The Interpretation of Quaternary-Sediments of the Çiftlik Basin (Ovalibağ),Niğde, Turkey

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Abstract -Quaternary – Holocene basin fills loosely cemented sediments through drilling in the whole plain of Çiftlik (Central Anatolia Cappadocia Volcanic Province, (CACVP) were investigated to elucidate the nature of basin fill deposits as well as the timing of sediment aggradation, paleosol and soil formation. Twelve (12) lithofacies comprised of Holocene sediments in the area are gravel, sand, mud, mud 1 (black peat), mud 2 (brown peat), mud 3 (orange peat), mud 4 (light brown peat), gray or green clay, light yellow clay and tuffs or pumice, paleosol, pumice describe the associated lithofacies (A-K). Paleosols and peat levels (Histosol) are recognized that they are inceptisols, Spodosol and andisol, according to the soil taxonomy. Paleosol or muds is mainly composed of opal A, opal CT, quartz, feldspar, pyroxene and clay minerals such as smectite, illite and chlorite. Weathering of the tuffs resulted in consumption of SiO_2, Al_2O_3+Fe_2O_3, TiO_2 and K_2O by precipitation of smectite±illite in paleosols. SiO_2, Ca, Na and K is depleted in the all paleosol horizons or peat levels, and it is enriched in ground water or transported by rivers.

As a result of the ^{14}C aging method on the Çiftlik plain profiles, they are divided into age ranges such as late Glacial, Late Glacial Maximum, initial Holocene, early Holocene, middle Holocene, young Holocene.

Index Terms -*Sediment fills, source area, weathering, sedimentary material, paleosols, peat, ^{14}C aging, climate records, Quaternary-Central Anatolia, Çiftlik Plain*

I. INTRODUCTION

In this area called the Central Anatolian Volcanic Province (CAVP), approximately 300km to 400km wide and 1200m above sea level, south of the Anatolide belt, the Çiftlik basin (plain) is located in the centre. It is circular and has a diameter of about 15 km. Numerous studies have been carried out in and around the Çiftlik Basin. Today, the Çiftlik plain is located on a plateau at an average altitude of 1500 m above sea level, between latitudes N38°10' and longitudes E34°29'. It is seen that this area is located in the middle of Kırşehir and Niğde massifs. It is also surrounded by six (6) formations or volcanic complexes that were settled at different times in the evolution of this region. The oldest formation is Tepeköy, which was formed in the Late Miocene, the youngest formation is the Karatas formation formed in the Pleistocene. -chemical and biogenic conditions gave rise to lacustrine, palustrine and fluvial deposits which allowed stratigraphic studies in three different locations of Çiftlik Basin. These are Ovalıbağ (P1), located between latitudes N38°12' and longitudes E34°26', and at an altitude of 1521 m above sea level. Melendiz (P2), located between latitudes N38°11' and longitudes E34°27', at an altitude of 1532m above sea level, and finally Imam Hatip (P3), located between latitudes N38°10' and longitudes E34°28', is at an altitude of 1535m above sea level. All of these are located in Turkey's Niğde province. Çiftlik plain developed around the Late Pleistocene in the Quaternary and was later filled with sedimentary material (alluvial deposits) depending on time and space.

Type locality Ovalibağ (Çiftlik) (O-1 to O-15) (A-O), a profile from a collection of 63 specimens was studied in Ovalıbağ, where paleosols and terrestrial sediments were used (P1).

Only sediments of the P1 location will be considered in this article, the others will be completed afterwards.

The interpretation of the Çiftlik Quaternary sediments is based on the mineralogy, XRD, textures, and structures of the lithofacies of the above mentioned locations. The Çiftlik Basin of Niğde, Turkey (Figure 1) experienced a variety of sediment facies, indicating a range of depositional environments that occurred during the Neogene time. Furthermore, during the Miocene time, the Çiftlik Basin has a noticeable subsidence. The continental collision between Eurasian and Afro-Arabian plates during the Miocene put in place this basin. It is believed that the Çiftlik Basin has undergone successive phases of evolution; continental fluvio-palustrine to lacustrine sedimentation during the Neogene. To therefore reconstruct paleo-climate changes in this basin, various different parameters as observed in fluvial and lacustrine sediment archives during thousands of years (Quaternary) were used.

Many researchers have in various domains seek to discuss on the origin of the Çiftlik plain and the Central Anatolian geology, [30] described the geomorphological evolution of Çiftlik plain, [22] researched on diatomite's deposits/sediments of Ovalibağ, [46] explained the origin of Cenozoic volcanic developments in this region, [43] describing different pyroclastic formations and different pyroclastic formations, clarifying the understanding and effects of volcanism, [20], they used paleontological, sedimentological, mineralogical and chemical analyzes of diatomaceous lake beds to determine the Pliocene aged paleo environmental history of the Ihlara-Selime plain, [25], revealed that the Pleistocene-Holocene aged alluvial and lake sediments, called Bor-Ereğli (Central Anatolia) Quaternary deposits while [20] concentrated on the sedimentological characteristics of Aktoprak Basin in the South of Cappadocia, [30], determined whether the Çiftlik plain is tectonic or volcano-tectonic in character, and tried to reveal its origin and the age of some alluvial fans in Kuzey Çiftlik in Ovalıbağ. [24] tried to explain the history of volcanic activities in the region based on the K/Ar radiometric age data obtained from the volcanoclastic units of the Ürgüp Formation. [2] evaluated the origin of the Central Anatolian Quaternary volcanism. [37] renewed the stratigraphy of the ignimbritic units in the Cappadocia region by using paleontological, radio chronological, geochemical and paleo magnetic data. According to Gürel, each Anatolian lake basin has its own natural history, which evolved under the control of local, regional, and global factors [11].The diversity of the sediments is as a result of the varied rock types and landforms, processes and conditions that prevailed at the time of deposition of sediments into the basin.

II.GEOLOGICAL SETTINGS

The study area is located in the Aksaray L 32 map of Turkey 1/100,000 geological map. Niğde region covers the area where Taurides and Anatolides come together. In the study area, there are different tectono-stratigraphic units in terms of lithology, structural location and age.

To the southwest of the Tuz Gölü basin, the Quaternary deposits and volcanics of the Çiftlik region are at the center of the Kapodokya Volcanic Province. The geological studies carried out in the region since 30 years ago have revealed the scientific fields and stratigraphic levels. These are, respectively, 1) Non-volcanic basement, 2) Neogene volcanic rocks (ignimbrite and lava flows), 3) Quaternary mafic or intermediate lava flows (basalt or andesite), 4) Quaternary Göllüdağ pyroclastics, 5) Quaternary Göllüdağ dome (rhyolite or volcanic glass), 6) Alluvial (Quaternary), 7) Crater, 8) Caldera shaped (Figure 1).

A) Non-volcanic basement rocks:

Niğde Metamorphic Massif: The geological phenomena summarized above actually characterize the region in the form of five distinct rock units: (1) metamorphic, (2) ophiolites, (3) plutonic and volcanic rocks and their unconformably overlying (4) Tertiary sediments and sediments. volcano-sedimentary rocks and (5) Quaternary fillings and cover units consisting of volcanics. Metamorphic rocks are represented by a metamorphosed platform type sequence and contain ortho- and para-gneiss, meta-sediments intertwined with meta-basics. Marble intercalated with metamorphosed sandstone-shale-marl and marly limestone; They consist of various lithologies such as metamorphosed platform carbonates and meta-ophiolites (ultramafic and mafic rocks) that pass upward into pelagic limestone and calci-turbidites [16]. The main event affecting the entire massif is the progressively developing medium pressure-medium/high temperature and medium/low pressure-high temperature type metamorphism [15; 53]. The first phase is characterized by kyanite-biotite-garnet paragneiss and related cataclastic deformation [17]. The second phase is the contact metamorphism, which is characterized by recrystallization and andalusite-sillimanite-cordierite paragneiss around the widely spread pluton intrusion following partial melting and continental stretching [15]. In the region, [15] according to them,in 1991, these metamorphic consist of three lithodems, which are Gümüşler, Kaleboynu, and Aşıgedigi lithodems, respectively.

Ophiolites consist of ultramafic rocks, isotropic gabbro, plagio-granite, diabase, pillow lava and epi-ophiolitic sediments [71]. Ophiolites crop out as partial or almost complete successions in tectonic slices. They consist of two distinct rock assemblages: (1) metamorphic ophiolites (meta-ophiolite) that are deformed and metamorphosed by the metamorphic basement, and (2) essentially little or no metamorphosed ophiolites pushed over the basement. Central Anatolian granodiorite generally crops out on the northern and western margins. It cuts both metamorphic and ophiolites and is unconformably overlain by Tertiary cover units. Granodiorites were formed during the southward obduction of Neotethys Oceanic ophiolitic rocks onto the Tauride-Anatolide Platform in the Late Cretaceous and later [1], but before Late Maastrichtian crustal thickening and subsequent partial melting following arc-arc or arc-continental collision. It is thought to be caused by In the region, they present two distinct lithological sequences: volcanics and volcano-clastic. Volcanics contain rhyolitic lava flows, rhyodacitic and/or trachy-andesitic composition and basaltic dykes. volcano-clastic, on the other hand, are ignimbrite, tuff, ash flows and accretionary lapilli tuffs.

The cover units consist of Lower and Upper Tertiary sedimentary, volcanic and volcano-clastic rocks. In general, lower Tertiary rocks are represented by sedimentary units formed in the basins excavated over the rock assemblages described above.

It is composed of various volcanic, volcanic-sedimentary and epiclastic units, and the following units are reported by [9] named it.

B) Neogene volcanic rocks (ignimbrite and lava flows), Cappadocia Volcanic Province;

Ürgüp Formation

(1) The Erdaşdağ volcanics (Upper Miocene) is a unit consisting of Sarımaden, Gelveri, Cemilköy and Gördeles ignimbrite members belonging to the Ürgüp formation and younger, grey, yellow and pink colored andesitic composition lava and pyroclastics than the Balcı volcanite.

[14], as a result of microscopic examinations, the rocks are prophyric filled and contain feldspar, augite, hornblende and hypersthene as phenocryst. The matrix consists of feldspar and pyroxene microliths. Outside the region, this unit is unconformably overlain by the Kızılkaya ignimbrite.

4.51 ma was determined in the age determination by [46] using the K/Ar method. Considering that volcanism started earlier, volcanism started to be active in the Upper Miocene and therefore the age of these volcanic rocks was accepted as Late Miocene-Early Pliocene [11].

(2) Kulaklıdağ volcanics (Upper Miocene) is a unit consisting of black, grey, dark brown colored, plate-jointed, andesitic lava and pyroclastics.

[14], as a result of microscopic examinations, the rocks are prophyric filled and contain feldspar, clinopyroxene, orthopyroxene, hornblende and opaque minerals as phenocrysts. Gördeles and Cemilköy ignimbrite members belonging to the Ürgüp formation are found at the lower contact of the volcanite. This volcanite is unconformably overlain by the pyroclastics of the Kızılkaya ignimbrite, Hasandağ volcanic and Göllüdağ volcanics.

[14],determined 3.9 ma in age determination by K/Ar method. Considering that the volcanism started earlier, the volcanism started to be active in the Upper Miocene and therefore the age of these volcanic rocks was accepted as Late Miocene-Pliocene.

(3).Melendizdağ tuff (Plio-Quaternary) is a yellowish, greenish and brown colored tuff named by [3] The tuffs are locally ionized and fogged. The age of the unit can be accepted as Plio-Quaternary based on the stratigraphic sequence.

(4) Melendizdağ andazite (Plio-Quaternary), (Figure 1), consists of gray-black colored andesitic lava and pyroclastics. This rock, defined as andesite in microscopic examinations, has a porphyritic texture and contains mainly plagioclase, clinopyroxene and biotite pheno-crystals.The unit is unconformably overlain by the Balcı volcanics at the bottom, and unconformably overlain by the pyroclasts of the Göllüdağ and Hasandağ volcanics at the top. According to the age determination made by the K/Ar method, the age of 1.1 ± 0.2 Ma was determined [17].

(5) Agilli tuff and sands (Pliocene-Quaternary) consist of agglomerate, sandstone, claystone and tuffite. There are andesite, basalt and ophiolite pebbly tuffite and loose sandstone in the agglomerate and its average thickness can be accepted as 40 m.

Quaternary Fills: These form the uppermost parts of the region. It is in the form of various sedimentary and volcanic, alluvial fans and alluviums, as described by [3] or [11] named it.

C).Keçiboyduran volcanics (Quaternary): The rocks that form the Keçiboyduran hill with the combination of dirty white, yellow, brown pyroclastics and gray, black andesite, basaltic andesite are called Keçiboyduran volcanics [5]; [4]. These rocks are porphyritic in microscopic examination and contain feldspar, pyroxene, hornblende and augite as phenocrystals.2)Keçiboyduran pyroclastics (Quaternary) is an off-white, yellow, brownish tuff named by [5]. The tuffs are locally ionized and fogged. The age of the unit can be accepted as Quaternary based on the stratigraphic sequence.3)Phase I detrital tuffs (Quaternary) are white colored, locally homogeneous, partly mixed ash and tuffs containing obsidian, andesitic-rhyolitic fragments and pumice. This unit is located on the Hasandağı side on the phase I cinder-block and Akçeşme rhyoli rhyolite (outside this map).4) Kuyulutats slag cone (Quaternary) is a Strombolian type formed red, brown colored slag cone.5)Kuyulutatlar basalt (Quaternary) is a volcanic rock containing gray-black colored basaltic lavas. Microscopic examinations of these rocks show basaltic composition and ophitic texture.The phenocrystals here are feldspar, augite, hypersthene, olivine and hornblende. The paste consists of feldspar, augite, hypersthene, olivine and opaque mineral microliths. It cuts all the previously mentioned rocks in the region. It is certain that his age is Quaternary.6)Göllüdağ pyroclastics (Quaternary) are pyroclastic sediments developed due to Early Quaternary aged acidic volcanism in the Göllüdağ (Çiftlik-Niğde) region. Göllüdağ Volcanic Complex covers an area of approximately 90 km2 and pyroclastic sediments were spread in the region in the first and middle stages of its activity.These acidic pyroclastics are widely distributed in the western and southern parts of the Göllüdağ Complex, and at their base there are tuffs and soil layers. On this base, light gray-white colored, apheric glassy pumice pyroclasts with a grain diameter of less than 10 cm and lithic rock fragments such as green tones, poorly sorted rhyolite, rhyodacite and black basalt and obsidian with the same grain size as pumice were detected. Pumice pyroclasts have an irregular surface and contain more than 60% pores. The pores are elongated, connected and parallel to each other. Pumice pyroclasts are of rhyolitic composition and contain amorphous phase (glass), plagioclase, sanidine and quartz phenocrystals. Chemically it contains SiO_2, Al_2O_3 and K_2O, but they are very poor in terms of Fe, Mg, Mn. Presence of basalt from lithic rock fragments within the pumice pyroclasts is evidence that they may be of different origins. Geochemical data and the presence of obsidian from the lithic fragments in the pumice indicate that the pumices are the product of the Göllüdağ Complex, which presents a dome structure, and the presence of plagioclase in the pumice indicates that a fractionation has occurred in the rhyolitic dome. According to field studies and grain size distribution analysis, the pumices of the region are of ferato-plinian type and are fallback products formed as a result of explosive volcanism. On the pumice, there are 7 meters thick turbulence (surge) deposits. It contains ash-size fallback products and spherulitic textured, poorly sorted rhyolite blocks and other poorly sorted lithic blocks. With the sedimentological studies, it was determined that they were deposited as a result of plinian- and ferato-plinian-type dry eruption volcanism and as turbulence deposits. The explosions are thought to have occurred rhythmically many times. The development of pumice-, turbulent deposits and rhyodacitic dome are observed in the region.7)The Göllüdağ volcanic (Quaternary) contains rocks composed of white, yellow colored rhyolitic pyroclastics and rhyolite-vitrophir-obsidian dome and lava flows spread over an area of 10 km in diameter. The pyroclastics mentioned in detail above are composed of pumice, obsidian, pelite and tuffs. The main domes forming the rhyolites are Büyük Göllüdağ, Küçük Göllüdağ, Boztepe, Kabaktepe and Nenezidağ.

Radiometric ages obtained from obsidian are around 1.08-0.44 Ma, and according to this, according to the radiometric dating of the Göllüdağ Volcanic Complex, it is Middle Pleistocene [9]. Alluviums (Quaternary), this unit can be divided into three sub-units in the region. These:

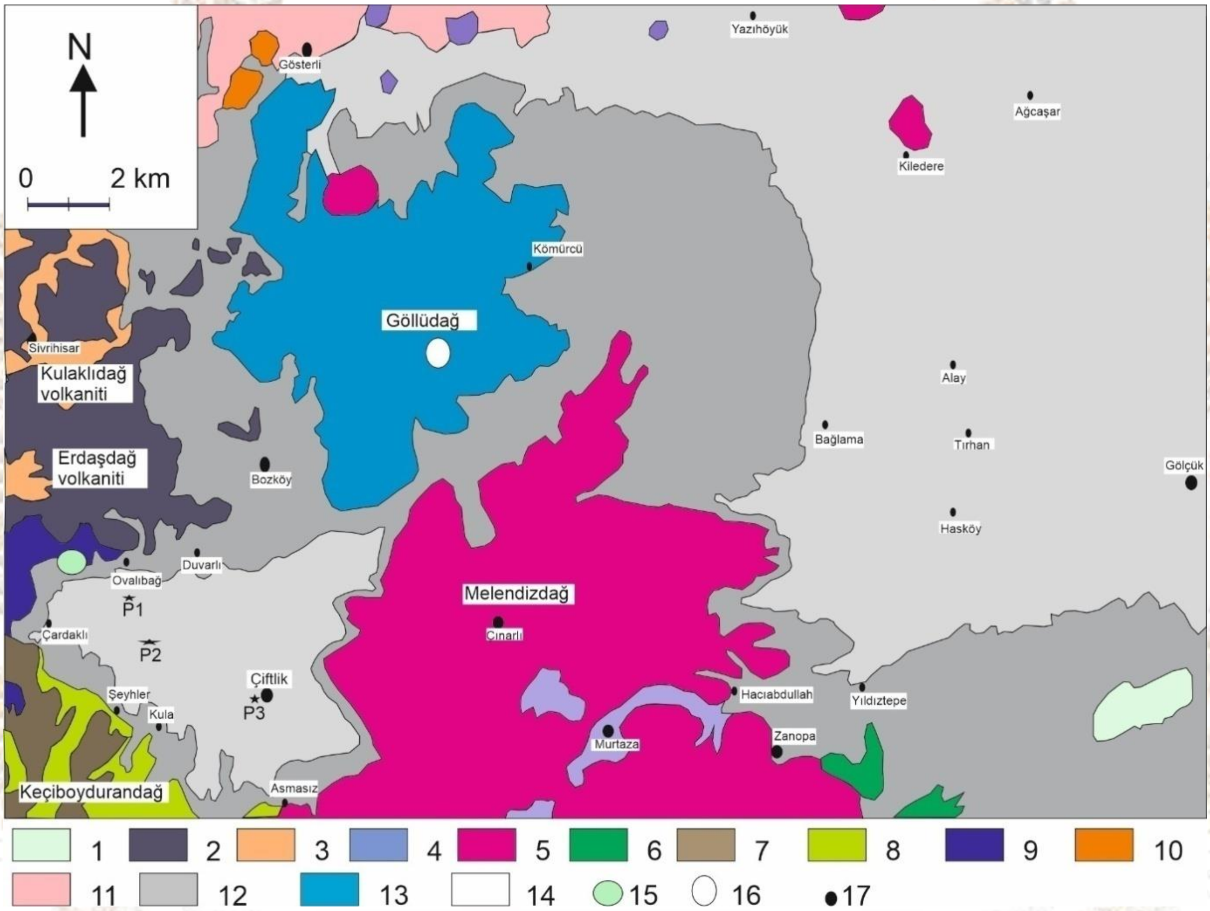
(a)Alluvial fan: These fans have varying material depending on the units on which they develop, and generally contain semi-cemented or unconsolidated volcanic, angular pebbly and sandy, limestone pebbly and sandy, clayey and silty fragments.

(b)Slope Debris: The type of pebbles in the unit, which is poorly sorted, does not have a specific matrix, and consists of angular pebbles, depends entirely on the type of basement rock on which they rest. According to its stratigraphic position, the age of the unit must be Holocene and its formation continues today. It overlies the basement rocks with angular unconformity.

(c)Alluvium: It usually consists of lithologies such as clay, sand, gravel. The alluvium observed in dry stream beds all over the study area is Holocene in age.8)The crater is one of the volcanic outlets in the region.9)The caldera is one of the volcanic outlets in the region.

Tectonic Characteristics of the Research Area

The Neogene-Quaternary volcanism in Central Anatolia is associated with the post-collision between the African-Arabian and Eurasian plates [53; 57]. As a result of this collision, two different fault systems developed in Cappadocia. These systems correspond to the left lateral Ecemiş Fault Zone, the Gümüşkent Fault Zone and the right lateral Tuz Gölü Fault System, oriented N-S dominantly in the NE-SW direction. The second group is normal type faults that started in the Upper Miocene and lost their activity, trending N600-700E, parallel to the volcanic axes and suitable for the main eruption center. NE-SW trending faults are Gümüşkent (Middle Kızılırmak) and Niğde faults [64]. Some of these faults are covered by young volcanic products.The Central Anatolian Volcanic Province (CAVP) must have been under the influence of the two main tectonic activities mentioned above. These fault systems cut the long axis of the Central Anatolian volcanics approximately perpendicularly. In CAVP, many faults occurred in N-S, NW-SE and NE-SW directions.The Tuz Gölü Fault Zone, which is considered as one of the important structural elements of Turkey, is approximately 190-200 km long, 5-25 km wide, NW-SE trending intra-continental fracture zone extending from the north of Tuz Gölü to the south of Niğde. It mostly consists of examples showing step-like half-graben and horst-graben structures varying from parallel to semi-parallel [63] and is a dip-slip fault with a right-lateral strike-slip component [62]).The Ecemiş Fault is a N250E strike-slip, left-sided strike-slip fault, with a length of approximately 300 km between Erciyes Mountain (Kayseri) and Mersin and a total slip of approximately 80 km. The Keçiboyduran-Melendizdağ Fault is a fault extending parallel to the Tuz Gölü Fault Zone in the Aksaray-Niğde region of the Central Anatolia Region . This fault zone is also parallel to the Hasandağı Fault Set.



[Legend: 1 Sineksizyayla metagabroo (Pre-Upper Cretaceous); 2 Erdaşdağ volcanics (Upper Miocene); 3 Kulaklıdağ volcanicS (Upper Miocene); 4 Melendizdağ tuff (Upper Miocene-Pliocene); 5 Melendizdagandazite (Upper Miocene-Pliocene); 6 Agıllı tuff and sands (Pliocene); 7 Keçiboyduran volcanics (Quaternary); 8 Keçiboyduran pyroclastics (Quaternary); 9 Stage I debris tuffs (Quaternary); 10 Kuyulutats slag cone (Quaternary); 11 Kuyulutatlar basalt (Quaternary); 12 Göllüdağ pyroclastics (Quaternary); 13 Göllüdağ volcanics (Quaternary); 14 Alluvial (Quaternary);15 Crater; 16 Calderas; 17 Settlement].

Figure 1. Geological map of Çiftlik plain and its immediate surroundings [44] were modified by 1/100 000 geological maps and field studies).

III.MATERIALS AND METHODS

Field work was effected using the geological data processed on the 1/100000 scale topographic map and the other modified from MTA, 1/2 000 000 scaled map covering this region. The geology of the area was reviewed by making use of previous studies, especially the study area and field trips were made to try to eliminate errors that can be found on the previous maps. In order to identify the vertical and lateral distribution of unconsolidated sediments and paleosols, three stratigraphic sections were taken into consideration. These drillings took place principally within the Çiftlik plain in the following locations Ovalıbağ, Melendiz Confluence and Imam Hatip (see P1, P2 and P3 on Fig.1). In the field, approximately every 5 cm sampling and profiles with a depth of up to 7 m were created. The paleosol, caliche, and unconsolidated or semi-consolidated sediment fill levels were observed exactly, facies features were recorded and sampled.

Sixty three (63) sediment samples were collected using hand drills from Ovalıbağ, which are known as accumulation zones, which were previously determined according to soil taxonomy. The depth of this zone in the study area varies between 1-50 cm. On the other hand, at levels below 50 cm, depths of 7 or rarely up to 9 m have been reached by opening rifts with the help of hand drilling or diggers. In the analysis, the samples were taken as at least 20 gr in order to homogenize. In the study area, samples every 5 cm from the levels below 50 cm belonging to the A and B zones of the modern soil were placed in locked nylon bags in the field and the number was written on it with an acetate pen. More than 10 rock samples including tuffs, obsidian, and rhyolite were taken to represent the geology in the region (volcanic rocks) and to determine trace element concentrations.) is given below as a protocol.

Type locality Niğde (Çiftlik, Ovalıbağ, N 38° 12'17.81" E-34°26' 41.67"; Beginning of profile 750cm (Protocol 1a)

Sample No cm	$CaCO_3$	colour	Plants	Pebbles %	sand%	silt%	Clay%
OVAd1(0-3)	none	grey	present	--	--	25	75
OVAd1(6-10)	none	grey	present	--	2	33	65
OVAd1(17-20)	none	grey	present	--	2	37	61
OVAd2(0-4)	none	grey	present	--	1	31	68
OVAd2(8-10.5)	none	grey	present	--	2	40	58
OVAd2(15-17)	none	grey	present	--	2	39	59
OVAd2(20-22)	none	dark grey	present	--	2	35	63
OVAd2(24-26)	none	dark grey	present	--	2	38	60
OVAd2(28-30)	none	dark grey	present	--	5	35	60
OVAd2(38-40)	none	dark grey	present	--	10	42	48
OVAd3(0-3)	none	grey	present	--	10	50	40
OVAd3(6-9)	none	grey	present	--	25	42	33
OVAd3(14-16)	none	grey	present	--	17	44	39
OVAd3(16-18)	none	grey	present	--	10	50	40
OVAd3(22-24)	none	grey	present	--	10	51	39
OVAd3(29-31)	none	grey	present	--	5	61	34
OVAd3(33-35)	none	dark grey	present	--	5	50	45
OVAd3(37-39)	none	grey	present	--	10	55	35
OVAd3(43-45)	none	grey	present	--	25	42	33
OVAd3(47-50)	none	grey	present	--	20	50	30
OVAd4(0-3)	none	grey	present	--	15	53	32
OVAd4(5-7)	none	grey	present	--	35	35	30
OVAd4(10-13)	none	grey	present	--	10	50	40
OVAd4(15-17)	none	grey	present	--	32	42	26
OVAd4(20-22)	none	grey	present	--	40	35	25
OVAd4(26-28)	none	grey	present	--	45	31	24
OVAd4(30-32)	none	grey	present	--	66	20	14
OVAd4(34-36)	none	grey	none	--	70	25	5
OVAd4(38-40)	none	orange grey	none	--	75	20	5
OVAd5(0-3)	none	grey	none	--	2	43	55
OVAd5(5-9)	none	grey	none	--	60	20	20
OVAd5(11-14)	none	grey	none	--	75	15	10
OVAd5(17-19)	none	dark grey	none	--	5	45	50
OVAd5(21-23)	none	dark grey	none	--	55	35	10
OVAd6(0-3)	none	grey	none	--	5	66	29
OVAd6(6-8)	none	grey	none	--	5	65	30
OVAd6(12-14)	none	dark grey	none	--	2	70	28
OVAd6(16-19)	none	grey	none	--	25	65	10
OVAd6(21-24)	none	grey	none	2	15	53	30
OVAd7(4-6)	none	dark brown	none	--	35	37	28
OVAd7(10-12)	none	grey	none	--	--	40	60
OVAd7(14-16)	none	dark grey	none	--	--	37	63
OVAd7(18-20)	none	dark grey	none	--	--	35	65
OVAd7(25-28)	none	grey	none	--	5	45	50
OVAd8(10-15)	none	grey	none	--	60	30	10
OVAd8(21-23)	none	grey	none	5	70	20	5
OVAd8(28-36)	none	grey	none	15	72	10	3
OVAd8(38-46)	none	orange grey	none	--	15	70	15
OVAd9(46-56)	none	grey	none	5	40	45	10
OVAd9(56-60)	none	grey	none	2	35	43	20
OVAd9(60-66)	none	grey	none	--	65	25	10
OVAd9(66-73)	none	grey	none	--	74	21	5
OVAd9(73-75)	none	grey	none	--	5	70	25
OVAd9(75-83)	none	dark grey	none	20	65	10	5
OVAd9(83-92)	none	dark grey	none	25	55	15	5
OVAd11(0-10)	none	orange	none	15	60	15	10
OVAd11(10-20)	none	orange	none	5	70	10	15
OVAd11(20-30)	none	white	none	--	20	45	35
OVAd11(40-50)	none	orange	none	--	5	65	30
OVAd13(10-20)	none	white	none	2	50	35	13
OVAd13(30-40)	none	white	none	10	42	35	13
OVAd14(50-62)	none	orange	none	--	50	25	25
OVAd14(62-70)	none	white	none	15	25	35	25

A total of 63 terrestrial sedimentary samples were collected from the region for research purposes (protocol 1).

A total of 15 terrestrial sedimentary samples were collected from the region for research purposes.
Table 1. Samples compiled for thin section and SEM analyzes, XRD and XRF-ICP device measurements from Ovalibağ (P1)profile of the Çiftlik Plain.(Protocol 1b)

Sample	Paleosol	Depth (cm)
O-1	Histosol	6-10
O-2	Histosol	15-17
O-3	Histosol	38-40
O-4	Histosol	0-3
O-5	Inceptisol	12-14
O-6	Histosol	10-12
O-7	Histosol	25-28
O-8	Inceptisol	10-15
O-9	Spodosol	28-36
O-10	Mollisol	73-75
O-11	Spodosol	83-92
O-12	Andisol	20-30
O-13	Inceptisol	10-20
O-14	Inceptisol	30-40
O-15	Andisol	50-62

In order to analyze the characteristics these samples, the following steps were used to prepare the sedimentary material samples from the research area mentioned above were taken for laboratory research. The following steps were followed to prepare these samples for petrographic, XRD and SEM analysis.
The following steps were followed to prepare the samples for XRD measurements [65]. Clay minerals in pure water were first oriented by saturating [Ca]++ with Ca-Clay, glycol-clay and dried at room temperature. XRD measurements of the samples were carried out with the SİMENS D-5000 Diffractometer instrument of detailed clay and other minerals (Cu Kα radiation, λ = 1.54056 A° and 0.03 steps), and some samples were heated up to 350-550 ^{0}C and their XRDs were taken [65]
SEM devices were used to determine the structure and texture of the clays (METU, Department of Metallurgical Engineering)

From the excavated sedimentary fills at Ovalıbağ, fifteen (15) characteristic samples were duly selected from a total of sixty three (63) samples collected from a drill hole of about 750cm deep labeled P1 as shown above.

The geological and tectonic map of the area selected as the target was prepared and systematic sampling was started. Three types of samples were taken from the field: paleo-sol, caliche and unconsolidated clastic sediments. Here, especially alluvial fans, lake shores and regions that may be lakes were determined by preliminary studies, and sampling was made from the points where the features of the region and the old paleo geographic features intersect. During the sampling, due to its suitability for the field, it was acted according to the geographical directions and the Magellan brand GPS device was used while the soil lines were laid, and the coordinates of each sample point were recorded in the field.

IV.RESULTS

Hand Drills and Profile Descriptions

Samples were taken during field studies here in the Çiftlik Plain by making 3 hand drills using sondage with a diameter of approximately 10cm at different areas with the best sediment representation. After this, these samples were examined briefly in the field then later much more accurately in the laboratory. Profiles were made, sorted and classified according to the USA soil classification and FAO-world soil resources report No:103 WRB 2007 [54].

Stratigraphic type section descriptions in the Çiftlik plain is in the following region:

The lithostratigraphic strut section described belongs to Ovalibağ (Çiftlik plain) region. Most importantly, a lithostratigraphic strut section that can represent the whole region was searched and it was determined that this type of section was found at (N 38°12'17.81; E 34 ° 26'41.67; beginning of profile 750cm); The findings and results of this research are as follows:

<u>Unit 1 (40cm thickness),</u> This unit forms the uppermost part of the profile made up of modern soil. The remaining part of the profile is made up of dry peat. The grain size of this modern soil and the rest of the unit is predominantly sticky clay and some silt. The other particle-size component is made up of some sand and rich in grass and plant rootlets. The unit is rich in humus and dark grey from top to grey in the lower parts of the unit. Characteristic of peaty swamps.

<u>Unit 2 (thickness 123cm),</u>This unit is made up of mostly grey clay ,massive and plastic with many plant remains at the lower part of the unit. Reed roots (oxidized) can be seen more and more from 16cm to 19cm. filaments stems, leaves? of black plants (burnt?) from 23cm.Some plants burnt in grey clay. At depths of 40cm to 43cm.It equally becomes silty at depth with some gravels and sand. At the base of grey clay, there is no sand. After, comes a smooth transition to shiny clays without plants, then from 45cm to 46cm, few plants resurface. At depths between 47 to 58cm, grey clay becomes silty, with oxidized vertical roots. This unit is characteristic of deep lakes and back swamp deposits because of its plastic nature.

Unit 3 (thickness of 140cm). Fell back into the hole and caused some sort of mixture,pumice sands at 5 to 14cm, lots of coals and black plants, Presence of grey granular clays, The upper units characteristic of peaty swamps. At 14 to 18cm depth, there is a dark brown and very rich organic peat with floating islands caused by the presence of sand. From 18 to 28cm, coarse pumice sands (5cm) were mixed at the end of grey clay. The last part of the unit fell back into the hole. This unit is characteristic of reworked tephra and a lot of clay, silt and a few grains of sand. The unit is equally grey and has plants rootlets. At lower depths of this unit, nice orange Brown peat is present which is different from the aforementioned peat. This peat has sands within it and is characteristic of peaty swamps.

Unit 4 (36cm). Coarse pumice sands in beige-grey matrix to levels without clay, with small dark beds of basaltic cinder. This unit is characteristic of pumice fallout.

Unit 5 (33cm) and unit 6 (20cm). Gravels and small pebbles without clay. In unit 6,there is pumice sand in grey clay and in the lower depths of this unit, there is grey sand in grey clay matrix. This is characteristic of fluvial deposits.

Unit 7 and 8 (67cm thick).Greenish clay with forms of oxidized reeds and pumice sand in grey clay in unit 8 and characteristic of back swamps.

Unit 9 (232cm).Contains fallout (breaking on rp) pumice. small sandy gravels in light grey beige clay.Fallout fine pumice (surge base) with no structure between 30-50cm.Between 40-50cm, beds of pure orange clay that gathers in rp and probably in lake.Between 558 and 658cm seems lost or the existence of rupture or hiatus, unit space or diastem,after which was observed granular pumice fallout with some 5cm pumice.Beyond this,in the RP, orange lacustrine clay with several passes between 683-700cm and finally with fall-outs becoming finer.From 700 -725cm, pumice fallout with elements of up to 5mm diameter was observed ending with visible orange clay sanctioning end of hole. It is imperative to note here that [13] gave the average age of the sediments here between 1280 and 1420 AD. This section is explained in detail and the proceeding diagram presents samples and their environment where these were formed.

Looking at the profile of Ovalıbağ (Ov, P1 profile), there are very few lacunae. The reason for this is that the drilling site is located on the old river flood surface or lake. Since there is a direct inflow of stream and/or spring water on the shallow lake, erosion surfaces, that is, levels with very little lacunae, have been formed due to the effect of the stream during the periods when the lake shore level decreases, and the shallow lake or coastal part eroded very little. In addition, three separate hand soundings were made in this Ovalıbağ locality, and it was determined that their lithological characteristics changed in short distances. This confirms the point described above.

Table 2. Ovalibağ paleosols and terrestrial sediments (Çiftlik)

0-69 cm: Dried peat with plant residues, black silt with traces of vegetation, peat bogs. (Unit I)
69-192 cm: Deep lake with solid grey sticky clay back marshes, up to 13-14 cm from the upper border. [Unit II].
192-332 cm: unit 3 fell back into hole, pumice sand, Peat (very organic clay, dark brown, Peat (very organic clay, dark brown), floating islands (due to sand) peat bogs and reworked tephra? [Unit III].
337-373 cm: Pumice sands (up to Drive 8/10 in beige-gray clay, coarse pumice sands with beige-gray matrix, clay-free sands small black bed (basalt ash? clay-free sand less sands, pumice fall? [Unit IV].
373-400 cm: gravel and pebbles, without clay, stream. (Unit V)
406-426 cm: gray sands in gray clay matrix, stream (Unit VI)
426-440 cm: oxidized reed-shaped greenish clay, back swamps. [Unit VII]
440-493 cm: sandy sands in gray clay [Unit VIII]
hiatus
493-725 cm: fallout of pumice and ripples in shallow lake, small sandy pebbles in light gray beige clay, beds of pure orange clay, possibly lacustrine? [Unit X)
Driver "lost" (11 to 12): 558-658- Hiatus
Orange lacustrine clay, granular with few fading of 3: Elements of up to 5 mm in diameter, pumice sprinkle, visible orange clay.
END OF WELL: 725 cm

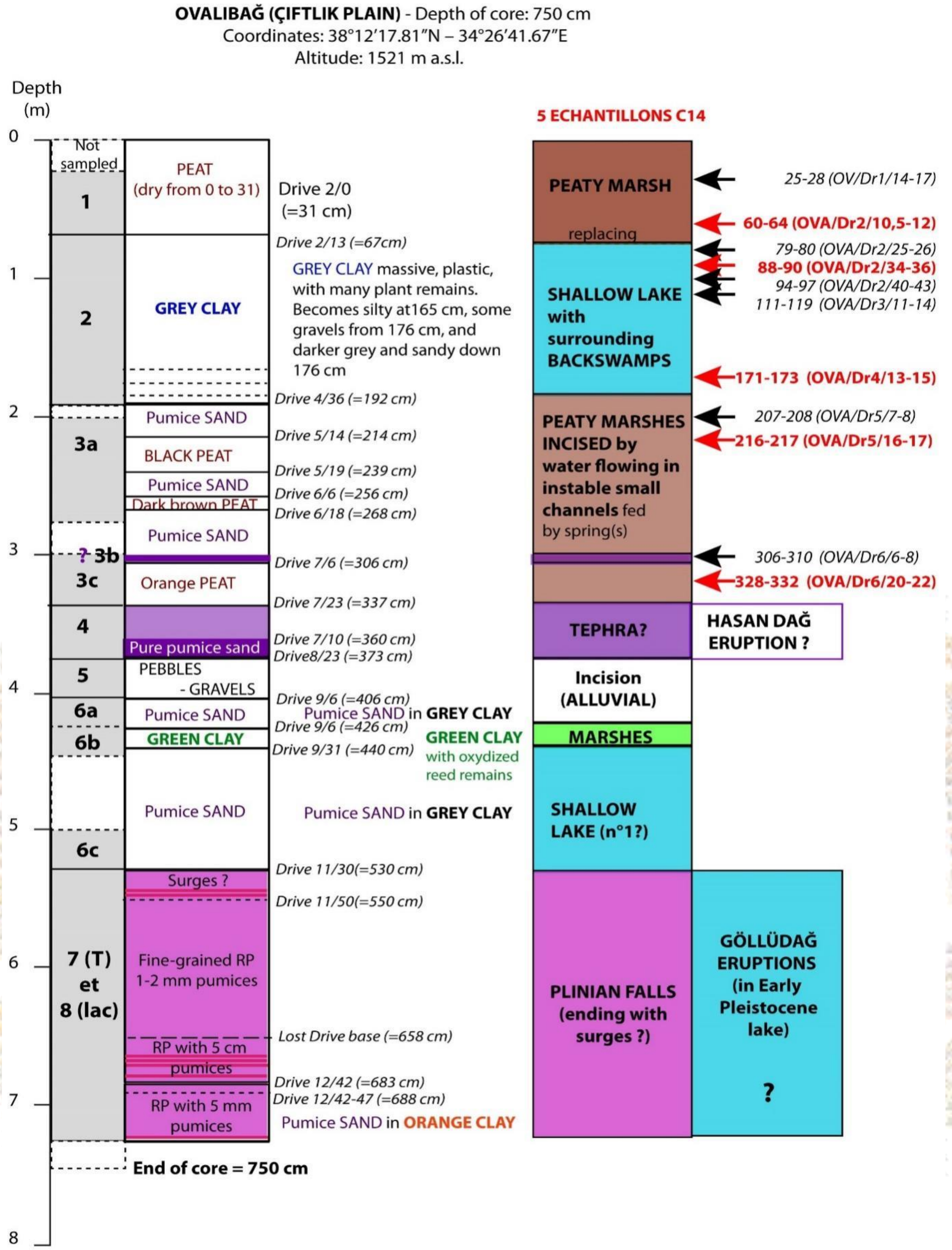


Figure 2. Stratigraphic strut section and lithological features of the Ovalıbağ (Çiftlik) region (Source: [33] unpublished and modified)

Sedimentary Rock Petrography

Thin section studies

Thin section investigations of paleosol and terrestrial sediments (Niğde- Çiftlik) in Çiftlik region (Ovalıbağ)

As seen in Figure 3, vertical distributions of minerals and rock fragments are very different in Çiftlik (Ovalıbağ) pillar section locality. The reason for this is that, as mentioned above, the Çiftlik region consists of a small plain in the middle of the Cappadocia Volcanic Province, completely surrounded by volcanic mountains and in the middle of them, and the fluvial sediment inputs to this open basin change over time and the sediment inputs are constantly changing under the influence of climate changes. In some levels of these three profiles mentioned above, there are levels rich in plant roots (see profiles; peat or marsh sediments) and plant cell structures are observed very clearly in thin section examinations. These levels also contain feldspar, quartz, glass splinters and rock fragments. Iron oxide, clay and micrite wraps are evident, starting from the grains and continuing to the clay-rich cement by getting larger towards the center of the cavity. In the middle levels of the same section, it is observed that rock fragments such as feldspar, diopside and basalt and pumice are enriched. It was determined that the amount of clay and iron oxide in the cement that binds the grains to each other decreased. In the upper parts of the same profile, feldspar and rock fragments are enriched. The most important finding here is the obvious observation of the six binding phases mentioned earlier. These are respectively iron oxide cement (1), clay cement (2), iron oxide and clay cement (3), clay-silt cement (4), pure iron oxide cement (5). At some levels of these sections, enrichment of pine splinters is observed. The grain sizes of the glass splinters coarsen upwards. This shows us that there is an increase in stream flow energy. These levels are mostly concentrated in the middle and upper parts of the profiles. Lateral transitional stream and/or lacustrine layers are also encountered at the same levels of the profiles.

As a result, when the profiles belonging to the paleosol and terrestrial sediments of Çiftlik region (Ovalıbağ) are examined in terms of sediment petrographic characteristics, it is observed that they contain clay, silt, mud, sand and gravel. It has also been determined that they, namely the grains, are not attached but some levels are compressed (perhaps with the load created by the glaciers). In addition, it has been determined that they are transported at close range and are not exposed to chemical weathering and contain angular grains. The aforementioned grains contain minerals such as pine splinters, quartz, feldspar, mica, olivine, diopside. Others are basaltic and/or andesitic rocks. Binders are clay, iron oxide and/or mud.

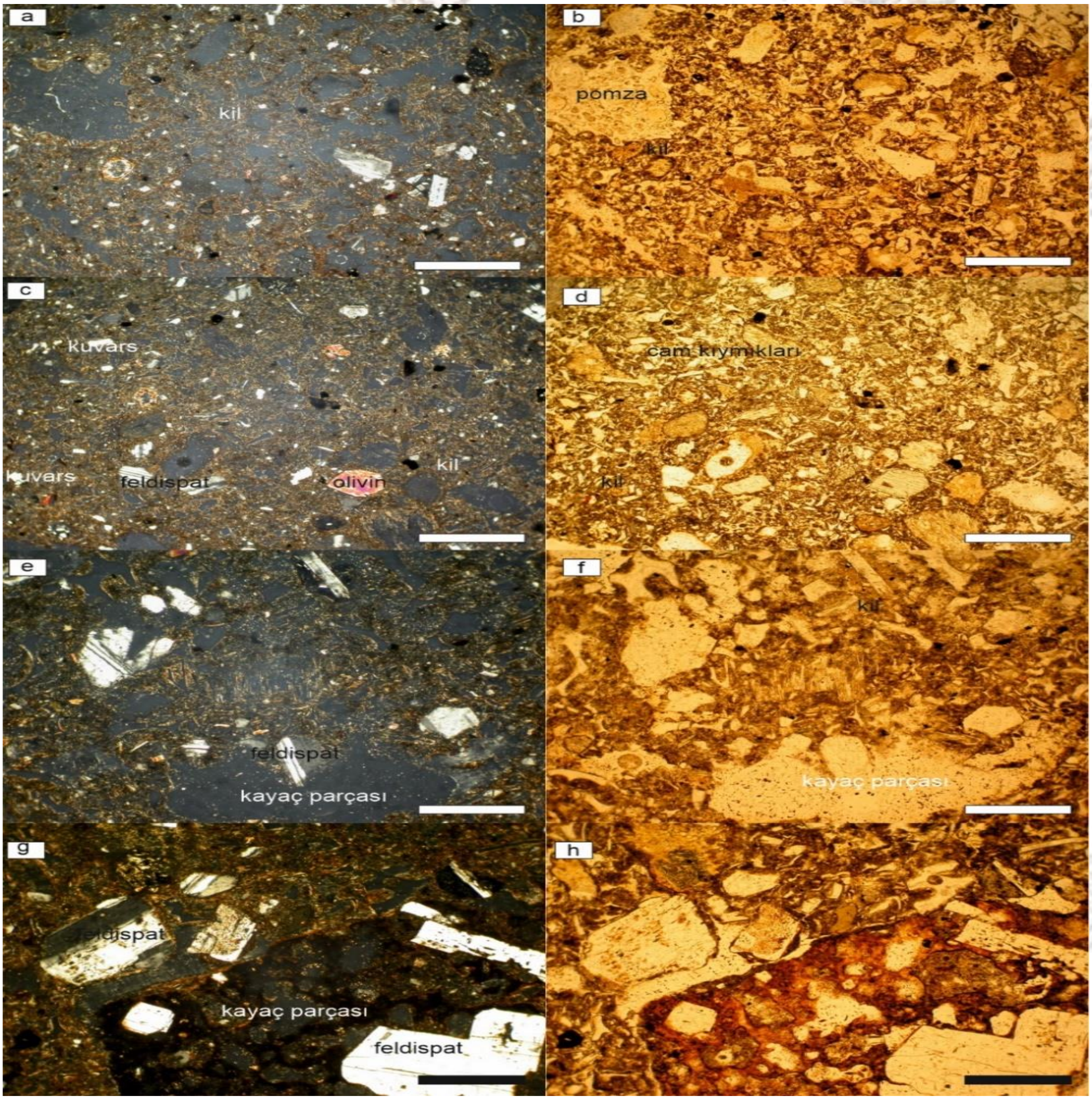


Figure 3. Photomicrographs of the samples from the Çiftlik region; (a) Double-nicol image of sample O-10 (sample no: O-10, double-nicol image, bar scale 0.5 mm); (b) Single nicol image of sample O-10, quartz, glass splinters, biogenic fragments (plant root, cell image is well preserved) and rock fragments (basalt, clay lumps and pumice), grains anchored with iron oxide, clay and argillic grains (sample no: O-10, single nicol, bar scale 0.5 mm); (c) Double nicol image of sample O-8 (sample no: O-8, double nicol image, bar scale 0.5 mm) (d) feldspar, olivine, coarse grained glass shards, biotite, heavy minerals (rutile) fine grained clay , fixed with micrite and clay cement (sample no: O-8, single nicol, bar scale 0.5 mm); (e) Single-nicol image of sample 0.5 (sample no: O-5, single-nicol image, bar scale 0.5 mm); (f) feldspar, quartz, diopside, heavy minerals and rock fragments (andesite, basalt), fixed with fine-grained clay cement, also very prominent iron oxide binder (sample no: O-5, double nicol, bar scale 0.5 mm). (g) Single-nicol image of sample 0.5mm (sample no: O-3, single-nicol image, bar scale 0.5 mm); (h) feldspar, quartz, heavy minerals and rock fragments

(andesite, basalt), fixed with fine-grained clay cement, also very prominent iron oxide wraps (sample no: O-3, double nicol, bar scale 0.5 mm).

SEM studies of paleosols and terrestrial sediments of Çiftlik region (Ovalıbağ)

When the SEM image of the samples belonging to the paleosol and terrestrial sediments of Çiftlik region (Ovalıbağ) in Figure 4 is examined (A), it is observed that feldspar crystals exposed to little weathering and clay minerals as wraps surround the feldspar and contain very fine grains. (B) spongy smectite and occasional illite fragments (non-autogenic) were detected. (C) A close-up view of spongy smectite and glass splinters, proving that they can occur not only as clastic but also autogenic. (D) euhedral spongy smectite and illite crystals that have not been exposed to weathering, voids are evident and there is a zeolite mineral on the right side of the picture. As a result, it was determined that both detrital grains and autogenic minerals, especially clay minerals, were formed in this Çiftlik region.

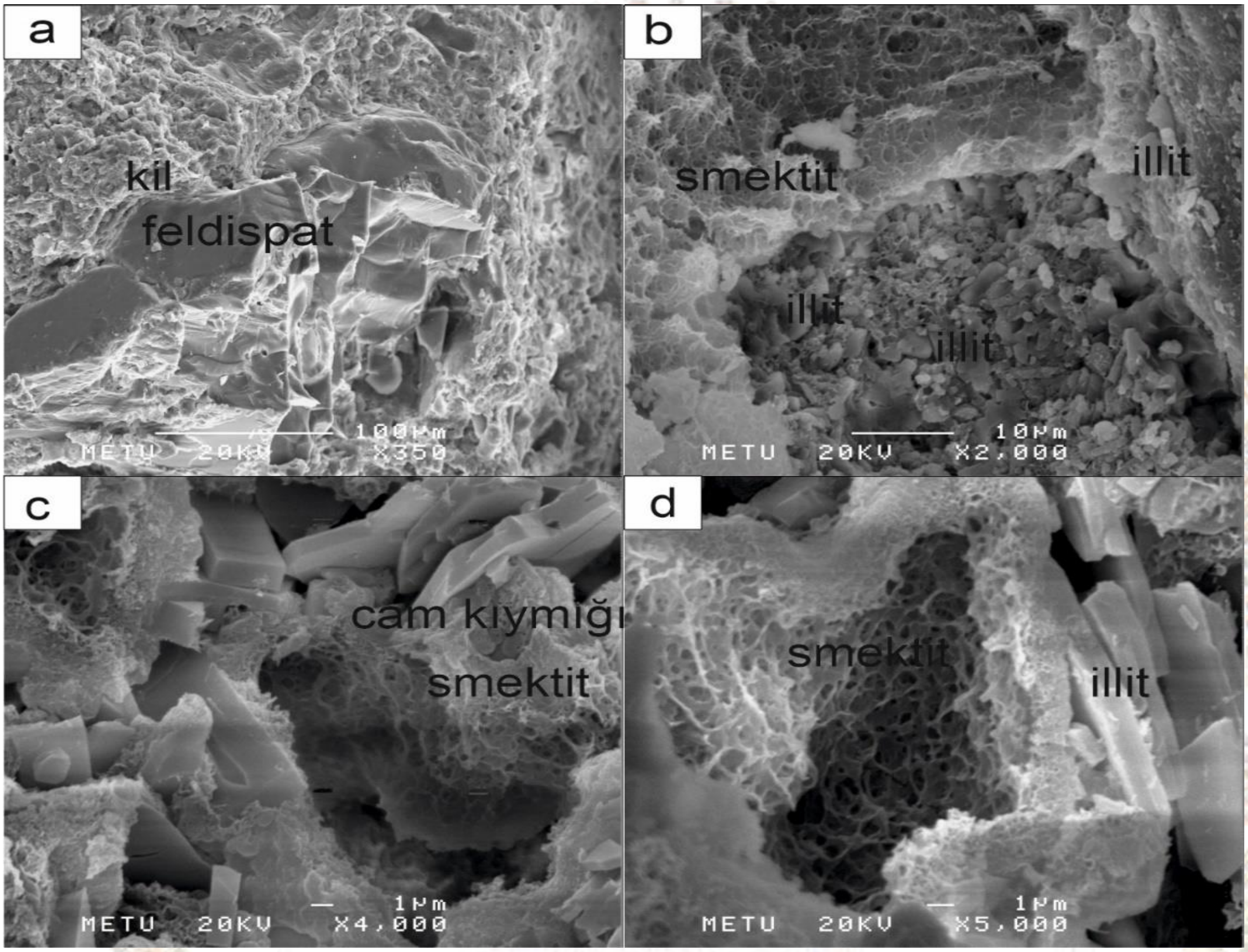


Figure 4. SEM image of the samples from the Çiftlik region, (A) feldspar crystals exposed to little weathering and clay minerals as wraps surround the feldspar (Ova-6), (B) spongy smectite and locally illite fragments (non-autogenic), (Ova-6), (C) close-up view of spongy (spongy) smectite and glass splinters (Ova-7), (D) euhedral spongy smectite and illite crystals that have not undergone weathering, voids are evident and a zeolite mineral on the right side of the picture (Plain-9)

XRD Studies and Clay Mineralogy
Ovalıbağ (15 examples) (Çiftlik)

The data obtained as a result of XRD measurements made from whole rock and enriched clay fraction in the profiles of Ovalıbağ region selected as the type locality in Çiftlik plain are given in Table 2 and Figure 5.

As mentioned in the Sedimentary Rock Petrography section above, the profile levels determined in this region are commonly feldspar, hornblende, pyroxene, quartz, heavy minerals and clay minerals, and zeolite (analcime) minerals are also concentrated in some levels of the same profile.

As clay minerals, smectite (montmorillonite) is observed only in some levels of this profile. As other clay minerals, high amounts of illite and chlorite are common at all levels of the profile. At some levels of the profile, small amounts of kaolin accompany common clay minerals. The presence of kaolin minerals represents the rainy period. Detritic chloride and illite represent the typical inter-glacial period. These levels are marsh levels where decomposition is intense and there is excessive acidification and washing at these levels. The test ratio between feldspar and clay minerals is very significant, and feldspar is absent or present in trace amounts at the paleo-soil or sedimentary levels of the residue of clay minerals. At some levels of the profile where feldspar minerals are concentrated, clay minerals and amphiboles decrease. Clay minerals and feldspar act similarly at all levels of the section. Quartz and feldspar amounts decrease significantly towards the upper levels of the profile. These levels are typical marsh levels and are thought to represent the environment of the river flood surface or the poorly ventilated lake shore.

When these data are compared with Table 3, it is observed that the paleosols can be classified as entisol (clay minerals of the parent rock), and inceptisol (illite, smectite, aluminum chloride) and Spodosol [(illite, aluminum chloride, (smectite)] in the Ovalıbağ profile in the Çiftlik plain. However, it is possible to find paleosols such as Andisol (allophane, imogolite, halloysite).Another remarkable point in the vertical distribution of minerals in the profile is that carbonate enrichment levels develop first and clay enrichments are observed at the end of these levels, and other orogenic minerals such as zeolites are formed at these levels. Euhedral clay minerals precipitate before the formation water in the formation and eventually zeolite minerals are formed in the more basic environment.This is a sequence known in the literature during salt deposition in lacustrine or riverside (floodplain) environments.

It is possible to follow the climatic changes according to the mineralogical and lithological findings during the formation of these paleo-soil and other sedimentary rocks. Paleosol levels with sepiolite, calcite and gypsum minerals definitely represent dry periods. On the other hand, kaolinite, amorphous material deposits (diatomite), stream levels and mud flow levels give moist phases. The accumulation of these paleosols corresponds to the Quaternary/Holocene strata. It shows that the accumulation of paleosol and sedimentary material in the Buda Çiftlik plain corresponds to a period of approximately 10 thousand years. The increase of paleosol formations towards the upper parts of the profile confirms this. On the other hand, it can be used in the selection of ceramics, cement and other industrial raw materials since the last ten years.

The abbreviations used in the Tables and Figures below are:)

smc: smectite (smectite)
chl: chloride (chlorite)
ill: illit (illite)
fds: feldspar (feldspar)
qtz: kuvars (quartz)
Opal A: amorphous quartz
amp: amphibole
Op-CT: opal Cristabolite – Tridymite

+: mineral distribution indicator (relative abundance of mineral)
acc: traces (accessory)

The abbreviations for the samples used in the XRD measurement are as follows (15 samples in total):

Ovalıbağ (15 samples)

Note: In the material method section, sampling levels are given in detail, namely as a protocol.

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Table 3. XRD measurements of the samples taken from the stratigraphic pillar section of Çiftlik-Ovalıbağ region were made. By using these XRD charts, mineral species and amounts were determined semi-quantitatively; Using these XRD charts and the Siroquant software program, mineral types and amounts were determined quantitatively (for abbreviations, see legend, page:)

Sample	Soil Type	smc	ill	chl	amp	Op-CT	qtz	fds	Opal A
O-1	histosol	0.4	18.4	15.0	4.2	1.7	15.5	38.2	+
O-2	histosol	0.3	18.4	21.6	3.9	3.9	6.9	43.9	+
O-3	histosol	0.3	17.9	27.6	9.5	0.0	8.7	50.0	+
O-4	histosol	0.4	15.6	10.4	6.8	0.2	14.7	52.1	+
O-5	inceptisol	3.2	16.3	20.0	3.9	0.0	8.4	48.2	+
O-6	histosol	4.6	20.1	18.7	8.0	1.4	14.4	32.7	+
O-7	histosol	0.3	14.6	25.7	4.1	1.9	15.4	37.9	+
O-8	inceptisol	3.9	19.3	12.0	5.1	2.2	16.3	41.1	+
O-9	spodosol	0.6	14.0	15.9	12.2	3.4	11.4	42.4	+
O-10	mollisol	0.7	15.3	16.6	6.2	1.5	12.7	46.8	+
O-11	spodosol	0.5	13.6	15.0	3.2	4.7	11.3	51.8	+
O-12	andisol	1.0	27.7	18.3	9.1	2.9	8.7	32.3	+
O-13	inceptisol	10.2	25.8	15.7	6.0	2.4	7.4	32.5	+
O-14	inceptisol	0.8	28.2	17.0	8.6	2.3	7.7	35.4	+
O-15	andisol	10.1	42.4	18.6	15.2	1.1	0.8	11.8	+
Ov1	diatomite	acc	acc		acc	+++	++	+	+

tuff	tuff		acc	acc	++	++	++	+
rhyolite	rhyolite			acc	+	++	+++	+

abbreviations: smc: smectite, ill: illite, chl: chlorite, amp: amphibole, o-ct: opal CT, qtz: quartz, fds: feldspar, +: relative abundance of mineral, acc: accessory.

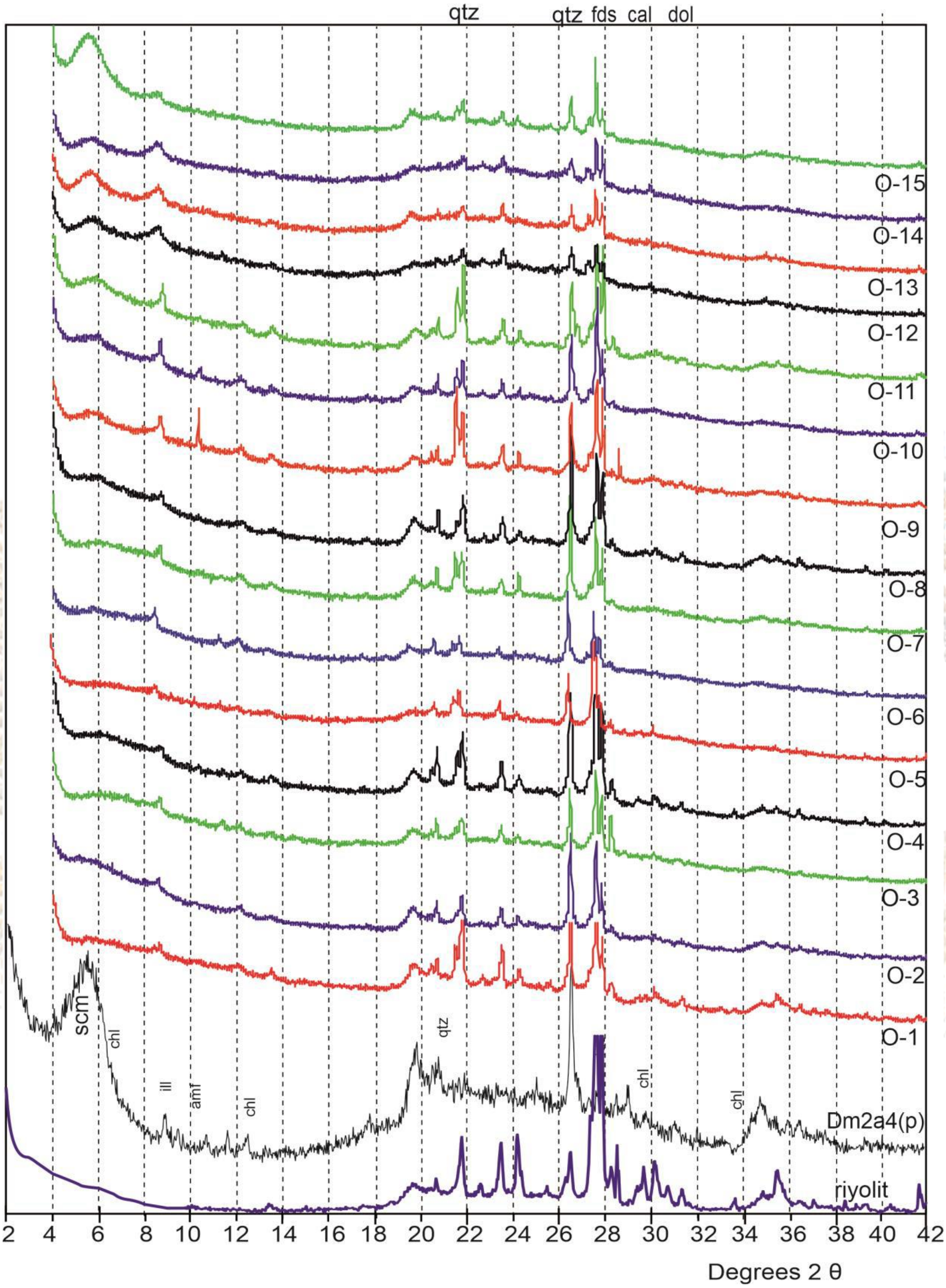

Figure 5. XRD patterns of Ovalibağ profile and an example of their evaluation.

V. DISCUSSION AND CONCLUSIONS

Niğde - Çiftlik Plain is in a low-level perimeter position, in the northwest, the southern Cappadocia volcanic heights (Hasandağ, Keçiboyduran, Melendizdağ), in the north, the Sileğin corridor located at the Göllüdağ foot, is fed from the Derinkuyu Plain, which forms the eastern gravity basin of the plain, from the north-east. In addition to these, it is bordered by a low level on the east and west coasts of the plain: (i) in the west: Cappadocia Keçiboyduran, Melendizdağ (late Miocene and Pliocene aged), (ii) in the east: deformed volcanic rocks forming the Göllüdağ-Melendiz barrier. The Çiftlik plain is remarkably flat and is covered by dry, low-level steppe vegetation. The height of the plain is 1400 m near Çiftlik, and this altitude decreases to 1220 m on the Derinkuyu plain in the southwest of the research area and separates the two plains. In line with the increase in altitude, the flow network of the plain today runs from the northwest Çiftlik to the southwest, namely Ihlara-Aksaray.

The geological situation of the Çiftlik plain and its surroundings

To the southwest of the Tuz Gölü basin, the Quaternary deposits and volcanics of the Çiftlik region are at the center of the Kapodokya Volcanic Province. The geological studies carried out in the region since 30 years ago have revealed the scientific fields and stratigraphic levels. These are, respectively, 1) Non-volcanic basement, 2) Neogene volcanic rocks (ignimbrite and lava flows), 3) Quaternary mafic or intermediate lava flows (basalt or andesite), 4) Quaternary Göllüdağ pyroclastics, 5) Quaternary Göllüdağ dome (rhyolite or volcanic glass), 6) Alluvial (Quaternary), 7) Crater, 8) Caldera shaped (Figure 1).

NE-SW trending faults have developed in the research area and the Central Anatolian Volcanic Province is 300 km long and 60 km wide in this depression zone, and this depression area is filled with ignimbrite and volcanic rocks, paleosol, caliche and sedimentary rocks. The younger Tuz Gölü Fault cuts this depression basin as a right-lateral strike-slip fault in the NW-SE direction. Since similar faults have been active in the region for millions of years, the area (Bor Plain) has been cut like a chessboard and travertine or silica or kaolin clays have been formed at the intersections of these faults (hydrothermal outlets are observed).

Selection of research sites on the Çiftlik plain and its immediate surroundings

Within the scope of this article, 3 localities were investigated, and this was selected for further examination in the locality in order to be able to comment on the basin as a result of the fact that the Çiftlik plain is very heterogeneous (facies differences) and presents different lithologies. This is the case where paleosols and terrestrial sediments of Ovalıbağ (Niğde, Çiftlik) were investigated in detail.

The lithological components of the above-mentioned profile are clayey, silty, muddy, sandy and sparsely pebbly or gravelly-containing paleo-sol, sand silt, clay or gravel accumulations. The clastic levels in the profile usually represent periods of abundant wind, storm, water, flash flooding and precipitation (eg gravel accumulation in the profiles). Since these deposits are of short duration (less than a hundred or a thousand years), paleosol and swamp soil development are not observed, so these levels can be described as units without vegetation. As a result of detailed lithological studies, especially the climate records can be followed in the marsh or alluvial fans on the lake or its shores (for example, [29, 23,30]. When the Çiftlik plain is compared to today's climate on a local basis for the last 20 000 years, the climate has changed alternately between rainy and dry periods, especially 11-7.5 thousand years ago (BC) (Early Holocene) with a little bit of debris in this period, that is, flash floods or storms (desert storms) or as a result of natural disasters (earthquake, volcanism, fire, landslide, etc.).[6] and [72], [12] and [29] They conducted similar and detailed studies in Central Anatolia. This study started in 2014, and some important localities in the north, south and middle of the Çiftlik plain were examined in detail. Findings close to these findings were made, for example, in the Konya plain and Ereğli-Akgöl regions, for example [6] and [72] pollen and aging from three levels; [12] focused on facies and geomorphology studies and [29] obtained facies and mineralogical studies. This study, on the other hand, gained great importance as it filled the research gap that was left empty between the Konya plain and the Central Anatolian Cappadocia Volcanic Province and that could not be done before, that is, it completed the gap in between scientifically. In addition to the central regions of the Çiftlik plain, this study also sought to establish a connection to investigate the whole plain by investigating the parts on the coast of the same plain and on the alluvial fan. Therefore, it has the feature of being a master's thesis unique to this region (the research has completed both the geographical area deficiency of the Holocene sediments and the research has been carried out to cover the whole plain for the first time). In addition, the Çiftlik plain has changed since the last 7.5 - 6.5 thousand years ago (Middle Holocene) when compared to the current climate on a local basis, the climate has changed alternately between rainy and dry periods, especially between 6.5 - 4.0 thousand years ago (BÖ), in this period with clastic inputs, that is, flash floods, raids or storms (desert storms) or as a result of natural disasters (earthquake, volcanism, fire, landslide, etc.) and they had to make very important and compelling decisions for the human communities living in this period. Previously, very humid, water resources and fertile soils were formed, but this very fertile plain began to be affected by natural disasters and dry periods, and desertification of the plain began at a later stage [22] compared to the Bor plain in this period. As a result of these natural forces, human societies started to live on the shores of fresh water sources, namely lakes, streams and water sources, where they could live well (in this way, many old mound areas (late Middle Holocene) known in Central Anatolia began to form.

In the Late Holocene period, however, conditions suitable for today's climate conditions emerged in Central Anatolia, but steppe or desertification continued, and the climate changes observed in Europe and Anatolia from the last 2,200 years to the present and the temperature changes compared to the 1950 average are as follows: Significant temperature increases and decreases continued during the same period, and it was determined by this project that the warming period accelerated and global warming values increased. Accordingly, climate changes continued in Central Anatolia, and in summary, the important events are as follows:

Name	Time (AR)	When	Change compared to 1950 average
Little Ice Age	370 - 100	MS 1580 - 1850	- 0.5 - 0.7 ºC
Late Maundar Minimum	300 - 200	MS 1650 - 1750	
Medieval Warm Period	1050 - 570	MS 900 - 1380	+ 0.5 - 0.8 ºC
Dark Age Cold Period	1500 - 1000	MS 500 - 1000	
Roman Warm Period	2200 - 1500	MÖ 188 - MS 512	> 2.5 ºC

Rapid temperature increases have caused the water resources to dry out in Central Anatolia and become what they are today. As it is today, the stress due to climate change has been noticed by the human communities living in Çiftlik plain since about 6.5 thousand years ago. Increasing population and increasing environmental stress also increased the competition between civilizations and some civilizations collapsed under the influence of stresses (for example, Hittite civilization;[41 ; 38].

Sedimentological, geological, geomorphological, mineralogical and geochemical methods were successfully applied in order to determine the climate records in the Çiftlik plain, which was also emphasized above, and the obtained data were interpreted in a purposeful manner.

Sedimentary Rock Petrography

Various sedimentary levels have been identified in the Çiftlik plain and its immediate surroundings, filling it horizontally over time. These are in order: gravel, sand, mud, mud 1 (black peat), mud 2 (brown peat), mud 3 (orange peat), mud 4 (light brown peat), gray or green clay, light yellow clay and tuff or pumice , paleosol, pumice (A-K) associated lithofacies were extracted within the scope of this article.

Paleosol levels, lake-alluvial fan, lake shore, swamp plains and stream levels, and occasional paleosol horizons are commonly found in this region's profiles. Weathered opal A, opal CT, feldspar, quartz and igneous rock fragments and overlaid clay and iron-oxy minerals are frequently observed, as well as clay grains and fine-grained matrix voids filled and bonded with autogenic clay crystals. Sometimes weathered rock fragments and pyroxene clay minerals are attached with iron oxide and fine-grained calcite. As a result, according to the sedimentary petrographic features determined by thin section and SEM images of paleosol horizons and other clastic sedimentary levels, it shows that the clastic grains are angular, that is, they were transported from short distances. Clastic grains are opal A, opal CT, feldspar, hornblende, pyroxene, quartz, rock fragments, heavy metals and clay minerals, respectively. Weathering in paleosol horizons is quite advanced compared to clastic levels and basement rock levels, clay and plant roots and plant leaves are quite abundant. Similar findings are reported by [23], [22], [32] and [22] publications. On the other hand, clastic sedimentary material and paleothoracic rocks are generally found with angular quartz, feldspar and micaschist and overlying clay and iron oxide, these grains are attached very little, and fragments of weathered feldspar and metamorphic rocks are associated with very fine grained calcite and clay in small amounts. It can be classified as a plant roots and silt-sized paleo-soil horizon, while angular quartz, feldspar and volcanic rock fragments and clay minerals are attached to small amounts by iron oxide and fine-grained calcite, while a silicified plant root-rich paleosol horizon is observed at some levels. At some levels, weathered pyroxene or amphibole is attached by quartz feldspar and clay minerals, iron oxide, organic matter and fine-grained calcite. As a result, the clastic grains were slightly rounded, indicating that they were transported from nearby ground. It is bonded with very fine cement as a result of rapid decomposition. In addition, plant roots were detected at this level and they were silicified. The environment is alluvial fan, stream/swamp or lake environments. The bumps surrounding the minerals are thought to be algae or chemical precipitation. It was carried out by algae that surrounded the fine grains in water with organic coating, and similar findings were reported by [23], [22], [28]. They also stated in their 2018 and [22] publications.

XRD Studies and Clay Mineralogy

The XRD patterns of the samples obtained from the Çiftlik plain were examined and according to this, minerals such as feldspar, quartz, amphibole, pyroxene, opal A, opal CT and olivine are common. It is well rounded, which has been carried to the lake centre, lake shore or lake shore marshy plains or alluvial fan environment either from heights in the immediate vicinity by streams (not well rounded) or as a result of desert storms. As clay minerals, there are clay minerals such as smectite (montmorillonite), chlorite, illite and very small amounts of kaolinite, and their amounts vary at various levels of the profiles. The fact that coarse-grained, that is, clastic, clay fragments were not detected in thin-section examinations, and that the grains were thinner than 0.004 mm, proves that they are autogenic. As a result of SEM measurements, both autogenic and clastic clay grains were detected. In particular, many researchers have made investigations and researches about the autogenic formations of clays. For example, [19] tried to explain the autogenic clay formation and paleoclimate connections of the Central Anatolian Cappadocia Volcanic Province (CACVP) in their new studies conducted in 2006, 2008 and 2010. According to these researchers, they proved that the above-mentioned clays were formed autogenously and/or secondary by weathering of volcanic pines, feldspars, pyroxenes and amphiboles in CACVP. On the other hand, the presence of clay coatings and various iron-containing features (opaque minerals) on the clastic grains indicate improved drainage. These features are due to the decrease in the groundwater level at the base and cause the water level to decrease there and the splitting of elongated channels in some places in the plain.

Other binders, carbonate and sulfates, were not observed in this study area, however, they act as binders in high amounts in Ak Göl (Ereğli) and Niğde Bor plains. The reason for this difference is the absence of carbonate rocks that are thought to be found as binders in Çiftlik plain. In Bor and Ak Göl, for example, calcite is in close proximity, that is, Ulukışla group sediments (especially carbonate-rich rocks), Niğde Metamorphic Massif (see geology section, marble, micaschist) mostly consists of calcite crystals, dissolved $CaCO_3$ Bor or anion to Ak Göl plain and as cations, it is transported to the plains by groundwater or rivers in solution. In addition, the hydrothermal springs or volcanic tuff in the Bor area released high amounts of Si and Mg, thus, carbonate-containing cement and sepiolite clay minerals were formed under alkaline environmental conditions.

General Results

Detailed technical visits, field studies and literature reviews were carried out in the region within the scope of this project, which was carried out in the Çiftlik district of Niğde province and its surroundings. In addition, the following results were obtained by selecting more than 60 samples from the Ovalibağ drillings made in the field and 200 samples obtained, and performing geological, mineralogical and sedimentary petrographic analyses.

1) As a result of field trips and literature review in the region, 1/100,000 geological maps of the region were renewed and redrawn from MTA. Considering the redrawn geological maps and the geology of the region, the generalized pillar section of the region was redrawn and new interpretations specific to the region were made.
2) Vertical (stratigraphic) hand sounding profiles were created by carefully examining the hand soundings made in the field, and their stratigraphic sequence and facies features were explained.
3) In thin section examinations, muddy, silty and sandy levels in each profile commonly contain clastic grains opal A, opal CT, quartz, feldspar, pyroxene, amphibole, olivine and rock fragments (especially volcanic rock fragments). Fine-grained clays and muds are common as binders, although iron dressings may also be found at some levels. These are very fine-grained and surround the above-mentioned grains.
4) Since most of the grains in the region are very poorly rounded, it is thought that they were transported from close distances, that is, by rivers and in periods when the wind effect was low, while well-rounded pieces were transported from long distances during desert storms.
5) In XRD measurements, the clastic grains, especially minerals such as opal A, opal CT, feldspar, quartz, amphibole, pyroxene and olivine, and clay minerals such as smectite (montmorillonite), chlorite, illite and very small amounts of kaolin change at various levels of the profiles. Another binder is minerals such as iron oxide.
6) In summary, Çiftlik plain experienced the most suitable climate period 11 - 6.5 thousand years ago. This plain experienced the end of the most suitable climate 6.5 - 4.6 thousand years ago, and the transitional phase took place 4.6 - 3.6 thousand years ago. The Dry Late Holocene period has been dominant in this plain since 4.6 thousand years ago and the climate records of the plain are compatible with the climate records of the Bor plain.

The limitation to this research is the fact that individual stratum could not be attributed their real ages due to limited financial means to carry out carbon 14 (^{14}C isotope) dating to actually determine when the strata were deposited but because they are loose or loosely cemented sediments,they were deposited in the Quaternary.

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