TRIGGERING OF SUBDUCTION IN THE HELLENIC ARC BY WESTWARD MOTION OF ANATOLIA

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ABSTRACT

Historical and instrumental seismological data show that large earthquakes (M≥6.8) in the western part of the Northern Anatolia Fault Zone (Marmara Sea area) are followed within a time period of 3-5 years by large shallow and intermediate depth (h≤100km) earthquakes in the Hellenic Trench-Arc System, whereas the inverse pattern (events in Hellenic Trench-Arc followed by Marmara Sea events) has an almost double interevent (delay) period. Appropriate statistical tests using random catalogues verify the robustness of the observation. This result along with previous observations that large Marmara earthquakes are followed within a period of 3 years by strong earthquakes (M≥6.0) along the Northern Aegean-Ionian Islands seismic zone suggest a seismotectonic process where the westward motion of the Anatolian microplate initially triggers ruptures on dextral and normal faults along the northern boundary of the Aegean microplate. These ruptures facilitate the southwestward motion of the Aegean microplate and its overthrusting on the Mediterranean lithosphere, as well as the subduction of the oceanic Mediterranean lithosphere under the Hellenic arc. Hence, this kinematic model, in addition to its theoretical significance, can also contribute to the intermediate term earthquake prediction. The large Izmit earthquake (17.8.1999, M=7.5), in the western part of the North Anatolian Fault (NAF), has already been followed by the Skyros strong earthquake (26.7.2001, M=6.3) along the Northern Boundary of the Aegean microplate. Therefore it can be expected that this process may lead to the triggering of large earthquakes in the Hellenic Trench-Arc System during the next few years, as also supported by independent evidence.
Key words: Triggering, Hellenic Arc, Anatolia, Intermediate-term prediction

INTRODUCTION

The broader Aegean area (34^{o}N-41^{o}N, 19^{o}E-30^{o}E) is tectonically the most active part of the whole western Eurasia (Papazachos and Comninakis, 1971; McKenzie 1978; Lepichon and Angelier 1979). The intense crustal deformation in this area cannot be explained only by the northward motion of the African plate (with respect to Europe) because the rate of this motion is relatively low (~10mm/yr) (Dewey et al., 1973; Minster and Jordan 1978; McClusky et al., 2000). The active tectonic setting in the Aegean area is mainly attributed to the fast southwestward motion (30-35mm/yr with respect to Europe) of the Aegean microplate and to the westward motion (20-25mm/yr with respect to Europe) of the Anatolian plate (McKenzie 1970, 1972, 1978; Oral et al., 1995; Reilinger et al., 1997; Papazachos, 1999, 2002).

Seismic activity in the Aegean area is mainly concentrated along the three tectonic boundaries of the area, which are related to the fast southwestward motion of the Aegean plate (fig.1): a) the Northern Aegean plate Boundary, NAB, (Marmaras Sea – northern Aegean trough – central Greece – Ionian islands), dominated by strike-slip dextral ruptures of shallow earthquakes, b) the Eastern Aegean plate Boundary, EAB, a broad area with an extensional field and east-west trending normal faults where shallow earthquakes occur and, c) the Southern Aegean Plate Boundary, SAB, formed by the Hellenic Trench – Sedimentary Arc System where shallow earthquakes (h≤40km), as well as intermediate depth earthquakes (40km<h≤100km) are found. Correlations between the strong earthquakes along these boundaries have been observed during the last three decades (Galanopoulos, 1971; Papazachos and Papadimitriou, 1984; Papadopoulos, 1988; Brodsky et al., 2000). Recently, it was also observed that the westward motion of Anatolia results in strong earthquake seismic activity in the North and East Aegean Plate boundaries (Papazachos et al., 2000).

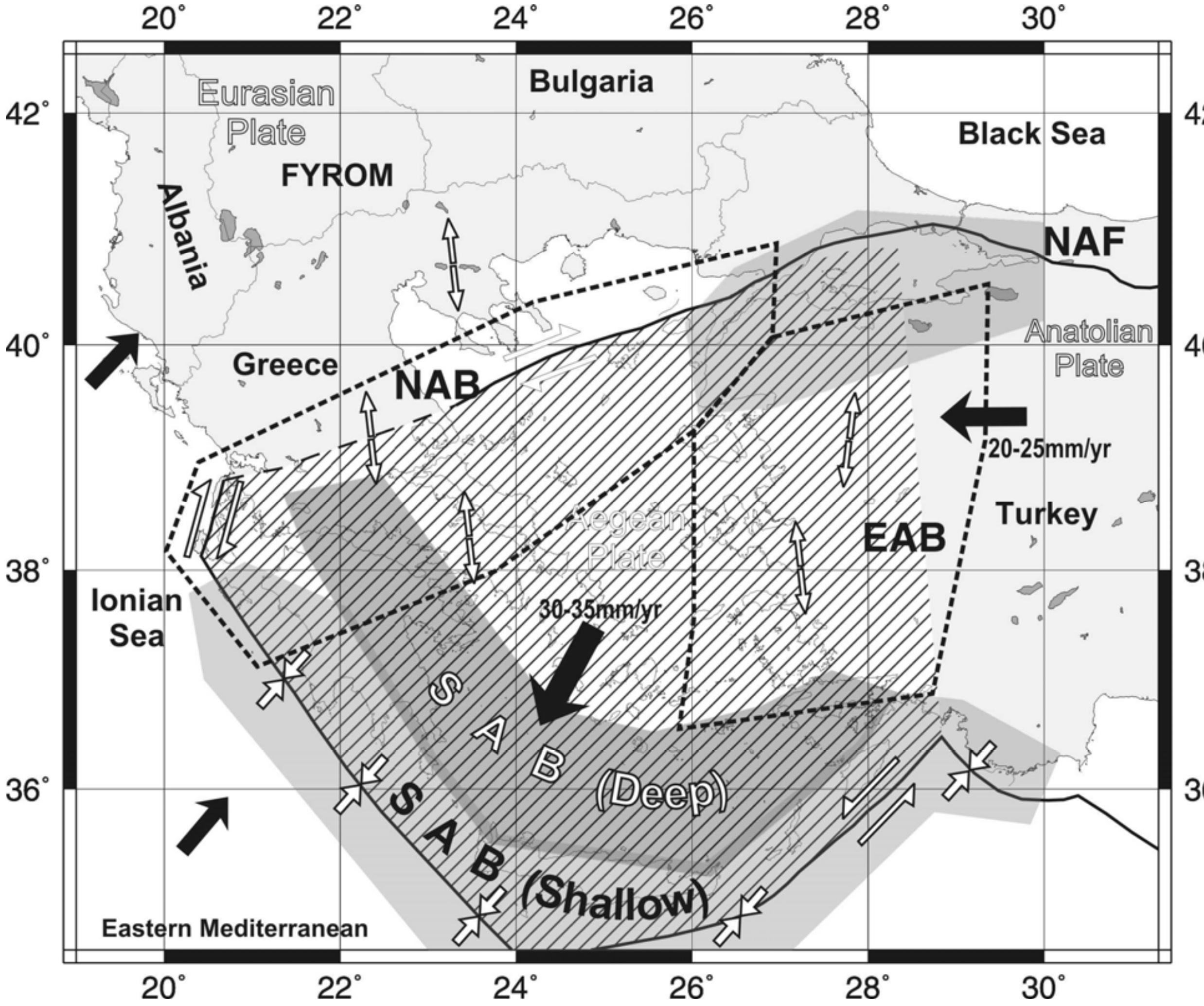

Figure 1. *Main tectonic features in the broader Aegean area. The hatched area denotes the approximate limits of the Aegean microplate, where the three boundaries (North Aegean Boundary-NAB, East Aegean Boundary-EAB and the Southern Aegean Boundary-SAB) are shown. Solid vectors denote the major plate motions and open vectors show the local stress field and fault slip. The Marmara Sea area (western part of the North Anatolia Fault-NAF zone) is also shown.*

In the present work we examine a possible interaction between the westward motion of Anatolia, as this motion is expressed by the generation of large shallow mainshocks (M≥6.8) in the westernmost part of the North Anatolia Fault Zone (Marmara sea), and the lithospheric convergence and subduction in the Hellenic Trench–Arc system, as this convergence and subduction are expressed by the generation of large shallow and intermediate depth mainshocks. The knowledge of such interaction is of tectonic interest because these lithospheric movements (westward motion of Anatolia, convergence and subduction in the Hellenic Trench-Arc system) are responsible for the generation of the present-day stress and deformation pattern observed in the Aegean lithosphere. Moreover, it is also of practical interest since it can be useful for earthquake prediction and hazard assessment purposes.

THE DATA

The data used in the present paper concern the basic parameters (epicenter coordinates, focal depth, origin time, magnitude, maximum macroseismic intensity) of large (M≥6.8) mainshocks which occurred in the two tectonic regions. The first region (R=1) is the Marmara sea area (39.5°N–41.0°N, 26°E-30°E) where only shallow (typically h≤20km) earthquakes occur.

The second region (R=2) includes the Hellenic Trench, where shallow, mostly thrust earthquakes (h≤40km) occur, as well as the deeper section of the Hellenic Arc, where earthquakes of intermediate focal depth (40km<h≤100km) occur, which corresponds to the Southern Aegean Boundary (SAB). Information was extracted from a recently published catalogue of historical and instrumental earthquakes (Papazachos and Papazachou, 2002). The typical errors in the epicenter coordinates and focal depths are of the order of 20km, while for magnitudes the corresponding uncertainty is ±0.3. Only information for mainshocks, which are expected to be better controlled, is used in the present study.

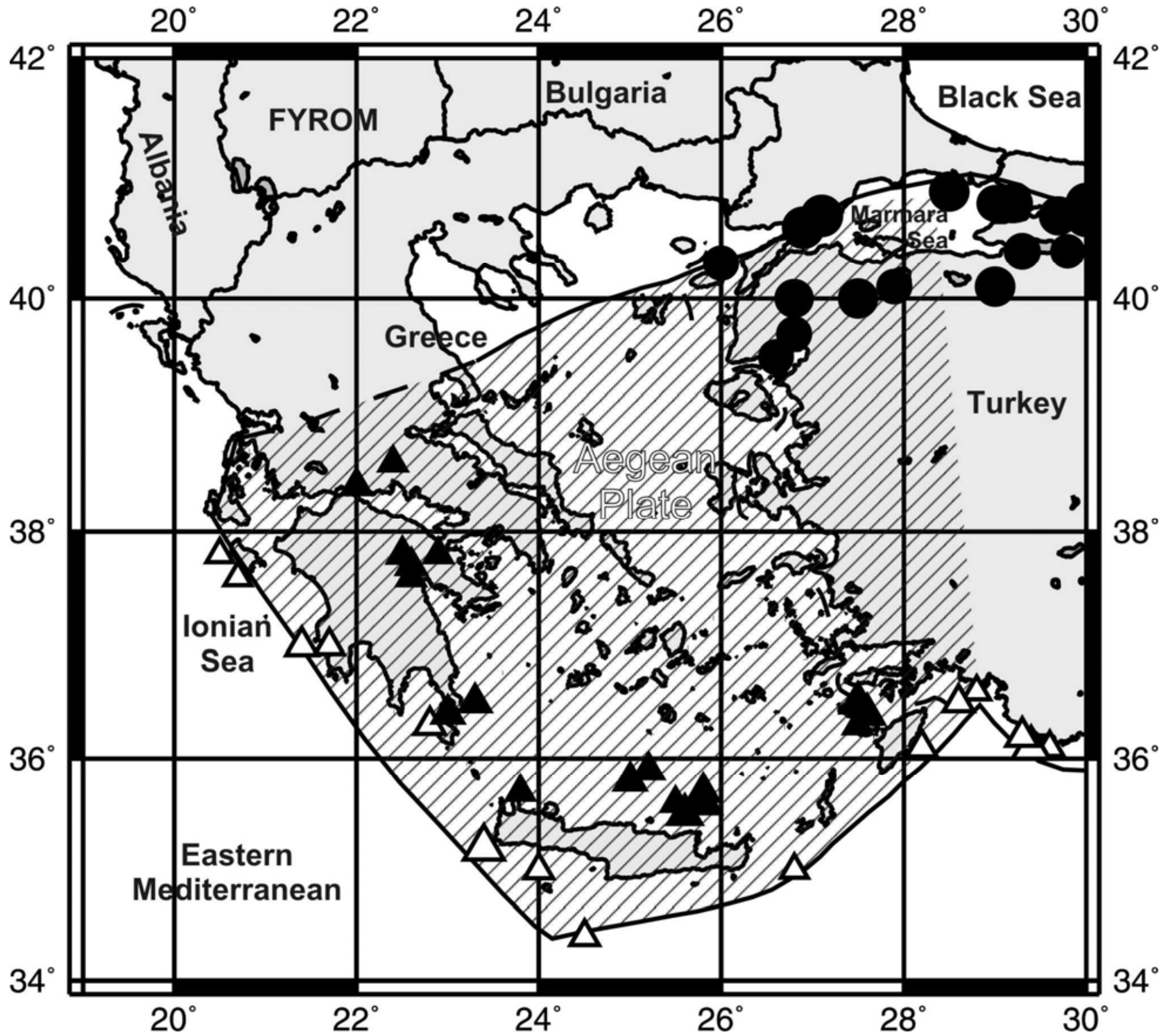

Figure 2. *Foci of large shallow earthquakes in the Marmara sea region (black circles), which triggered large shallow earthquakes (open triangles) in the Hellenic Trench and large intermediate focal depth earthquakes (black triangles) under the sedimentary part of the Hellenic Arc (see Tables 1 and 2 for details).*

Two samples of data are examined in the present study and presented in Figure (2). The first sample includes information for all large (M≥6.8) shallow events in the Marmara area and in the Hellenic Trench, as well as intermediate depth events (40km≤h≤100km) along the Hellenic Arc since 1840. The second sample includes the two known big (M≥8.0) historical earthquakes, which have occurred since 550BC and all very large (M≥7.4) events that occurred after 1500 in the two regions, as well as the known large (M≥6.8) events associated with these mainshocks.

Almost all Marmara sea events for which fault plane solutions are available show strike-slip faulting along the North Anatolia Fault (NAF) and its branches, with a typical dextral fault plane solution (247°/66°/-165°; Papazachos and Papazachou, 2002), confirming the westward motion of Anatolia with respect to Europe. For the southern Aegean, shallow events occur on low-angle thrust faults (typical solution 309°/23°/-101°) along the Hellenic Arc due to the convergence and subduction of the Eastern Mediterranean lithosphere beneath the overriding Aegean microplate. Intermediate depth events occur in the inner Hellenic Arc, showing downdip extension related to the slab-pull, with ruptures exhibiting a mixed pattern of strike-slip and thrust faulting.

EVIDENCE FROM COMPLETE DATA

Table (1) lists all events of the first data sample examined, which concerns the complete data (all $M \geq 6.8$ events in the Marmara Sea-R=1 and Hellenic Trench-Arc system-R=2) and the corresponding information. Most mainshocks in the Marmara area are more or less isolated events, whereas events along the Southern Aegean Boundary mostly occur in groups of two or more events. It is also easily seen that the recent Izmit earthquake (17.8.1999, M=7.5) is rather isolated event, the only large earthquake to occur in both regions after 1965, hence it was excluded from subsequent analysis. The average return period (examining the period 1840-1965) for the Marmara Sea (R=1) and Southern Aegean Boundary (R=2) events is $t_1=18.1 \pm 10.7$yr and $t_2=5.7 \pm 5.3$yr, respectively.

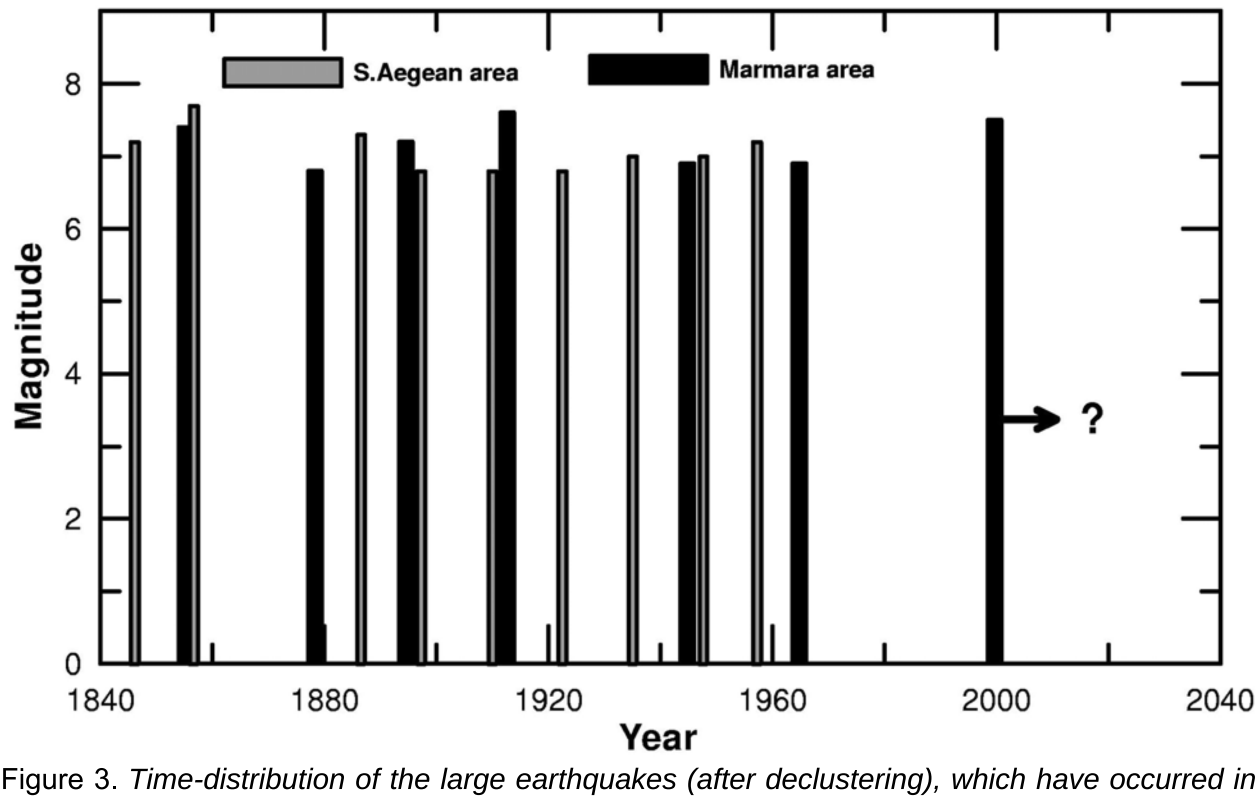

Figure 3. *Time-distribution of the large earthquakes (after declustering), which have occurred in the Marmara and Southern Aegean area.*

If we make the hypothesis that each event is "triggered" by the immediately preceding event, either in the same or in the other region, it is not possible to perform a direct correlation between the two regions as there is significant possibility for such large events ($M \geq 6.8$) to be "triggered" by another event in the same region. To overcome this limitation we decided to exclude (decluster) all events in each region, following a mainshock in the same region, which fall in the typical postshock period of this mainshock. For the postshock period, T_a, of an event with magnitude, M, we used the relation:

$$\log T_a = 0.06 + 0.13\, M \qquad (1)$$

which has been proposed by Papazachos et al. (1997) using global data from large earthquakes (up to M=7.5). Excluding all these triggered postshocks (marked by **t** in Table 1), which fall in the postshock period of a preceding event in the same region, resulted in a smaller data set for both regions, with 7 mainshocks (including the 1999 Izmit event) for the Marmara area (R=1) and a return period t_{11}=24.1±7.7yr and 9 mainshocks for the SAB region (R=2) with a return period of t_{22}=13.9±6.6yr. The time distribution of these examined events is seen in Figure (3).

Table 1. *Information on the mainshocks with M≥6.8, which occurred since 1840 in the area of Marmara (R=1) and in the Hellenic Arc-Trench System (R=2).*

N	Date	φ^o_N, λ^o_E	h	M	R	Triggered Postshocks	Maximum Intensity
1	1846:03:28	35.8, 25.0	i	7.2	2	-	Heraclio (VII)
2	1851:02:28	36.6, 28.8	n	6.8	2	t	Leivesio (X)
3	1855:02:28	40.1, 29.0	n	7.4	1	-	Brusa (X)
4	1856:10:12	35.6, 25.8	i	7.7	2	-	Heraclio (IX)
5	1859:08:21	40.3, 26.0	n	6.9	1	t	Imbros (IX)
6	1863:04:22	36.4, 27.6	i	7.5	2	t	Rhodos(X)
7	1878:04:19	40.7, 29.7	n	6.8	1	-	Izmit (VIII)
8	1886:08:27	37.0, 21.4	n	7.3	2	-	Philiatra (X)
9	1887:07:17	35.7, 25.8	i	7.2	2	t	Heraclio (VIII)
10	1889:08:25	38.4, 22.0	i	7.0	2	t	Fteri (VIII)
11	1894:07:10	40.8, 29.2	n	7.2	1	-	Istanbul (VIII)
12	1897:05:28	37.6, 22.6	i	6.8	2	-	Tripoli (VII)
13	1898:06:02	37.7, 22.6	i	7.0	2	t	Tripoli (VII)
14	1903:08:11	36.4, 23.0	i	7.2	2	t	Cythera (IX)
15	1910:02:18	35.7, 23.8	i	6.8	2	-	Chania (VIII)
16	1912:08:09	40.6, 26.9	n	7.6	1	-	Murefte (X)
17	1922:08:13	35.0, 26.8	n	6.8	2	-	Zakros (VII)
18	1926:03:18	36.1, 29.6	n	6.9	2	t	Castelorizo (VIII)
19	1926:06:26	36.5, 27.5	i	7.6	2	t	Rhodos (XI)
20	1926:08:30	36.5, 23.3	i	7.2	2	t	Sparti (VIII)
21	1935:02:25	35.9, 25.2	i	7.0	2	-	Anoghia (VIII)
22	1944:10:06	39.5, 26.6	n	6.9	1	-	Ayvacik (IX)
23	1947:10:06	37.0, 21.7	n	7.0	2	-	Pylia (IX)
24	1952:12:17	34.4, 24.5	n	7.0	2	t	Heraclio (VI)
25	1953:03:18	40.0, 27.5	n	7.4	1	t	Yenise (IX)
26	1957:04:25	36.5, 28.6	n	7.2	2	-	Rhodos (VIII)
27	1959:11:15	37.8, 20.5	n	6.8	2	t	Zante (VII)
28	1962:08:28	37.8, 22.9	i	6.8	2	t	Corinth (VIII)
29	1964:10:06	40.1, 27.9	n	6.9	1	-	Manyas (IX)
30	1965:03:31	38.6, 22.4	i	6.8	2	t	Agrinio (VIII)
31	1999:08:17	40.8, 30.0	n	7.5	1	-	Izmit (X)

In order to examine a possible correlation between the Marmara Sea (R=1) and the SAB region (R=2), it is necessary to compare the return period of interevent times between R=1 and R=2 events. A simple calculation shows that, if randomly distributed, the average interevent time between events in the two regions should be equal to ~7.9yr, which is almost identical to the average observed interevent time between declustered events from both regions, found to be equal to 7.5±5.9yr from the Table (1). However, when examining the interevent times separately, it is easily calculated that the average interevent time for events in R=2 to occur after events in

R=1 is quite small, t_{12}^{av}=5.2$\pm$3.7yr, whereas for the opposite order of occurrence this interevent time almost doubles, as t_{21}^{av}=9.8$\pm$7.1ys. Therefore, it seems that events along the Southern Aegean Boundary tend to occur shortly after corresponding events in the Marmara area, which on the other hand tend to be delayed after mainshocks in SAB, compared to the prediction of a Poissonian (random) time distribution. It should be noted that the 1999 Izmit event was not included in the estimation of t_{21}^{av}, as its “delayed” occurrence would artificially increase t_{21}^{av}, though such increase would favor our conclusions.

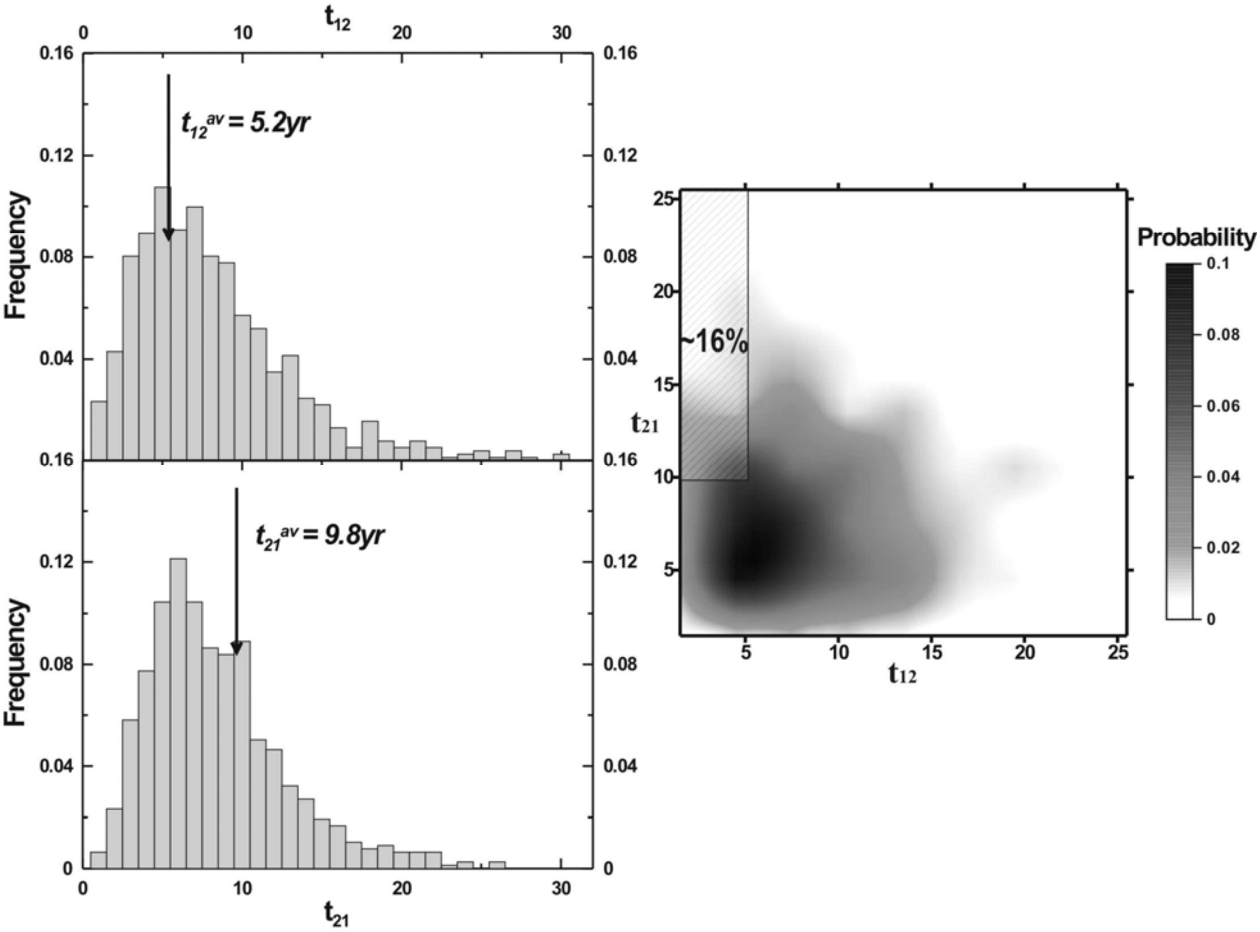

Figure 4. *(left) Histograms of the distribution of interevent times between pairs of successive events in Marmara Sea (R=1) followed by Southern Aegean area events (R=2), t_{12}, and pair with the opposite order, t_{21}, as these are defined by random catalogue tests. The observed values, t_{12}^{av} and t_{21}^{av} values are also shown by arrows. (right) Two-dimensional probability distribution of the t_{12} and t_{21} values obtained from random catalogues. The hatched area is defined by the observed values range (t_{12}^{av} and t_{21}^{av}), corresponding to a probability of 16% for random occurrence.*

In order to verify the significance of the previous observation we used a simple Monte Carlo approach where random catalogues with events in regions 1 and 2 were generated, following a Poissonian (random) time distribution pattern, adopting the average return periods previously defined. A large number (~1000) of random catalogues were used. The average interevent time between events in both regions was 8.1$\pm$3.1yr, close to the value estimated from the data (=7.5yr) and the theoretically expected value (=7.9yr), showing a more or less random distribution, if both regions are examined. On the left side of Figure (4) the frequency histograms of the interevent times t_{12} and t_{21}, as these are determined from the random catalogues are shown. In the same figures the average interevent times, t_{12}^{av} and t_{21}^{av} (previously estimated from the declustered mainshocks) are denoted by arrows. The distributions show that there is significant probability (~31%) that the observed preferable occurrence of events in SAB (R=2) after events in Marmara (R=1), indicated by the small t_{12}^{av}, is random. A similar high probability (~30%) can be assessed to the observation that Marmara Sea (R=1) tend to delay to occur after events in SAB (R=2), suggested by the almost double t_{21}^{av}. However, this also suggests that the simultaneous occurrence of both events (small t_{12}^{av} and large t_{21}^{av}), although their average interevent rate is similar to the randomly expected (~7.5-8 years), has a small probability to occur (~9%) simultaneously, if both (occurrence of 1→2 and 2→1 pairs) are independent.

It could be argued that the occurrence of 1→2 and 2→1 pairs is anticorrelated, i.e. in random catalogues where events in R=2 occur by chance immediately after R=1 mainshocks (small t_{12}) would tend to lead to large t_{21} interevent times. If t_{12} and t_{21} are completely anticorrelated, then the expected random probability of t_{12} and t_{21} would be almost identical, as happens in the examined case with similar probabilities (~30%). In such a case, the probability of simultaneous occurrence of small t_{12}^{av} and large t_{21}^{av} would be this probability ($\simeq$30%). In reality the true probability lies between the probability of independent events (~9%) and the probability of totally anticorrelated events (~30%). On the right side of Figure (4) the joint probability distribution of t_{12} and t_{21} determined from random catalogues is presented. The hatched area denotes the cases with $t_{12} \le t_{12}^{av}$ and $t_{21} \ge t_{21}^{av}$, which corresponds to a probability of ~16%. This is the actual probability that the observed t_{12}^{av} and t_{21}^{av} occur by random chance.

The previous results demonstrate that there is a clear "causal" relation (with a high probability of 84%) between large mainshocks in Marmara area and SAB. Instrumental data show that although interevent times between the two areas are almost identical to the values expected from a random behavior, events in SAB happen preferably after Marmara Sea mainshocks, which in return are clearly delayed and anticorrelated with SAB mainshocks.

Table 2. *Information on the known big mainshocks with M≥8.0 and on the very large mainshocks with M≥7.4 which occurred since 550BC and 1500AD, respectively, in the area of Marmara (R=l) and in the Hellenic Trench -Arc System (R=2), as well as for the large (M≥6.8) earthquakes associated with these big and very large mainshocks.*

N	Date	φ^o_N, λ^o_E	h	M	R	Maximum Intensity
1	358:08:24	40.7,29.7	n	7.2	1	Izmit (IX)
	362:12:02	40.4,29.8	n	6.8	1	Iznit (VIII)
	365:07:21	35.2,23.4	n	8.3	2	Gortys(VIII)
	368:10:11	40.4,29.3	n	7.0	1	Iznik (VIII)
2	1296:06:01	40.8,29.0	n	7.0	1	Istanbul (VIII)
	1303:08:18	36.1,29.4	n	8.0	2	Rhodos(X)
3	1509:09:10	40.9,28.5	n	7.4	1	Istanbul (X)
	1513:03:28	36.1,28.2	n	7.2	2	Rhodos(VIII)
4	1737:03:06	40.0,26.8	n	7.2	1	Ezine (IX)
	1741:01.31	36.2,29.3	n	7.4	2	Rhodos(VIII)
	1750:06:07	36.3, 22.8	n	7.2	2	Cythera (IX)
5	1754:06:15	37.8,22.5	i	7.0	2	Peloponnese (VIII)
	1754:09:02	40.7,30.0	n	7.6	1	Izmit (X)
	1756:02:13	36.3,27.5	i	6.8	2	Rhodos (VII)
6	1766:05.22	40.8,29.1	n	7.1	1	Istanbul (IX)
	1766:08:05	40.7,27.1	n	7.6	1	Tekirdag (X)
	1769:12:10	35.6,25.5	i	6.8	2	Heraclio (VIII)
7	1805:07:03	35.0,24.0	n	7.0	2	Chania (VIII)
	1809:02:07	39.7,26.8	n	6.9	1	Eskistanbul (VIII)
	1810.02.06	35.5,25.6	i	7.5	2	Heraclio (IX)
	1811.06.15	37.6,20.7	n	6.8	2	Zante (VII)

EVIDENCE FROM HISTORICAL DATA

Table (2) gives the main parameters for the two well known big shallow mainshocks which occurred in the Hellenic Trench (365AD M=8.3, 1303 M=8.0), for all known very large

($M \geq 7.4$) shallow and intermediate focal depth ($40 \leq h \leq 100$km) mainshocks which occurred since 1500 in these two regions (Marmara and SAB), as well as for the known large shocks ($M \geq 6.8$) which occurred there within ten years before and after each of these mainshocks. This data sample forms seven groups of shocks. It is important to observe that in all seven cases a large mainshock in the Marmara sea (R=1) is followed by at least one mainshock in the Hellenic Arc - Trench System (R=2) but only in two of the seven cases large mainshocks in R=2 are followed by such shocks in R=1. Though the data set examined is incomplete, this pattern of preferential sequence (1→2) further supports the conclusion derived by the complete set of data that the generation of large earthquakes in the Marmara sea area triggers such earthquakes in the Hellenic Trench -Arc System and that the opposite triggering of large earthquakes in Marmara by the generation of such earthquakes in the System does not apply.

Table (2) shows that the time difference, t_{12}, between two successive earthquakes the first of which occurred in R=1 and the second in R=2 varies between 1.4yrs and 7.2 yrs, with $t_{12}^{av}{}_{(historical)}=3.3 \pm 1.9$yr. This is even smaller than the value t_{12}^{av} previously determined from instrumental (post 1840) data, probably due to the declustering procedure followed for those data. However, it may also be due to the larger magnitude of the historical events examined ($M \geq 7.4$), which could possible accelerate the triggering effect.

CONCLUSIONS AND DISCUSSION

Historical and instrumental data support the idea that large ($M \geq 6.8$) shallow (h<20km) earthquakes in the western part of the North Anatolia Fault Zone (Marmara Sea area) trigger large shallow ($h \leq 40$km) earthquakes in the Hellenic Trench and/or large intermediate focal depth ($40\text{km} \leq h \leq 100$km) earthquakes in the sedimentary part of the Hellenic Arc. As can be seen from Tables (1) and (2), the average magnitude of the triggering earthquakes is 7.1 ± 0.3 and of the triggered events is 7.3 ± 0.4, both with important macroseismic results. It was also estimated out that the mean time difference, t_{12}, between triggering (R=1) and triggered (R=2) mainshocks (fifteen cases) is 5.2 ± 3.7 years using instrumental data (post 1840) and 3.3 ± 1.9yr using historical data.

The generation of the large earthquakes in the Marmara Sea area is due to the westward movement of the Anatolian lithospheric plate. It is known that this motion leads, within a period of three years, to the generation of strong earthquakes ($M \geq 6.0$) on dextral and normal faults along the Northern Aegean Boundary (Northern Aegean-Ionian islands) of the Aegean microplate (Papazachos et al., 2000). The rupture on these faults “facilitates” the southwestward motion of the Aegean microplate (with respect to stable Europe). This motion results in its overriding on the eastern Mediterranean lithosphere, expressed by the generation of shallow earthquakes along the Hellenic Trench, and the subduction of the oceanic lithospheric slab (front part of the oceanic Meditteranean lithosphere), identified by the generation of intermediate focal depth ($40\text{km} \leq h \leq 100$km) earthquakes under the Hellenic arc. There are cases of mainshocks which show initiation of overthrusting and subduction in the Hellenic Trench-Arc System without any obvious triggering from Anatolia related (Marmara Sea) events, but these cases are rare.

The proposed process and the “causal” relation between Marmara Sea mainshocks and Southern Aegean Boundary events is important for the understanding of the seismotectonic setting of the broader Aegean area, but also for the theoretical modelling of the present-day dynamics of the Aegean (e.g. Meijer and Wortel, 1997). Observations of such long-range interactions for major earthquakes have already been made in several other cases (e.g. Romanowitz, 1993; Pollitz et al., 1998) and recently also theoretically demonstrated (Casarotti et al., 2001), hence their phenomenological but also theoretical existence is now becoming more and more acceptable (Stein, 1999). Moreover, this relation suggests that the push exerted on the Aegean by the westward motion of Anatolia plays an important role on the deformation and stress field of the overriding southern Aegean margin and that it also controls, at least partly, the Hellenic subduction kinematics.

However, the observation of triggering also allows a possible quantification of the expected activity, hence an intermediate-term earthquake prediction of large shallow and intermediate depth earthquakes in the Hellenic Trench -Arc System, since the interevent time of 3-5 years (deduced from both historical and instrumental data) can be used to estimate the time of occurrence of such earthquakes after the generation of a large earthquake in the Marmara Sea area. The last very large earthquake in this area occurred on the 17th August 1999 (M=7.5, 40.8^{o}N, 30.0°E) in Izmit and was followed by a strong earthquake (26 July 2001, M=6.3, 39.1^{o}N, 23.9°E) in the northern boundary of the Aegean plate, as expected. It is, therefore, very probable that intense seismic activity with one or more large earthquakes ($M \geq 6.8$) will occur during the next few years in the Hellenic Trench -Arc System. The start of generation of such earthquakes in southern Aegean during the next few years is also suggested by accelerated seismicity of intermediate magnitude shocks (Papazachos et al., 2002), as well as by the non-occurrence of large earthquakes in this tectonically very active area during the last almost four decades. In fact the results presented here may well explain this lack of large event seismicity in the SAB, as the Izmit event occurred rather late (~35 years) after the last large Marmara Sea event, but within the 2-σ (95%) limits of the average return period ($t_1=24.1 \pm 7.7$yr). This delayed occurrence and the "causal" relation between events in the Marmara Sea area and Southern Aegean Boundary events may well explain the lack of large events ($M \geq 6.8$) in the Southern Aegean for the corresponding time period (1965-present.)

Papazachos et al. (2000) have shown that strong earthquakes generated along the Eastern Aegean plate boundary (EAB) by normal faulting also follow strike-slip ruptures along the northern Aegean plate boundary. This observation indicates that this normal faulting is also associated with the southwestward motion of the Aegean microplate. The faster movement of the "front" (southwestern) part of the Aegean lithosphere with respect to its "rear" (northeastern) part (Papazachos, 1999) results in an extensional field and the generation of such earthquakes by normal faulting. Hence, on the basis of the proposed pattern and since the very large Izmit earthquake (M=7.5) has been already followed by the strong Skyros earthquake (M=6.3) we can conclude that strong earthquakes may probably also follow during the next few years in this eastern region of the Aegean area.

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