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THE FIRST PALEOSEISMIC TRENCH DATA FROM ACIPAYAM FAULT, FETHİYE BURDUR FAULT ZONE, SW TURKEY

Kürçer A.[1], Özdemir E.[1], Uygun Güldoğan Ç.[1] and Duman T.Y.[1]

[1]Department of Geological Research, General Directorate of Mineral Research and Exploration, 06800 Ankara, Turkey, akin.kurcer@mta.gov.tr

Abstract

The Acıpayam Fault is an active fault segment which is located on the central part of Fethiye Burdur Fault Zone in SW Turkey. According to the Active Fault Map of Turkey published by MTA (Turkey), it is described as a Quaternary fault. Acıpayam Fault extends from Acıpayam at northeast to Akköprü Dam at southwest. The general strike of fault is N 35°E, approximately 60 km long and it's a normal fault with minor sinistral strike-slip component. The fault is composed of three fault section, which are named as Örenköy, Olukbaşı and Yolçatı, seperated from each other by step-over zones. In this study, active tectonic features of Acıpayam fault are investigated and paleoismological trench surveys are perfomed at the Örenköy fault section. Two cross trenches were excavated along the fault. The samples collected from the trenches were dated using the ^{14}C dating method. Örenköy trenches were photographed using the Paleoseismological Three Dimensional Virtual Photography Method, which is a new tecnique for paleoseismology. According to the trench microstratigraphy, structural data and dating results, Acıpayam fault is described as a Holocene fault. The date of last event that occurred on the Acıpayam fault is between 3030 ± 30 BP and 2410 ± 30 BP.

Keywords: *Acıpayam fault, Fethiye Burdur Fault Zone, SW Turkey, Paleoseismology, Trench, ^{14}C dating method.*

Περίληψη

Το ρήγμα Acipayam είναι ένα τμήμα ενεργού ρήγματος το οποίο εντοπίζεται στο κεντρικό κομμάτι της ζώνης ρηγμάτων Fethiye Burdur στην ΝΔ Τουρκία. Με βάση το ν Χάρτη Ενεργών Ρηγμάτων της Τουρκίας που δημοσίευσε η MTA (Τουρκία), περιγρά φεται ώς ρήγμα Τεταρτογενούς ηλικίας. Το ρήγμα Acipayam εκτείνεται από το Acipayam στα ΝΑ ως το Akköprü Dam στα ΝΔ. Η γενική παράταξη του ρήγματος είναι Β 35°Α, με 60 km περίπου μήκος και είναι κανονικό ρήγμα με μικρή αριστερόστροφη συνιστώσα Το ρήγμα αποτελείται από τρία τμήματα, που ονομάζονται Örenköy, Olukb aşı και Yolçatı, που διαχωρίζονται μεταξύ τους από ζώνες κλιμακώσεων. Στην παρούσα έργασία, διερευνώνται τα ενεργα τεκτονικά χαρακτηριστικά του ρήγματος Acipayam και εκτελούνται παλαιοσεισμολογικές τομές στο τμήμα Örenköy του ρήγματος. Δύο τομές εκσκάφθηκαν κατά μήκος του ρήγματος. Τα δείγματα που συλλέχθηκαν από τις τομές χρονολογήθηκαν με την μέθοδο ^{14}C. Οι παλαιοσεισμολογικές τομές του Örenköy φωτογραφήθηκαν χρησιμοποιώντας την μέθοδο Paleoseismological Three Dimensional Virtual Photography, η οποία είναι μία καινούρια τεχνική για την παλαιοσεισμολογία. Με βάση την στρωματογραφία της

τομής, τεκτονικές δομές και τα αποτελέσματα της χρονολόγησης, το ρήγμα Acipayam περιγράφεται ως Ολοκαινικό ρήγμα. Η χρονολογία του τελευταίου γεγονότος που συνέβη στο Λέξεις κλειδιά: βρίσκεται ανάμεσα 3030 ± 30 BP και 2410 ± 30 BP.
Λέξεις κλειδιά: *Ρήγμα Acipayam, Fethiye Burdur Ζώνη Ρηγμάτων, ΝΔ Τουρκία, Παλαιοσεισμολογική Τομή, Χρονολόγηση ^{14}C.*

1. Introduction

The eastern Mediterranean region, including the surrounding areas of western Turkey and Greece is seismically active and rapidly deforming regions within the continents due to the northward convergence of the African and Arabian plates with respect to the Eurasian plate along a complex plate boundary. As a result of this convergence tectonic processes, the active tectonics of the Anatolian Block and its vicinity is mainly controlled by the intracontinental active fault systems (etc. North Anatolian Fault System, East Anatolian Fault System, Dead Sea Fault Zone, Fethiye Burdur Fault Zone) and the Aegean and Cyprean Subduction Zones (Figure 1).

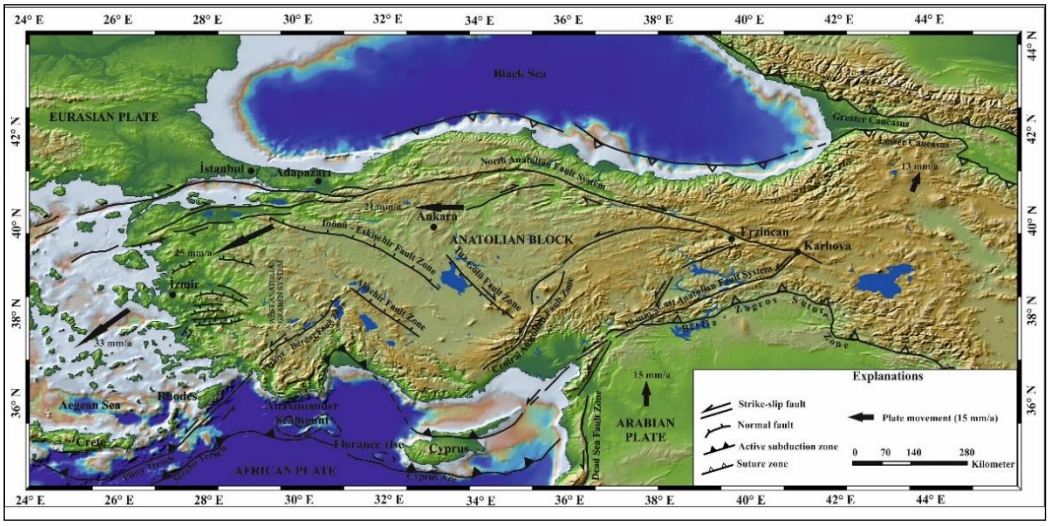

Figure 1 - Simplified active tectonic map of eastern Mediterranean region superimposed on topography (modified from Çiftçi, 2007; Koçyiğit and Özacar, 2003; Kürçer, 2012; Okay *et al*., 2000; Özsayın, 2007; Woodside *et al*., 2002; Yolsal-Çevikbilen and Taymaz, 2012; Zitter *et al*., 2005; Kürçer *et al*., 2015) Black arrows and corresponding numbers show GPS-derived plate velocities (mm-year) (Reilinger *et al*., 2006). Geomapp Application data were used for the digital elevation model.

The Southwestern Turkey is a complex deformation area which is mainly controlled by the Western Anatolian Graben System (WAGS) and partly by the Fethiye Burdur Fault Zone (FBFZ). Many papers have been published about the seismicity and active tectonics of the SW Turkey and surrounding area (i.e. Dumont *et al.*, 1979; Koçyiğit, 1984; Şaroğlu *et al*., 1987; Barka and Reilinger, 1997; Yağmurlu, 2000; Yaltırak *et al*., 2010; Över *et al*., 2010 and 2013a, 2013b).

The Fethiye Burdur Fault Zone (FBFZ), is first proposed by Dumont *et al*. (1979) as a sinistral strike-slip fault zone and is the NE extension of Pliny-Strabo trench in to the SW Anatolia. According to the Koçyiğit (1984), the origin of the WAGS is Aegean-Cyprean arc trench system and FBFZ is included in WAGS. Şaroğlu *et al*. (1987) suggested that the central part of FBFZ is composed of active sinistral strike-slip faults. Based on the GPS studies Barka and Reilinger (1997) claimed that the FBFZ is still an active sinistral strike-slip fault zone. FBFZ is described by Yağmurlu (2000) as a fault zone which is composed of several fault segments whose lengths are varying from 10 to 40 km. According to the Yağmurlu (2000), the FBFZ is a transform fault between

Cyprus and Hellenic arc. Neotectonic development of the basins (etc. Çameli, Eşen, Burdur) located on the FBFZ were studied by Alçiçek (2007) and Alçiçek *et al*. (2005, 2006, 2013). Based on the geological and structural data and mammalian fossils three different tectonic phase are identified in these basins. FBFZ is described by Yaltırak *et al*. (2010) as a sinistral shear zone in 40 km wide. Late Cenozoic stress state of basins along the FBFZ were studied by Över *et al*. (2010) and Över *et al*. (2013a, 2013b). According to the fault plane slip data and inversion of focal mechanism solutions predominantly stress regime is NW-SE extension. Additionaly May 12, 1971 Burdur earthqauake sequence was studied by Taymaz and Pierce (1991). Based on the seismological data and geological observations the source of this sequence is a normal fault, which is trending NE and dipping NW. Several archaeoseismological studies were performed on the Kibyra ancient city which is located on the central part of FBFZ. Based on the archaeogeological data collected from Kibyra fault is an active sinistral strike-slip fault (Akyüz and Altunel, 1997; 2001; ten Veen *et al*., 2007; Karabacak, 2011; Karabacak, *et al*., 2013). In contrast to this view several authors dosen't accept the existence of Kibyra fault (Elitez and Yaltırak, 2014). In order to test of kinematic characteristics of FBFZ, Kaymakçı *et al*. (2014) had conducted paleomagnetic and kinematic study in the region. Paleomagnetic data, slickenside pitches and contracted paleostress configurations along the FBFZ indicated that the faults in the FBFZ are mainly normal in character. Several paleoseismological studies were performed northern part of the FBFZ (etc. Bozcu *et al*., 1997; Yağmurlu *et al*., 2008).

According to the Active Fault Map of Turkey (Emre *et al*., 2013) active faults in the SW Turkey have been evaluated as normal faults with minor sinistral strike-slip component (Figure 2). Acıpayam fault is located on the central part of FBFZ (Figure 3).

This study mainly concerned with the active tectonic and paleoseismological fatures of Acıpayam fault. The aim of this paper to understand the Holocene seismic activity of Acıpayam Fault. To accomplish this, we have performed paleoseismic trenching along the Acıpayam Fault.

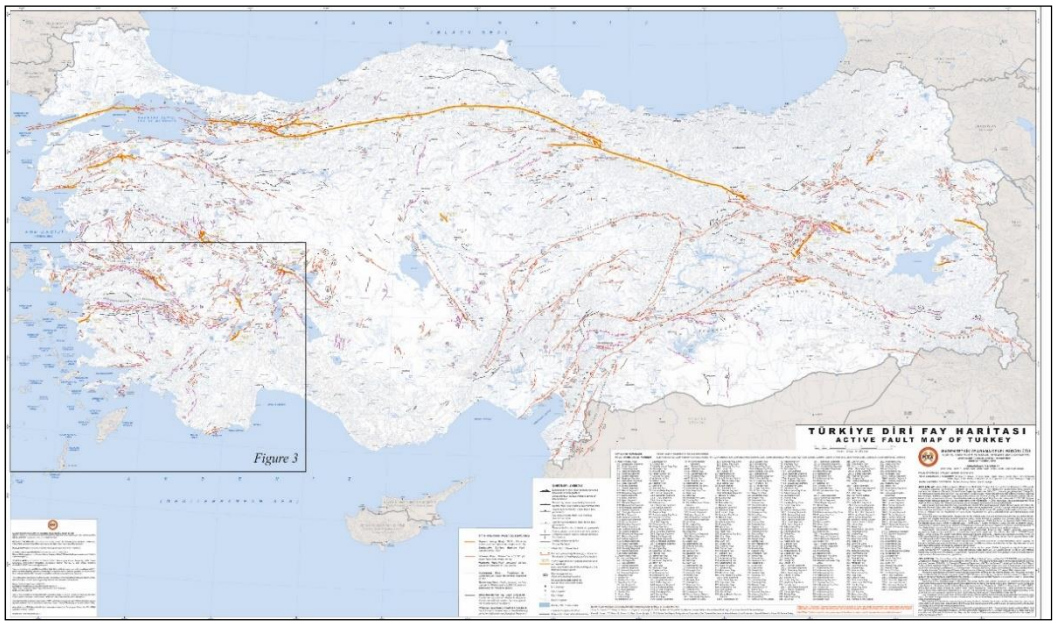

Figure 2 - Active fault map of Turkey (Emre *et al*., 2013).

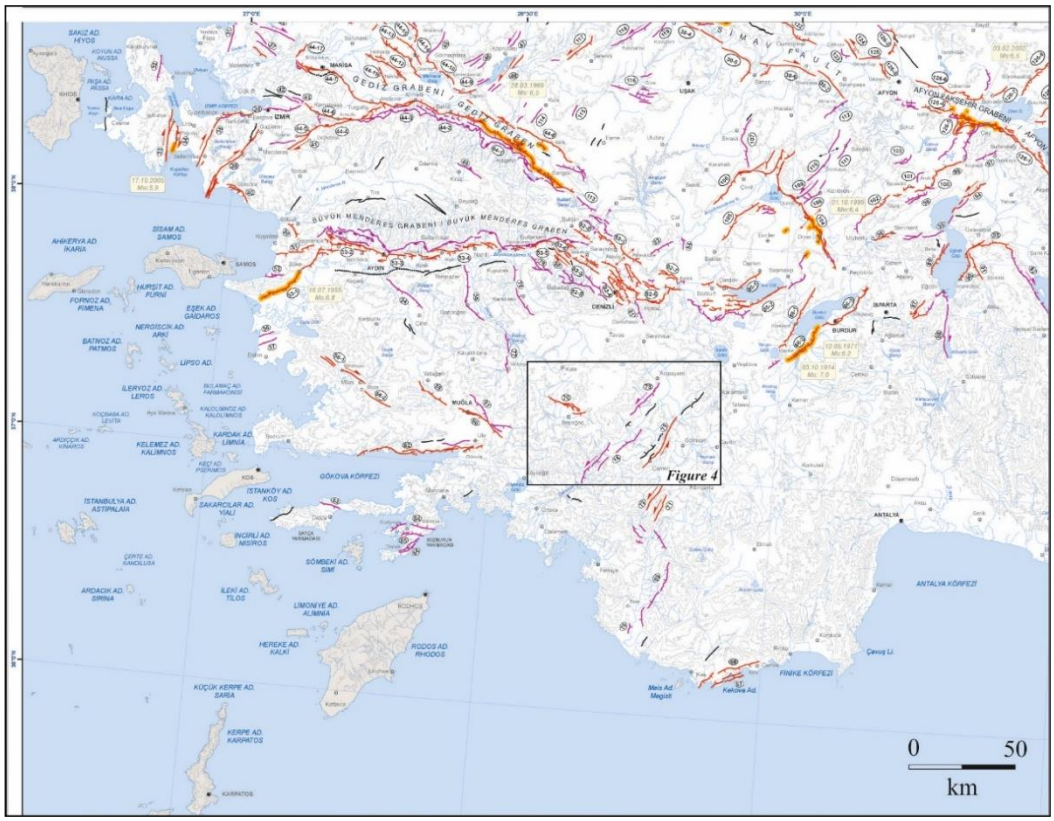

Figure 3 - Active fault map of SW Turkey (Emre *et al*., 2013). Acıpayam fault is represented by number 73.

2. Acıpayam Fault

Acıpayam Fault (AF) is an active fault which is about 60 km in length, is characterized by a number of normal faults with minor left lateral strike-slip component (Figure 4). The general strike of AF is N35°E and it's composed of three main fault section, which are named as Örenköy, Olukbaşı and Yolçatı, seperated from each other by step-over zones. Mesozoic ophiolitic rocks, Paleocene-Eocene clastics and carbonates, Early Miocene continental clastics, Late Miocene-Pliocene continental and lacustrine deposits and Quaternary fan deposits are cutted by the Acıpayam Fault along the fault trace.

The Yolçatı section, which is the southwesternmost part of AF, is 23 km long normal fault. The central part of AF is called as Olukbaşı section. The length of this section 12 km. Örenköy section which is the northeastern part of AF is 20 km long a normal fault with minor sinistral strike-slip component.

3. Paleoseismic Trenching along the Acıpayam Fault

In this study, two paleoseismological trenches which were parallel to each other were excavated along the Örenköy section of the AF (Figure 4). The fault trace is characterised by a fresh fault scarp on the field (Figure 5). Örenköy trench site, which was selected by aeiral photo analyses, tectonomorphological structures and geological observations, is located at 500 m NE of Örenköy in an area where Quaternary alluvial fan deposits (Figure 6). Four samples which were collected from the two trenches and dated in Beta Analitic Laboratory (USA) using the ^{14}C dating method.

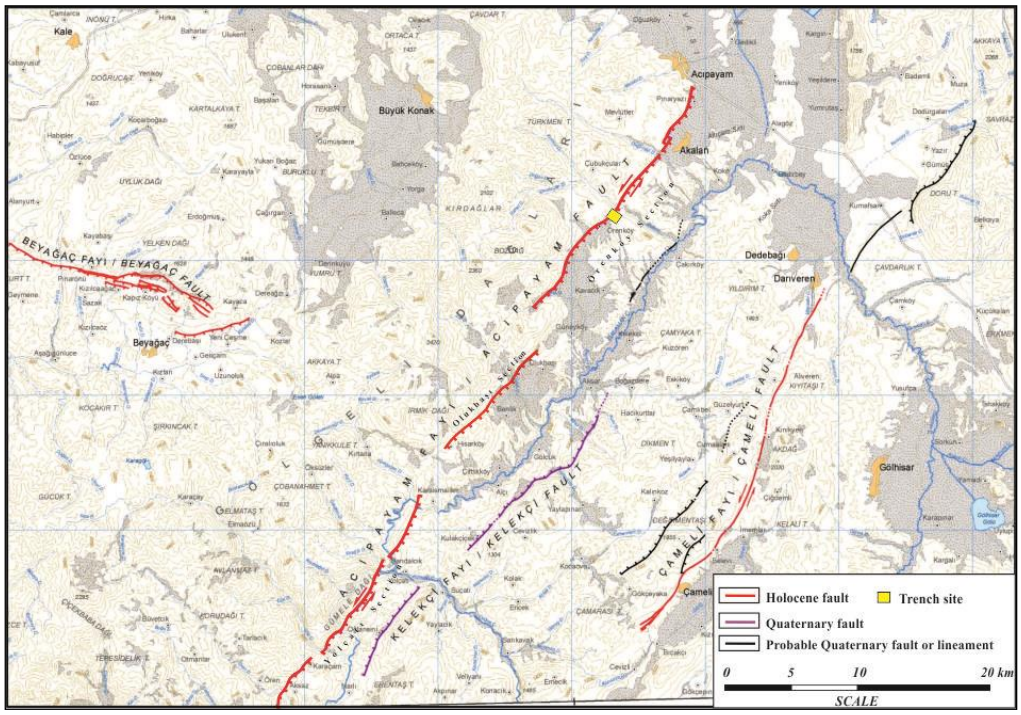

Figure 4 - Active fault map of Acıpayam Fault and its vicinity (Modified from Emre *et al.*, 2011).

The trenches were excavated perpendicular to the direction of Örenköy fault section (N40°W). Here we present the 13 meters of the northern wall of Örenköy Trench 1 exposure to summarize the deformation style and fault characteristics (Figure 7).

Three different sedimentary package were identified on the trench walls. The oldest package was interpreted as Mevlütler formation (Aquitanian-Burdigalian). This formation is consisted of fluvial deposits. The second package is Plio-Quaternary (?) alluvial fan deposits. It's composed of sand, mud and gravel alternation. And the relatively youngest package is consisted of gravel. Based on the ^{14}C dating results the youngest units (3 to 7) are evaluated as Holocene deposits.

The trenches were photographed using the Paleoseismological Three Dimensional Photography Method which is a new technique for paleoseismology. This method was applied previously in several paleoseismological studies (etc. Kürçer, 2012; Kürçer and Gökten, 2012; Kürçer and Gökten, 2014).

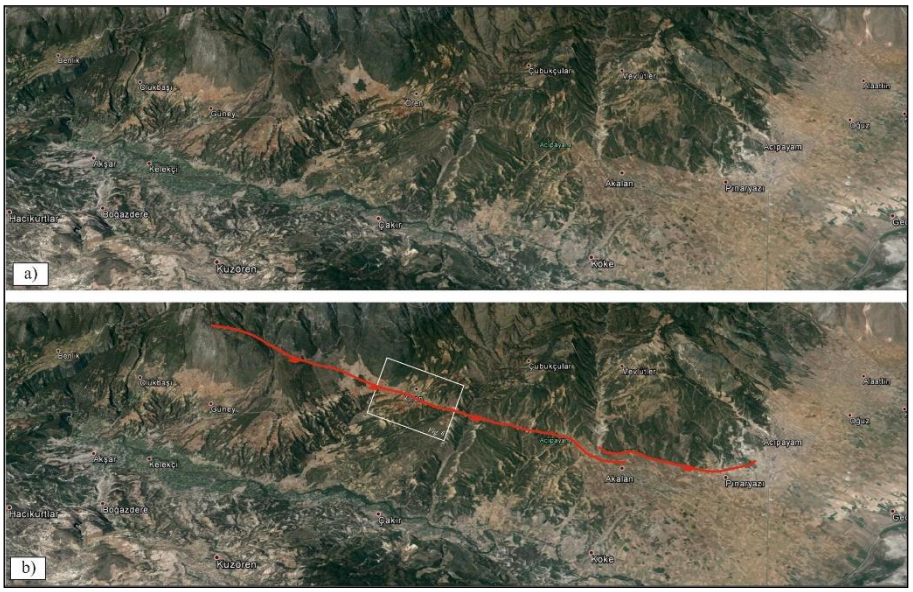

Figure 5 - Google Earth views of the Örenköy Section, (a) Uninterpreted, (b) Interpreted (vertical scale three times exaggerated, view to W).

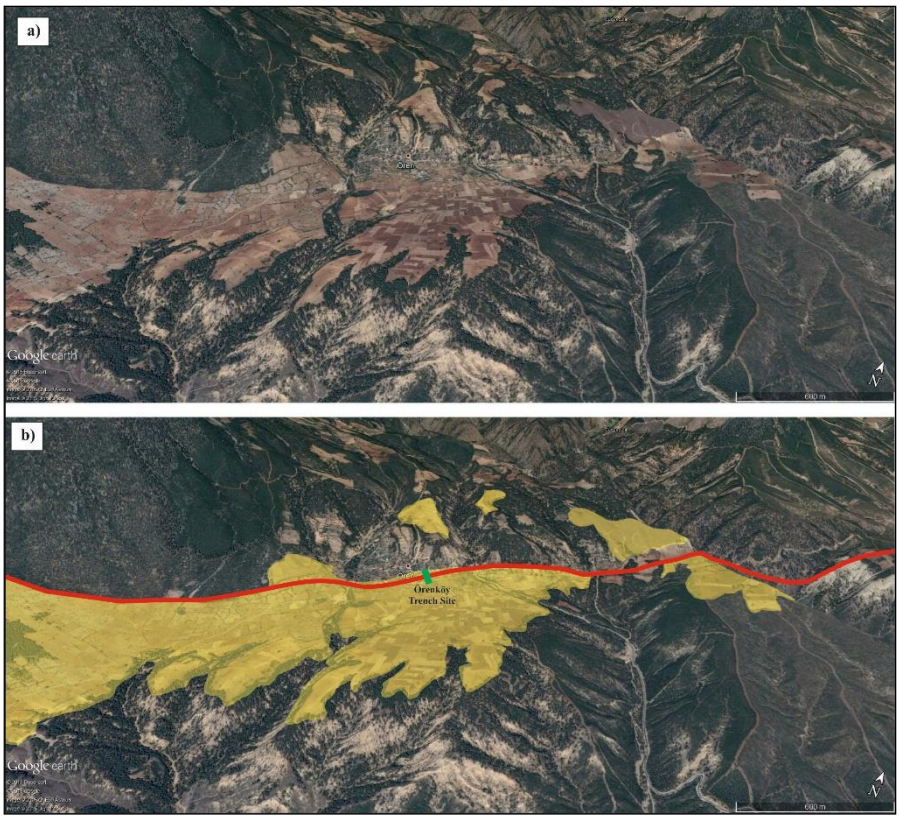

Figure 6 - Google Earth views of the Örenköy Trench site, (a) Uninterpreted, (b) Interpreted (vertical scale three times exaggerated, view to NW).

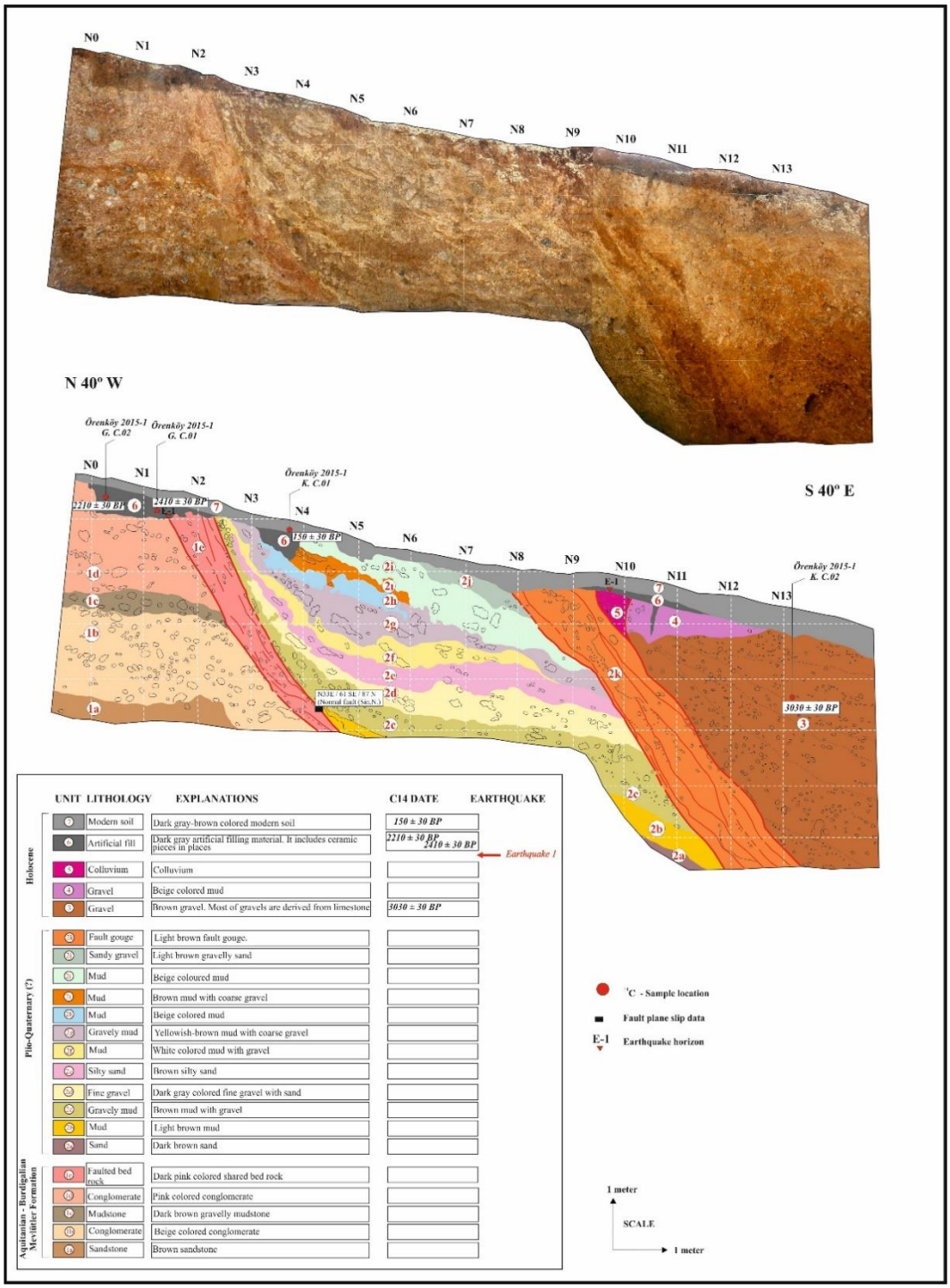

Figure 7 - Photomosaic and Trench log of northern wall of Örenköy Trench 1.

4. Discussion and Conclusion

In this study reliable paleoseismic data were obtained about the Holocene activity of Acıpayam fault. Based on the trench microstratigraphy, structural pattern and ^{14}C dating results the Holocene activity of Acıpayam fault revealed precisely. According to the dating results, the last event that occurred on the Acıpayam fault was dated between 3030 ± 30 BP and 2410 ± 30 BP.

Additionaly, based on the structural observations and fault plane slip data measured from trenches, the kinematic characteristics of Acıpayam fault was revealed. According to the fault plane slip data, Acıpayam fault is a normal fault with minor sinistral strike-slip component (Figure 7).

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