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SIMPLE GEOLOGICAL CATEGORIES AS PROXIES TO VS30 IN TURKEY AND IRAN

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Vs30 is considered as the fundamental parameter depicting site conditions in the project Earthquake Model of the Middle East Region (EMME, http:\\emme-gem.org), aiming at the assessment of earthquake risk in the region. The project needed proxies to Vs30, so that the effect of site amplification can reasonably be introduced into the risk assessment. The statistical relationships between geological units and Vs30 have been already used for developing maps of site classes in other regions of the world (e.g. Wills et al. 2000; Lee and Tsai 2008). Country-scale and province-scale geological maps, which are usually available, are developed by interpretation of data from detailed studies on geomorphology, lithology, and engineering geology. Consequently, the first proxy to Vs30 was chosen as geological description. The samples of Vs30 were compiled from Turkey, and Iran. The data was used for identifying simple geological categories as proxies to Vs30. The statistical inferences for these categories are presented for their potential use for the regions that show geological similarities to Turkey and Iran. They can also suggest first-order estimates of Vs30 for sites of new strong motion stations in Turkey, Iran, and their neighbors if the seismic surveys on those sites are not conducted.

There are three main sources of data for Vs30 that is used for the aims of project EMME. The first is the dataset provided by the National Strong Motion Project of Turkey (Sandıkkaya et al. 2010). The second is compiled from a microzonation study on the city of İstanbul in Turkey (OYO Inc. 2007, 2009). The third is based on a set of exploration studies for site conditions of strong motion stations in Iran (Sinaeian et al. 2008, 2010). The three datasets are abbreviated as *Tr*, *K*, and *Ir* respectively. The Vs30 estimates in the dataset *Tr* is obtained by the technique of Multi-Channel Analysis of Surface Waves (Park and Miller 1999). Those surveys are supplemented by logs of geotechnical exploration boreholes opened as close as possible to the center of survey. The Vs30 data from İstanbul is gathered by suspension P-S logging technique (Ogura 1988) applied on two sides of Bosporus strait. That data is also supplemented by boring logs. The data from Iran is gathered by Seismic Reflection surveys near strong motion stations. It was supplemented by geological descriptions shown on national geological maps (Sinaeian et al. 2008, 2010). Most of the data is from softer formations. The data for Vs30 that is greater than 760 m/s (i.e., the lower limit for NEHRP Class C) is generally from the database *Ir*. The spatial distribution of seismic surveys is shown in Figure 1.

The emphasis was primarily put on the datasets *Tr* and *K* to identify basic geological categories. 5 general geological categories are derived from the geotechnical descriptions on borelogs:

1. *Soils*: Thick (+30 m) Neogene or Quaternary deposits consisting of clay and sands layers.
2. *Coarse deposits*: thick (+30 m) Neogene or Quaternary deposits with layers of gravels and boulders which are thicker than 10 m.

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3. *Soil-rock transitions*: 10 to 30 m thick deposits resting on rock formations.
4. *Sedimentary formations*: carbonate and clastic rocks (limestone, sandstone, marl), and tuff.
5. *Igneous and metamorphic formations*: granite, andesite, basalt, marble, metaflysch, serpentinite, volcanic dikes.

The identified geological categories are associated with geological descriptions available in the dataset *Ir*. An additional category, the terraces, is specific to that last dataset. Terraces are supposed as soils resting on rock formations. All Iran sites that are described as soil on rock were accepted as transitions. The summary statistics for each category are presented in Table 1.

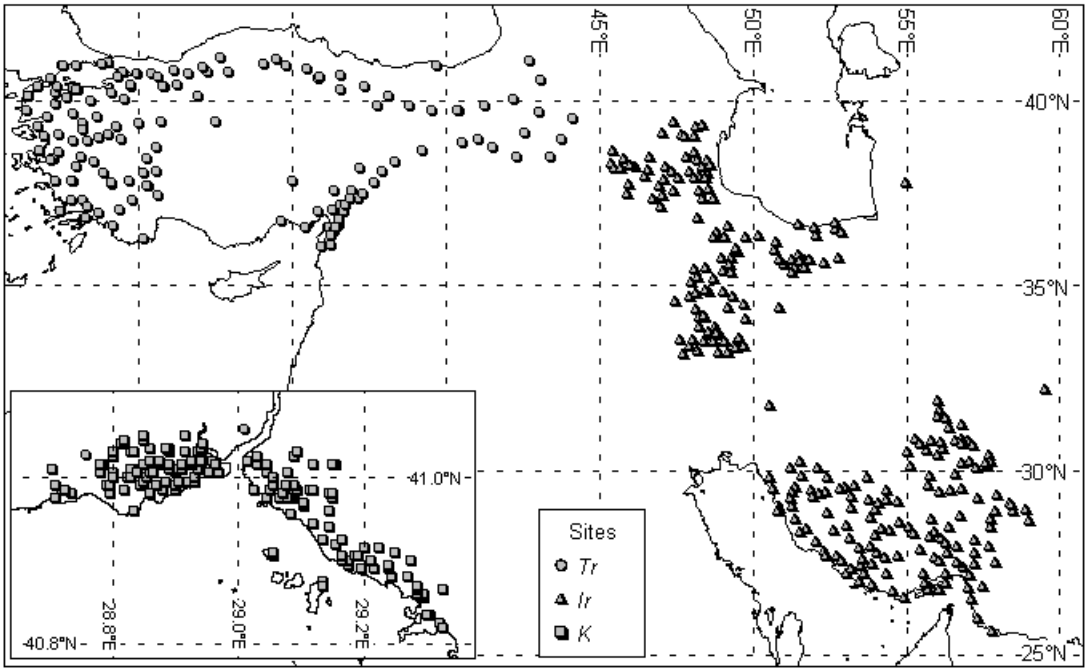

Figure 1. The spatial distribution of sample for Vs30.

Table 1. The summary statistics for geological categories.

Geological Category	Sample Size			Mean of Vs30 (m/s)			St. Deviation of Vs30 (m/s)		
	Tr	*K*	*Ir*	*Tr*	*K*	*Ir*	*Tr*	*K*	*Ir*
Soils	79	32	38	301	313	634	59	71	282
Coarse Deposits	21	0	-	451	-	-	104	-	-
Transitions	15	47	17	366	352	611	72	84	147
Terraces	-	-	132	-	-	718	-	-	344
Sedimentary Formations	32	58	69	534	693	763	150	161	282
Igneous and Metamorphic Form.	5	10	6	622	693	1064	180	111	308

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