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Implications of some early Jewish sources for estimates of earthquake hazard in the Holy Land

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Abstract
For the past two millennia the Holy Land was under the yoke of successive invaders and oppressors, not a fertile ground for growth of historiographic traditions. Consequently, earthquake cataloguers had to rely largely on chronicles and texts written at distant administrative and cultural centers of the day, where earthquake destruction suffered by a culturally and economically depressed province may have been overshadowed by damage in more important parts of the empire. On this assumption, and aided by an implicit notion that the lands bounded by the Dead Sea Rift and Anatolian Fault systems are seismically contiguous, early cataloguers often extended the impact of earthquakes documented in nearby East Mediterranean countries to the Holy Land. Once published, such reports of supposed destructive intensities in Israel were used by Judaic scholars and archaeologists to date poorly defined, often metaphoric, literary seismic echoes, and to justify assigning seismic origin to equivocal signs of damage, asymmetry, or abandonment at archaeological sites of corresponding age. The spread of damage and intensity portraits are therefore enhanced and distorted, and so is their application in palaeoseismic analysis. Four test cases are presented, illustrating the use and misuse of local Judaic sources in identifying destructive intensities supposedly generated in the Holy Land by earthquakes of 92 B.C., 64 B.C. and 31 B.C., and in postulating a regional seismic catastrophe in 749 A.D..

Key words *historical seismology – paleoseismology – Israel – Dead Sea Rift*

1. Introduction

Catalogues of historical earthquakes in the Holy Land include numerous events with inflated implied damaging intensities, which reflect decisions of the cataloguers rather than actual felt reports. Locally written historiographic materials are scarce and earthquake echoes in religious, homiletic and literary texts are difficult to identify and elucidate. Since in the past two millennia the country was under the yoke of different regional powers, cataloguers tended to rely on chronicles and documents written in distant administrative and cultural centers of the day, and extrapolated earthquakes reported to have occurred there to Palestine and Jordan. Such decisions to extend the spread of damage to the Holy Land, often relied on a tenuous correlation to some supposed seismic literary motive in one of the texts written locally, or on a more sweeping assumption that the original chroniclers simply did not bother to record damage sustained by a distant and strategically and economically depressed province. Moreover, some early cataloguers (a detailed list is given in table I) seem to have viewed the Dead Sea Rift (DSR) and the Anatolian Fault Zone as an interconnected seismogenic system that affects the whole Near East simultaneously.

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Table I. Catalogues and lists of historical earthquakes in the Holy Land.

Author	Type	Location	Sources	Comments
Perrey (1850)	Cat	Lev	Prim-Sec	4th-19th cent.
Tholozan (1879)	L	S	Ns	Fragmentary
Diener (1886)	L	Le	Ns	Fragmentary
Arvanitakis (1904)	Cat	Isr	Sec-Prim	
Blankenhorn (1905)	L	Isr	Ns	
Willis (1928, 1933)	Cat	Isr	Catl	
Sieberg (1932)	Cat	Isr, S	Nss	
Shalem (1949, 1951)		Isr	Prim-Sec-Catl	Fragmentary
Amiran (1950-1951)	Cat	Isr	Catl-Sec-Prim	
Grumel (1958)	L	B	Prim-Sec	4th-15th cent.
Plassard and Kogoj (1962)	Cat	Le, S	Cat	
Ben Menahem (1979)	Cat	Isr, Le, S,	Catl-Sec-Prim-Arch	
Taher (1979)	Cat	A	Prim-Sec	6th-18th cent.
Poirier and Taher (1980)	L	S	Ns	
Al Hakeem (1987)	L	S	Ns	
Alsinawi (1988)	L	A	Ns	
Degg and Doorenkamp (1989)	Cat	Isr	Catl	
Ghawanmeh (1992)	L	Lev	Catl-Sec	8th-18th cent.
al Tarazi (1992)	L	J	Ns	

Cat – catalog; L – list; Loc – area of prime interest to the author; Isr – Israel, J – Jordan; S – Syria; Le – Lebanon; Lev – Levant (Is, Jor, Le, Sy); A – Arabia; B – Byzantine; Catl – catalog data; Sec – secondary sources; Prim – primary sources; Arch – archeological data; Nss – no specific sources; Ns – no sources.

This paper focuses on the possible implications of some of the locally written ancient local Jewish sources in study of the Holy Land earthquakes. The contents are presented in a series of test cases, which examine the use and misuse of such documents. In each case a very brief explanation of the character, advantages and shortcomings of each document or group of documents is given. The issue of 92 B.C. earthquake shows how perception of seismic, historic and geographic elements in ancient texts affects the implied damaging intensity estimates for the 198/154/*ca.*140/130 and the 92 B.C. Israel catalog entries; the earthquake of 64 B.C. illustrates the circuitous way in which a distant earthquake not only was extended to Jerusalem, but also how on strength of palaeoseismic correlations its epicenter was moved from North Syria-Anatolia to the Dead Sea; 31 B.C. earthquake presents the problem of geographic perception of spread of damage, and draws attention to the self enhancement of catastrophic image through adhesion of supposed literary earthquake motives; and 747-749 A.D. earthquakes illustrate the pitfalls of fusion of felt reports dated in different time-counting

frames into a single earthquake, which then grows through adhesion of reports of supposed archaeoseismic damage.

2. Seismotectonic framework

Israel lies near the junction of the Eurasian, African and Arabian Plates (fig. 1). Its tectonic pattern is dominated on the south by the Arabo-Nubian craton, on the west by the Syrian Arc - a sigmoidal belt of Late Cretaceous-Neogene folds and faults that extends from the Sinai Peninsula up to Palmyra in Syria – and on the east by the Dead Sea Rift (DSR) – a more than 1400 km long complex transform fault along which the Arabian Plate slips northwards relative to the Sinai-Israel part of the African Plate at a mean long term rate of 5 to 10 mm/yr (for references: *e.g.,* Garfunkel, 2001; Garfunkel *et al.*, 1981; Salamon *et al.*, 2003; Westway, 2003). Rather than a sensibly straight continuous dislocation, the DSR consists of colinear and offset segments, and shows local restraining and releasing bends and stepovers with associated transpressive blocks and transtensional pull-apart basins. Most studies assume a post Eocene interplate displacement of 105 km, that occurred in two stages: first a continuous northerly movement of 75 km, and then, due to a change in pole of plate motions 4 myr ago, a diagonal extension with normal faulting and ultimate development of rift morphology. Obviously, ongoing motion along DSR and the convergence of Eurasia and Africa would require rotations, displacements, and space readjustments also across the Syrian Arc structures. Geological evidence of such differential vertical and tilting movements was found but the inferred rates and sense of motion differ widely. While distribution of recent seismicity (fig. 2) confirms that DSR is the major seismogenic element in the region, activity along individual segments is uneven with a strong clustering along the Gulf of Elat and Dead Sea segments, and conspicuous quiescence along the intervening Arava and Jordan Valley segments. It appears that the segmentation would lead mainly to moderate magnitude earthquakes say M_L = 5.5-6.5, with intensities determined by depth and site conditions. Seismic activity was documented also along DSR's NW aligned subsidiary fault zones, particularly the Carmel-Tirza zone, and some low magnitude events were identified also farther away along the Syrian Arc, suggesting that some reactivation of tectonic elements may have taken place in the past.

The early attempts to quantify the regional seismic regime relied on scanty instrumental data, on some 20th century macroseismic observations, on historic earthquake catalogues and on the general distribution of the main tectonic elements. Arie (1967) attributed most of

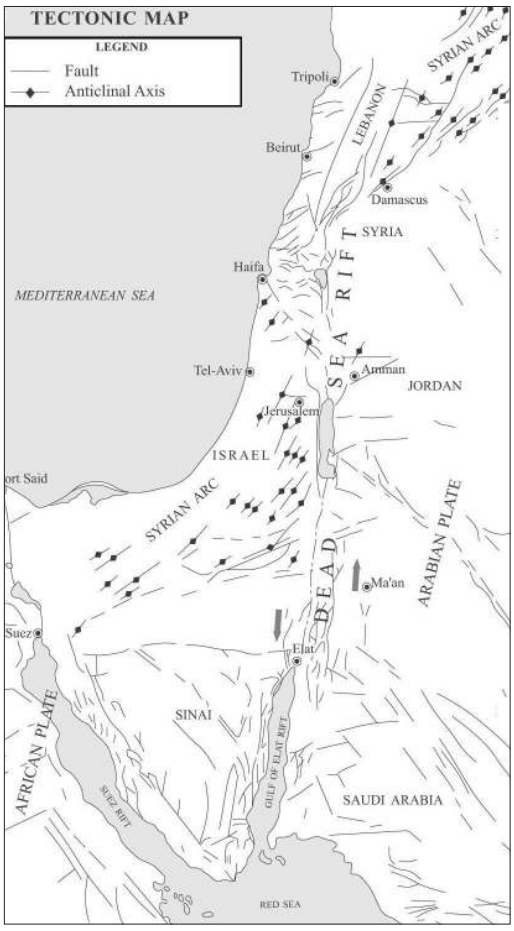

Fig. 1. Tectonic sketch map (after Picard, 1943; Bartov, 1990).

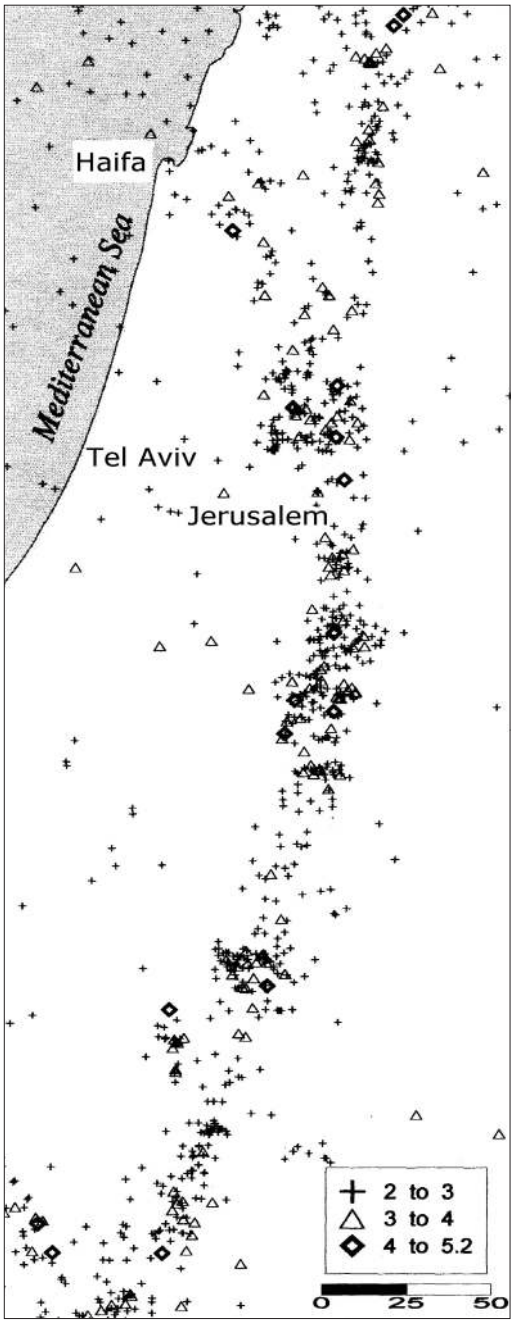

Fig. 2. Seismicity of Israel from 1984 to 2002 (Israel Geophysical Institute, Seismological Division, 2003).

the significant regional activity to DSR main fault, discounting the NE-SW trends and the NW-SE trends suggested respectively by the isoseismal maps of Sieberg (1932) and Shalem (1951), and suggested magnitude-frequency and magnitude-intensity relationships $\log N = 4.9 - 0.8\,M$ and $M = 0.5\,I_{max} + 1.8$, with a recurrence interval of about 40 year for $M = 6$ and 220 year for $M = 7$. Ben-Menahem *et al.* (1976), and Ben-Menahem (1979, 1991) used the historic catalogue data base far more extensively, estimating magnitudes and locations along the main seismotectonic zones of the East Mediterranean region. A uniform $b = 0.86$, and a values of 3.35 for the Mediterranean offshore zone, (with $M_{max} = 7.2$ every 2600 year), 3.1 for the Israel inland segment of DSR (with $M_{max} = 7.3$ every 1500 year), and 3.75 for the Syrian segment ($M_{max} = 8$ every 1400 year) have been calculated. With small modifications these values were accepted also for Jordan (Abou Karaki, 1987; Kovach, 1989; Kovach *et al.*, 1990). Following two decades of countrywide seismological monitoring and a more detailed structural analysis with emphasis on prospective post-Pliocene faults, Shapira and Shamir (1994), Shamir *et al.* (2001), and Shapira and Hofstetter (2002) proposed more detailed frequency-magnitude relationships. They identified 17 seismotectonic zones in Israel and 7 around it, for which they obtained a uniform $b = 0.96$, except for 1.07 for Suez, and 0.98 for Cyprus, and M_{max} values of 7.5-7.75 for DSR, 6.5 for the Carmel-Tirza fault and for the offshore zone and 5.5-6 for a greater part of the Syrian Arc structures. The catalogue is taken to be complete for $M = 6.5$ at least since 100 A.D., and for $M = 6$ since 1000 A.D.. The estimated recurrence intervals for the part of the DSR across the densely populated part of Israel and Jordan, between south Lebanon to the Dead Sea, are 75 and 960 years respectively for $M = 6$ and $M = 7$. Already North (1974, 1977) and Ben-Menahem *et al.* (1976) drew attention to the apparent difference between the total slip of 5-10 mm/yr along the DSR, which was inferred from long term geological evidence, and the seismic slip of 1-3 mm/yr computed from the short term instrumental and historical data. The deficit was attributed to some form of aseismic creep, but so

far a decade of geodetic monitoring of the Galilee-Golan segment of the DSR indicated that no consistent motion in excess of 1mm/y could have taken place. An obvious alternate explanation was that the available historic record is too short to include large magnitude earthquakes (or clusters of earthquakes) with long recurrence interval. Whatever the mechanism, the very idea of slip deficit seems to have led to intuitive overestimates of earthquake magnitude, and to a tendency to assign seismic origin to signs of abandonment, damage, and construction asymmetry at archaeological sites, as well as to features of soft sediment deformation and mass movement. It appears however, that some of the updated plate tectonics models suggest that the slip deficit is much smaller, with a total slip of only 4 mm/yr. Even more extreme in this context are the conclusions of Sneh (1996) that the distribution of Neogene formations younger than 16 myr across the DSR is continuous and shows no lateral offset, and of Horowitz (2001) who discounts the concept of the 105 km interplate displacement altogether.

In the past twenty years studies of tectonics and seismicity of the Eastern Mediterranean and the DSR, too numerous to list here, attempted to incorporate past earthquakes in analysis of plate kinematics and in identification and characterization of active structures. Unfortunately, unlike the rapid progress in collection and processing of instrumental data, in modeling of plate motions, and in field studies of individual faults, historic input changed very little and still relies on the collective wisdom of largely unverified and incestuous earthquake catalogues (table I). In the 20th century, more than two dozens of earthquake catalogues and lists were published, creating an impression of a complete and reliable data base, which was repeatedly researched and verified. Rather than retrieve and cross verify the primary historical, literary and sacred sources, however, each cataloguer relied largely on his predecessors and on assorted secondary sources. Thus, fragile or erroneous evidence propagated from one catalogue to another, gaining stature and credibility. In some cases indiscriminate copying of slightly different descriptions of the same event from different older catalogues led to doublets and even triplets in the newer ones, while at the same time different events were fused merely on the strength of assumed proximity in time or location. Transmission of evidence through the catalogues is uneven, and changes in dates, location and extent of damage or even elimination of events are left unexplained. Such disregard of historical methodology and inadequate retrieval and analysis of primary sources, resemble the historical seismology of Europe half a century ago. In our case, however, shortcomings of the data base are treated as an unavoidable evil, since the century-long earthquake cataloguing is assumed to have exhausted all possible sources of information. Consequently, too often this residual uncertainty provides a license to tailor historic magnitudes and epicenter locations (including import of distant earthquakes), to the chosen tectonic concept, with the result that vague statements on the «overall historic seismicity» are invoked in support of contradictory claims, such as a threefold deficit of seismic slip on one hand, and a close fit between the total and the seismic slip on the other. Catalogue data are used also in paleoseismic correlations to confirm the earthquake origin of alleged sedimentary «seismites» (*e.g.,* Ken-Tor *et al.*, 2000; Migowski *et al.*, 2004), yet the choice of «seismite» producing events from the catalogues appears to be guided by frequency and sequence of the seismites to be confirmed.

3. Local historical sources

Most of the catalogued information about historical earthquakes in the Holy Land comes from chronicles and texts written outside. This is not surprising, since for two millennia (except perhaps for the Crusader Kingdom), this area was not autonomous and was governed from distant capitals be they Roman, Byzantine, Ummayad, Abbaside, Mamluk or Ottoman (table II). Shifting political fortunes, invasions and conquests, and internal clashes driven by differences in religion, traditions, and political allegiance, arrested the economic and cultural development for extensive periods. In the major centers of the day, where chronicles were written and archives were kept, the attitude to the Holy

Table II. Dominant regimes in the Holy Land.

Hellenistic period	
Early hellenistic	332 B.C.-167 B.C.
Late hellenistic	167 B.C.-37 B.C.
Roman and Byzantine periods	
Early Roman	37 B.C.-132 A.D.
Late Roman	132 A.D.-324 A.D.
Byzantine	324 A.D.-638 A.D.
Early Arab to Ottoman periods	
Umayyad	638-750
Abbasside	750-1099
Crusader / Ayyubid	1099-1291
Late Arab	1291-1516
Ottoman	1516-1917

Land and Jerusalem was marked by a separation between the heavenly and the earthly and mundane. Places sacred whether to Jews, Christians or Moslems, were revered and extolled in mystic religious terms, but except for drastic political changes and acts of persecution, daily events, were given little weight. The chroniclers may have been lax in verifying possibly distorted or exaggerated news from afar, but also may have not bothered to report a destructive earthquake in this depressed area, either because it was overshadowed by damage across the more important parts of the empire, or because it was of little interest to the writers and readers alike. On the latter assumption the modern cataloguers extrapolated to Israel and Jordan the impact of earthquakes that hit the Levant as well as Turkey, Armenia and Greece. Since the implied damaging and destructive intensities not only inflate the local macroseismic record, but also increase the radius of damage (and thus also the inferred magnitudes) to vast proportions, verification based on materials written locally or focused specifically on the Holy Land is called for.

One little explored group of such sources, which includes the Jewish and Samaritan texts forms the main topic of this paper. From the outset it should be clear that these materials differ in character from the Roman, Byzantine and Moslem chronicles. The unhappy political history of the Jewish people after the destruction of the Second Temple in 70 A.D. by the Romans and the end of independent statehood, discouraged the writing of historical chronicles. Except for a few works, such as those of Josephus Flavius (the 1st century A.D. Jewish-Roman historian), the Books of Maccabees (a part of the Roman Catholic canon), and Megillat Taanit (a pre-Talmudic, 1st century A.D. or earlier, text with a later interpretative scholion), the Jewish writers stressed the universal theological, legal and moral aspects of contemporary happenings, with little attention to factual details. Only sketchy chronological data are available about even the leading figures, whose writings and oral rulings were embedded in the Talmud and in post-Talmudic literature and molded the future spiritual life of the nation. Similarly shrouded in uncertainty is history of the early Jewish poetry and chronology of the leadings poets. Because of emphasis on argumentative, legal and philosophical approach, and the convolute language full of biblical allusions and metaphors, it is often hard to perceive whether the text refers to a real event. The Scriptures as well as the later homiletic and poetic works frequently use earthquake motives as a descriptive tool in depiction of divine wrath and retribution, in extolling heavenly and worldly might, in theophanies and in apocalyptic visions. Elucidating the true intention of the writers is complicated further by the lack of punctuation and phonological signs, which introduce further ambiguities in perception of texts written in the 22 letter vowel-less alphabet. Usually, the later interpreters preferred to assume that the text reflects a true earthquake since this provided a possible chronological indicator of the time of the author. First, the broad time frame of the text was inferred from characteristics of language and style and then the suspect earthquake echo was attributed to the most prominent or closest shock reported in that time range by one of the local or regional catalogues. Once made, such tenuous correlations often bounced back into seismological literature as a confirmed fact, indicative of local earthquake intensity.

Caution is needed when attempting to identify an earthquake by checking whether a date given or implied in an ancient Jewish text falls on the day and month date of an earthquake indicated in one of the occidental or oriental texts which use one of a myriad of calendars and eras followed by other communities of the region (*e.g.,* Grumel, 1958; Bickerman, 1968; Samuel, 1972; Meimaris, 1992). The Jewish lunisolar calendar (months according to the moon and the years according to the sun, thus ensuring that festivals celebrated on fixed dates fall also in fixed seasons) is based on a 19 years cycle, with 12 years of 12 months and 7 leap years of 13 months (for bibliography: *e.g.,* Mahler, 1916; Akavia, 1953, 1976; Frank, 1956; Finegan, 1998; Stern, 2003). In early times all calendar decisions (start of a new month, festivals, intercalation of the 13th month to compensate for the difference between the lunar and solar years) were in the hands of the religious leadership (the Sanhedrin) and were based not only on observation of the moon and the sun and on a secret system of calculations, but mainly on the ripeness of the crops. When growth was arrested by unfavorable conditions it was common to intercalate another month, to delay the spring and the celebration of Passover. The order of intercalations therefore was not fixed as it is now (years 3, 6, 8, 11, 14, 19 in each 19 years cycle) and indeed according to one of the traditions, once Rabbi Akiva (1st century A.D.) had to intercalate three years in succession. While the general calendar rules were published by Rabbi Hillel II in mid-4th century, order of intercalation was not unified until the final sealing of the calendar practices in the times of Rabbi Saadia Hagaon about 920-930 A.D. Thus, attempts to harmonize pre-10th century felt reports on strength of coincidence of the day and month dates given in Jewish and Christian sources may be misleading, if based on current conversion tables, such as those of Akavia (1976).

Further chronological indicators used in Jewish texts include the Era of Adam, which starts in AM 3760 with creation of Adam, Creation Era which starts a year before the Era of Adam in AM 3761, Destruction Era that starts from the destruction of the Second Temple by the Romans in Summer 70 A.D., the Era of Contracts synonymous with Seleucid Era (Babylonian count starting Spring 311 and Macedonian count starting Autumn 312 B.C.) and a continuous sabbatical count, which marks a fallow year every seventh year. Though ostensibly the starting points are well defined, the texts indicate some deviations, whether as a result of confusion between the Eras of Adam and Creation or because of different perception of the month on which reckoning starts, Nissan in the Spring, or Tishri in the Autumn (so that even the Hebrew date for Destruction was assigned alternately to 3828, 3829 and 3830 of Creation Era). In Palestine, the Era of Contracts starts in Autumn 312 B.C., AM 3449 (for references: *e.g.,* Meimaris, 1992; Di Segni, 1997), however some texts (including 1 Maccabees) follow the Babylonian system and start the count in Spring 311 B.C., while Frank (1956) reports also evidence for start in Autumn 313 B.C.. Even the count of sabbatical years, may have not been followed uniformly (for references: *e.g.,* Wacholder, 1973; Stern, 2003) in spite of its far reaching economic and social implications. Thus detailed calibration of a first millennium Hebrew year date, becomes meaningful only when three such independent chronological indications are given.

Examples of analysis and use of the early Hebrew sources outlined below include the pre-1st century A.D. quasihistorical Scroll of Fasts and its later scholia and their implications in analysis of the 198/~ 140/92 B.C. earthquake reports; the 1st century A.D. historical works of Josephus Flavius and pre-6th Talmudic tractates for the 64 and 31 B.C. earthquakes and a liturgical poem, a 10th century prayer book and two Samaritan chronicles for the 747-749 A.D. earthquakes. A voluminous literature developed around each such text or group of texts. To keep the bibliography within reasonable limits only a few works are cited in each case, usually those with the most extensive list of references on the topic.

4. 92 B.C.

This event illustrates the role of locally composed Jewish texts in analysis of several 2nd century B.C. earthquakes that were import-

ed into the Israeli catalogues from elsewhere in Eastern Mediterranean.

Catalogues used in assessment of seismic hazards in Israel (*e.g.,* Ben-Menahem, 1979, 1991; Degg and Doorenkamp,1989; Amiran *et al.*, 1994), list a major earthquake (M_L = 7.1) and a tsunami, that caused extensive damage in Syria, Israel, Cyprus and Egypt in 92 B.C.. They rely on entries in the older catalogues of Willis (1928, 1933) and of Plassard and Kogoj (1962). The former copies Mallet (1853), who in turn copies von Hoff's (1840) undocumented *«Erdbeben in Syrien und auf der Insel Cypern»* and the latter follow Sieberg's (1932) undocumented *«In Syrien ein schweres erdbeben das bis Agypten gefult wurde»*. The third source is an entry in the pre-70 A.D. Megillat Taanit (Scroll of Fasts) retrieved by Shalem (1956). Classical sources that report an earthquake that hit Apamea in Phrygia about that time, do not mention any effects in Egypt, Israel, Levant nor Cyprus (*e.g.,* Guidoboni, *et al.*, 1994; Ambraseys and White, 1996, 1997). Admittedly, at first Ambraseys *et al.* (1994) inferred from a Greek inscription at Magdolum that an earthquake hit Egypt between 97 and 94 B.C., however it turned out that «*seismos»* in the inscription probably refers to *«extortion»* (Mazza, 1998) or «disturbance» (Ambraseys and White, 1996). Therefore, the Scroll of Fasts remains the only primary record of damaging intensities and tsunami in this region and thus merits further attention.

4.1. *Evidence of Megillat Taanit (Scroll of Fasts)*

This text, written before the destruction of the Second Temple in 70 A.D., is a summary of earlier oral traditions which lists 35 day and month dates of joyous events in early Jewish history, mainly during the Hasmonean period (167 B.C.-37 B.C.), on which mourning and fasts were prohibited (for references: Noam, 2003; for non-Hebrew text: *e.g.,* Grossberg, 1905; Zeitlin, 1922; Lichtenstein, 1931). Emphasis is on round the year observance and not on historiography, so that events are listed not in a chronological order but by month and day on which they happened. Though these rulings were observed only for a few centuries, the text was transmitted and preserved in the Jewish canon. Scroll of Fasts includes the Scroll (Megilla), which is very brief (since at the time of writing the commemorated events were still fresh in memory) and three versions of later addenda (Gemara = scholion), named after the three main surviving manuscripts, which explain the reasons for rejoicing on the listed dates. This elucidatory process, continued through the Talmudic period (2nd-6th century) until the late Middle Ages, but the source, veracity and sense of many of the addenda, which were appended at different times and by different persons, are not always clear. While many of the explanations are historically correct and reflect information transmitted orally or gathered from unspecified textual sources, others raise doubts as to the competence of the commentator. Scribal errors are common, particularly in copying of geographic and personal names. The problem is particularly vexing since the text survived only in few late copies which differ conspicuously from each other. The three principal versions known are the Parma manuscript (copied in the 14th century), the Oxford manuscript (copied in 15th century) and the Common («Vulgata») version, which is the latest. The Parma and Oxford manuscripts differ in all bar four interpreted events and must have evolved separately, the former from the Babylonian and the latter from the Jerusalem Talmud. The Common version, which appears to combine the former two, adds some further details of unknown provenance. Evidently, this blending of information was not accomplished in one go but represents a process recently shown to have started before the 11th century and to have ended in 1519 A.D. when first printed version was published in Mantova (Noam, 2003). The scholia represent therefore an aggregate of additions appended at different times by different editors and must be treated with caution.

The relevant parts of the entry for the 17th of the month Adar (the 33rd entry), in the Scroll and in the three versions of the scholion are presented in table III in literal unedited translation (even if the English text is unwieldy) indicating where a word may have two meanings. The

Table III. Comparison between the original text of the «Scroll of Fast» and the three versions of the scholion to the 33rd entry.

Scroll of Fast	«Parma» scholion	«Oxford» scholion	«Common» scholion
«... on the 17th the natives attacked the remnant of scribes in the country of Belikos and Beit Zabdai and a salvation came to the House of Israel».	«... and there was a release since the natives wanted to kill the scribes of Israel and they went to Beit Zabadi and sat there ... and the day they escaped was made into a holiday».	«... and there was salvation when king Janaeus saw killed Bukinos and Bukius his brother and escaped from him and went to Syria and in the country of Blikus all natives gathered to kill them and He [the Almighty] sent onto them a great «raash» [earthquake, clamor] and there was a great blow amongst them».	«... and when Janaeus came down to kill the scribes they escaped from him and went to Syria and stayed in country of Koselikos and the gentiles there rose to kill them and they «heziu» them a great «zia» [shocked them a great shock, scared them great scare] and they struck them a great blow and left some survivors and they went to Bet Zabadi ... Rabbi Hidka says the day the natives wanted to kill the scribes of Israel the sea upwelled and destroyed a third in the settled land».

Scroll and the Parma version do not mention earthquake nor inundation, Oxford version may refer to an earthquake and the Common version to an earthquake and a tsunami or inundation.

Though the word *«raash»* may stand also for *«clamor»* or *«noise»*, the Oxford version seems to indicate that 17th Adar commemorates the rescue of scribes (sages) by a God sent disaster. The Common version, derived from the Parma and Oxford texts, is more equivocal. The word *«zia» («earthquake»*, *«shock»* but also *«scare»* or *«tumult»*) is used to describe the blow dealt to the scribes and the fortuitous escape of survivors from tumult of attack without invoking any cataclysmic divine intervention. On the other hand, this version adds a report by Rabbi Hidka (one of the 2nd century A.D. sages) of a destructive inundation at the time «when the natives rose to kill the sages», implying that it interfered with the attack.

The Oxford and the Common texts either reflect an otherwise unknown earthquake and tsunami reported in now extinct local traditions, or present echoes of events already recorded in non-Judaic chronicles and texts. Thus details of location and time of the 17th Adar events are identified first and then are compared with the available earthquake records.

The consensus is that the misspelled location names Belikos, Belikot (Scroll), Chalbos (Parma), Cholbos, Chalikus (Oxford) Coselicos and Calicos (Common) as well as Beit Zabdin (Scroll), Beit Zabdai (Parma), Beit Zabadi (Oxford and Common), stand respectively for Chalcis and Zabadea in Lebanon-Syria (for references, *e.g.,* Hampel, 1976; Noam, 2003) (fig. 3).

Of the many localities in antiquity named Chalcis two were in Syria. Chalcis sub Libanum (thereafter Chalcis sL), present Anjar, Ayn al Jarr, was in the Beqaa in Lebanon, about 10 km SE of present Baalbek, near Zabadea, a narrow plain with present Zabadani, 25 km NNW of Damascus and ancient Kaprazabadion - present Qafr Zabad, 25 km SW of Chalcis sL (Dussaud, 1927; Millar, 1987). It seems less probable, that the texts refer to Chalcis ad Belum (thereafter Chalcis aB), present Hadir and Kinnisrin in north Syria, less than 100 km

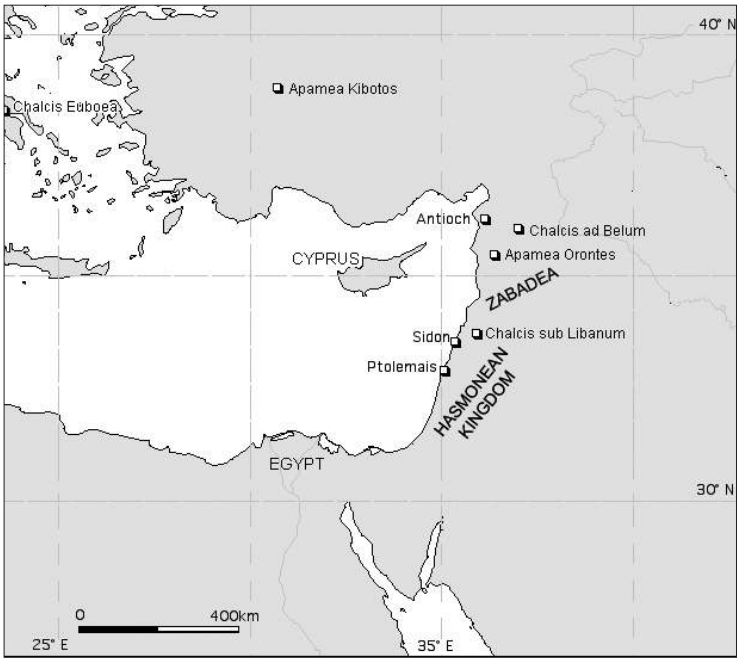

Fig. 3. Orientation map for the 198-92 B.C. earthquakes.

SE of Antioch (*e.g.,* Pauly and Wissowa, 1899, iii, c. 2078; Grainger, 1990, 1997; Barrington Atlas, 2000). None of localities with names akin to Zabadea (Zebed, Zebadi on the Orontes and Zabboude) near Chalkis aB appears to have a source in antiquity (Doussaud, 1927). Admittedly, Chalkis sL, Chalkis aB and Zabadea are away from the Levant coasts, but Rabbi Hidka's report may imply only that the news of a catastrophic inundation along the littoral diverted the attackers.

Judaic scholars suggested two possible time frames for the events of 17th Adar in the Oxford and the Common versions. One follows the references to King Alexander Janaeus (103-76 B.C.), whose persecution of Pharisee opponents led to their flight to Syria (Josephus, Wars 1.4.6: Thackeray, 1976). The second, denies that the reference to Janaeus has any historical significance and assumes that the widely detested cruelty of the king (Josephus, Antiquities 13.13.5; 13.14.2: Marcus, 1976; Josephus, Wars, 1.4.3-6: Thackeray, 1976), led the later day interpreter to blame him also for the misfortunes of the «remnant of scribes». According to this interpretation, the term refers to survivors from oppression and slaughter that followed one of the political upheavals in the 2nd century B.C. Levant, when segments of the multicultural population were paying heavy price for shifts in political fortunes and short-lived alliances. Indeed, in the Oxford version the reference to Janaeus seems to be garbled and inserted out of context and «Bukius and Bukinos» are regarded as a colloquialism rather than real persons (Efron, 1987). Instead, the 17th Adar salvation of the scribes is thought to have taken place during the victorious campaign of Jonathan Maccabaeus (160-142 B.C.) against Demetrius Nicator and then against the Zabadeans: «Jonathan pursued them, but he did not overtake them, for they had crossed the Eleutherus river, so Jonathan turned aside against the Arabs who are called Zabadeans and he crushed them and plundered them». (1 Maccabees, 12,30-31).

4.2. *Evidence of classical sources*

Classical sources report earthquakes during the reign of both kings. Janaeus's persecution of his religious opponents and their flight to Syria agree roughly with the *ca.* 90 B.C. date estimated by Guidoboni *et al.* (1994), and Ambraseys and White, (1996, 1997) for earthquakes that destroyed Apamea in Phrygia (Apamea Kibotos, present Kelenai on the Meander River in Turkey). According to Athenaeus's extract from 1st century Nicolaus of Damascus (Deipnosophists, 8.332: Gulick, 1957), the earthquake was accompanied by flooding, change of river courses, appearance and disappearance of lakes and ingression of sea waters, while Strabo (Geog., 12.8.18: Jones, 1917), tells of earthquake destruction of Apamea and the gift of Mithidrates Eupator to rebuild it. Since Apamea Kibotos is a 100 km of hilly country away from the coast, catastrophic river floods along Meander and Marsyas and changes in nearby lake levels are more likely than a marine ingression. Floods were common in this region and Schurer (1979) comments on the Noah's elements in the local lore and points out that the term Kibotos, was usually employed for Noah's arc.

During Jonathan's reign, between Tyre and Ptolemais in Phoenicia a «wave from the ocean lifted itself to extraordinary height and dashed upon the shore engulfing all men and drowning them...», event extracted from the now extinct works of Poseidonius by Athenaeus (Deipnosophists, 8.332: Gulick, 1957) and by Strabo (Geog., 16,2.26: Jones, 1917). Since the event followed the battle between Diodotus Trypho (Grainger, 1997; Baldus, 1970) and the Seleucid army, the date is constrained by the start of Trypho's mutiny in 145/144 B.C. and his suicide in 138/137 B.C. Jonathan's campaign against the Zabadeans took place when he was still allied with Trypho, probably in 143/142 B.C.

This same event may be responsible for 1st century B.C. Poseidonius's report of a disaster along the Levant littoral, transmitted by Strabo (Geog. I, 215: Jones, 1917): «city above Sidon collapsed into the sea and nearly two thirds of Sidon itself was engulfed...and the shock extended over whole of Syria though with only moderate strength». Since the shock, amongst other violent occurrences, was described together with the famed emergence of the island of Hiera in 198 B.C., the two were assumed to be concurrent. Strabo's text, however, is a discourse on unusual natural phenomena, rather than a report of interrelated contemporaneous events (*cf.* Kidd, 1988, 1999; Ambraseys and White, 1996). Indeed, both 1st century A.D. Seneca (Nat.Quest. 6.24.6: Corcoran, 1972) and 1st century B.C. Lucretius (De Rerum Natura, 6,535-607: Bailey, 1947 and Rouse, 1966) refer to the earthquake in Sidon, without mentioning Hiera and other marvels of nature.

Yet another account of an earthquake in Jonathan's timeframe appears in 6th century John Malalas (Chronicle 8.25: Jeffreys *et al.*, 1986) who reports that in the days of Antiochus grandson of Grypos who ruled for nine years: «Antiochia the Great suffered from 'wrath of God' in the 8th year of his reign in the time of Macedonians 152 years after the original building of the wall by Seleucus Nicator at the 10th hour on 21st of Peritios February. It was completely rebuilt as Dominos the chronicler has written. It was 122 years after the completion of the walls and the whole city it suffered it was rebuilt better». As Downey (1938, 1961, 1963) pointed out, the dates are inconsistent. 152 years from the foundation of the city by Seleucius Nicator in 300 B.C., indicates the year 148 B.C., but the only Antiochus who ruled for 9 years was Antiochus VII Sidetes (138 B.C. to 129 B.C.) so that his 8th regnal year would have fallen in 130 B.C. Having failed to reconcile the dates and having found the reference to 122 years not indicative (different quarters of the city were built and walled at different times, none on which corresponds to either of the two indicated dates), he attributed the confusion to Malalas's mistaken chronology of the Seleucid monarchs and suggested that the entry lumps together at least two different earthquakes, one in 148 B.C. and the other in 130 B.C. While Malalas often errs in reporting events much before his time (*e.g.,* Jeffreys *et al.*, 1986; Jeffreys, 1990; Croke, 1990) and nothing is known about his source «Domninos the chronicler», an alternate explanation downrated by Downey (1938) may be more reasonable. Up to the death of

Demetrius I Soter in 150 B.C. Malalas's chronology of Seleucid rulers is parallel to that indicated by other sources. For the next 12 years, however, the accounts differ and converge again at the ascent of Antiochus VII Sidetes (138-129 B.C.). Misinformed on rulers and on events of this turbulent decade, Malalas assumes that the power was in the hands of one «Antiochus, descendant of Grypus and son of Laodice and Aristhrates». It is not clear whom he had in mind, but since Antiochus Sidetes was the only descendant of Grypus who ruled for nine years, Downey assumed that Malalas referred to him and dated the earthquake to the 8th year of his reign *i.e.* 130 B.C.. However, irrespective of who ruled and for how long, the 8th year from the year of demise of Demetrius I Soter in 150 B.C., a date on which all chroniclers agree, falls in 141/142 B.C., in close agreement with the estimated date of Jonathan's campaign and events of 17th Adar in Megillat Taanith and the tidal wave at Ptolemais. The month and day dates, this of 21 Peritos in Malalas and that of 17th Adar in Megillat Taanit fall in the same season, very close to each other and whatever the intercalation practices were, would have differed by five weeks at outmost. For example, had the current system been followed in the 150-140 B.C. decade (which it definitely was not) the two dates would have coincided in 140 B.C. and would have differed only by 3 days in 146 B.C. Though reduced from 18 years to 6, the inconsistency between dates given by Malalas still casts a shadow over this attempt to tie the Antioch earthquake with the events at Chalkis-Zebedani, Ptolemais and Sidon.

4.3. *Summary*

The uneven quality of textual evidence and obtuse presentation may of course reflect the confusion of the compilers of Megillat Tanit scholion as to the true nature of the 17th Adar events and the possibility that their explanations are more inventive than informed, can not be ignored. Whatever the case however and whatever the time frame chosen, the overall tenor of Megillat Taanit makes it most unlikely that a day on which a severe earthquake hit the Holy Land would be observed as a joyous day on which fasting and mourning are prohibited. In fact one would expect just the opposite, *i.e.* a fast to memorize the shock and its woes. Thus the scholion should not be used to document any damaging earthquake intensities and tsunami damage in Israel, whether in *ca.* 90 B.C. or *ca.* 140 B.C. Festive commemoration, however, would make sense, if the earthquake affected a more distant region in Syria, without harming the dilapidated and oppressed Jewish communities there. Comparison of the literary and historic characteristics of the Oxford and Common versions with descriptions of earthquakes and possible tsunamis in chronicles and texts, tips the scales slightly in favor of King Jonathan's period. So far no evidence was found of impact of the *ca.* 90 B.C. Apamea Kibotos earthquake on the Egyptian-Israeli-Levant coastal cities, 750 km away. On the other hand, the reported tidal wave between Tyre and Ptolemais, 75 km from Chalcis sL-Zabadea, the earthquake and submergence at nearby Sidon and the earthquake at Antioch 250 km away all occurred during Jonathan's reign, about mid 2nd century B.C.

Though the time frame is the same and all affected localities lie along a narrow strip between the littoral and the seismically active northern segment of DSR, attributing all reports to one single earthquake and, more important, to one seismogenic element would run ahead of the available evidence. Nevertheless, it is noteworthy that the recent paleoseismic study of the nearby Serghaya fault, along the northern restraining bend of DSR revealed indication of only one event in the age range of 170 B.C.-20 A.D. (Gomez *et al.*, 2003).

5. 64 B.C.

This event presents a further example of earthquakes imported into the Israeli catalogues on flimsy evidence. In this case the damage to the Temple compound and city walls of Jerusalem, supposedly reported in the Talmud projected an image of intensities high enough to locate the epicenter in the Dead Sea area.

Ben-Menahem (1979, 1991) and Amiran *et al.* (1994) report serious earthquake damage in

Jerusalem in 64 B.C., on the authority of previous cataloguers (Arvanitakis, 1904; Willis, 1928; Sieberg, 1932; Amiran, 1950-1951 and Plassard and Kogoj, 1962), as well as of the Talmud. All these catalogues related the damage to a devastating earthquake of $M_L = 7.7$ in North Syria and Antioch (fig. 4). Since this earthquake was reviewed in detail by Guidoboni *et al.* (1994) and by Traina (1995) and was examined also by Ambraseys and White (1996, 1997), only a brief summary is presented here. Their analysis builds on the statement of Justinus, 2nd century A.D., (Epit. Phill. Hist. 40.2.1: Seel, 1985) that a devastating earthquake hit Syria towards the end of the rule of Tigranes the Great, causing widespread destruction and leaving 170 thousand dead. Apparent disagreement over the duration of Tigranes's reign in Syria led Traina (1995) and Guidoboni *et al.* (1994) to date the earthquake to 65 B.C. and Ambraseys and White (1996, 1997), to 69 B.C. Yardley and Heckel (1997) warned however that Justinus often misunderstood, confused and misdated events and characters in the original text of Pompeius Trogos. Damaged locations are not specified, but 5th century A.D. Orosius (Hist. 6.5.1: Deferrari, 1964) writing more than four centuries later, mentions an earthquake that took place while Mithridates was attending a festival of Ceres in the Bosphorus (presumably the Cimmerian Bosphorus at Sea of Azov and Crimea), but does not say whether the king experienced the earthquake or just heard about it (Guidoboni *et al.*, 1994). The southward extent of damage is equally uncertain. Though Malalas (Chronicle 8.30: Jeffreys *et al.*, 1986), reports that Pompey rebuilt the bouleuterion in Antioch, established by Antiochus Epiphanes, «that has fallen», this does not necessarily indicate that the whole city was destroyed, as later cata-

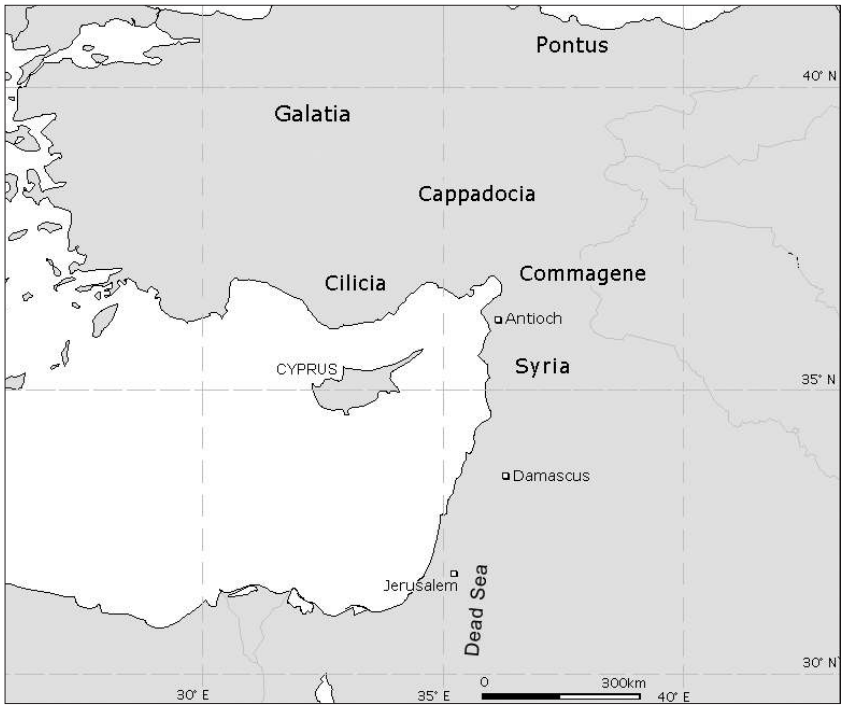

Fig. 4. Orientation map for the 64 B.C. earthquake.

loguers assumed. Thus the extensive damage to the city walls and the Temple compound in Jerusalem, 550 km to the south, allegedly reported in the Talmud, would be very significant, since it would indicate an earthquake of truly catastrophic proportions.

5.1. *Evidence from the Talmud*

Talmud (from «study», «teaching») is a vast body of texts accumulated over seven centuries, that deal with religious and legal norms to be followed by Jews. Though the laws that govern Jewish personal and community life were laid down in the Pentateuch (Tora), their practical application under ever changing realities required interpretation of the spirit of the written law. The new decrees were transmitted orally and the expanding legal code was known as the Oral Law (Oral Tora). In wake of political misfortunes, when religious and legal structures were disrupted, Rabbi Yehuda the Prince (2nd century B.C.) compiled the Mishna, a compendium of rules of conduct developed and transmitted by several generations of sages («tanaim»: the «repeaters»). Since Mishna is very concise and occasionally cryptic, it led to an interpretative corpus, Gemara, of elucidative commentaries, explanations and legal discussions by the later generations of sages (called Amoraim: «speakers»). One version developed in Palestine during the 3rd-early 5th centuries and the other developed in the Babylonian diaspora during the 3rd-6th centuries. While free of historiographic orientation and interests, this enormous body of texts, which spans 7 centuries of intense intellectual activity, includes numerous references to specific events. Usually, chronological details must be deduced from the context. Nevertheless, in absence of chronicles and histories, such material is very important, but its veracity and accuracy differ from one case to another and require a great deal of caution. The Jerusalem Talmud is often fragmentary and difficult to follow, but deals with some questions inapplicable to diaspora and is regarded by many to be more reliable for Palestine. The Babylonian Talmud is better edited (by «savoraim» – the «thinkers») and is more comprehensive and innovative, but some elements may have been glossed over by the editors.

Accounts of the supposed damage in Jerusalem emanate from the Babylonian Talmud, (tractates Sota, 59 B: Cohen, 1936; Menahoth 64 b: Cashdan, 1935; Baba Kama, 82 B: Kirzner, 1935) which tells of fight for power between the sons of Queen Salome Alexandra (d.67 B.C.), Hyrcanus and Aristobulus, the last kings of the Hasmonean dynasty. Hyrcanus and his Nabatean allies laid siege to Jerusalem, but at Passover time agreement was reached on supply of sacrificial animals to the Temple. A big basket with golden coins was lowered over the city walls, to be filled by the attackers and be hauled up. The attackers broke the agreement, took the gold but sent a pig instead and «when it reached halfway up the wall it stuck its claws into the wall and the Land of Israel was shocked over a distance of 400 parasangs by 400 parasangs» (a parasang, Persian mile is about 4000 yard long). Josephus (Antiquities, 14.2.2: Marcus, 1976) presents a more detailed account of the events but does not mention an earthquake nor a hog. Instead, the vehicle of divine punishment for preventing and mocking the Passover services is, «a strong and vehement storm of wind, that destroyed the fruits of the whole country, till a modius of wheat was then bought for eleven drachmae». Likewise, classical texts record the war between the last Hasmoneans (*e.g.,* Dio's Roman History 37.15.3-16.3: Cary, 1969), without mentioning the earthquake. Thus it is possible that the Talmudic text refers not to a real earthquake but to the general shock over the ungodly breech of agreement, which disrupted the services in the Temple and indeed this seems to be the approach in the Jerusalem Talmud. The earthquake motive appears to have been raised by Graetz (1888) who commented that the Talmudic text may contain an echo of the heavy earthquake that «according to Dio hit Asia about that time». This remark (which is glossed over in the later English and Hebrew editions of Graetz's memoir), was included in another context by Neubauer (1868) in his book on Geography of

the Talmud, from which it was extracted by Arvanitakis (1904) and included in his catalog. Since the Temple and the city walls were mentioned in the text, Arvanitakis assumed that they were damaged. Other cataloguers followed suit and in some cases increased the severity of the damage.

5.2. *Assessment in light of other sources*

The timeframe of the events described in the Talmud is indeed compatible with the record of the 64 B.C. earthquake in classical sources. The siege took place after the death of Queen Salome Alexandra in 67 B.C. and before the fall of Jerusalem to Pompey in 63 B.C., shortly after Mithridates's death. At the time of the conflict in Judaea, Pompey was engaged in war with Tigranes, which ended in late 66 B.C. and then, according to 1st century B.C. Livy (Summ. 101, 102: Schlesinger, 1967); and 2nd A.D. Appian (Mithr. Wars, 15,16: White, 1962), turned to Pontus. One of his commanders, Aemilius Scaurus, was sent to Damascus, from where he hurried on to Judea to take advantage of the civil war there. Offered comparable bribes by both sides, he ruled in favor of Aristobulus and the siege was lifted (Josephus, Antiquities, 14.2.3: Marcus, 1976; Wars, 1.6.3: Thackeray, 1976) The Talmudic report corresponds to Passover of 65/64 B.C. Both Passover and the festival of Ceres mentioned by Orosius are celebrated at the same time in the Spring.

Even if the fanciful Talmudic report is accepted, the image of extensive damage should not be. In fact, nothing was said about actual damage to city walls nor to the Temple, event that would have made a profound impression across the country. Instead, it is the cessation of services that is stressed. Josephus's fairly detailed account of the siege does not mention any disruption of the city defenses due to a sudden breech or collapse of the walls. Resistance continued unabated until the siege was lifted as a result of intervention by Aemilius Scaurus, who was swayed to the side of the defenders since «it was not the same thing to take a city that was exceeding strong and powerful, as it was to eject out of the country some fugitives, with a greater number of Nabateans» (Josephus, Antiq.14.2.3: Marcus, 1976). Robustness of Jerusalem fortifications at that time (*i.e.* after the damage was supposed to have taken place) was mentioned also by Strabo (Geography, 16.2.40: Jones, 1917) and Josephus (Antiquities, 14.4.1-3: Marcus, 1976) in their account of difficulties that faced Pompey when he laid siege to the city shortly thereafter. Thus, even if the 64 B.C. shock was felt in Jerusalem, it is unlikely that local intensity was much in excess of human perception.

Recently however, Ken-Tor *et al.* (2000) correlated 8 soft sediment deformation horizons («mixed layers») in the Holocene sediments of Nahal Zeelim in the Dead Sea region, with a succession of 8 earthquake events listed in the catalogues and concluded that the deformation was seismic in origin. The earliest such «mixed layer», with a calibrated radiometric age in the range of 200-40 B.C., was attributed to the 64 B.C. earthquake. Since this deformation unit was found in sediments differing in facies and at locations about 30 km apart, the authors assumed that such pervasive soft sediment deformation suggests that the epicenter was in the Dead Sea area and that the earthquake damaged the walls and the Temple in Jerusalem and that in Syria it was felt «as far as Antioch».

5.3. *Summary*

The implied damaging intensities assigned to the 64 B.C. event in Israel seem to be misleading and to rely on a fallacious hermeneutical chain, which proceeds as follows: a devastating earthquake in north Syria and Turkey is invoked in support of a questionable Talmudic story taking place in Jerusalem; inflated elements of the story enter a catalogue as evidence of earthquake damage in Jerusalem; the entry, repeatedly copied by the later cataloguers is correlated to a «mixed layer» of comparable time range in the Dead Sea area; and finally, the occurrence of «mixed layer» in sediments of different facies, 30 km apart confirms the seismic origin of the «mixed layer» and places the epicenter in the Dead Sea area.

6. 31 B.C.

On the authority of Josephus Flavius, the 1st century A.D. Jewish-Roman historian, all earthquake catalogues list a very strong earthquake that hit the Holy Land in 31 B.C. and assign a magnitude M_L ranging from 7 to 8 (*e.g.,* Ben-Menahem, 1979, 1991; Kuran, 1980). This earthquake attracted the attention of Judaic scholars and of archaeologists, who claimed to have found its manifestations in ancient literary texts as well as in features of damage at archaeological sites. Such findings, in turn, were used to document the extensive spread of damage and the high earthquake intensities. A closer look at the original report suggests however that the earthquake magnitude is overestimated and that at least some of the interdisciplinary correlations are incestuous.

6.1. *Earthquake evidence of Josephus*

Josephus Flavius reports: «At this time it was that the fight happened at Actium between Octavius Caesar and Anthony in the seventh year of the reign of Herod and then it was also that there was an earthquake in Judea such a one as had not happened at any other time and which earthquake brought a great destruction upon the cattle in that country. About ten thousand men also perished by the fall of houses, but the army which lodged in the field received no harm. When the Arabians were informed of this and when those that hated the Jews and pleased themselves with aggravating the reports, told them of it, they raised their spirits as if their enemy's country was quite overthrown and the men were utterly destroyed and thought there now remained nothing that could oppose them. Accordingly they took the Jewish ambassadors who came to them after all this happened to make peace with them and slew them and came with great alacrity against their army...» (Josephus, Antiquities 15,5.2: Marcus, 1976). A similar description is found in Josephus (Wars 1.19,3: Thackeray, 1976) but the number of casualties is 30 000.

Since Josephus does not mention any localities that were destroyed or damaged, it is obvious that the high magnitudes were assigned on the strength of the «catastrophic» language of description. The contents, however, are not entirely consistent. Josephus reports tenor thirty thousands of dead in the built areas and immense losses in «cattle» (rather «herds», Prof. Steve Mason, pers.comm.), stressing that the army that camped in the open was spared. At that time, however, also the herds were kept in the open or in primitive pens, so that the army may have escaped harm not because it was in the field but rather because it was far away from the earthquake epicentre. Similarly, the account of the Arab invasion from the east implies that the Arab forces were not hit by the earthquake and that they were too far from the disaster area to have had a first hand knowledge of the extent of damage in Judea (fig. 5). Josephus does not say where exactly the two armies were at the time of the earthquake, but their approximate disposition may be inferred from his description of military engagements immediately prior to the earthquake (Joseph., Antiquities 15.5.1: Marcus, 1976). These included Herod's victory at Dion and his subsequent defeat at Kanatha, after which the Jewish forces retreated into the mountains (Galilee or Samaria) from where they waged a highly successful guerilla warfare against the Arab armies. Consensus is that Kanatha and Dion lie east of the DSR: Kanatha is about 100 km east of Tiberias, but for Dion two alternate locations were offered: one less than halfway from Tiberias to Kanatha (*e.g.,* Schurer, 1973; TAVO, 1980) and the other in Jordan, about 25 km northeast of Pella (Ptolomey, in Schurer, 1979). Josephus's description suggests therefore a modest spread of damage, so that Judea in his account must have been the historic Kingdom of Judah, rather than the much larger Judea of the Hasmoneans and Romans, which according to Josephus (Wars 3:35-38, 13.3.4-5: Thackeray, 1976) and Pliny (Nat.Hist.5.70, 5.73: Rackham, 1958) included amongst others the Galilee, Samaria, Perea, Idumea and Golan. Geographic descriptions of Josephus however are not always consistent (for references *e.g.,* Schalit, 1968, Boettger, 1879, Shahar, 1996) and in this case he uses Judea both in the narrow and the wide sense. Extent of the damage to the south is uncertain since in barren

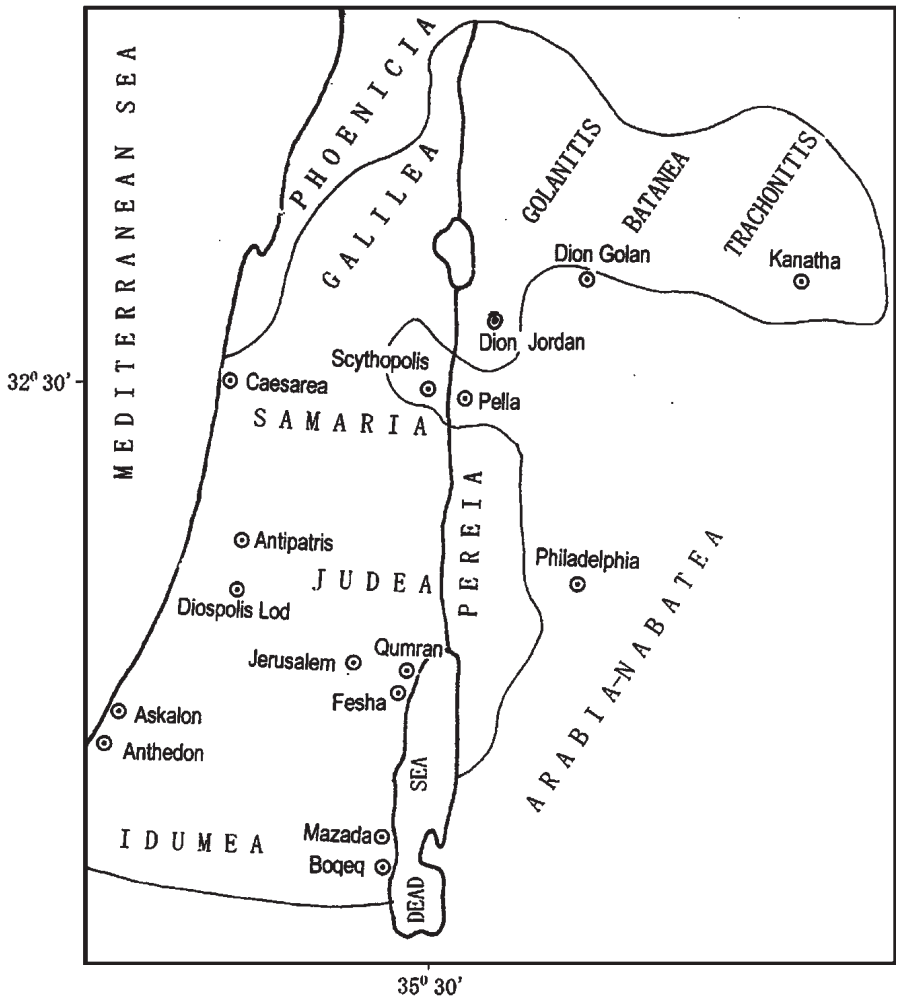

Fig. 5. Orientation map for the 31 B.C. earthquake.

areas of the Negev and Arava even a severe impact might have escaped notice. All that may be said is that Josephus and other chroniclers who record the triumphant advance of Augustus across Syria and Palestine to Egypt after the battle of Actium, do not mention any signs of a supposedly devastating earthquake that took place only about a year earlier. Moreover, the lavish reception and excessive supplies Herod provided to the Roman Army on their way to Egypt and back (Josephus, Wars, 1,20.3: Thackeray, 1976; Antiquities 15.6.7: Marcus, 1976) are out of line with the reported earthquake devastation of the country, even if Herod was desperate to win favor with Ceasar.

6.2. *Earthquake evidence from Malalas*

Of the Roman and Byzantine chroniclers, only John Malalas (Chronicle, 10.3: Jeffreys *et al.*, 1986) mentions earthquake damage in

Palestine during the second half of 1st century B.C.: «during the reign of Augustus city in Palestine, named Salamine suffered from the wrath of God Augustus rebuilt the city and called it Diospolis».

The entry is rather vague since Augustus reigned for more than half a century and the location of Salamine-Diospolis is not clear. In Palestine only two cities bore the name Diospolis: Dion, already mentioned before (either in Golan or in Jordan) renamed with other cities of Decapolis after the conquest of Pompey in 64/63 B.C. and Lod (Lydda) in the Coastal Plain, renamed in 199 A.D., by Septimius Severus (Schwartz, 1991). Admittedly, Malalas may have extracted the information from some post-200 A.D. source, that used the new name, but neither Diospolis-Dion nor Diospolis-Lod are known to have replaced a previous Salamin, or to have had any connection to Augustus. In the Levant, however, very many location names were derived from Salem or Salam, so that one finds for example on the outskirts of Diospolis-Lod a Deir Abu Salame, a hitherto unexplored site with remnants of Greek inscriptions (Peress, 1952 and Vilnay, 1974) and next to Diospolis-Dion in Jordan, an unexplored Roman military settlement, Shalem or Salem Salumnias, (*e.g.,* Tsafrir *et al.*,1994).

It seems that even if Malalas refers to the same event as Josephus did, the conclusion regarding the size of the earthquake would not change. Both Diospolis/Lod and Diospolis/Dion-Jordan are within the suggested reduced spread of damage. No ancient derivative of Salem was found for Dion/Golan. Of locations outside Palestine, it is improbable that Malalas lumped together Salamiyya (Salamias or Salaminias) on the Orontes in Syria, with either Dion-Golan about 250 km away, or with Diopolis north of Laodicea, 100 km away (Dussaud,1927). Also, since he knew of Salamin in Cyprus (Malalas, Chronicle, 12:48: Jeffreys *et al.*, 1986, reports that Salamin was destroyed by an earthquake in the days of Constantinus Chlorus) it is unlikely that he located it in Palestine while copying some early report of an earthquake that hit Cyprus. The only possible, albeit tenuous, suggestion that the spread of damage extended farther to the north, is implicit in another report of Malalas, which he did not relate to the Palestinian earthquake. Malalas (Chronicle 9.21: Jeffreys *et al.*, 1986) tells that during his visit to Antioch in about 15 B.C., Agrippa ordered the removal of collapse rubble, which accumulated in the old hippodrome in Antioch as a result of «former earthquake/s». Traina (1995) and Downey (1938) assume that these were post-64 B.C. earthquake repairs, the same as the rebuilding of the bouleuterion by Pompey. Agrippa's order implies therefore that either the work was not completed, or that the repaired hippodrome was damaged once again by a subsequent shock sometime between 64 and 15 B.C. In this time window Guidoboni *et al.* (1994) and Ambraseys and White (1996) list three earthquakes: in Palestine in 31 B.C., in Phrygia in 27 B.C. and on Cyprus in 17 B.C., but there are no grounds to relate any of these shocks to damage in Antioch.

6.3. *Evidence from other sources*

So far, the ongoing study of possible seismic echoes in contemporary Judaeo-Christian sources provided no clues to analysis of this earthquake's parameters. It appears that numerous scholars traced its echoes in some of the apocrypha and pseudoepigrapha composed in the first few centuries A.D. (*e.g.,* Stone, 1990 found them in 4 Ezra: Klijn, 1983, in Baruch 2: Mignana, 1917 and Charlesworth, 1983, in Book of Shem), however none are explicit and all lack distinct historic clues. The texts may refer to a shock or tumult, or may use the earthquake only as a metaphor. Thus for example, modern editors of the Talmudic tractate Megilla (3.1: Simon, 1938) saw an echo of the 31 B.C. event in the report: «The targum [translation] of the Prophets was composed by Jonathan ben Uzziel from the mouth of the prophets Haggai, Zacharia and Malachi and the land of Israel quaked over an area of 400 parasangs by 400 parasangs and a voice came forth and exclaimed who is this that has revealed my secrets to mankind». The timeframe is right, since Jonathan ben Uzziel lived in 1st-2nd century A.D. and so is the biblical allusion since Haggai (2.6-7; 2:21) and Zacharia (14:4-5) include

explicit and Malachi (1:3) veiled references to earthquakes. The text, however, may be referring not to an earthquake but to the shock and distress caused by disclosure of holy texts to non-Jews. Similarly far-fetched was Mignana's (1917) and Charlesworth's (1983) correlation of the prediction in Book of Shem (7:20) that «when the year starts in Libra [September 24-October 23] there will be in Galilee a severe earthquake» to the account of Josephus.

Such uncertainties are particularly striking in the case of the Dead Sea Scrolls (DSS), a rich corpus of more than 800 documents, found in the caves at the northwestern end of the Dead Sea and associated with the sectarian community that occupied Khirbet Qumran during 2nd century B.C.-1st century A.D. (*e.g.,* Garcia Martinez, 1994; Vermes, 1995; Wise *et al.*, 1996; Garcia Martinez and Tiglechaar, 1997). This collection of documents and the nearby archaeological site represent one of the most extensively studied and certainly the most hotly debated topics and produced a voluminous literature (for references: *e.g.,* Schiffman and VanderKam, 2000; Schiffman *et al.*, 2000; Flint and VanderKam, 1999; Wise *et al.,* 1996). About one fourth of the retrieved DSS materials includes texts specifically related to the community, one third includes biblical texts and the rest are non sectarian texts (for bibliography: *e.g.,* Dimant, 1995, 2000). None of these documents includes information on when the materials were composed or copied, by whom and where and only several include elements that are chronologically meaningful. The still ongoing analysis of texts identified 16 explicit references to earthquake disasters, 6 general literary allusions and further 5 which extol the importance of earthquake safe construction (*e.g.,* «... this is the tested rampart the precious cornerstone that will not allow foundations shake or tremble from their place» (Rule of Community VIII:7-8); or «For you place the foundation upon rock and the beams to correct size and a true plumb line to stretch out, tested stone for a strong building which will not shake...» (Hodayot, XIV:26, *cf.* Book of Psalms 104:5). None of these motives is unequivocally related to the 31 B.C. earthquake and they may reflect echoes of other earthquakes preserved in the collective memory at the time of writing. The better known biblical echoes of ancient seismic disasters in Israel and Levant, relevant here, include for example the destruction of Sedom-Gomorrah (21-17 century B.C.) and Jericho (15-12 century B.C.), the Apheq (century 854 B.C.) and Uzziahu (758 B.C.) earthquakes and the Lebanese coast tsunamis (590 B.C., 138 B.C.) and possibly also the supposed allegoric crucifixion earthquake (33 A.D.). The number of earthquake motives in the DSS is too small and dating of the texts is not precise enough to determine whether frequency of seismic metaphors in the texts increased after the 31 B.C. event. In fact the ratio of earthquake echoes to other natural phenomena used in linguistic imagery of that time (sea storms, floods, winds and thunders, fire), is fairly constant for texts similar in character. In poetic and apocalyptic texts, where the use of imagery is most frequent, earthquake echoes represent about 10-20% (this is also the ratio in the Book of Psalms). None of the texts shows a pervasive use of literary earthquake motives that might suggest that the writer went through the trauma of a seismic disaster.

Though contemporary textual echoes are scarce, numerous instances of seismic damage, abandonment and rebuilding related to the 31 B.C. earthquake were reported from archaeological sites in Israel. The implicit damaging intensities reinforce the devastating image of this event. The first and best known, was identification of earthquake destruction and related conflagration at Khirbet Qumran, the assumed center of the DSS community (for references de Vaux, 1973; Humbert and Chambon, 1994; Magness, 2002). Correlation of supposed signs of seismic damage (a N-S running «earthquake fault» across the entire site with a 35cm downthrow across one of the ritual baths, massive breakage of jars under the fallen ceiling of a pantry, damage to the main tower, collapse of rooms at the southeastern part of the site and signs of abandonment of the site) with Josephus's account, provided de Vaux with a critical chronological marker for the site. At the same time it provided the geologists (starting with Zeuner, 1955), with evidence for ongoing deformation along the DSR. Subsequently, all in-

dividual elements of this archaeoseismic evidence were shown to be ambiguous or unacceptable. Features described by de Vaux were attributed either to static geotechnical instability effects (*e.g.,* Zavislock and Gibb in Steckoll, 1967 and 1969; Karcz and Kafri, 1978); erroneous interpretation of elements of construction (Hirshfeld, 2003) and a later collapse of upper part of the building (Milik, 1959), or to destruction whether by Aristobulus II or Hyrcanus II (in 67-63 B.C.), Gabinius (in 57 B.C.), the Parthians (in 40/39 B.C.), or Antigonus (in 40-37 B.C.). The numismatic evidence for desertion of the site was rejected (*e.g.,* Leonard, 1997; Magness, 1995, 1998). Moreover a series of GPR traverses across the «earthquake fault», conducted by A. Beck and I. Karcz in August 1995, revealed no displacement in excess of survey resolution and the NS fault line marked by de Vaux is neither continuous nor disruptive. At this time however de Vaux's hypothesis is so firmly entrenched that geophysicists have assumed that it was Josephus himself who described the details of seismic damage at Qumran (Nur, 1991). Similarly, once the strike slip nature of motion along the DSR became known, archaeologists have changed the nature of displacement along the «earthquake fault» from vertical to horizontal (*e.g.,* Shanks, 1998a,b). In the footsteps of the «Qumran earthquake», several other locations across the country were thought to have been hit in the 31 B.C. event, amongst them Massada and Jericho along the Dead Sea, Agappias (probably Anthedon, between Gaza and Askalon), Askalon, Antipatris (Arethousa) and Stratton's Tower along the Mediterranean and recently also the city of Tiberias. It was also assumed that at least some of the intense building activities of Herod were spurred by the need for post earthquake repairs (*e.g.,* Roller, 1998). Archaeological evidence is tenuous at best, in fact Netzer (1991, 1997) in his detailed analysis of architectural complexes of Massada has shown that the signs of a possible seismic damage there are much later than 31 B.C., while Mazar *et al.* (1966), Gichon (1993) and Fischer *et al.* (2000) found no 31 B.C. seismic effects even at Ein Fesha and Ein Boqeq, next to Qumran. The claim that 31 B.C. earthquake was amongst those that according to historical sources caused severe damage to Tiberias (Marco and Agnon, 2004) would have implied that the city was destroyed fifty years before it was built by Herod Antipas in 18 A.D. named to honor Tiberius (who ruled between 14-37 A.D.).

6.4. *Summary*

It appears that the textual evidence reflects a relatively modest earthquake with magnitude in the range of 6-6.5, rather then a major catastrophe. The earthquake motives found in assorted texts and tentatively attributed to the 31 B.C. earthquake are non indicative and may represent literary metaphors, or echoes of any real events preserved in the collective memory at the time of writing. While there is no doubt that this area was repeatedly shaken by earthquakes, in itself the archaeological evidence found at Qumran is equivocal and the signs of alleged seismic damage may reflect static and geotechnical damage, or destruction and damage inflicted by man.

7. 749 A.D.

All local and regional earthquake catalogs list one or more earthquakes that in mid-8th century A.D. hit the Middle East and caused severe damage in Egypt, Palestine, Jordan, Syria and Iraq. Recently however, all multiple year dates given in ancient texts were attributed to inconsistent use of different calendars and eras in dating the same event of 18th January 749 A.D. (*e.g.,* Tsafrir and Foerster, 1989, 1992; Guidoboni *et al.*, 1994). This reduction of all felt reports to the same denominator implies destruction that extended from Egyptian littoral, to Iraq and Iran (fig. 6) with M_L estimates in the range of 7.3 to 8. This image was strengthened even further by reports of alleged signs of seismic destruction at a myriad of archaeological sites in Israel, Jordan and Syria. In Israel, reduction of all dates to a common denominator relied on chronological clues found in two ancient Hebrew texts which describe a fast that allegedly commemorates a large earthquake on 18th January 749 A.D., as well as on archaeological and

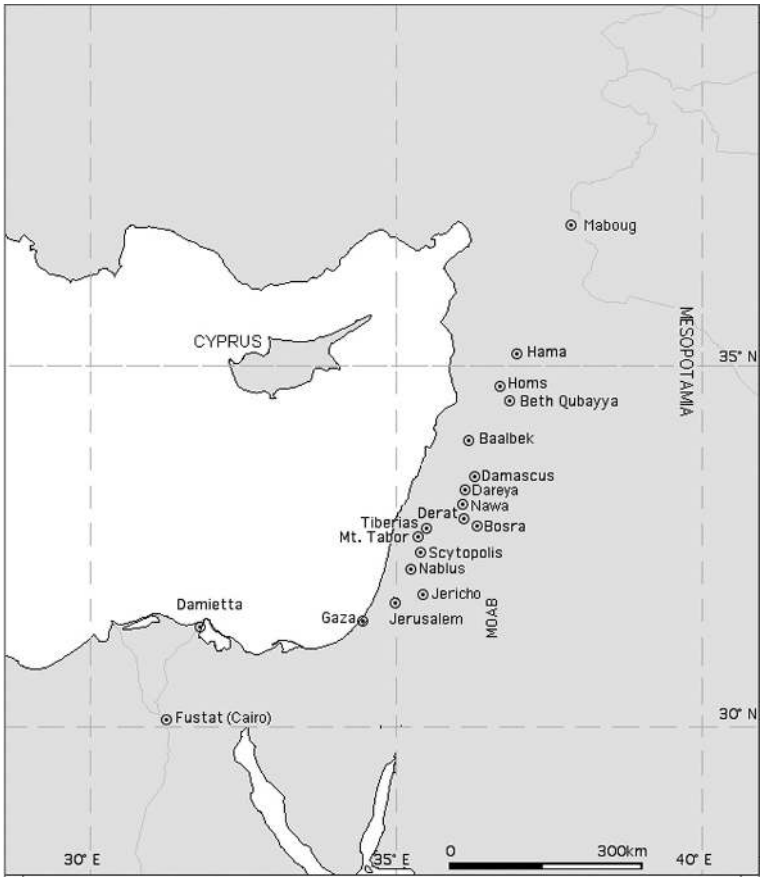

Fig. 6. Orientation map for the 747-749 A.D. earthquakes.

numismatic evidence. These findings were generally accepted and incorporated in regional earthquake catalogues. A closer examination shows however that such clues rely on highly questionable assumptions and, even more important, that the Byzantine and Arab chronicles and traditions clearly report at least two discrete events up to three years apart and hundreds of kilometers apart. Moreover, comparison of texts that describe only one earthquake, shows that the difference between the reported dates, locations and descriptions of damage is too striking to be attributed merely to erroneous date calibrations. Under such circumstances intensity maps with Mercalli Modified Scale values freely assigned to both textual and archaeological indications and attributed to one single event (*e.g.,* Marco *et al.*, 2003) would be misleading.

7.1. *Evidence of multiple earthquakes*

Theophanes, d.818, (Turtledove, 1982; Mango and Scott, 1997), one of the major source for events of that period, lists two earthquakes that hit Palestine and the Levant in mid-8th century A.D. The first entry, the day and month of which is cited by nearly all later authors and cata-

loguers, dates the earthquake to January 18th, A.M. 6238 (747 A.D., according to the indiction-based calibration of Ostrogorsky, 1928):

«... a great earthquake in Palestine, by the Jordan and in all of Syria on 18 January in the 4th hour. Numberless multitudes perished, churches and monasteries collapsed especially in the desert of the Holy City».

The second event occurred in AM 6241 (749/750), but the day and month are not given. The record was entered immediately after that of the birth of Leo, Emperor Constantinus's son, on 25 January 750 A.D.:

«... there was an earthquake and terrible destruction in Syria as a result of which some cities were entirely destroyed others partially so while others slided down entire, with their walls and houses, from positions on mountains to low laying plains a distance of 6 miles or thereabout. Eyewitnesses affirmed that the ground in Mesopotamia was split along two miles and that out of the chasm was thrown a different soil very white and sandy, in the midst of which they say there came up an animal like a mule quite spotless that spoke in a human voice...».

Though dimensions are scaled up, the implied landslides, surface rupture and sand boils sound authentic (in a semiarid area they would be more common during the wet season) and the fantasy part is restricted to the mule-like oracle. 9th century Nicephorus (Bekker, 1837; de Boor, 1880; Mango, 1990) presents an almost identical description of the 750 A.D. shock but not of the 747 shock. He used the same sources as Theophanes and though he was more selective (Whitby and Whitby, 1989), in this case the absence seems to reflect a lacuna or an illegible paragraph (as marked in the extant text). More tenuous evidence of two events comes from the Great Chronographer (*e.g.,* Whitby and Whitby, 1989) and the Minor Chronicles (Schreiner, 1979) which report the 18 January 747 earthquake and then a series of «wondrous events» after the birth of Leo in 750 A.D.

Strangely enough, even though both earthquakes are listed also in later chronicles, such as those of 9th century Anastasius Bibliothecarius (Migne, 1879), Paulus Diaconus (Muratori, 1861) and the 12th century Georgius Cedrenus (Bekker, 1839), as well as in the more recent compilations of Baronius (1593), de Muralt (1855), Perrey (1850) and Grumel (1958), the second earthquake of Theophanes is still ignored by many.

Further evidence of more than one earthquake comes from old and modern catalogs based on Moslem sources such as those of 15th century Jalal ad-Din as-Suyuti (Nejjar, 1973) and Poirier and Taher (1980), who mention two distinct earthquake events that in AH 130 (747/748) and AH 131 (748/749 A.D.) damaged Jerusalem and Damascus, while Caetani (1912) lists references to earthquakes in Muslim and Christian chronicles under the years AH 129, 130 and 131.

As-Suyuti cites the eye witness evidence of Abdalla al Katir, a well known historian and scientist (d. AH 196, 811/812 A.D.), transmitted by al Wadai (d. AH 716, 1316/1317 A.D.), who reports «we were hit in Damascus by an earthquake in AH 130 that led the inhabitants to leave the city. In this earthquake the poultry market collapsed under the fallen rocks» and continues «...and they told me that a devastating earthquake in AH131 split the roof of the mosque so that one could look through it at the skies. Thereafter another earthquake took place and the crack had closed». It is probable that these two successive earthquakes are responsible for the hesitant and possibly confused accounts of 13th century Sibt ibn al Jawzi, d.1257 (A. Elad, 1991, pers. comm.) followed by 15th century Ibn Tagri Birdi (Shaltut, 1929), which report strong earthquakes (plural) in Syria in AH 130, with heavy damage in Jerusalem, in the wake of which people of Damascus fled into desolate areas for 40 days and add «and it was said that the earthquakes took place in AH 131».

Obviously a discrepancy exists between the two pairs of dates, the 18 January 747 A.D. and early 750 A.D. of Theophanes and AH 130 (747/748 A.D.) and AH 131 of the Arab chronicles. Both sources were written within fifty years from the events. Arab texts were composed locally, while Theophanes, though far from infallible (*e.g.,* Proudfoot, 1974; Mango and Scott, 1997; Burgess, 1999) is believed to have drawn information about Palestine and south Syria from a local Melekite chronicle written about 780 A.D. and brought by monks

who fled persecution in Palestine (Brooks, 1906; Proudfoot, 1974; Mango and Scott, 1997). Information about Iraq and North Syria may have come to Theophanes from a local source that used the Babylonian count of Seleucid years starting in Spring 311 B.C. rather than in Fall 312 B.C., leading to the date of early 750 A.D., rather than early 749 A.D. No explanation was found so far for the gap of a year between the 747 A.D. of Theophanes and the 130 AH date of the Arab sources.

7.2. *Single-event reports*

Inclusion of an earthquake record in a chronicle, depends on whether the writer regarded it important enough relative to other events of that period and on the interest the shock-hit area held for him and for his prospective readers. It is difficult therefore to determine whether an event is not included in a chronicle because it was unknown to the author, or because it was dismissed as irrelevant. Some Byzantine and later Arab chroniclers such as 12th century Michael Glycas, 13th century Leo Grammaticus and the 10th century Said ibn Batriq (Eutychius), ignore the mid-8th century earthquake altogether. Others follow Theophanes, like the 9th century Gregorios Hamartolus (de Muralt, 1863), who repeats verbatim the 749/750 A.D. entry in Theophanes, with a comment on the «incredible» mule-like oracle and still others record the earthquake without any identifying details. 14th century Zonaras (Pinder, 1897) for example, says nothing about the time, location and extent of damage, but enters the event after the fall of Germanikeia into Constantinus's hands, (745/746 A.D. according to Theophanes) so that he may be referring to either of the two shocks. Even less definite are reports such as that of the 10th century Mukadassi (Le Strange, 1887) who writes that «earthquake in the days of the Abbasids threw down the sanctuary except the part round the mihrab», which may refer to the 750 A.D. event (*i.e.* after Marwan's death and ascent of Abbasides) but also to one of the later earthquakes, or the statement in «Commemoratorium de Casis Dei» (808: Tobler and Mollinier, 1880) that the Church of Maria Nea is still in ruins after having been damaged by an earthquake, but it is not clear which earthquake of the 8th century it was.

Once a text includes only one mid-8th century earthquake the critical questions are which one it is or whether the text almagamates two or more events into one report. Answer is not always possible, because of uncertainties in definition of the era used and because translators of chronicles expanded, calibrated and even «corrected» the details of time and location in the original text. Moreover in some oriental chronicles, the sequence in which events are described does not always reflect their true chronological order. Finally, all single-event reports give either the day and month, or the month, or the year of the earthquake but none gives the full date, which obstructs the analysis, particularly since also the later event of Theophanes may have taken place in or shortly after January.

The reports which do supply pertinent information about either the date, location or intensity of damage sustained in a single mid-8th century event are reviewed below.

7.2.1. Oriental Christian sources

The most extensive information about the spread of damage comes from oriental Christian sources, but it does not necessarily refer to one and the same event. The four major Syriac chronicles, i) Pseudo Dionysius of Tel Mahre (Chabot, 1895; Witakowski, 1987, 1996; Harrak, 1999), now attributed to anonymous 9th century monk from Zuqnin monastery, ii) 11th century Elias of Nisbin (Brooks, 1910; Chabot, 1910), iii) 12th century Michael the Syrian (Chabot, 1899) and iv) mid 13th century «*Chronicon 1234*» (Chabot, 1937) provide (or imply) only year dates for the earthquake. Despite some confusion between the Macedonian and Babylonian reckoning of Seleucid years, it seems that they all refer to the later of the two Theophanes's events. Elias of Nisbin, the only one with a specific interest in chronology, dates the shock to AH 131 (*i.e.* 748/749 A.D.), which he says, lasted from 30 Ab AS 1059 to 20 Ab 1060. The attached chronological tables show however that his AS years started in the spring,

in AS 1059 on 25 Jummada AH 130 (Spring 748) and in 1060 on 7 Ragab, AH 131 (Spring 749 A.D.). «*Chronicon 1234*» (mid 13th century A.D.) written about half a century after Michael but using the same sources, dates the earthquake to AS 1060 (with an erroneous parallel of AH 134, which may be a copying or printing error for AH 131). Michael provides no year date (unlike Russell, 1985, thought), but in a footnote appended to the translation, Chabot (1899) dates it to year 741 of Alexandrine Africanus era (*i.e.* AM 6241, AS 1060, 749/750 A.D.). In the accompanying tables, Chabot corrected Michael's chronology pulling the AS and A.D. dates one year back *i.e.* to AS 1059 = 748/749 A.D., but and it is not clear whether the correction should apply also to his own note. Both he and others (for references: *e.g.,* Weltecke, 2003) indicate that Michael's chronology is full of errors, whether of the author or of the copyists. Pseudo Dionysius, placed the earthquake in AS 1059, with equivalent date 747/748 A.D. (suggestive of Macedonian conversion). Indication, albeit tenuous, that this earthquake is not the one of 18 January, is that none of the chroniclers mentions the near coincidence of the earthquake with the Feast of Mary for the Seeds (blessing of crops), one of the principal feasts of the Virgin in Syrian tradition (observed on 15 January, which in 749 fell on Sunday, so that it would have been celebrated a day or two later).

Pseudo Dionysius provides no details of the damaged localities except for Maboug and refers archly to a «grand et violent tremblement de terre dans la region occidentale». Chabot (1894) pointed out however that amongst the Jacobite writers, the terms «western» and «eastern» territories reflected the two ecclesiastic provinces with centers in Antioch and Tagrit and had no strict geographic significance. The other three chronicles list numerous localities that suffered, mainly in areas to the east of DSR. In Palestine only Tiberias, Mt.Tabor and Jericho are mentioned, but significantly nothing is said about any damage or destruction in Jerusalem, in striking contrast to the Arab chronicles. This major difference, as well as lack of reference to the 18 January 747 event of Theophanes confirm the post 746 A.D. divergence between Michael and Theophanes (*e.g.,* Brooks, 1906; Proudfoot, 1974). Elias refers only to displacement of a village near Mt. Tabor (with no damage nor casualties) and to damage in the church of Maboug (a distance of about 500 km), whereas Michael and the «*Chronicle 1234*» record intense damage at localities from Maboug in northernmost Syria to Baalqa and Moab areas east of the Rift, listing Ghautah, Dareiya, Bosra, Nawa, Derat, Baalbek, Damascus and Beit Qoubaye, which may be a corrupted form of Koubaiyat or Qoubaiat at the foot of Jebel Akkar about 45 km southwest of Homs (ancient Edessa) and 25 km south of Crac de Chevalliers. On the other hand, their account of damage, subsidence and inundation along seashores does not mention any of the Mediterranean coastal cities and town by name and refers instead to stormy seas and submersion of a Yemenite coastal fortress in the area of Baalqa and Moab, which lie east of DSR (along rhomb shaped depressions of Lake Kineret, Dead Sea and Gulf of Aqaba) and to destruction of Tiberias and lateral displacement of springs near Jericho along the western side. It is not impossible that a local tsunami-like storm wave was generated in the Dead Sea whether due to a nearby fault, massive local slide, or by a temporary halt of flow along the Jordan River and a subsequent dam-break wave at the inflow into the Dead Sea. A similar association of earthquake-induced flooding or inundation along the coast and an «enormous death toll and destruction in Tiberias» is made by 10th century A.D. Agapius of Menbidj (Vasiliev, 1912). Here however, the earthquake was placed in January (Kanoun), without a year date, but after the record of Constantinus's incursion into Syria (*i.e.* the conquest of Germanikeia) and prior to Abu Muslim's revolt (Ramadan AH 129, May 747). This would suggest that he refers to the earlier of Theophanes's two earthquakes and this is supported by the lack of any reference to damage in Menbidj.

Severus ibn al Muqaffa (Evetts, 1947) refers to damage along the Mediterranean coast, saying first that the shock was felt strongly in Egypt, but caused no damage nor casualties, except for Damietta and then proceeds to report the destruction of six hundred

towns and villages, «from city of Gaza to the farthest extremity of Persia». Again no location names are given, with a comment that no orthodox churches nor monasteries were damaged. In addition Severus mentions that many ships were lost at sea. The earthquake took place on 21 Tuba (17 January) on the day of our Lady, Dormition day, which in Coptic tradition was celebrated between 16 and 18 January, unlike in the Byzantine empire where since 6th century it was celebrated on 15 August (*e.g.,* Garritte, 1958; Gamber, 1984). Year of the earthquake is not given, but closely related events (imprisonment and release of Patriarch Michael, Nubian incursion into Egypt etc.) are dated by Severus to AH 130 (747/748 A.D.). His description of events prior and after the earthquake, however, is confused particularly with respect to Marwan campaigns and the Abasside mutiny, which contrary to what Russell (1985) assumed admit the earlier date of AH 129 (746/747 A.D.). The 13th century compilers al Makin (Erpenius, 1625) and Petrus Ibn Rahib (Cheiko, 1903) report a widespread destruction of cities and loss of life under the ruins and flooding along the coast, but do not mention any specific localities. The day and month date of 21 Tuba follows Severus, but the year appears to have been misrepresented. The text suggests that rather than the year of the earthquake, AH 120, 460th year of Diocletianus (two incompatible dates of 737/738 A.D. and 744/745 A.D.) refers not to the earthquake but to the year of ascent of Patriarch Abnachajil (Kail, Michael), in course of whose 23 year long tenure the earthquake took place. While the Diocletianus year agrees with the official chronology of Patriarchs of Alexandria, the Hejira dates of al Makin and Erpenius do not. Indeed Michael's ascent is given as AH 120 (737/738 A.D.) rather than the now known date of 743 CE and the ascent of the preceding Patriarchs Cosmas and Theodoros is respectively AH 108 (726/727 A.D.) instead of 729 A.D. and AH 109 (727/728 A.D.) instead of 730. In view of al Makin's Coptic background this may seem strange, but similar apparent inconsistencies appear also in Ibn Rahib chronicle, who tabulates the succession of patriarchs using the Alexandrine-Africanus era. The dates of ascent and duration of service, differ from both al Makin and from the official chronology of the patriarchs and chronological calibration of the dates is inconsistent.

Finally the Mekhitar d'Airavanq chronicle (Brosset, 1869) mentions an earthquake in 751 A.D., in times of Constantine Copronymus. This later date is supported also by lack of reference to the day and month date of 18 January, which is the day on which the Armenians in the Holy Land celebrate Christmas (12 days later than elsewhere).

7.2.2. Arab sources

Near contemporary local Arab reports of an AH 130 earthquake (or possibly two), traced back to 8th century, appear in two 11th century compilations of traditions transmitted by the diarists of the prominent Jerusalem family Abd el Rahman, the 11th century cousins al Wasiti and Ibn al Murajja (Hasson, 1979; Elad, 1995). The eastern and western parts of Al Aqsa compound in Jerusalem were damaged and repairs were ordered by the Caliph Abu Jafar al Mansur (754-775) during his visit in AH 141 (757/758). Once completed, however, the mosque was hit by another earthquake (presumably in 757 A.D.) to be repaired only in the days of Caliph al Mahdi (probably following his visit in AH 163). One of the traditions in Ibn al Murajja transmitted by Thabit ibn Istanibiyadh reports that the «first» earthquake occurred on a cold and rainy night of Ramadan AH 130 (*i.e.* in May) and includes a vivid description of a crack that opens and on a command from Heaven closes instantaneously. This wondrous motive appears also in description of some other earthquakes in the Moslem literature and it is just possible that the holy month of Ramadan is invoked to lend reliability to the story (Elad, 1995 and pers. comm.). Yet another tradition that emerged from Jerusalem and was carried over to the later day chronicles, reports damage across whole Syria (Bilad al Sham) but emphasizes the destruction in Jerusalem and injuries to the descendants of Shadad al Aws, one of the Prophet's companions.

7.2.3. Samaritan sources

Damage in Jerusalem is not mentioned in two local sources that emanate from the Samaritan community near Nablus (Schechem) only 50 km away. Samaritans, now a tiny remnant of once large and powerful community with strong Jewish affinities, trace their origin to one or more of the twelve Tribes of Israel (Manasse) and see themselves as torchbearers of the original values, who kept to the written law (the Torah) through millennia of uninterrupted habitation in the Holy Land (for references: *e.g.,* Crown, 1989, 2001). The Jews, however, believe that Samaritans descend from people brought into the Holy Land in 8th century B.C. by the Assyrian conquerors, to replace the Jews who were expelled to Assyria. While subsequently the newcomers accepted the principal tenets of Judaism, they were accused of having kept idolatrous practices (*e.g.,* 2 Kings 17:33) and were not accepted into the fold. Samaritans strictly observe the Written Law, the Samaritan Toras and holy books are in the ancient Hebrew script and tradition of Passover sacrifice has continued. They reject, however, the later parts of the Scriptures and the later holy days and festivals, regard Moses as the only Prophet and Messaiah to come and reject the sanctity of Jerusalem in favor of Mt. Gerizim near Nablus. It is possible, therefore, that the lack or reference to mid-8th century damage in Jerusalem reflects lack of interest and disdain. Over the years the rift between Samaritans and the Jews ranged from uneasy coexistence to bitter rivalry, hatred and armed conflicts. Since Samaritan historical materials are scarce, much of the information about such disputes, wars and fates under the rule of various masters of the Holy Land comes from extrinsic, evidently biased sources. Even more serious is the problem of provenance and authenticity of the available Samaritan texts, since in some cases allegations were made that the supposedly faithful copies of ancient manuscripts were fabricated or expanded by copyists to sell to travellers and scholars.

Chronicle Adler (Adler and Seligsohn, 1902), thought to represent a relatively recent compilation, reports: *«a l'epoque de Merwan un grand tremblement de terre et lieu, jamais il ny eu eut d'aussi terrible.»* Somewhat more informative is the 14th century chronicle of Abu l'Fath, which exists in many manuscript versions and «was plagiarized, summarized, abstracted, paraphrased and edited for several other chronicles which were then presented as different old chronicles» (Stenhouse, 1989). The chronicle has a shorter original version which brings the text up to the rise of Mohammed and an expanded version to bring it more up to date. Abu l'Fath wrote the chronicle in 1355, following a discussion he had with the High Priest in 1352 lamenting the virtual absence of materials on history of the Samaritans (Payne-Smith, 1863; Vilmar, 1865; Stenhouse, 1981). He used some extinct (or not found) Samaritan sources and is thought to have used extensively materials then available in Damascus and Gaza. Thus it is not clear whether the following description of an earthquake is based on primary notes: «In the days of Marwan an extraordinarily powerful earthquake struck everywhere. Houses collapsed on their inhabitants and untold numbers of people perished. It was a terrible earthquake that had no precedent. Those who survived it stayed out in the open for many days while the earth was still shaking underneath them» (Dr. Paul L. Stenhouse, pers. comm.: from MS Samaritain, Bibliothèque Nationale de France, Paris). The year of the earthquake is in question. Before recording the earthquake the chronicler says: «Marwan bin Muhammad the last of Ummayads who ruled five years and two months. From the beginning of Islam to this time was 131 years and three months». Marwan ruled between 744-750 A.D., so it is possible that the 131 AH and 3 months date refers to the earthquake of 748/749 A.D.. However, after the earthquake entry, the chronicle records the Ummayad-Abbaside conflict and the rise of Abu Muslim, which occurred earlier (Ramadan 747 A.D.).

7.2.4. Judaic texts

One of the two Jewish documents used in description and dating of the mid-8th century earthquake is a liturgic poem (*piyyut*) called «Seventh earthquake». Liturgic poetry was used in synagogues to expand, enliven and re-

place some of the fixed prayers and break the monotony of the services, not only on holidays, but also on Sabbaths, days of fast and on special occasions. The use of this literary form was widespread in Palestine since the days of the Talmud and the structure and style did not change much over the ages, so that the date of composition can not be deduced from literary form or language alone.

The other text used comes from a 10th-11th century book of prayers and accompanying occasional texts, that was found in the famed Cairo depository (Genizza).

This poem (Zolai, 1937; Margalioth, 1941) laments an earthquake that caused a widespread destruction and extensive casualties in Tiberias («rage in fear and dark chaos will capital Tiberias») and a catastrophic flooding in the plain of Sharon («in wrath and anger sunk crowds in plains in Sharon Valley»). In modern times Sharon refers exclusively to the central Coastal Plain of Israel, but in the 4th century it was used by Eusebius also for a part of Jordan and Yizrael Valleys between Mt.Tabor and Tiberias (Weitz, 1939; Brawer, 1940). The poet adds: «I heard how disaster befell the city and the old and young in it have perished», where it is just barely possible that «the city» refers to Jerusalem rather than to Tiberias. The language includes elements of Habakkuk, ch.3.12, (earthquake significance is lost in King James Version which gives «...Though didst march through the land in indignation..» rather than the literal «...in wrath shall march the land...» where «wrath» may stand for «earthquake» similar to the Byzantine chronicles). The poem repeatedly refers to a fast in memory of this earthquake, observed on the 23rd of Shvat. Zolai (1937) was unable to decide if the title of the poem refers to a seventh shock in course of the same earthquake swarm, or to a seventh earthquake in a series of events preserved in some extinct tradition. In his opinion, however, the form and style dated the poem to 10th-12th century, a period during which Tiberias was damaged only in 1033/1034 A.D. and in 1202 A.D. Since in end 11th century the Jewish community in Tiberias was too small for its misfortunes to trigger a nationwide day of fasting, he concluded that the fast of 23rd of Shevat commemorated the earthquake that in 1033/1034 hit Tiberias, Jerusalem, Ramle and other towns and villages. This date was rejected by Margalioth (1941), who argued that the fast of 23rd Shvat was mentioned already by Pinneas the Poet, who in a 10th century text was mentioned amongst «ancient» authors and that the poem includes a veiled reference to Moslem rulers. He assumed therefore that the earthquake should be backdated and placed between the Arab conquest (about mid-7th century) and the beginning of 9th century, a period he regarded as consistent with the literary form and style of the poem. Having found no evidence that successive earthquakes that hit the Holy Land were counted in numerical order, he read the title of the poem as «*Earthquake of the Seventh* (feminine)» rather than «*Seventh* (masculine) *Earthquake*». The *«Seventh»* (feminine) stands for a sabbatical (fallow) year and Margalioth indicated that in the above time range only the earthquakes of 712/713 A.D. and 747/748 A.D. occurred in a sabbatical year. Having found no details about the former he dismissed it as unimportant and dated the earthquake to 23rd Shvat (28 January), 748 A.D. in agreement with two late Arab chronicles of Mukaddasi (d.14th century) and Ibn Tagri Birdi (d.15th century) who transmit news of an earthquake in AH 130 (747/748 A.D.). Twenty years later, Margalioth (1960) found a reference to the 23rd Shvat fast in a 10th-11th century book of prayers found in the Cairo Genizza depository: «On 23 Shevat a fast to the Land of Israel, since the land trembled and many cities fell and sages and pious and the just and the [etc.]... died under the ruins. And it is referred to in texts 'in wrath the earth will pace ahead' and since destruction of Jerusalem to the date it happened in Land of Israel the count of in wrath [in wrath = *b z a' m*]».

Margalioth (1960) recognized that [«*b z a' m*»] is a gematric expression in which letters of alphabet were substituted for numbers. This form of codification is quite common in old Jewish texts and varies in complexity (for references: *e.g.,* Levias, 1903; Scholem, 1971; Lipiner, 1989). The simplest code proceeds in alphabetical order with the first nine letters equivalent to 1-9, the next nine to 10-90, the next four to 100-400 and the end letters (five letters in the Hebrew alphabet: *chav*,

mem, *nun*, *peh*, *tsadik*, assume different form when at end of a word) to 500-900. There are, however, more than 70 gematric conversion codes, some relatively simple and some based on complex permutations or multiple-tier systems. The ancient and modern numerologists applied such diverse techniques to discover hidden meanings of words and expressions, for example by treating the numerical value of a word as a clue to another word with the same numerical value. Occasionally the code is selected so that the number, word or expression would lead to a specific biblical verse or moral. Consequently, gematric hints must be treated with caution, since it is not always clear what code the writer used. Margalioth used one of the most common codes ($b = 2$, $z = 7$, $a' = 70$, end $m = 600$) to arrive at the 679th year since the destruction of the Temple (70 A.D.) and obtained a final earthquake date of 23rd Shvat, 17 January 749 A.D., one year later than his former interpretation. In support of this ameliorated date Margalioth cited Theophanes' (d.818) account of an earthquake in Palestine on 18 January 747 and Michael the Syrian's (d.1199) account of an earthquake in Syria and Palestine in 749 A.D.; combining the day and month of the former with the year of the latter. Unfortunately, neither the 748 nor the 749 A.D. date is fully consistent with Margalioths own arguments. On one hand, he showed that in 749 A.D. the Jewish and Julian day and month dates of 23rd Shvat and 18 January nearly coincided, whereas in 748 A.D. they were 10 days apart, but on the other hand 748/749 A.D. was not a sabbatical year, whereas 747/748 A.D. was. Margalioth opted for the 749 A.D. year date, assuming that the 8th century count of sabbatical years followed an obscure system that lagged a year behind that used currently (Wacholder, 1973). Tsafrir and Foerster (1992) took the same stand, reinforced by their find of a mint condition 748 A.D. coin underneath seismic collapse rubble in the excavations of Beth Shaan. A somewhat similar situation was reported by Tsafiris (1989) from Cappernaum, where the last in a hoard of coins found under collapse rubble was minted in 744 A.D.. Cushioned by the great authority of Margalioth, one of the leading Judaic scholars of his time, the 18 January 749 A.D. earthquake took roots in the local historical, literary and archaeological literature and is occasionally referred to as the «Great Earthquake». Particularly numerous are reports of damage and destruction it caused across Byzantine-Ummayad complexes in Israel, Jordan and Syria and of the far reaching implications it had. Thus for example, archaeologists (*e.g.,* Ben Dov, 1985, 2002; Wightman, 1993) report extensive damage in Jerusalem, particularly southwest of the Temple Mount, dated by them to 747 A.D.. They claim that the damage, particularly that to a central Ummayad administrative building, still under construction at the time of the earthquake, was responsible for Marwan's decision to abandon his plans to move the center of power from Damascus to Jerusalem. This suggestion, while plausible, ignores the fact that the Arab chronicles reporting the AH 130 and 131 earthquakes record similar damage and destruction in Syria and Damascus itself. Furthermore, it is not altogether clear, what was the structural effect of the punitive removal of fortifications of Jerusalem, Damascus and Baalbek ordered by Marwan in about 744/745 in retaliation for their sympathies with his opponents (Wellhausen, 1973) and whether the city walls were dismantled or demolished with a resulting weakening of the adjacent buildings.

The ingenious proposal of Margalioth relied on some questionable assumptions and was not entirely consistent in chronological analysis as well as in perception of the texts (Karcz and Elad, 1992; Berberian, 2001). Since the Creation, Destruction and possibly also the Sabbatical year counting customs varied at that time, identification of a year date in a Jewish text is fully meaningful only if the years are given in all three reference systems and are consistent. Similarly, the present conversion tables that Margalioth used are not applicable in detailed calibration of pre-10th century month and day dates, when calendar and intercalation practices were not fully fixed. Thus the choice of a year date using coincidence of the Julian and Jewish month and day, which was behind the decisions of Margalioth to move the day and month of Theophanes's 18 January 747 earthquake from 747 to 749 A.D. and to move the sabbatical count so that the fallow year falls in 749 rather than in 748, may be misleading. Berberian (2001) raised further weighty objections to Margalioth's methodology. First, he drew attention to a piyyut, which counts in nu-

merical order 10 earthquakes reflecting largely allegoric seismic echoes in the Bible and denied that the «seventh» refers to a fallow year and even more important, that the «Seventh earthquake» may refer to an allegoric rather than a historical event. Second, since the gematric interpretation of the Hebrew expression «*b z a' m*» follows a method, which is not unique but one of many, the figure of 679 years after destruction is equivocal and would change according to the chosen conversion code. Finally, Berberian pointed out that the form and style of the poem can not indicate its age even with a resolution of several centuries (indeed the intuitive dating of Zolai and Margalioth spans almost six centuries) and suggested that the poem may have been composed much earlier than mid-7th century.

7.3. *Summary*

It appears that Margalioth's assumptions are questionable and do not provide a solid enough basis for harmonization. Part of the problem was that he was unaware of most of the mid-8th century earthquake records in Byzantine, Eastern Christian and Moslem chronicles and texts, which indicate that difficulty in harmonizing the day, month and year dates stems from there have been more one event. In fact, the unresolved question is whether there were only two such earthquakes or more. Whatever the case, it is apparent that the image of widespread damaging intensities produced by a single high magnitude earthquake is misleading. It is probable that the intense damage in northern Israel and Jordan (possibly also in Jerusalem and Damascus) includes the collapse of structures weakened in the previous earthquake with epicenter more to the south.

8. Conclusions

A two stage, circuitous interdisciplinary mechanism leads to overestimates of historical earthquake intensities in the catalogues of earthquakes in the Holy Land. The first stage starts with a tentative identification, usually by Judaic scholars or by archaeologists, of supposed seismic evidence either in literary or homiletic texts, or at archaeological sites. Usually such evidence is equivocal and admits explanation and interpretation that are unrelated to any seismic effects. The supposed literary earthquake motives may represent linguistic allusions or metaphors that reflect biblical events and quasi-historical traditions preserved in the collective memory at the time the text was written. Equally the word or a phrase with supposed seismic connotations, may in fact refer to tumult, fear, or horror. Usually, the prevailing argument for seismic significance rests on a correlation to an earthquake indicated in one of the earthquake catalogs within a time-window tentatively defined for the text. Such correlations, though obviously biased, first by the quality of the catalogue used and then by the vested interest of the scholar in obtaining a *terminus post quem* date for the text, often involved earthquakes that were documented only more than five hundred kilometers away. In a similar fashion, early archaeologists in the Holy Land justified the assigning of seismic origin to features of «total disaster», structural damage and repairs, architectural asymmetries and site decay and desertion. Since the same features may result from indifferent design and workmanship, static decay of buildings or willful destruction by man (*e.g.,* Karcz and Kafri, 1978, 1981; Rapp, 1986; Stiros and Jones, 1996), it is the correlation to historic records that tips the scale in favour of seismic interpretation. Also in this case, in addition to a sense of drama, seismic interpretation provides a chronological marker that aids in dating the site and relating it to a discrete historical event. Once such correlations, textual or archaeological are published, they are accepted by earth scientists as independent evidence of the time, extent and even earthquake intensity and all simplifying assumptions on which correlation rests are ignored. In the next stage of the process, the supposedly reliable earthquake impact undergoes self enhancement by adhesion of further textual seismic echoes or further archaeoseismic interpretations.

It should be clear that this is not to say that the local textual, archaeological or palaeoseismic evidence, is of no value, in fact just the reverse is

true. To realize its full potential, however, analysis of such evidence must be accompanied by a detailed budget of assumptions and uncertainties inherent in each and every interpretation.

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