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EARTHQUAKE MODEL OF THE MIDDLE EAST (EMME) PROJECT: ACTIVE FAULTS AND SEISMIC SOURCES

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The Earthquake Model of the Middle East (EMME) Project is a regional project of the GEM (Global Earthquake Model) project (http://www.emme-gem.org/). The EMME project covers Turkey, Georgia, Armenia, Azerbaijan, Syria, Lebanon, Jordan, Iran, Pakistan, and Afghanistan. Both EMME and SHARE projects overlap and Turkey becomes a bridge connecting the two projects.

The Middle East region is tectonically and seismically very active part of the Alpine-Himalayan orogenic belt. The active tectonics of the EMME Project region has been shaped by the northward motion of the African, Arabian, and the Indian plates with respect to the Eurasian plate. After the elimination of the Neo-Tethys Ocean that had existed in the intervening areas between these plates, continental collision of the Arabian and Indian plates with the Eurasian plate created the Bitlis-Zagros and the Himalayan Fold and Thrust Belts, respectively. Even today the continental convergence and active crustal shortening is still going on between these plates as evidenced by GPS measurements and high seismic activity observed in the EMME Project region. Many major earthquakes have occurred in this region over the years causing casualties in the millions. The intense tectonic deformations along the Caucasus region are also the result of the continental collision and the continuing continental convergence. The northward subduction process is active along the Hellenic Trench, Cyprian Trench, Central Caspian, Makran and the Hindu-Kush (Figure 1).

The left-lateral strike slip Dead Sea Fault takes up the differential motion between the African and the Arabian Plates. The North Anatolian, East Anatolian, Northeast Anatolian, Sevan, Main Recent, Elbruz, Doruneh, Ashkabad, Nayband, Neh, Herat, and the Chaman Faults are prominent strike-slip faults that are capable of generating large magnitude earthquakes in the region.

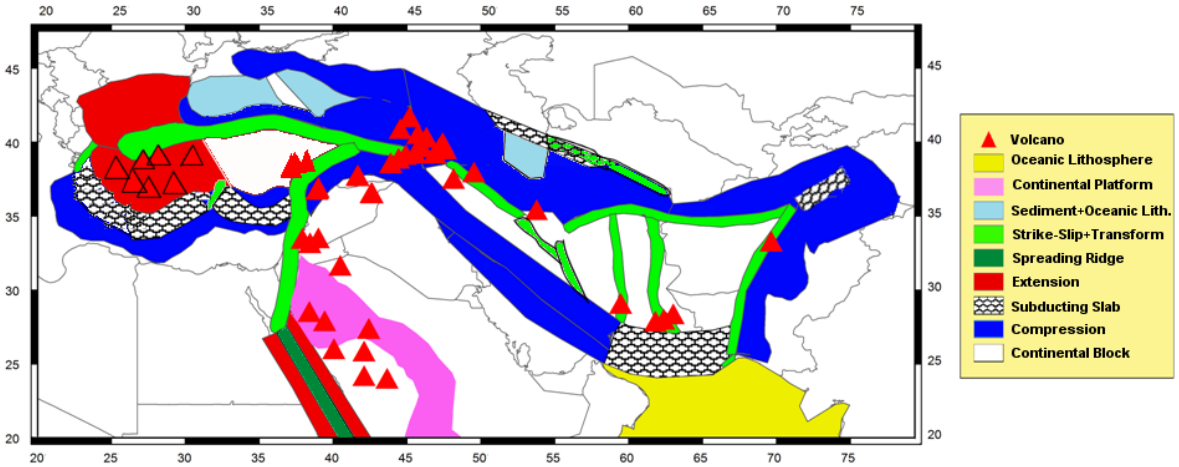

Figure 1. Tectonic regionalization of the EMME project region.

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The EMME project consists of three main modules: hazard, risk, and socio-economic modules. The EMME project uses PSHA approach for earthquake hazard and the existing source models have been revised or modified by the incorporation of newly acquired data. The most distinguishing aspect of the EMME project from the previous ones is its dynamic character. This very important characteristic is accomplished by the design of a flexible and scalable database that permits continuous update, refinement, and analysis. An up-to-date earthquake catalog of the Middle East region has been prepared and declustered by the WP1 team.

Active Faults

A digital active tectonic map of the Middle East region is generated in ArcGIS format. A total of 3,397 active fault sections are defined and faults with a total length of 91,551 km are parameterized for the EMME Project (Figure 2). Additionally, the digital active fault map of Afghanistan, which was prepared by the USGS (Ruleman et al., 2007) was added to the EMME Project active fault map. We developed a database of fault parameters for active faults that are capable of generating earthquakes above a threshold magnitude Mw ≥ 5.5. This database includes information on the geometry and rates of movement of faults in a "Fault Section Database" following a revised and extended version of the WGCEP-2007 format (Wills et al., 2008) and information on the timing and amounts of fault displacement in a separate "PaleoSites Database". A digital reference library, that includes the pdf files of relevant papers, reports and maps, is also prepared.

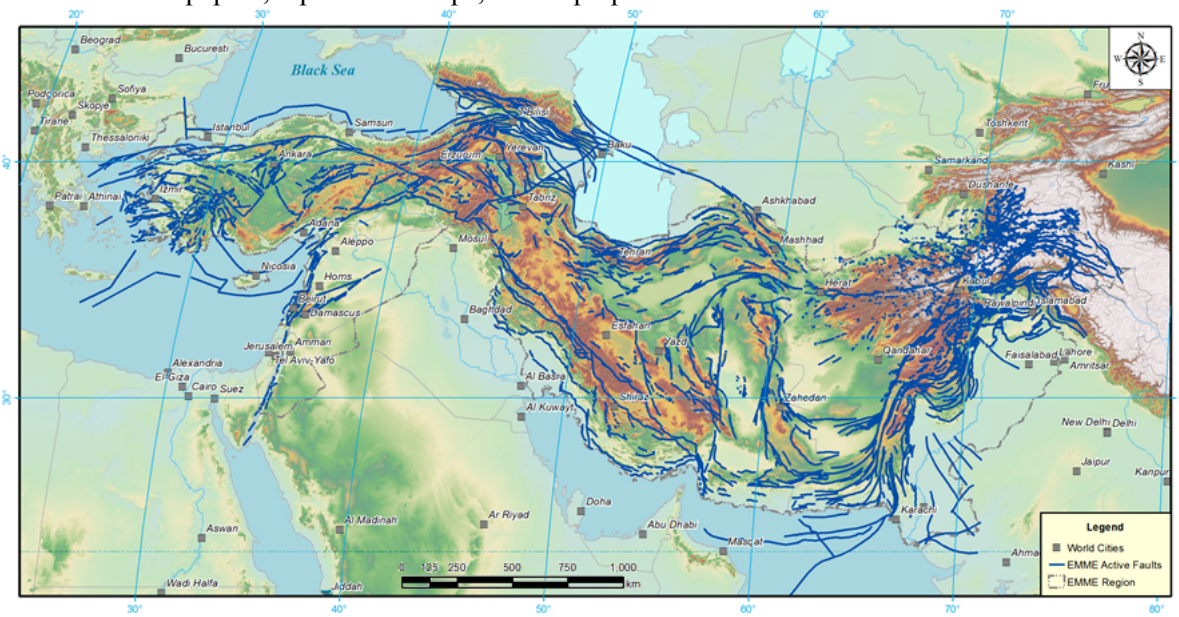

Figure 2. Active fault map of the EMME Project region.

Fault Section Database

The "Fault Section Database" contains 36 entries for each fault section. Some of the important parameters are as following: Fault name, segment name, section name, fault trace (list of latitudes and longitudes), faulting type, fault section length, average strike, average dip and rake estimate, average upper and lower seismogenic depth estimate, average long term slip-rate estimate (both horizontal and vertical), maximum displacement (both horizontal and vertical), and average aseismic-slip-factor estimate. The reference codes for each fault parameter data are given as multiple entries in the database and full references are also supplied in a separate reference database.

Note that "Fault Section" is different than "Fault Segment", because geologists associate the word segment with the occurrence of characteristic earthquakes that are limited by a segment's boundaries. We may use "fault segment" in conjunction with earthquake recurrence models, but "fault section" is intended to include basic descriptive information about faults, not the recurrence model information (Wills et al., 2008). A new "Fault Section" is defined wherever any of the fault parameters change, thus "Fault Section" has a physical meaning. "Fault segments" may have more than one "fault sections".

Paleo-Sites Database

Paleoseismic data have been acquired at more than 30 sites and published in the literature for some major faults in the Middle East region. These data have been compiled and information on the timing and amounts of fault displacements are given in a "PaleoSites Database" that also includes the published recurrence intervals and their references.

Seismic Source Zones

Finally seismic source zones in the Middle East region have been delineated based on seismicity, active faults, tectonic regionalization and GPS results. The areal seismic source zone map of the EMME region is given in Figure 3.

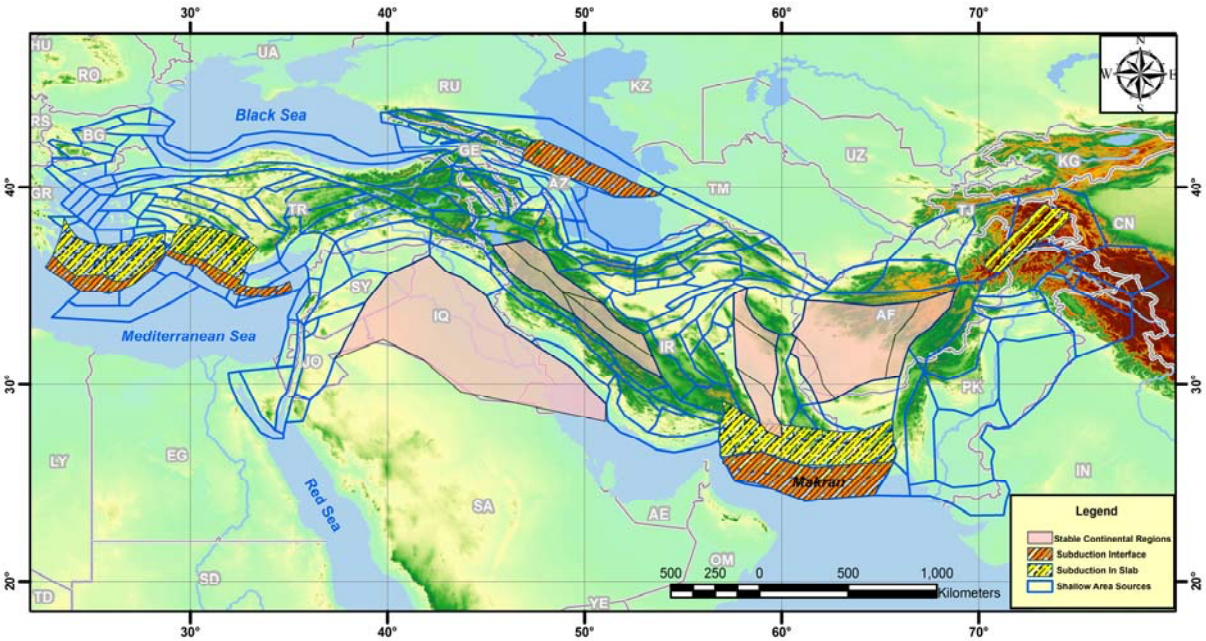

Figure 3. The seismic source zonation map of the EMME region.

ACKNOWLEDGMENTS

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