

*A PAPER PRESENTED TO THE EURO-MEDITERRANEAN SEMINAR ON NATURAL,
ENVIRONMENTAL AND TECHNOLOGICAL DISASTERS- HOURTI BOUMEDIAN
UNIVERSITY OF SCIENCE AND TECHNOLOGY, ALGERIA ALGER, OCTOBER 8-10 2001*

***SEISMOLOGICAL ENGINEERING CONSIDERATIONS OF THE
EASTERN ARAB REGION***

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ABSTRACT

This paper emphasizes the importance of coordinated teamwork in seismic risk mitigation, reviewing the major landmark efforts conferences and recommendations previously adopted, with an objective to focus the seismological research in the region. A review of the pertinent data on the eastern portion of the Arab Region (Al Mashriq) is presented for further development, which can only be achieved by cooperative research efforts

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INTRODUCTION

The natural disasters have their socio-economic impact on the civil communities. The infrastructure is usually the most vulnerable to disasters in particular roads, bridges, dams, transit and aviation systems, Schools, navigable waterways, energy resources, drinking water and solid and hazardous waste.

Mitigation and disaster reduction of natural hazards, earthquakes in particular involves the establishment of seismic networks and preparations of seismological engineering zoning maps to be utilized in urban development planning particularly in developing nations where, resources are usually scarce or where budget allocations to natural disaster reduction does not have the priority

The UNESCO Intergovernmental Conference on Earthquake Mitigation in Paris on February 1976 was a landmark in international awareness of hazard reduction measures. The CASTARAB meeting in Rabat in August 1977 adopted a number of resolutions on the importance of seismological research. The First Arab Seismological Seminar was organized in Baghdad by the Iraqi Seismological Observatory in November 1978; this was followed by the second Seminar which was held in Rabat in October 1981. The Third Seminar was organized in Riyadh on March 1986, and a Fourth Seminar was planned to be held in Sana'a in April 1994 but was postponed. A number of resolutions and recommendations were adopted at a time when emerging seismological recording facilities were developing rapidly in the region.

We should mention the UNESCO effort that followed the second Arab seminar in Rabat in developing the PAMERAR project for the mitigation of earthquake risk in the Arab region that was launched in 1986.

These efforts and the various resolutions adopted did not move the seismological research activities in the region; until the RELEMR efforts were initiated in the eastern Mediterranean region in early 1993.

Historical seismicity of Yemen was depicted, from 52 documented events and a historical isointensity map is drawn, as shown in figure 2, Alsinawi (1988), Al Aydrus (1997) and Alsinawi & Al Aydrus (1998).

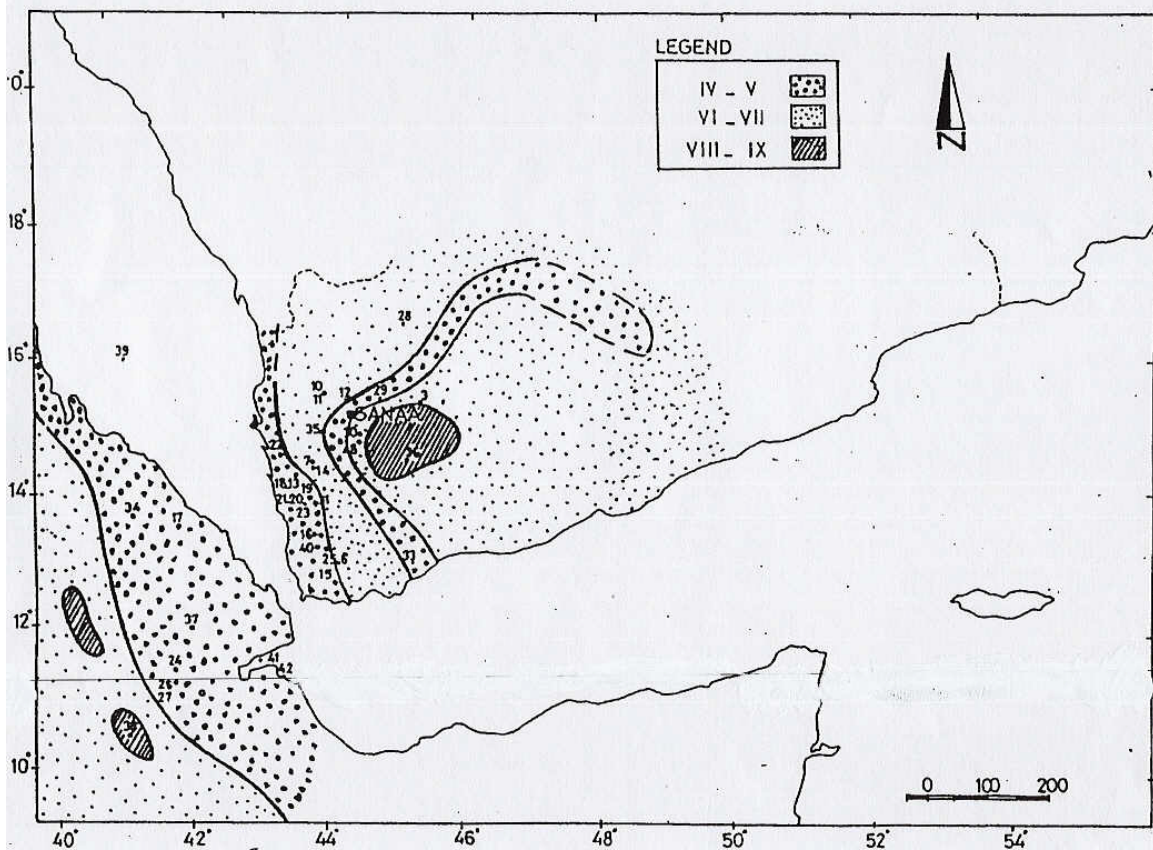


Figure 2: HISTORICAL ISOINTENSITY MAP FOR YEMEN, Alsinawi&Al Aydrus (1998).

(ii) Recent Seismicity

As for the recent seismicity, a catalogue of more than 7380 events was located of various magnitudes. Most of the events were localized at the boundaries of the Arabian subcontinent in addition to a number of intraplate events Alsinawi (1993). It was found that 75% of the events have magnitudes (mb) ranging between 4.0-5.5; more than 75% of those events have focal depth range of 10-40 kms. The seismicity level of the Zagros and Gulf of Aden were the highest. The Gutenberg-Richter recurrence relationship was found to be as follows, Alsinawi&Hamad (1991)

$$\text{Log (N)} = 7.073 - 0.92 \text{ mb} \dots\dots\dots(i)$$

A seismic zoning map was constructed for the study area depicting four major seismic intensity zones range of III-IX, as shown figure3, Hamad (1989) and Alsinawi (1997).

SEISMIC HAZARD OF IRAQ

Seismic hazard investigations were carried by the author in Iraq for the period 1900-1988; 90% of the more than 1000 events catalogued depict a magnitude (mb) range of 4.0-5.5. The focal depth range for more than 75% of the events ranged between 0-50 kms. The frequency magnitude relationship gave the following values thus reflecting intermediate Seismicity, Al Qasrani (1990) and Alsinawi & Al Qasrani (1992):

$$\text{Log (N)} = 6.85 - 0.89 \text{ mb} \dots\dots\dots(ii)$$

A seismic hazard map for Iraq was also constructed showing four major damage zones range of III- VIII, as seen in figure 4, Alsinawi & Issa (1986)

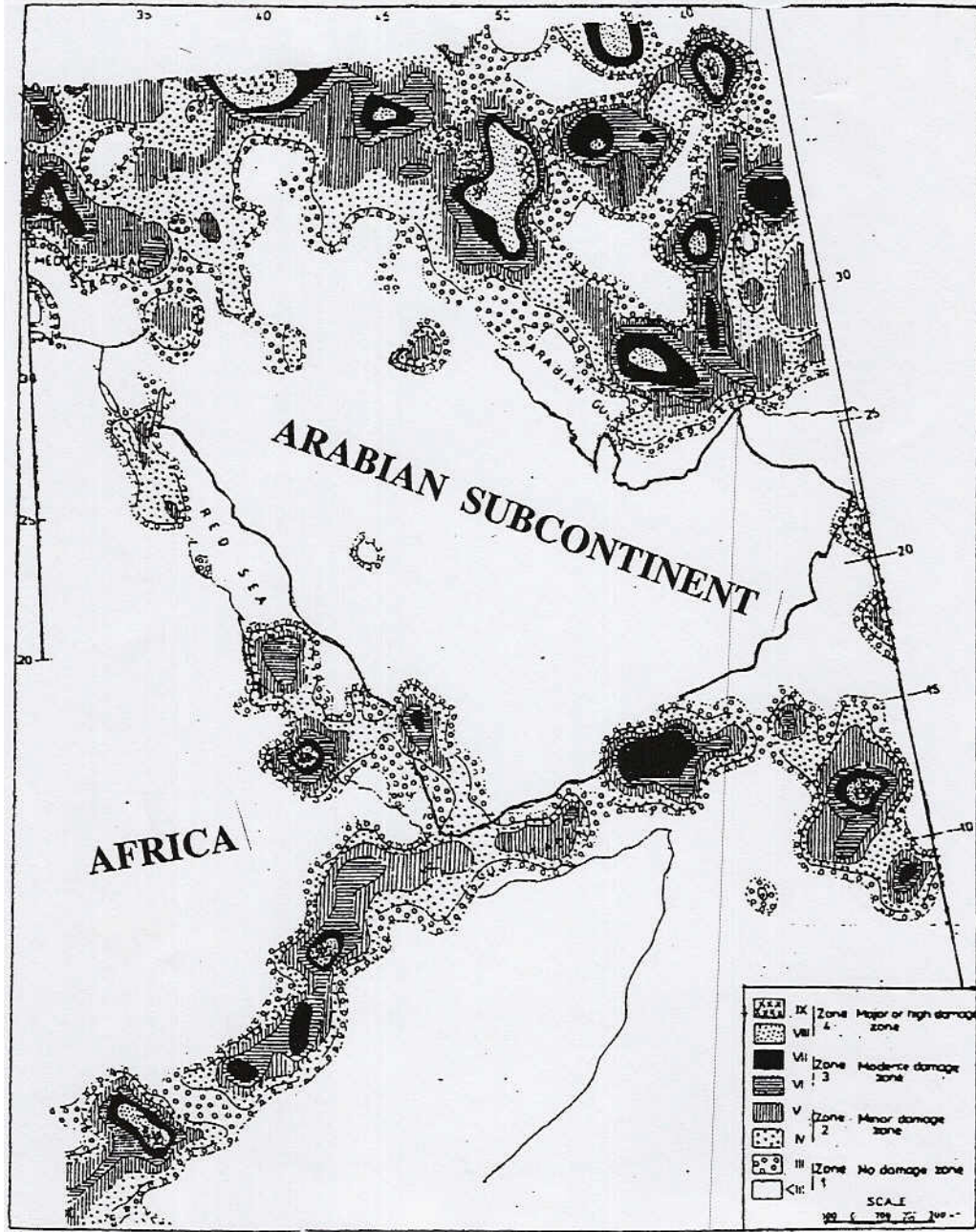


Figure 3: SEISMIC ZONING OF AL MASHRIQ AREA, Alsinawi & Hamad(1991).

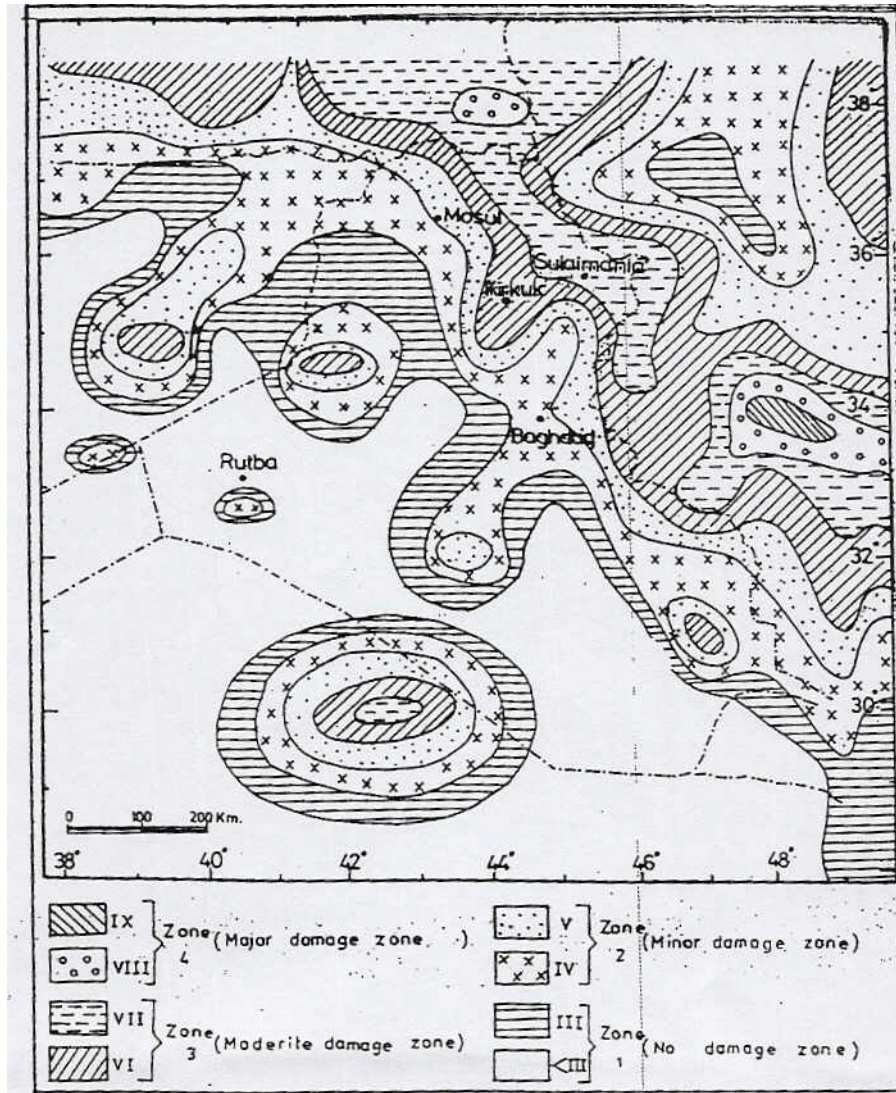


Figure 4:ISOINTENSITY ZONING MAP FOR IRAQ, Alsinawi & Issa (1986).

An isoacceleration map was also constructed for various return periods and the trend of values increases towards the eastern, northeastern and northern directions, as seen in figure 5, Alsinawi & Al Qasrani (1992).

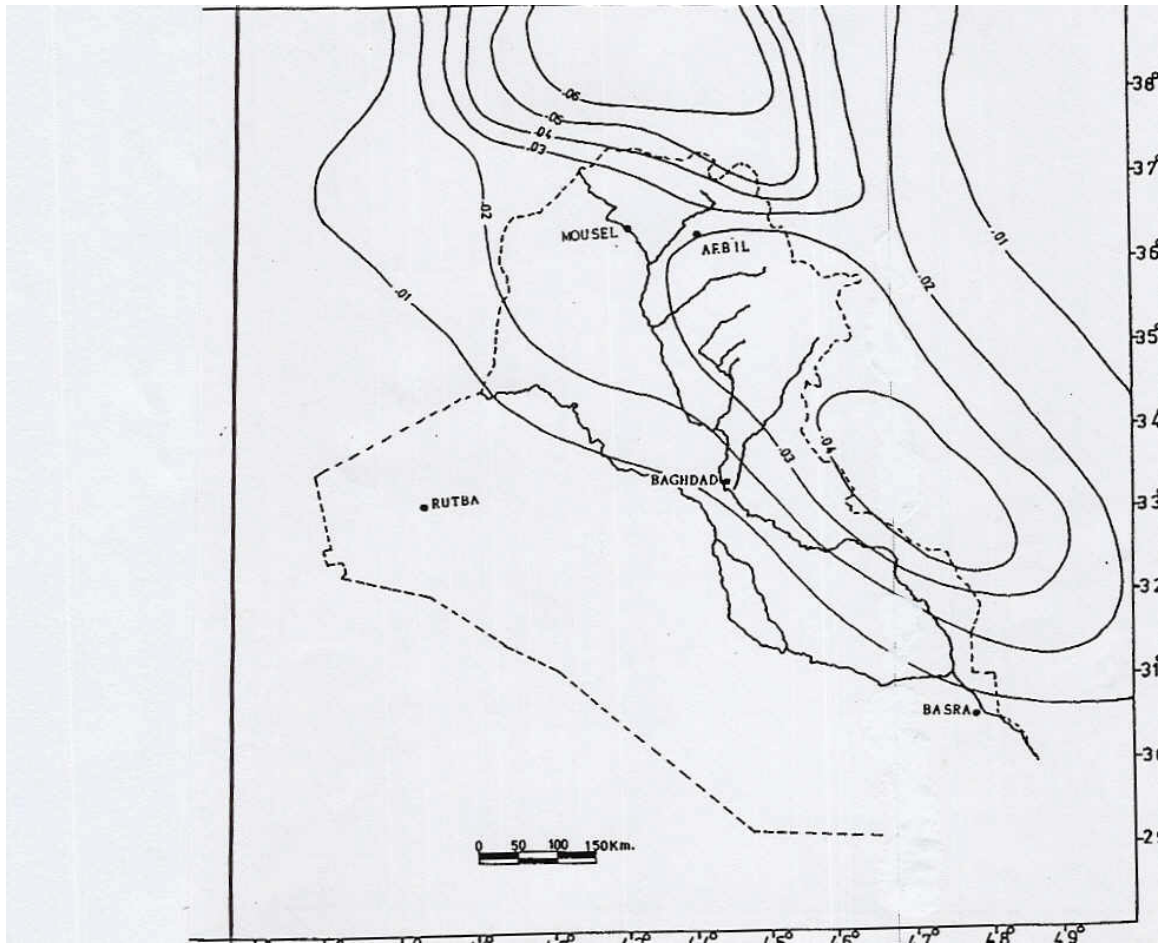


Figure 5: ISOACCELERATION MAP OF IRAQ FOR A RETURN PERIOD OF 25 YEARS, (C.I =0.01 G), Alsinawi & Al Qasrani (1992).

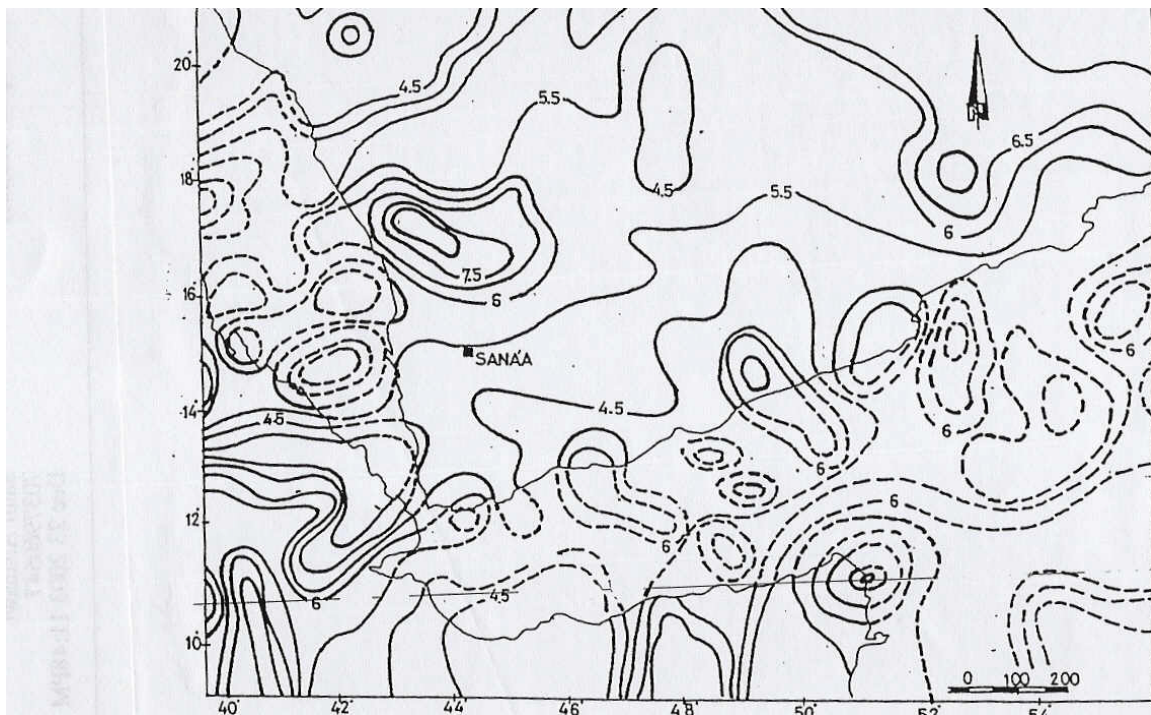
SEISMIC HAZARD OF YEMEN

Seismic hazard investigations in Yemen were also carried out by the author, thus complimenting the SW portins of Al Mashriq area Alsinawi & Al Aydrus (1998). Seismicity of Yemen is closely related to regional basement tectonics, volcanically and the expanding Red sea due to the northwesterly rotation of the Arabian subcontinent during the Tertiary and Quaternary; Alsinawi & Al Salim (1983) and Al Aydrus (1997).

A catalogue of 750 events for the period (1900-1994) was compiled and a Gutenberg-Richter recurrence relationship was computed to be:

$$\text{Log (N)} = 7.0 - 0.97 \text{ mb. (iii)}$$

Isointensity maps were constructed for epicentral distances of 0,100 and 300 kms. Figure 6 is an isointensity map for Yemen with zero effective radiuses, Alsinawi & Al Aydrus (1998).



**Figure 6: ISOINTENSITY ZONING MAP OF YEMEN, (Eff. Rad.=0)
Alsinawi & Al Aydrus (1998).**

ATTENUATION CALCULATIONS

In earthquake design consideration, the magnitudes of attenuation is of great importance .An attempt to study the attenuation of earthquakes generated P waves in Iraq was carried out by Alsinawi & Al Tikriti (2000).

P waves recorded at Baghdad (BHD) and Mosul (MSL) seismological observatories were picked from earthquakes originating in Iraqi territories or from neighboring Turkey and Iran.

Thirty seven such events were chosen, twenty three were recorded at Baghdad and fourteen at Mosul observatories The path of the investigated earthquakes cover the central, northern and central regions of Iraq, with magnitude ranges (mb) of (4.1-5.7).

The amplitude distance curve method of Nuttli (1980) was utilized in this investigation and the mean attenuation value obtained for the whole area is 0.0035 Km^{-1} , as shown in figure7. This value is less than the value obtained for Iran, 0.0045 Km^{-1} , Attenuation research is highly recommended in the South and Eastern Mediterranean region, Alsinawi and Al Tikriti (2000).

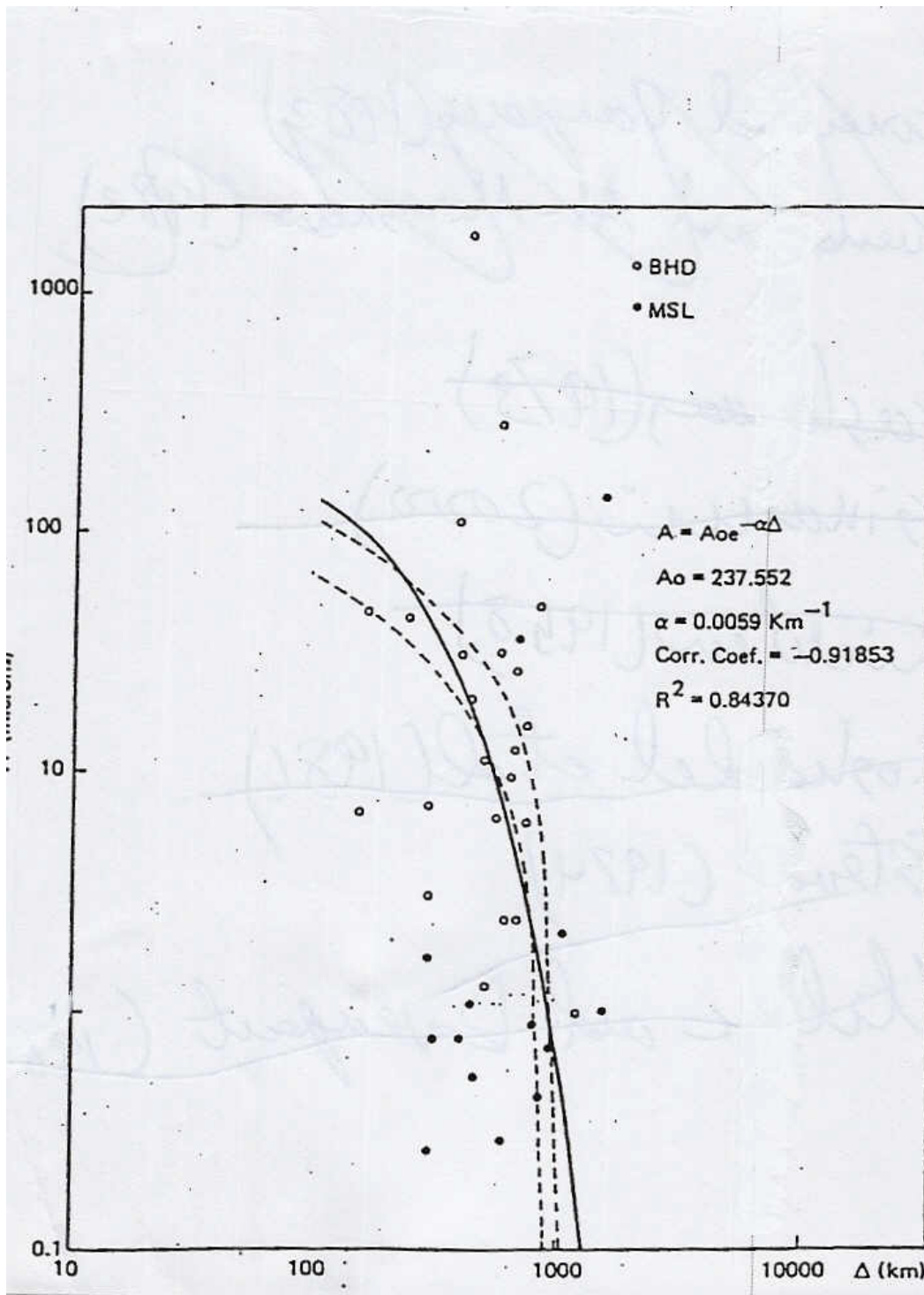


Figure 7: AMPLITUDE DISTANCE CURVES FOR EARTHQUAKE P WAVES RECORDED AT BAGHDAD (BHD) AND MOSUL (MSL) STATIONS WITH EPICENTERS IN TURKEY AND IRAN, Alsinawi & Al Tikriti (2000).

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