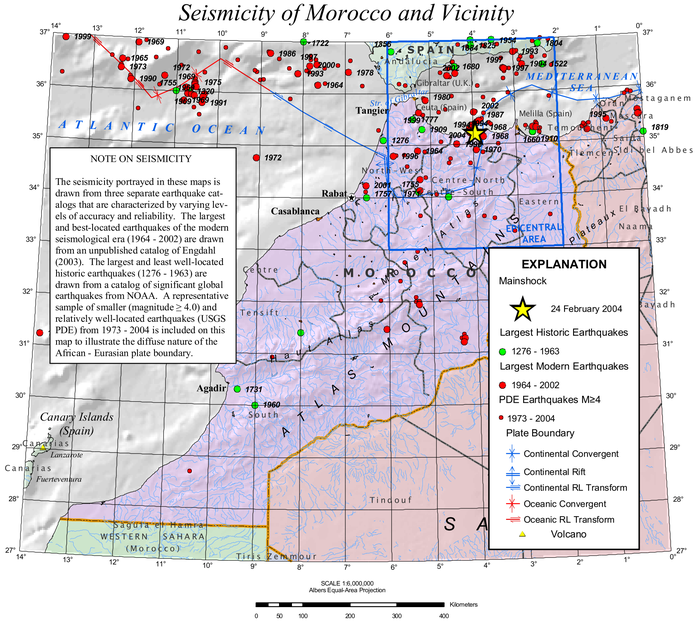
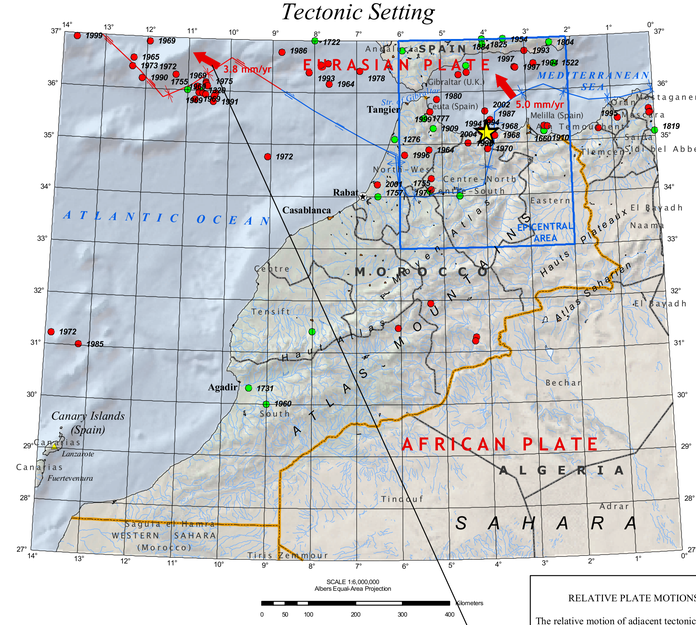
M6.4 Al Hoceima, Morocco Earthquake of 24 February 2004

Seismicity of Morocco and Vicinity

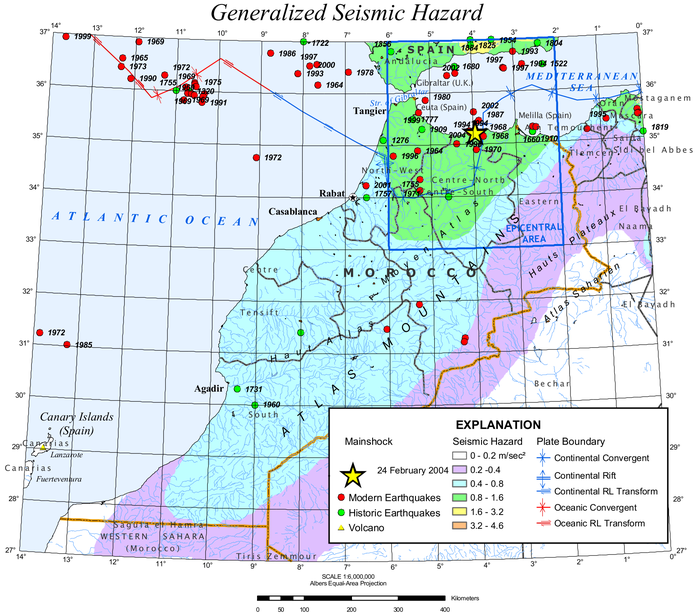


Epicentral Area

Tectonic Setting



Generalized 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.

AL HOCEIMA, MOROCCO

24 February 2004 02:27:46 UTC
35.235° N., 3.963° W.
Depth 1 km (poorly constrained)
Mw = 6.4 (USGS)

This earthquake occurred near the Moroccan port city of Al Hoceima. More than 571 persons were reported killed and over 400 injured. Widespread damage to unreinforced mud brick and stone structures and concrete apartment buildings was reported in Al Hoceima and surrounding villages. Early reports said that the worst damage was in the villages of Ait Kamara, Tamassint, Imzourn, and Tizi Ayash. Officials reported that more than 20,000 persons were homeless, either because their dwellings were destroyed or from fear of aftershocks.

The earthquake was experienced both east and west of Al Hoceima and was felt widely in southernmost Andalucia and Murcia Provinces of Spain.

RELATIVE PLATE MOTIONS

The relative motion of adjacent tectonic plates is depicted on the map by short vectors shown at selected locations on the plate boundary. In this presentation, one of the plates is defined as the reference plate. The vector therefore represents the direction of motion of the adjacent plate relative to the reference plate. The rate of relative motion is labeled next to the vector.

The components of the vector perpendicular and parallel to the plate margin approximate convergent/divergent and transverse direction of motion between the plates, respectively. As viewed from the reference plate, an inward directed component suggests convergence at and near the plate boundary that may be expressed as crustal folding, uplift, thrust faulting, or plate subduction. Similarly, an outward directed component suggests plate divergence such as would be expected at a zone of crustal spreading. Transcurrent or transform faulting would be expected when the dominant vector component is parallel to the plate margin.

In this case, the African plate is moving relative to the Eurasian reference plate at velocities 5 mm/yr or slower. The relatively slow convergence of the two plates results in a diffuse zone of seismicity that extends across northern Morocco into the Atlantic Ocean west of the Strait of Gibraltar.

DISCUSSION

This earthquake occurred near the eastern end of the Rif mountain belt, which is part of the diffuse boundary between the African and Eurasian plates. The epicentral region is the most seismically active area in Morocco. The geologically prominent Nekor fault lies about 30 km to the southeast of the February 24 earthquake. Numerous northeast-southwest trending faults occur in the epicentral region, and the preliminary determination of the earthquake's focal mechanism is consistent with the earthquake having occurred as slip on one of these faults. The February 24, 2004, quake occurred near the epicenter of the May 26, 1994, magnitude 6.0 Al Hoceima earthquake that injured one person and caused significant damage to adobe buildings.

The most deadly Moroccan earthquake in the 20th century was the 1960 magnitude 5.7 Agadir earthquake that killed 12,000 people and injured 25,000. Agadir is in western Morocco, about 750 km southwest of the February 24, 2004, earthquake.

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 Villaseñor, 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

Base map data, such as place names and political boundaries, are the best available but may not be current or may contain inaccuracies and therefore should not be regarded as having official significance.

Photos: Agence France Presse

DATA SOURCES

EARTHQUAKES AND SEISMIC HAZARD
USGS, National Earthquake Information Center
European-Mediterranean Seismological Center (EMSC)
IASPEI, Centennial Catalog (1900 - 1999) and extensions (Engdahl and Villaseñor, 2002)
HDF (unpublished earthquake catalog) (Engdahl, 2003)
Global Seismic Hazard Assessment Program
UN Office for the Coordination of Humanitarian Affairs

PLATE TECTONICS
PB2003 (Bird, 2003)

VOLCANOES
Smithsonian Institution, Global Volcano Program

BASE MAP
NIMA and ESRI, Digital Chart of the World
USGS, EROS Data Center

NEWS SOURCES
Africa Daily http://www.africadaily.com
Associated Press (AP)
Channel News Asia http://www.channelnewsasia.com/stories
CNN http://www.cnn.com/2004/WORLD
Reuters http://www.reuters.com
USAToday http://www.usatoday.com/new/world

Map prepared by U.S. Geological Survey
National Earthquake Information Center
27 February 2004
Map not approved for release by Director USGS