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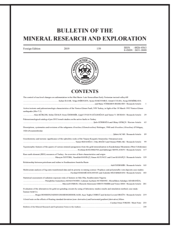

Paleoseismological catalog of Pre-2012 trench studies on the active faults in Turkey

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ABSTRACT

Instrumental and historical earthquake catalogues have to be examined and evaluated to understand the long-term seismic behaviour of active faults. Although the instrumental records have been determined from the national and international observatories, the historical seismic catalogues are very limited in Turkey. For the reason, we aimed to compile paleoseismological trench studies carried out before 2012 in the areas of onshore and offshore sections of Turkey. In terms of a Turkey Paleoseismological Project (TURKPAP) posted by General Directorate of Mineral Research and Exploration (MTA) in the 2012 year, a number of paleoseismological investigations have been initiated and documented for archiving at a standardized data layout. In this study, we compiled all paleoseismological trench surveys with the definite dates of past strong seismic events occurred in Turkey before that date. By using this compilation, not only the historical earthquakes but also many paleoseismologic parameters of the studies have been listed clearly.

1. Introduction

The areas, experienced strong seismic events, have been the target for paleoseismological studies. In this manner, historical earthquakes could be determined. It could allow us to obtain detailed data about spatial and temporal attitudes of active faults, and assessment of paleo-earthquake records. The catalogues of destructive earthquakes in the European Archive of Historical Earthquake Data (AHEAD) system are updated continuously. But this system is not going to solve the problem of lack of proper historical catalogue in Turkey. For this reason, Turkey needs a historical earthquake archive. Without information about the past seismic events sourced from active faults, it is impossible to achieve assessment and planning the hazard and risk studies. In this paper, all paleoseismological trench surveys compiled in Turkey to be the foundation for future studies. All studies completed up to 2012 years were examined regarding the national boundary of Turkey that has paleoseismological data on land, sea and lake studies including definite dating results about the past seismological events. After 2012, a systematic catalogue started to organize in the content of paleoseismology project (TURKPAP) prepared by General Directorate of Mineral Research and Exploration.Because of that, the investigations in the content of TURKPAP and the other papers have not been included in this catalogue.

In this paper, we exploited and compiled all paleoseismological trench studies that discovered and confirmed the presence of historical and pre-historical earthquakes. Only the definite trench locations were issued in this catalogue. Geographically unknown locations could not be included. All used data have been collected, selected, listed and inserted into

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a new paleoseismological catalogue of Turkey. Another focus of our work is the development of long earthquake records that are critical for determining the distribution of earthquake recurrence intervals along the active faults. Electronic supplementary material in this paper gives a chance to readers for comparing the recurrence interval and source of devastating earthquakes.

2. Active Faults in Turkey

Turkey has very complex tectonic features because of the Arabian, African and Eurasian plate motions. This situation creates a number of single active faults and fault systems. They generated devastating earthquakes in the past, and are capable to produce many of them in the future. Taking their various characteristics and locations into account, we grouped them to represent their paleoseismological outcomes. They are handled in the given order; 1) North Anatolian Fault System; 2) East Anatolian Fault System; 3) Horst-graben system in western Anatolia, 4) Central Anatolia, and 5) A part of Dead Sea Fault System inside the border of Turkey.

North Anatolian Fault System (NAFS) is the subject of several studies to understand the long-term behaviour of its different segments. In fact, it is one of the most active strike-slip structures in the world comprising the plate boundary between Eurasia and Anatolia. The NAFS is a 1500 km long right-lateral strike-slip fault system running convex to the Black Sea coast. It is located between Karlıova in the east and the Aegean Sea in the west (Figure 1). Most of the paleoseismologic studies were performed along the NAFS in Turkey. Some of the events occurred in adjacent segments could be correlated with each other. Because different recurrence intervals for the same segments have been suggested owing to suspicious dating results. It is not surprising outcomes regarding the various characteristics of each segment. This catalogue provides the comparison of previous earthquakes dated by paleoseismological researches.

Another important megastructure in Turkey is the East Anatolian Fault System (EAFS). It is the 580 km long and NE-SW-trending sinistral zone of deformation located between Karlıova in the NE and Antakya in the southwest (Arpat and Şaroğlu, 1972; Lovelock, 1984; Şaroğlu et al., 1992; Şengör et al., 1985) (Figure 1). The last known devastating earthquakes sourced from the EAFS are the 1874 Lake Hazar and the 1971 Bingöl earthquakes that created surface ruptures (Jackson and McKenzie, 1984; Ambraseys and Jackson, 1998). Thus, all the geological studies in literature evidently indicate the

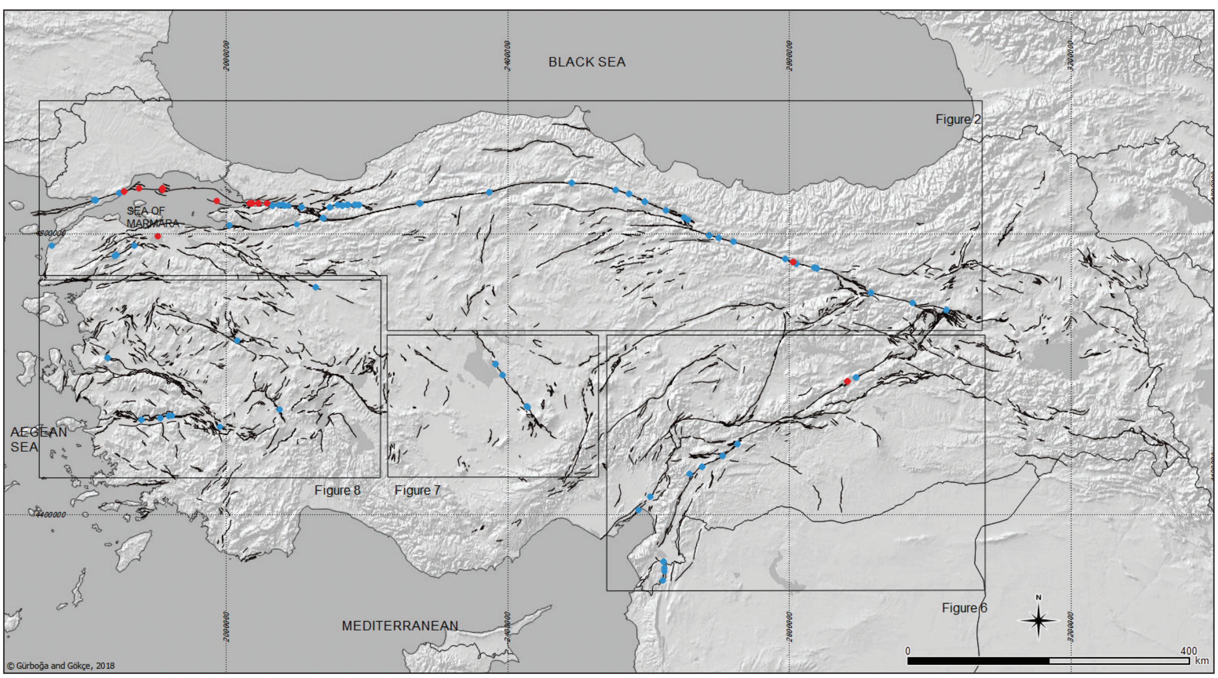

Figure 1- Active fault map of Turkey. Different coloured circles represent the locations of paleoseismological trench surveys on land (blue) and core surveys on lake-marine (red). Active faults are compiled from Emre et al., 2013 and 2018.

activeness of EAFS. Even if the historical seismicity and field observation indicate the high activeness of the EAFS, its seismicity is relatively lower than the NAFS. For this quiescence, the EAFS may be locked and accumulating the energy (Dewey et al., 1986; Yönlü et al., 2017). Therewithal, paleoseismological trench surveys are very limited along the EAFS (Yönlü et al., 2017). We added the paleoseismological studies along both the DSFS and the EAFS in this paper.

Horst-graben system in western Anatolia is very famous active continental extensional province in the world. Margin-boundary active faults have created moderate to large earthquakes recently (Tan et al., 2008). In terms of paleoseismological studies carried out along these active normal faults, reliable conclusions were obtained.

All the NAFS, EAFS, and the western and central Anatolian graben-horst systems were taken into account to classify the trench studies along the active faults. In each research, different active fault maps and references have been used to define fault segments, thus, more than one names came up for the same fault and segment. To produce uniformity, active fault map prepared by Emre et al. (2013 and 2018) are used as a base map in this paper (Figure 1). The term segment preferred by authors of this manuscript means that it is a section of a single fault separated from the adjacent fault parts by the intervening variations such as bending, bifurcation, and jumping. Moreover, main attributes of this catalogue are seen in table 1.

2.1. Paleoseismological Studies Along The North Anatolian Fault System

The total length of the NAFS was examined under three parts (Figure 2). These are the eastern_NAFS (Figure 3 and table 2), the central NAFS (Figure 4 and table 3), and the western_NAFS (Figure 5 and table 4). The locations of the paleoseismological trenches are illustrated from the east towards the west regarding the segments in the relevant tables.

Paleoseismology studies the core samples to provide reliable dating results. The water-saturated core sediments make materials suitable for radiocarbon dating. Both the marine and lacustrine core samples were taken from Sea of Marmara and small lakes along the NAFS and they produced a well correlated data. As the attributes are listed in table 5, their results are given in the red circles in figures 1, 2.

2.2. Paleoseismological Studies Along the East Anatolian Fault System

There is no common agreement on the segmentation of the EAFS as is those on the NAFS. The number of segments varies between 2 and 14 according to different authors (Barka and Kadinsky-Cade, 1988; Perinçek and Çemen, 1990; Şaroğlu et al., 1992; Hempton and Dewey 1981; Muehlberger and Gordon 1987; Westaway, 1994; Duman and Emre, 2013; Yönlü et al., 2017). To be consistent, the segmentation prepared by Emre et al., (2013 and 2018) is on this catalogue. Red and blue circles define the offshore and onshore paleoseismological surveys, respectively (Figure 6 and table 6-7).

2.3. Paleoseismological Studies on the Central Anatolia

Paleoseismological investigations are very limited in Central Anatolia. Only one trenching was performed along the Lake Salt Fault Zone by Kürçer (2012). The locations and results are in figure 7 and table 8.

2.4. Paleoseismological Studies on the Area of Horst-Graben System in Western Anatolia

Western Turkey is one of the most important areas experiencing the intracontinental extension in the world. The extensional regime yields a number of horst-graben structures bounded by the normal faults. The recent earthquake activity indicates the earthquake potential of the area (Tan et al., 2008; Kalafat et al., 2011; Kadirioğlu et al., 2018). Even though paleoseismological researches are more important for such seismically active areas, we have 23 studies with radiometric dating results (Figure 8 and table 9).

Table 1- The sample format of catalogue: F. name of fault system, S. name of segments, Tr. name of trench, T. given name of trenches in here, Lon. Longitude, Lat. Latitude, T. number of total events, Eq date min. oldest dated earthquake, Eq date max. youngest dated earthquake, Corr. correlated event date with historical catalogue, Rptr L. calculated rupture length, Rupture M. calculated rupture magnitude, Slip R. calculated slip rate on the segment, Rec Int. calculated recurrence interval, Last rup. the last event rupture along the segment, and Ref. obtained references.

No	Name_of_F	Name_of_S	Name_of_Tr	Code_T	Lon	Lat	Event_T	Eq_date_min	Eq_date_max	Corr	Rptr_L	Rptr_M	Slip_R	Rec_Int	Last_rup	Ref
19	NAFS	Refahiye	Yaylabeli	Re2	38,94000383	39,95808632	5			1939	400	7,9	22	200-350	1939	Kozacı et al., 2011
20										1254	150	-		200-350		
21										1045		-		200-350		
22								717	844			-		200-350		
23								302	724	499		-		200-350		
28								-881	-673		360	7,7-8,4				
29								-1406	-1291		170	7,2-7,8				

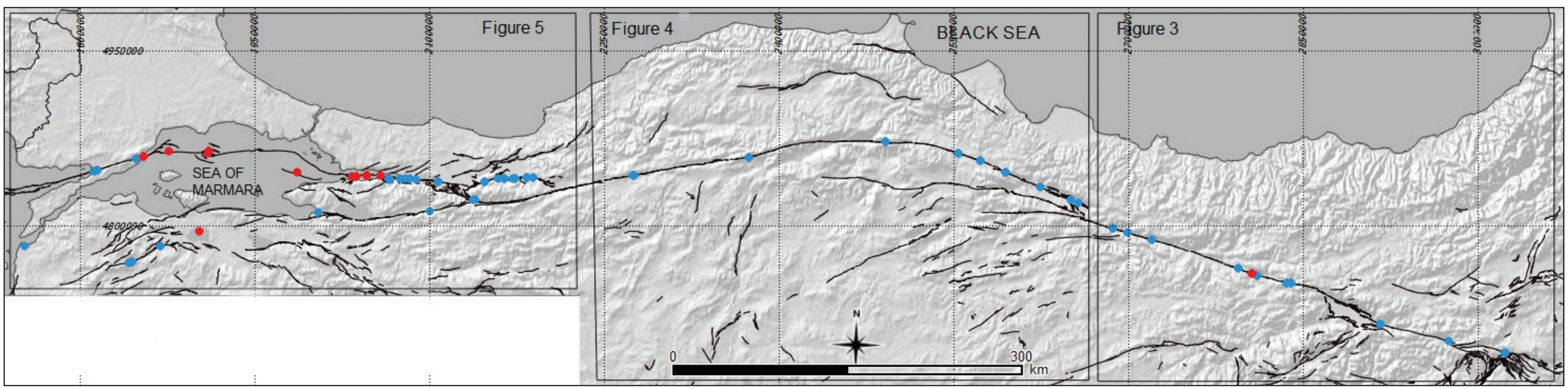

Figure 2- The simplified active fault map of NAFS (Emre et al., 2013 and 2018). The blue circles point out the locations of paleoseismological trench sites on land. Red circles represent the locations of core samples from lake and sea. The locations of figure 3, 4, and 5 were illustrated in the figure.

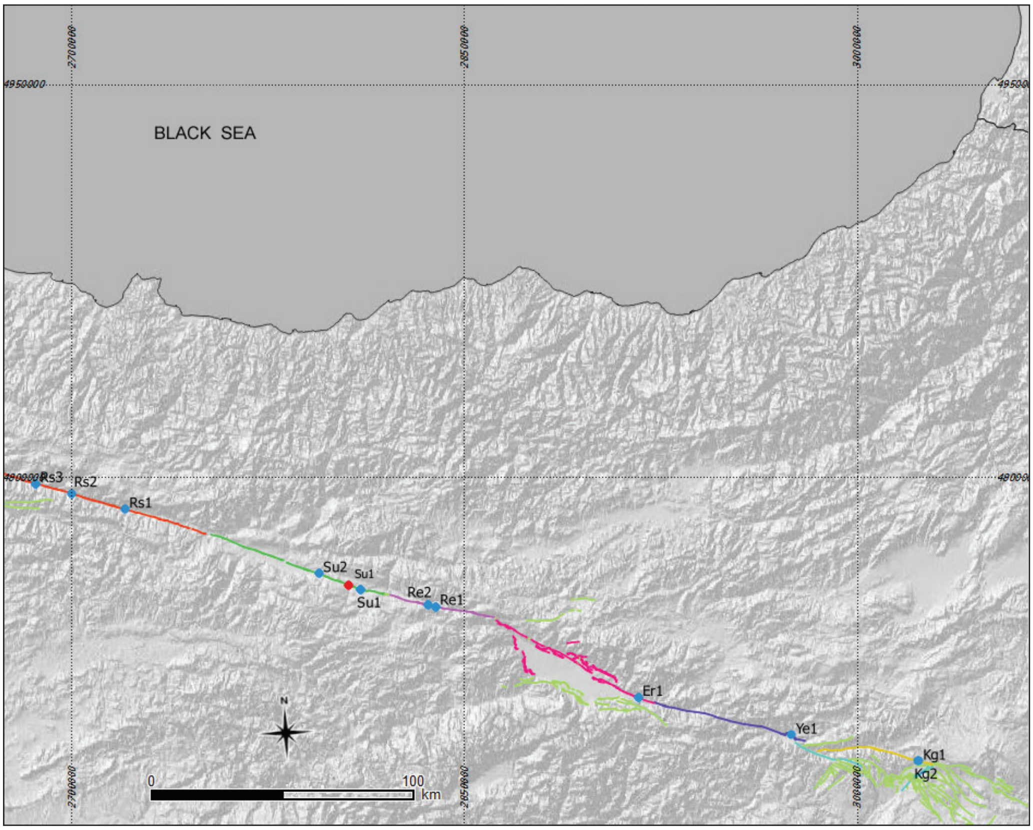

Figure 3- The map shows the east NAFS (Emre et al., 2013 and 2018), and trench locations on the digital elevation model. Their attributes are in table 2. The colouring makes a distinction among fault segmentations.

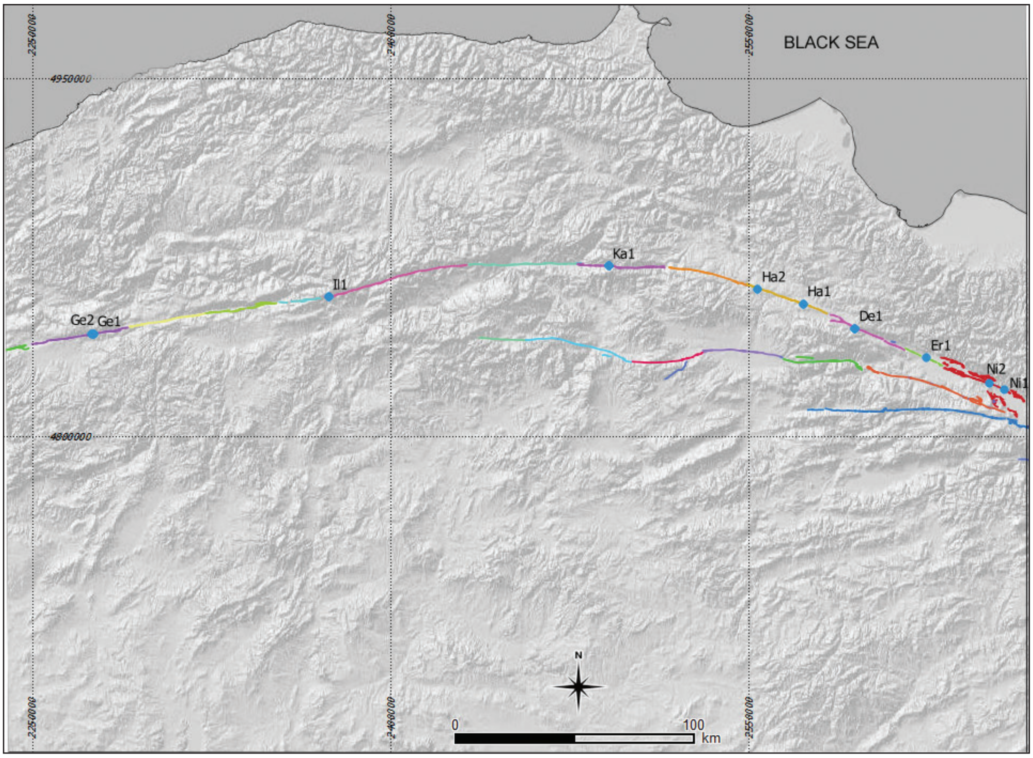

Figure 4- The map shows the central NAFS (Emre et al., 2013 and 2018) and the trench locations on the digital elevation model. The attributes are in table 3. The colouring makes a distinction among fault segmentations.

Table 2- The paleoseismological catalogue of the east_NAFS.

No	Name_of_F	Name_of_S	Name_of_Tr	Code_T	Lon	Lat	Event_T	Eq_date_min	Eq_date_max	Corr	Rptr_L	Rptr_M	Slip_R	Rec_Int	Last_rup	Ref
1	NAFS	Kargapazarı	Yoncalık1	Kg1	41,08346391	39,32817372	2	-8500	-6150			-				Sancar and Akyüz, 2007
2								-5960	-4300			-				
3			Yoncalık2	Kg2	41,07599539	39,32993262	2		-6325			-				
4								-6325	-2105			-				
5		Yedisu	NA	Ye1	40,5272098	39,44612412	2	450				-			1784	
6								50	450			-				
7		Erzincan	NA	Er1	39,8565447	39,60596802	5	1673	1950	1784		-		200-250		Okumura et al., 1994
8								1461	1639			-		200-250		
9								1323	1524			-		200-250		
10								1066	1275			-		200-250		
11								684	935			-		200-250		
12		Refahiye	Çukurçimen	Re1	38,97311	39,95147615	7			1939		-		200-900	1939	Hartleb et al., 2006
13								980	1420	1254		-		200-900		
14								930	1070	1045		-		200-900		
15								360	540	499		-		200-900		
16								-230	50			-		200-900		
17								-1450	-800			-		200-900		
18								-2880	-200			-		200-900		
19			Yaylabeli	Re2	38,94000383	39,95808632	5			1939	400	7,9	22	200-350	1939	Kozacı et al., 2011
20										1254	150	-		200-350		
21										1045		-		200-350		
22								717	844			-		200-350		
23								302	724	499		-		200-350		

Table 2- continued

No	Name_of_F	Name_of_S	Name_of_Tr	Code_T	Lon	Lat	Event_T	Eq_date_min	Eq_date_max	Corr	Rptr_L	Rptr_M	Slip_R	Rec_Int	Last_rup	Ref
24		Suşehri	Günalan	Su1	38,637781	40,021301	6			1939	350	7,7-8,3			1939	Fraser et al., 2012
25										1668	250	7,6-8,3				
26										1254	170	7,2-7,8				
27										499	360	7,7-8,4				
28								-881	-673		360	7,7-8,4				
29								-1406	-1291		170	7,2-7,8				
30			Eskibağ	Su2	38,45680753	40,08078116	4			1939		-			1939	Polat et al., 2012
31												-				
32									580	499		-				
33								-840				-				
34		Reşadiye	Umurca	Rs1	37,596501	40,324874	3			1939		7,8			1939	Zabcı et al., 2011
35										1668		-				
36										1254		-				
37			Reşadiye	Rs2	37,355531	40,384651				1939		-				
38										1254		-				
39										1045		-				
40			Reşadiye A	Rs3	37,19827468	40,42081951	7			1939		-		1-1375	1939	Fraser, 2009
41								1570	1939	1668		-		1-1375		
42								261	642	499		-		1-1375		
43								-257	260			-		1-1375		
44								-908	-705			-		1-1375		
45								-2019	-1804			-		1-1375		
46								-2280	-2067			-		1-1375		

Table 3- The paleoseismological catalog of the mid_NAFS.

No	Name_of_F	Name_of_S	Name_of_Tr	Code_T	Lon	Lat	Event_T	Eq_date_min	Eq_date_max	Corr	Rptr_L	Rptr_M	Slip_R	Rec_Int	Last_rup	Ref
47	NAFS	Niksar	Direkli	Ni1	36,85324306	40,62788542	2			1942					1942	Akyüz et al., 2009
48								-480	-412							
49			Alanıcı	Ni2	36,77970833	40,65340625	2			1942					1942	
50									500							
51		Erbaa	Çevresu	Er1	36,47409553	40,752534	3			1942	48	7			1942	Kürçer et al., 2009
52										1668						
53								700	1300							
54		Destek	Destek	De1	36,1210966	40,86727874	8			1943				385±166	1943	Fraser et al., 2009
55								1438	1787	1668				385±166		
56								1034	1325					385±166		
57								549	721					385±166		
58								17	585	236				385±166		
59								-351	28					385±166		
60								-705	-392					385±166		
61								-913	-595					385±166		
62		Havza	Alayurt	Ha1	35,86532194	40,96235961	6			1943		7,7			1943	Hartleb et al., 2003
63								800	1200							
64										236						
65								400	1000							
66								-4600	-3550							
67			NA	Ha2	35,6396014	41,01836178	4			1943				600-900	1943	Yoshioka et al., 2000
68								1159	1374					600-900		
69								365	740					600-900		
70								-2330	-1557					600-900		

Table 3- continued

No	Name_of_F	Name_of_S	Name_of_Tr	Code_T	Lon	Lat	Event_T	Eq_date_min	Eq_date_max	Corr	Rptr_L	Rptr_M	Slip_R	Rec_Int	Last_rup	Ref
71	NAFS	Kamil	Elmacık	Ka1	34,89651403	41,10719986	8			1943	280	7,6	25	97-912	1943	Fraser et al., 2010
72								549	651	529			25	97-912		
73								-23	103				25	97-912		
74								-609	-185				25	97-912		
75								-971	-814				25	97-912		
76								-1227	-968	-1200			25	97-912		
77								-2050	-1777				25	97-912		
78								-2556	-2235				25	97-912		
79		Ilgaz	Ilgaz_Aluç	Il1	33,504261	40,9817499	5			1943			12,5	280-620	1943	Sugai et al., 1999
80								1495	1850	1668			12,5	280-620		
81								890	1190	1050			12,5	280-620		
82								640	810					280-620		
83								0	150					280-620		
84		Gerede	Ardıçlı	Ge1	32,34083333	40,82305556	5			1944					1944	Okumura et al., 2002, 2003
85										1668						
86								1171	1668							
87								943	1298	1050						
88								643	918							
89			Demirtepe	Ge2	32,32899671	40,82162075	4			1944			17	330	1944	Kondo et al., 2004 and 2010
90								1640		1668			17	330		
91								1210	1460				17	330		
92								840	960	1035			17	330		

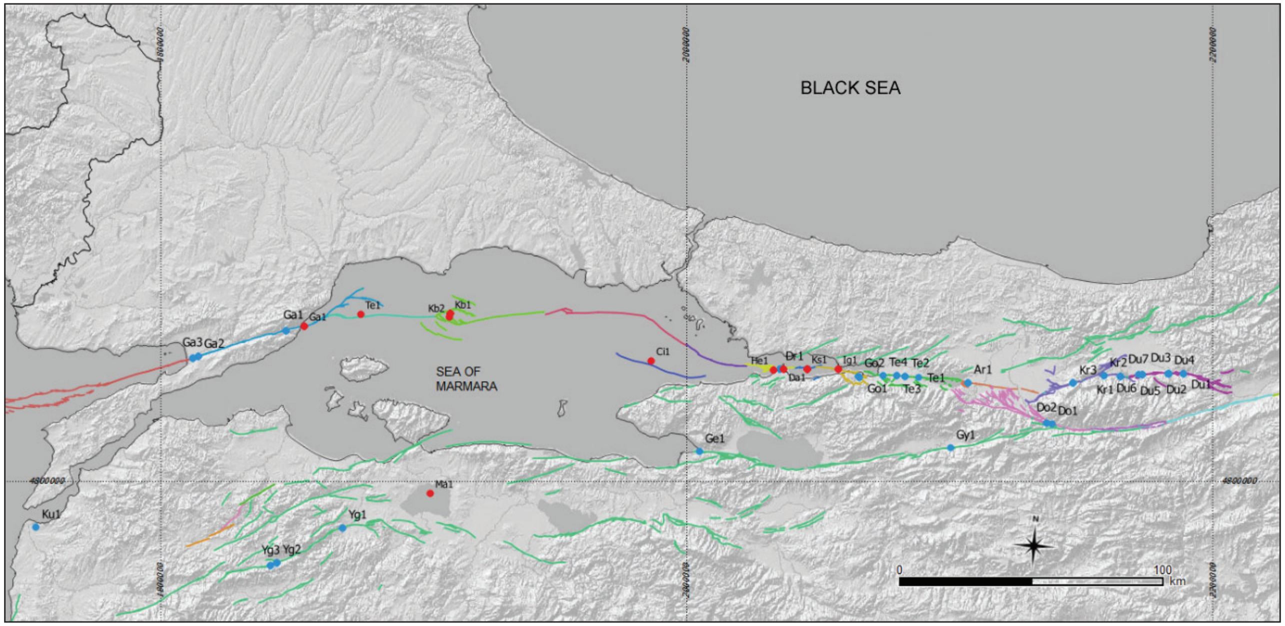

Figure 5-The map shows the western NAFS (Emre et al., 2013 and 2018) and trench locations on the digital elevation model. Related attributes are in table 4 and 5. The colouring makes a distinction among fault segmentations.

Table 4- The paleoseismological catalogue of the west_NAFS.

No	Name_of_F	Name_of_S	Name_of_Tr	Code_T	Lon	Lat	Event_T	Eq_date_min	Eq_date_max	Corr	Rptr_L	Rptr_M	Slip_R	Rec_Int	Last_rup	Ref
93	NAFS	Düzce	Kaynaşlı	Du1	31,31385751	40,77609568	4			1999					1999	Pantosti et al., 2008
94								1475		1878						
95								1035	1640							
96								685	1220	967						
97			Mengencik	Du2	31,24884726	40,774718	3			1999					1999	
98								1685	1900	1878						
99									1685							
100				Du3	31,24635776	40,77466174	3			1999					1999	
101								1700	1900	1878						
102								1445	1900							
103				Du4	31,24604613	40,77466434	2			1999					1999	
104								1495	1900							

Table 4- continued.

No	Name_of_F	Name_of_S	Name_of_Tr	Code_T	Lon	Lat	Event_T	Eq_date_min	Eq_date_max	Corr	Rptr_L	Rptr_M	Slip_R	Rec_Int	Last_rup	Ref
105	NAFS	Düzce	Çakır Hacı Ibrahim	Du5	31,13142313	40,76621592	3			1999					1999	Pantosti et al., 2008
106								1488	1900	1878						
107								1488	1900							
108				Du6	31,13083814	40,76708091	2			1999					1999	Emre et al., 2001
109								1700	1900	1719						
110			Çınarlı	Du7	31,11182353	40,76553579	3			1999					1999	Pantosti et al., 2008
111								1675	1900	1878						
112								1280	1700							
113		Karadere	Eften	Kr1	31,02969988	40,7583738	5			1999				400-500	1999	Sugai et al., 2001
114								1551	1929					400-500		
115								892	1232					400-500		
116								54	353					400-500		
117								-147	120					400-500		
118			Aksu	Kr2	30,95620694	40,75690868	3			1999					1999	Pantosti et al., 2008
119								1670	1900	1878						
120								685	1020							
121			Kazımiye	Kr3	30,82077942	40,72638926	5			1999					1999	Dikbas and Akyüz, 2010
122										1719						
123										1419						
124								420	584	554						
125								231	584	358						
126		Dokurcun	Relief	Do1	30,73289469	40,58398436	2			1967				200-300	1967	Palyvos et al., 2007
127								1693						200-300		
128			Mudurnu_ Beldibi	Do2	30,70939821	40,58649144	2			1967	55	7,1			1967	Ikeda et al., 1991
129								1650		1668						
130		Arifiye	NA	Ar1	30,34772	40,71097	4			1999			22		1999	Dikbas et al., 2009
131										1719			22			
132										1567			22			
133										1000			22			
134		Geyve	Loc5	Gy1	30,28289093	40,48516157	1	-398	-204							Yoshioka and Kuscu, 1994

Table 4- continued.

No	Name_of_F	Name_of_S	Name_of_Tr	Code_T	Lon	Lat	Event_T	Eq_date_min	Eq_date_max	Corr	Rptr_L	Rptr_M	Slip_R	Rec_Int	Last_rup	Ref
135	NAFS	Tepetarla	Acısu	Te1	30,12375089	40,71967278	1	1120	1280	1180					1999	Pavlides et al., 2006
136			Ottoman_ Canal	Te2	30,06301	40,72169	3			1999					1999	Rockwell et al., 2001b
137										1754		7				
138										1719		7,5				
139			Köseköy	Te3	30,02527	40,72359	3			1999					1999	Rockwell et al., 2001b Rockwell et al., 2009
140								1754	1894	1878		7				
141										1719		7,5				
142			Asağıyuvacık	Te4	29,96326	40,72101	2			1999					1999	Pavlides et al., 2006
143								1290	1630	1509						
144		Gölcük	Hisar River	Go1	29,85926418	40,70830343	3			1999		7,4		210-280	1999	Klinger et al., 2003
145								1539	1825	1719		7,4		210-280		
146								1357	1548	1509				210-280		
147			Denizevler	Go2	29,85346	40,71328	4			1999					1999	Pavlides et al., 2006
148								-3131	920	554						
149								-4575	-3616	-4096						
150								-9058	-7530	-8294						
151		Darıca	Hersek MT	Dr1	29,49720	40,72134	4			1894					1999	Özaksoy et al., 2010
152										1754						
153										1719						
154										1509						
155		Gemlik	Terme	Ge1	29,15977	40,42246	2			1857			5	438	1857	Özalp et al., 2013
156								1216	1770	1419	95		5	438	1857	Özalp et al., 2013, 2003
157		Yenice_ Gönen	Muratlar	Yg1	27,59485	40,07472	3			1953					1953	Kürçe et al., 2008
158								1208	1538	1440						
159																
160			Seyvan	Yg2	27,31502	39,93714	6			1953				300-600	1953	Dirik et al., 2008
161								1290	1410					300-600		
162								650	900					300-600		
163								240	530					300-600		
164								-50	140					300-600		
165								-400	-340					300-600		
166				Yg3	27,2901	39,92495	3			1953				660±160	1953	Kürçer et al., 2008 Pavlides et al., 2009
167								620	1270	620				660±160		
168								-2500						660±160		

Table 4- continued.

No	Name_of_F	Name_of_S	Name_of_Tr	Code_T	Lon	Lat	Event_T	Eq_date_min	Eq_date_max	Corr	Rptr_L	Rptr_M	Slip_R	Rec_Int	Last_rup	Ref
169	NAFS	Ganos	Güzelköy	Ga1	27,26931	40,73172	5			1912		7,4	17	323±142	1912	Meghraoui et al., 2012
170								1429	1776	1766						
171								1311	1397	1354						
172								692	1320	1063						
173								-1042	76							
174			Kavaklı	Ga2	26,88568	40,61564	5			1912		7,4	18	275	1912	Rockwell et al., 2001a
175										1766						
176										1354						
177								824	1350	1063						
178								-2000	-2000							
179			Saroz	Ga3	26,86186	40,61019	4	1655		1912				283+113	1912	Rockwell et al., 2001b Rockwell et al., 2009
180								1655		1766				283+113		
181								900		1354				283+113		
182								900		1063				283+113		
183		Kumkale fault	Kumkale	Ku1	26,23313	39,98318	2	130	780							Kürçer et al., 2012
184								1000	1300							

Table 5- The paleoseismological catalogue of onshore core samples along the NAFS.

No	Name_of_F	Name_of_S	Name_of_Tr	Code_T	Lon	Lat	Event_T	Eq_date_min	Eq_date_max	Corr	Rptr_L	Rptr_M	Slip_R	Rec_Int	Last_rup	Ref
w1	NAFS	Darıca	Hersek west	He1	29,46950777	40,71829668	3			1894						McHugh et al., 2006
w2										1766						
w3										1509						
w4		Suşehri	Asağı Tepecik_ Core	Su1	38,58849	40,03884	4			1668					1939	Hubert_ Ferrari et al., 2012
w5										1543					1939	
w6										1254					1939	
w7										1939		7,9			1939	
w8		Manyas	Manyas_ Core	Ma1	27,97317	40,21588	2			460						Leroy et al., 2002
w9										368						
w10		Ganos	Transform basin	Ga1	27,34987	40,75183	5			1965						McHugh et al., 2006
w11										1912						
w12										1859						
w13										1828						
w14								1810	1922							

Table 5- continued.

No	Name_of_F	Name_of_S	Name_of_Tr	Code_T	Lon	Lat	Event_T	Eq_date_min	Eq_date_max	Corr	Rptr_L	Rptr_M	Slip_R	Rec_Int	Last_rup	Ref
w15	NAFS	Kumburgaz	Central_ Basin_core	Ku2	27,9994	40,8208	2			1343						McHugh et al., 2006
w16										740						
w17		Tekirdağ	Tekirdağ_ Basin_ Core	Te1	27,59718	40,80774	2			1912						
w18										1063						
w19		İzmit_ Körfez	İzmit	Ig1	29,75936	40,7338	3			1999						
w20									824	740						
w21									182	181						
w22		Çınarcık	Çınarcık	Ci1	28,92013537	40,72271163	2			986						Sarı and Çağatay, 2006
w23										553						
w24		Darıca	Lag	Da1	29,51579	40,72175	4			1719						Bertrand et al., 2011
w25										1509						
w26										987						
w27										740						
w28		Kumburgaz	Central	Kb1	27,99999	40,83338	6			1963						McHugh et al., 2006
w29										1343						
w30										860						
w31										740						
w32										557						
w33										268						
w34		Karamürsel	Karamürsel	Ks1	29,62	40,72836	8			1999						Çağatay et al., 2012
w35										1509		7,2				
w36										1296						
w37										865						
w38										740						
w39										358						
w40										268						
w41										-427						

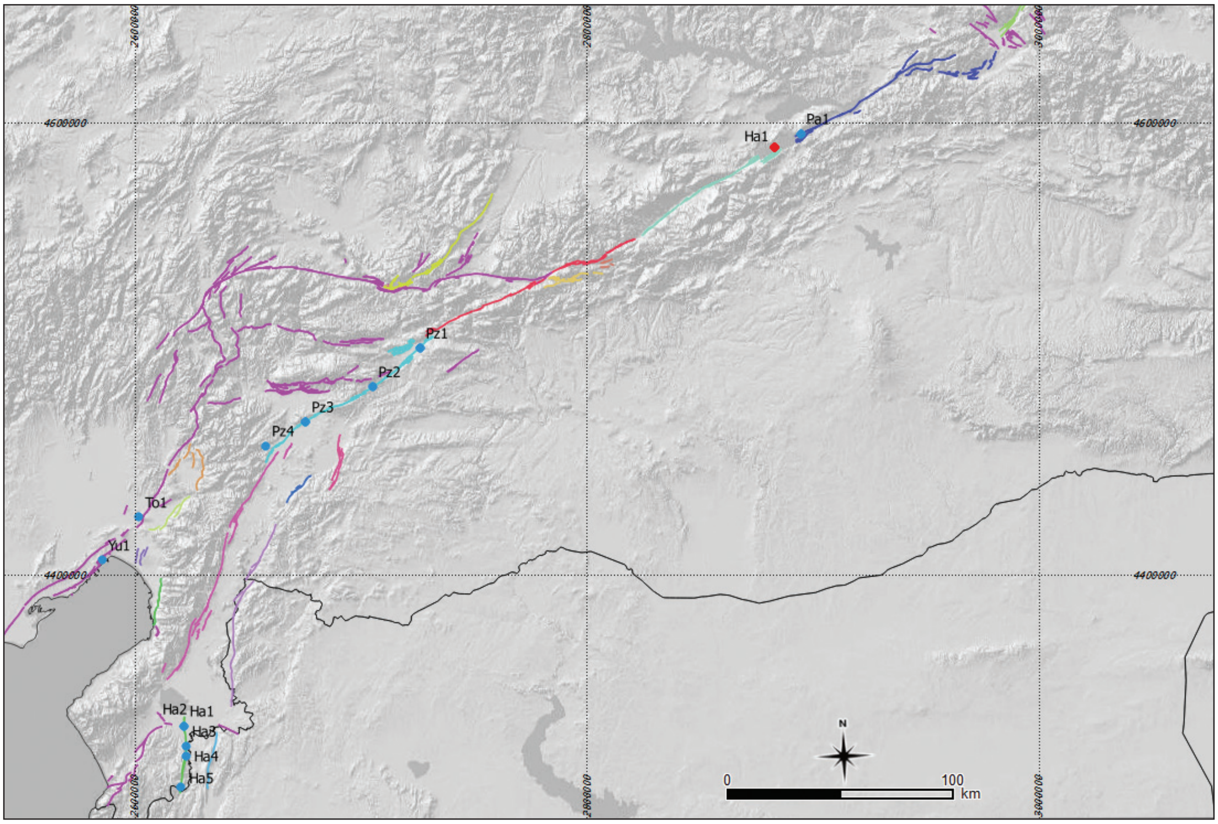

Figure 6- Paleoseismological trench (blue) and an offshore core sample from lake sediments (red) points along the EAFS. Their attributes are in tables 6 and 7. Colouring makes a distinction among fault segmentations.

Table 6- The paleoseismological catalogue of onshore core samples along the EAFS.

No	Name_of_F	Name_of_S	Name_of_Tr	Code_T	Lon	Lat	Event_T	Eq_date_min	Eq_date_max	Corr	Rptr_L	Rptr_M	Slip_R	Rec_Int	Last_rup	Ref
w42	EAFS	Pötürge-Palu	Hazar lake	Ha1	39,395 56	38,48 198	8			1874				300		Hubert_Ferrari et al., 2005
w43										1789						
w44										1513						
w45										1284						
w46										995						
w47										602						
w48								440	1							
w49								-650	-300							

Table 7- The paleoseismological catalogue of the EAFS and DSFS.

No	Name_of_F	Name_of_S	Name_of_Tr	Code_T	Lon	Lat	Event_T	Eq_date_min	Eq_date_max	Corr	Rptr_L	Rptr_M	Slip_R	Rec_Int	Last_rup	Ref
185	EAFS	Palu	Hazar Gölü	Pa1	39,53072	38,53218	5	1680	1940	1874		7,1		100-360		Çetin et al., 2003
186									1420	1513		7,4		100-360		
187									400	450				100-360		
188										150				100-360		
189										-3620				100-360		
190		Pazarcık	Balkar	Pz1	37,56969	37,73666	5	900	1200	1114	60			1000-1200		Karabacak et al., 2012
191								-420	-200		40			1000-1200		
192										-1800				1000-1200		
193								-2800			80			1000-1200		
194										-8500	60			1000-1200		
195			Nacar	Pz2	37,32592	37,58721	3	900	1200	1114	60			1000-1200		
196								300	399					1000-1200		
197									-1000					1000-1200		
198			Tevekkeli	Pz3	36,98811	37,453574	5	1500	1600	1513	40			1200-1300		
199								200	250		70			1200-1300		
200								-4000	-3000		80			1200-1300		
201								-5400	-5000					1200-1300		
202								-8000	-7500		35			1200-1300		
203			Imalı	Pz4	36,78698	37,36097	2		-100							
204																
205		Toprakkale	Toprakkale	To1	36,14924	37,08404	2	425	570	524	40					
206								-1900	400	-1000	60					
207		Yumurtalık	İncirli	Yu1	35,96248	36,9145	2		-544	-1000	60					
208								-7292	-2814							
209	DEAD SEA	Hacıpaşa	Demirköprü	Ha1	36,35586	36,24927	2	1470		1872						Altunel et al., 2009
210									1442	1408						
211				Ha2	36,35588	36,2477	2	1801	1940	1872						
212										1408						
213			Ziyaret	Ha3	36,3653	36,16881	2	1650		1872				464-549		Akyüz et al., 2006
214								1310	1442	1408	20			464-549		
215			Yazlık	Ha4	36,36279	36,12799	2	1310	1426	1408	20			464-549		
216									1390	859				464-549		
217			Harabe	Ha5	36,33669	36,0071	2	1019		1408				464-549		
218									1019					464-549		

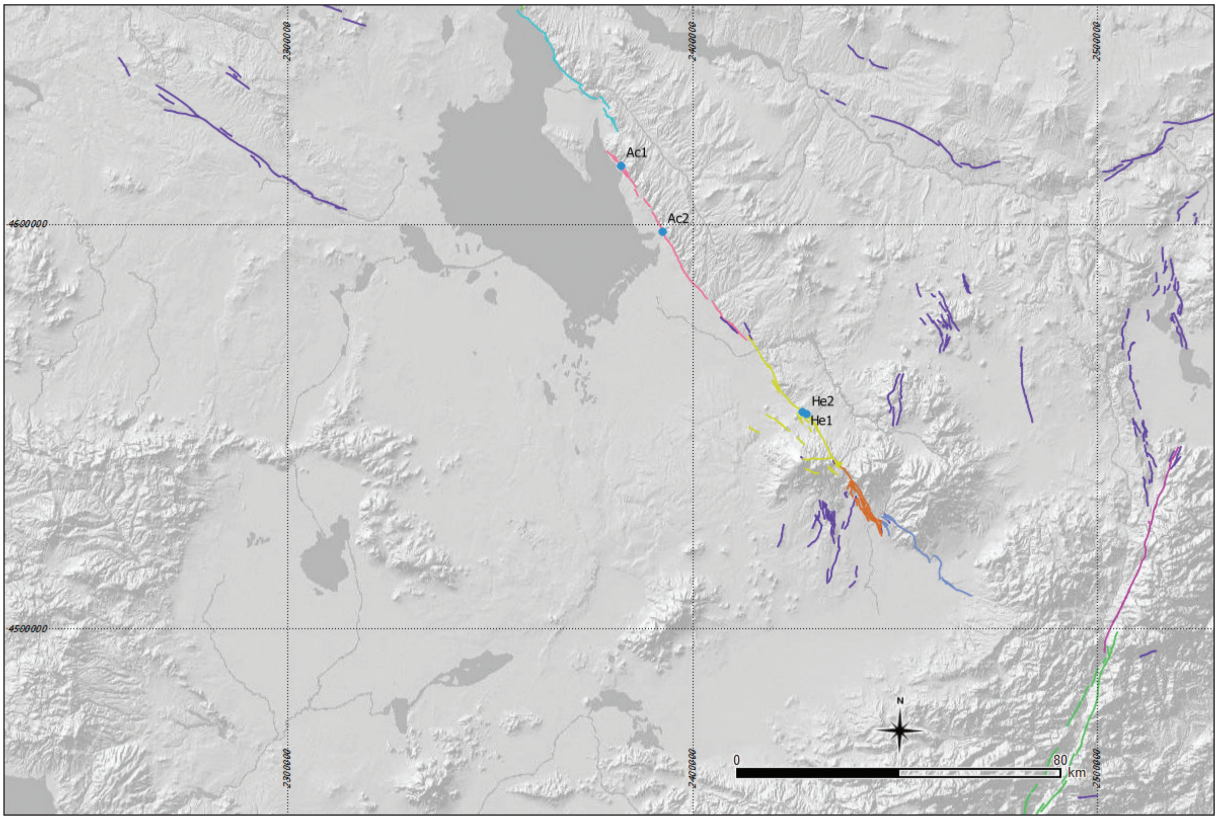

Figure 7- The map shows paleoseismological trench locations along active faults (Emre et al., 2013 and 2018) in central Anatolia. The attributes are in table 8. Colouring is for fault segmentation.

Table 8- The list of attributes for paleoseismological catalogue of the central Turkey.

No	Name_ of_F	Name_ of_S	Name_ of_Tr	Code _T	Lon	Lat	Event _T	Eq_ date_ min	Eq_ date_ max	Corr	Rptr _L	Rptr _M	Slip _R	Rec_ Int	Last_ rup	Ref
219	Tuz Gölü	Acıpınar	Tuzgölü	Ac1	33,64574	38,78449	4	-2130	-1660				0,05			Kürçer et al., 2011
220								-9630	-4940							
221								-21980	-16580							
222								-32590	-25410							
223			Altınkaya	Ac2	33,76614	38,63866	3	-7190	-1990				0,05			
224								-11310	-7190							
225								-24540	-16010							
226		Helvadere	Duru	He1	34,1696	38,23969	3	-1360	1950				0,03	4664		
227								-10550	-3600							
228								-27640	-14710							
229			Bağlar-kayası	He2	34,17942	38,23503	2	-3710	-580				0,03	4664		Kürçer et al., 2011
230								-8460	-7700							

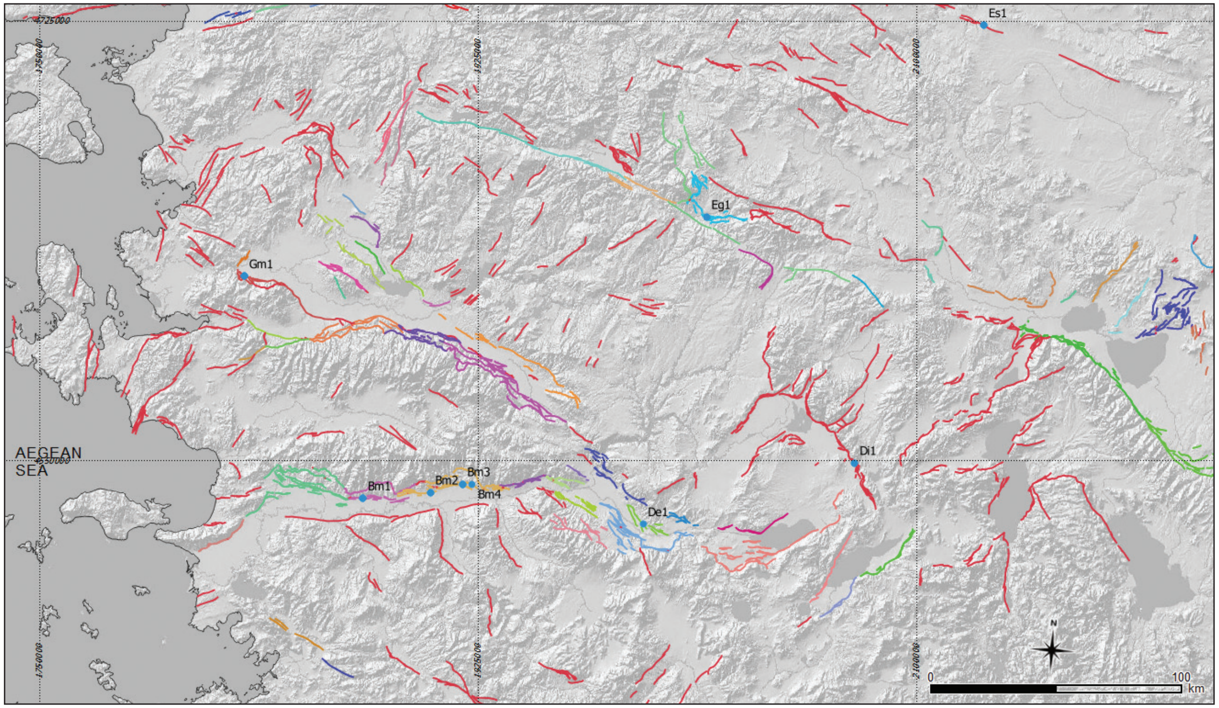

Figure 8- The map shows paleoseismological trench locations along the active faults (Emre et al., 2013 and 2018). Their attributes are in table 9. Fault coloring is for segmentation.

Table 9- The list of attributes for paleoseismological catalog of the western Turkey.

No	Name_of_F	Name_of_S	Name_of_Tr	Code_T	Lon	Lat	Event_T	Eq_date_min	Eq_date_max	Corr	Rptr_L	Rptr_M	Slip_R	Rec_Int	Last_rup	Ref
231	Manisa	Gediz - Manisa	Trench1-2	Gm1	27,3129506	38,6189389	4			926						Özkaymak et al., 2011
232										1595						
233										1664						
234										1845						
235	Büyük Menderes - Umurlu	Büyük Menderes - Umurlu	Umurlu	Bm1	27,93353	37,85839	4	1668		1899						Altunel et al., 2009
236								1488	1668	1653						
237									1441							
238								732	1190							

Table 9- continued.

No	Name_of_F	Name_of_S	Name_of_Tr	Code_T	Lon	Lat	Event_T	Eq_date_min	Eq_date_max	Corr	Rptr_L	Rptr_M	Slip_R	Rec_Int	Last_rup	Ref
239	Büyük Menderes - Atca	Büyük Menderes - Atca	Atca	Bm2	28,23628	37,89711	3	721								Altunel et al., 2009
240								353	721							
241								141	353							
242			Nazilli	Bm3	28,37878	37,93538	4			1653						
243									1017							
244								545	595							
245								17	220							
246				Bm4	28,42102	37,9378	1		597							
247	Denizli	Denizli	Kocadere	De1	29,2092706	37,83614272	1	-584								Meriç et al., 2006
248	Erdoğmuş	Gediz	Erdogmus1	Eg1	29,41141	38,95168	2			1970						Gürboğa, 2011, 2013
249								990	1020							
250	Dinar	Dinar	NA	Di1	30,15391	38,09996	2			80			1	1500	1995	Altunel et al., 1999
251								-1500	53	-1500			1	1500	1995	
252	Eskişehir	Eskişehir	Kanlıpınar	Es1	30,64542	39,69331	3	1280	1320			6,5				Kürçer et al., 2012
253								-390	20			6,5				
254								-810	-770			6,5				

3. Discussion

In agreement with historical and instrumental information, all previous researches confirm that NAFS reactivated during destructive earthquakes in the past centuries (Tan et al., 2008; Kalafat et al., 2011; Kadirioğlu et al., 2018). For this reason, we focused on the NAFS and analyzed its seismic activity segment by segment for the first usage of this catalogue. As is known from literature (Barka and KadinskyCade, 1988; Crone and Hailer, 1991; Knuepfer et al., 1989; Wheeler, 1987; dePolo et al., 1989; Crone and Hailer, 1991), the seismic and geometric segments of faults are still under discussion.

If any geometric segment or some part of it reactivates and creates a noteworthy earthquake, it is called a seismic segment. Such description creates some hesitations about the existence of huge past events on different segments. Similar controversial segmentations are present along the NAFS for destructive earthquakes. For this reason, we use the geometric segmentation suggested by Emre et al. (2013 and 2018) in our paper. Thus, the compilation of earthquakes and their usage in catalogues are very efficient for the scientific applications. Radiocarbon dating results from the palaeoseismological researches may not allow accessing a reliable data about certain strong earthquake all the time. However, most of them could be achieved by systematic trenching along the active faults, and the results enable to reach the certain data in this way. For instance, the 1688 earthquake was a very destructive event. It was identified and dated by the researchers along the NAFS. But the question is that which segments were reactivated. The catalogue evaluation could help us to answer of the question. The Erbaa, Destek, Ilgaz and Gerede segments are the sources of the 1688 earthquake according to previous works. On the other hand, the trenches along the Havza and Kamil segments located between Destek and Ilgaz do not record the 1688 earthquake (Figure 9). In this frame, were there two events happened along the different segments in 1688 or the 1688 event could not be determined along Destek and Ilgaz segments? Obviously, this catalogue will provide important data when it is necessary to make such a discussion and try to solve them in scientific ways.

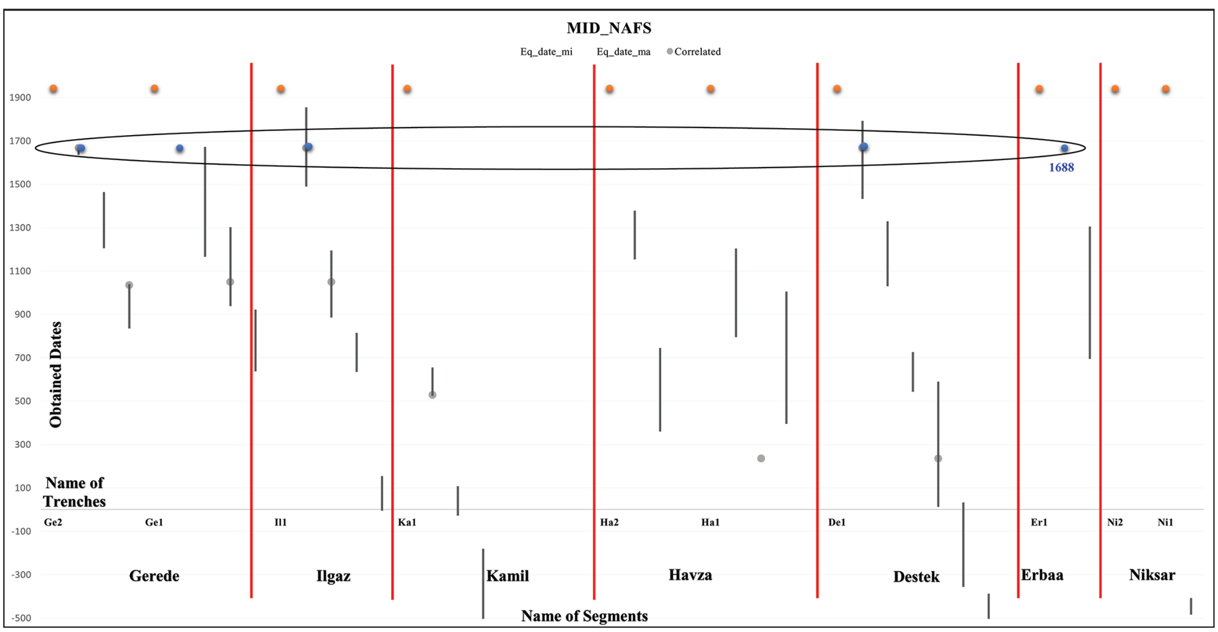

Figure 9- The chart shows comparison of the historical earthquakes from trenches in the central part of the NAFS. Red lines are the boundary of segments. The 1688 earthquake is an example for the problematic situations occurred along the central NAFS.

4. Conclusion

Totally 250 events obtained from the trenches on land, and 49 offshore data sets from core samples evaluated in paleoseismological studies published in both the national and international publications before 2012 were used for this catalogue. Only the studies that have definite locations, dating results and recurrence intervals are in it. The locations of all trenches are in the format of WGS84 system regarding given coordinate information in the source papers.

Excluding some parts of the NAFS, paleoseismological studies are scarce, locations of trenches and recurrence intervals in some researches are not clear along the active faults. Although some missing information is present in this catalogue due to the incomplete data in references, it is the first compiled catalogue including paleoseismological results covering whole Turkey. We believe that this compilation is to be very helpful for the researchers who would like to apply more paleoseismological works or seismic risk analyses.

Comparison results of trench studies along the NAFS, EASF, Western Turkey, and central Anatolia indicate that paleoseismological researches are very limited in central Anatolia (Tan et al., 2008). This is associated to very long recurrence interval of earthquakes in this area. If the trenching surveys are being increased in the future, this evaluation will come closer to the truth. The other comparison between segments and destructive earthquakes is done by using the Electronic Supplementary Material in this paper.

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