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Geochemical Records of the Ovalibağ Quaternary Sediments, Ciftlik Plain, Central Turkey

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Abstract:- Geochemical signatures could be used to reconstruct paleoenvironmental controls on paleosols and terrestrial sediments of the Ovalibağ locality in the Çiftlik Basin. In this article,the distribution of the chemical(major and trace elements) and mineralogical composition concentrations. This study helps us to understand the source area, weathering mechanism, abundance, concentration provenance and the economic concentrations of minerals whether hydrothermal or surficial (Low temperature geochemistry), provenance, tectonic settings, reservoir characteristics and in this case, climate variations and how they are distributed.

As a result of geochemical measurement, each profile shows a unique change, such as the increase- decrease in the vertical distribution of main and trace element contents. In the same profiles, as molecular weathering index values such as ∑bases/Al, clayeynes, salinization, calcification, provenance, redox conditions, weathering (CIA-K), leaching, immobilization and precipitation were calculated, the outcome helps us to understand how these terrestrial sediments were formed.The thickness, color and material differences between the different sedimentary levels in the region reveals that regional changes have an effect on the formation of sedimentation and erosion, while the amount of fogging or Fe movement also shows that there are climate changes.

Keywords:- *Geochemical, Trace Elements, Major Elements, Provenance, Ovalibağ, Climate Variation.*

I. INTRODUCTION

Many different researchers had delved into some geochemical aspects in the Central Anatolian Volcanic Province as a whole or part of their researches at different times in the evolution of this region.Orkun Ersoy et al,2020,wrote on'' Geochemical Evaluation of Suitability of Central Anatolian(Turkey) Volcanic Rocks for Rock Fiber Production''.Göksu Uslular ve Gençalioglu-Kus, revealed the geochemistry of '' Mantle source heterogeneity in monogenetic basaltic systems: A case study of Egrikuyu monogenetic field (Central Anatolia, Turkey)''.The ''Geochemical featuresof collision-related volcanic rocks in central and eastern Anatolia, Turkey'' was researched by Panel K et al,2010.Equally,the researchers Ersel GÖZ1 et al,2014 wrote on'' Geology, mineralogy, geochemistry, and depositional environment of a Late Miocene/Pliocene fluvio-lacustrine succession, Cappadocian Volcanic Province, Central Anatolia, Turkey,revealing detailed geochemistry of the Late Miocene/Pliocene paleosols/earth sediments.Selin Eda TEKIROG˘ LUa et al,2000,researched on''The experimental analysis on the Late Quaternary deposits of the Black Sea''.A. Gürel and S. Kadir,2018,worked on ''Palaeoenvironmental approach to the geology, mineralogy and geochemistry of an Early Miocene alluvial- fan to cyclic shallow-lacustrine depositional system in the Aktoprak Basin (central Anatolia), Turkey''and concluded their interpretation as based on an increase in the quantity of feldspar and opal-A and a decrease in the Fe_2O_3+MgO/Al_2O_3+SiO_2 ratio from south to north in the study area.Another research had as conclusion ''The weathering of ignimbrite and marble led to the depletion of SiO2, CaO, Al2O3, Fe2O3, TiO2, and K2O through the precipitation of smectite and illite in the paleosols, and CaO in the form of micrite and calcite in the calcrete horizons(Ali Gürel,2017).

This study therefore significantly contributes to fill the knowledge gab and better our understanding of the geochemistry of the Ovalibağ climate evolution. The lithological data obtained as a result of the stratigraphic strut section studies carried out in the Çiftlik plain were evaluated and the most suitable strut sections wereselected for chemical analysis. XRF, ICP-MS measurements were performed. The following abbreviations are used for this section.

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Table 1: Sampling Points and Location

Sampling Points	**Location**
O1-O15	Ovalıbağ (Type locality)
Tuff	tuff (Çiftlik – Göllüdağ)
Obsidian	obsidian (Çiftlik – Göllüdağ)
Rhyolite	rhyolite (Çiftlik – Göllüdağ)
D23(c)	Upper Miocene caliche of Cappadocia
D24(f)	Upper Miocene fluvial sediments in Cappadocia
D25(p)	Upper Miocene paleoterranean of Cappadocia
D26(i)	Cappadocia Upper Miocene coniferous
Ls	Cappadocia Upper Miocene limestone
Oph,	ophiolite
NASC*	North American shale composite

- Note: In the material and method section, sampling levels and their physical properties are given in detail, that is, as a protocol.

Only the sedimentary material was taken into account in the analysis, and chemical analyzes of the basement rocks containing this sedimentary material and the intermediate sedimentary material were not performed. As noted in the literature review (see Section I), the chemistry and mineralogy of basement rocks have been previously studied in detail by various scientists.

Again, as a result of previous literature studies, Soil Survey Staff, 2001; Retallack, 1990; The following table was created using Sheldon and Tabor, 2009 and Soil Survey Staff, 2001, 'Keys to Soil Taxonomy'. This table will generally be used to interpret the molecular decomposition rates of the paleosols and other unconsolidated sedimentary material formed in the Çiftlik plain.

- ∑bases/Al [($CaO+MgO+Na_2O+K_2O$) / Al_2O_3; hydrolysis]: It is an index obtained by dividing the sum of the basic oxides in the rock or soil by aluminum oxide, and itis a value that gives the hydrolysis process (the values usually give values very close to carbonation values).
- Claying (Al_2O_3 / SiO_2; hydrolysis): All kinds of clay minerals formed as a result of weathering or during diagenesis.
- Salinization [(Na_2O+K_2O) / Al_2O_3; salinization; Desertification]: It occurs in arid and semi-arid regions, in the basins or plains, in the low parts, in areas where the groundwater level is high. Various carbonates and salts dissolved in the groundwater rise to the surface by capillary action and precipitate there by the evaporation of water(Na, Ca, Mg and K salts and chloride, sulfate and bicarbonate).
- Carbonation [($CaO+MgO$) / Al_2O_3; calcification, calcification; Salinization]: Since precipitation is insufficient in arid and semi-arid regions, calcium and other divalent cations are washed into the soil. Carbonates accumulate in the subsoil. Therefore, carbonate nodules are formed in the lower layer of the soil.
- Provenance (TiO_2 / Al_2O_3); acidification, pH: means having the same source of origin. The change of similar values indicates that the gravity basin has changed.
- Redox conditions (∑Fe_2O_3+MnO/Al_2O_3); Oxidation: Oxidation is a reaction in which an atom, ion, or molecule loses electrons, or reduction is a reaction in which an atom, ion, or molecule gains electrons.
- Weathering (CIA-K) (Al_2O_3 / ($Al_2O_3+CaO+Na_2O$) * 100, (new element distribution): Here it is a value indicating whether mobile elements have been washed as a result of chemical weathering.
- Podzolization Ba/Sr leaching/hydrolysis: Podzolization: It occurs mostly under coniferous and broad-leaved forest cover where cold and humid climatic conditions prevail. Due to the excessive leaching of basic ions in the soil, silica that are difficult to decompose remain in the upper zones of the soil and therefore the topsoil becomes gray (soil with an ash-colored bottom; Russian).
- Immobility index 1 Zr / Ti acidification (pH): Here it is a value indicating whether the immobile elements have been washed as a result of chemical decomposition.
- Immobility index 2 Nb / Ti acidification (pH): Here it is a value indicating whether the immobile elements have been washed as a result of chemical decomposition.
- Hydrolysis weathering: Hydrolysis is the dissolution of common minerals that make up rocks, with the effect of [H]+ and [OH]- ions in water. For example, clay minerals are formed as a result of the decomposition of feldspars in volcanic rocks, that is, as a result of hydrolysis decomposition.

Table 10 Molecular dissociation indices compiled from the world literature (NV: normal values; SE: strong effect; Soil Survey Staff, 2001; Retallack, 1990; Sheldon and Tabor, 2009)

II. METHODS

For XRF-ICP analysis, the samples dried at 110 °C were sent to Niğde Ömer Halisdemir University Central Laboratory for chemical analysis. Here, 0.200 gr samples were mixed with 1.5 gr $LiBO_2$ and dissolved in 100 MLS 5% HNO_3. Other metals were collected as oxides. The main elements SiO_2, Al_2O_3, Fe_2O_3, MgO, CaO, Na_2O, K_2O, TiO_2, P_2O_5, MnO, Cr_2O_3 and the heating loss were measured as weight %.TOT/C and TOT/S are measured in wt%, they are not shown in total. Trace elements such as Ba, Cu, Zn, Ni, Co, Sr, Zr, Ce, Y, Nb, Sc, Ta were measured in mg/kg.

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The sediment grain size is of particular importance as it aids in the distribution of trace elements.High mobility elements are absorbed by clay and Fe-Mn oxides,these accumulate in the fine-grained component of the sediments.

III. FINDINGS

A. The Type Section of Çiftlik - Ovalıbağ Region

Major and trace element contents of clastic sedimentary material, paleosol and other sedimentary material levels in Çiftlik plain, Ovalıbağ region were determined as a result of XRF, ICP-MS measurements in Niğde Ömer Halisdemir University Laboratory, the percentages of major elements and trace elements in ppm (mg/kg) were determined. This locality is on the north coast of the Bor plain and is fed by the spring water. Excess water flows into the plain by streams. Therefore, many profiles with a wide variety and different lithologies have been determined in the region. Among them, the most suitable one was selected and given below.

B. Major Element Distribution:

Çiftlik plain Ovalıbağ region contains high amounts of SiO_2, Fe_2O_3 and Al_2O_3 at some levels of sedimentary, paleosol and other rocks. The reason why these zones give highvalues is that they contain minerals such as feldspar and smectite. On the other hand, SiO_2 amounts are quite high in the silkret zones.

On the other hand, CaO and Al_2O_3 amounts increase in paleosol and clastic sedimentary levels, while significant decreases are observed in SiO_2 amounts.

Therefore, a negative correlation (correlation) is observed between SiO_2 and CaO. The high SiO_2 contents in this profile are due to quartz, feldspar, opal-CT, glass (opaque A), amphibole, olivine and clay minerals. On the other hand, a notable observation is that soil zones containing swamp soils (Histosol) contain high amounts of 'Total C'. The reason for this is due to the presence of levels where organic acid concentrations remain in the upper zones of the soil, depending on the event of plant parts rich in organic matter. In addition, the ratio of clay minerals decreases in the zones where CaO content increases.

Because TiO_2 is known as an inert heavy metal in the soil and it is used as anindicator to find out whether the soil zones are heterogeneous (multi-source) or homogeneous (only the bedrock source). It has been determined that this profile has a distribution between 0.10 and 0.65 percent. This shows us that this profile was also affected by the rocks transported from the region other than the main rock during its formation. This finding is parallel to the findings mentioned in the previous sections.

C. Trace Element Distribution:

Vertical distributions and behaviors of trace elements such as Ba, Cu, Zn, Ni, Co and Sr in the Çiftlik - Ovalıbağ profile show similarities among themselves. In the profile here, heavy metals show a positive correlation when compared with the volcanic rocks of the region. These heavy metals are enriched in some zones and depleted in some zones. It is understood that the reason for this is the direct transport of clastic sedimentary grains from the volcanic mountains surrounding the plain to the Çiftlik Plain, which is filled by sediment, paleosol and caliche levels, with the help of streams. It is possible to enrich the heavy metals in the transported sediments. Generally, heavy metals increase in zones where SiO_2 amounts increase. This shows that streams and sediment input have increased into this semi-enclosed basin orvalley.

As with TiO_2, one of the heavy metals, Zr, is known as an inactive heavy metal in the soil and is used as an indicator to find out whether the soil zones are heterogeneous (multi-source) or homogeneous (only from the parent rock). In this profile, it was determined that it showed an oscillation between 122 and 142 mg/kg (ppm). This shows us that during the formation of this profile, other than the main rock, it was alsoaffected by the rocks transported from the region (such as wind, desert dust, glacial flow). Zr originating from Zircon ore minerals found in volcanic rocks is known as aninactive heavy metal in the soils where it is enriched. Zircon generally has a structure that shows radioactive decays containing Th and U.

In Figures 1 - 5, the molecular decomposition rates of the Çiftlik plain, Holocene agedclastic sediment, marsh soil and paleosols belonging to the Ovalıbağ profile were determined.

Compared to these Figures 1 - 5 and Table 1, in these, bases/Al: Some levels give very strong values and some levels give very low values. This shows us that the oxidation and reduction environment of this plain has changed a lot in the last 10 thousand years (Figure 1a). Claying: Since feldspar was transported by decomposing from the volcanic land, periodic differences occurred and accordingly new clay minerals were formed from the formation water by being transported (detritic) or during diagenesis. Accordingly, each level contains different values. The differentiation is therefore too great (Fig. 1b).

- **Salinization:** Although it is not very obvious as mentioned above, salinization has been observed to increase since the last 10,000 years. In other words, desertification continues rapidly (Figure 2a). Carbonation: It is very similar to the salinization values and is above normal values especially in marsh soils (Figure 2b).
- **Provenance:** Since the sediment gravity area is very narrow, there is not much change in the cullet and chemical inputs to Çiftlik plain. However, climatic changes and volcanic eruptions during sedimentation caused changes in the clastic input in Çiftlik plain, albeit slightly. These changes are very well visible throughout the profile(Fig. 3a). Redox conditions: Different oxidation conditions prevail in lake formation, paleo-earthing and alluvial fan environments and these changes are easily observed in the profile (Figure 3b).

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- **Weathering (CIA-K):** In the profile, especially in the sections where coarse grains are abundant, alluvial fan sediment entrances, the rate of weathering decreases and high values are observed at the opposite levels (Figure 4a). Podzolization: Polzolization values decrease considerably in places where salinization is increased. This trend is well followed in this profile (Fig. 4b).
- **Immobility index:** Since this basin is generally close and constantly fed with clastic and chemical cations and anions, no anomalies were detected (Figure 5a).
- **Precipitation:** Using the formula MAP (mm/year) = 221e0.0197(CIA−K) (Retallack, 1990), precipitation amounts for the past period can be given. Looking at Table 11, precipitation values of Upper Miocene aged Cappadocia caliche and limestone are in the order of 200 – 300 mm/year. On the other hand, precipitation regimes of Quaternary aged Çiftlik sediments are in the order of 800 – 1000 mm/year annually.

Table 2: Ovalıbağ Profile and Major Element Oxide Percentages, Trace Element mg/kg Contents (Oph: Ophiolite; and North American Mudstone Component (NASC, Gromet et al., 1984) and Molecular Weathering Index Values of Sediment and Parent Rock Samples)

Element %	**O-1**	**O-2**	**O-3**	**O-4**	**O-5**	**O-6**	**O-7**	**O-8**	**O-9**	**O-10**	**O-11**	**O-12**	**O-13**	**O-14**	**O-15**	**tuff**	**obsidian**	**rhyolite**	**NASC***
SiO2	62,42	65,12	66,49	64,18	68,66	72,43	63,64	67,5	63	66,64	64,36	71,12	69,98	71,52	72,22	73,32	74,9	74,58	58,3
TiO2	0,59	0,25	0,46	0,65	0,37	0,6	0,5	0,45	0,96	0,6	0,65	0,1	0,45	0,65	0,21	0,07	0,11	0,07	0,5
Al2O3	15,99	15,65	15,28	15,04	14,06	10,83	12,78	16,01	14,45	16,07	15,37	13,44	11,45	13,06	13,26	12,51	13,39	13,41	15,2
∑Fe2O3	4,05	0,75	2,93	3,15	2,1	3,85	2,91	2,79	5,87	3,94	4,36	1,24	1,24	1,1	1,2	0,99	1,19	0,92	5,5
MnO	0,1	0,09	0,05	0,04	0,05	0,08	0,05	0,03	0,05	0,1	0,1	0,1	0,17	0,1	0,1	0,08	0,06	0,06	0,06
MgO	0,85	1,39	0,8	1,09	0,61	1,18	0,99	0,97	1,39	0,99	1,35	1,14	1,17	1,35	1,13	0,09	0,16	0,06	2,6
CaO	2,66	2,47	2,91	3,69	2,67	3	3,35	3,8	3,8	2,9	3,36	0,66	1,41	0,57	0,61	0,47	0,63	0,58	3,2
Na2O	1,71	1,41	2,01	2,08	2,29	0,64	2,47	2,79	2,24	2,46	3,7	2,74	2,04	2,5	2,46	3,43	4,38	4,4	1
K2O	2,72	2,72	3,24	2,35	3,39	1,7	2,5	2,8	3,5	2,9	2,55	5,83	8,18	5,44	5,06	5,31	4,49	4,68	3,6
P2O5	0,07	0,07	0,05	0,03	0,05	0,03	0,02	0,05	0,07	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,1
Cr2O3	0,03	0,02	0,02	0,02	0,08	0,03	0,05	0,02	0,02	0,04	0,07	0,07	0,07	0,07	0,07	0,02	0,03	0,01	0,01
LOI	7,89	10,34	5,8	7,44	5,7	5,7	10,85	2,8	4,71	3,41	3,97	3,53	3,62	3,55	3,72	3,7	0,65	1,22	10
Total	99,08	100,28	100,04	99,76	100,03	100,07	100,11	100,01	100,06	100,06	99,85	99,98	99,79	99,92	100,05	100	100	100	100,07
TOT/C	0,04	0,05	0,03	0,09	0,04	0,02	0,09	0,04	0,24	0,03	0,03	0,03	0,03	0,03	0,03	10,45	0,01	0,03	--
TOT/S	0,02	0,02	0,01	0,03	0,01	0,04	0,05	0,29	0,01	1,03	0,03	0,03	0,03	0,03	0,03	0,01	0,06	0,02	--
ppm																			
Ba	220	225	210	190	195	225	230	255	234	201	210	229	260	255	245	65	800	257	636
Cu	29	42	32	35	35	32	29	41	40	35	39	41	42	39	45	25	39	38	--
Zn	98	125	124	106	116	114	145	120	122	140	139	127	135	127	129	17	26	116	--
Ni	20	25	22	30	25	32	26	23	27	32	30	35	30	39	30	15	17	27	58
Co	12	15	14	17	11	15	15	19	21	24	21	25	30	32	25	10	12	15	26
Sr	82	79	82	85	80	80	85	85	79	75	92	90	78	75	76	14	44	93	142
Zr	142	122	124	127	125	125	129	127	145	139	125	126	129	135	142	64	71	118	200
Ce	51	51	65	60	59	58	62	59	61	62	59	65	64	63	58	35	61	68	68
Y	15	15	14	17	15	15	19	20	21	21	25	22	24	27	27	23	14	21	--
Nb	19	17	19	19	15	17	21	22	22	18	17	17	14	19	24	16	13	17	--
Sc	10	14	10	15	14	17	11	17	13	12	17	18	12	11	14	10	15	7	15
Ta	14	17	15	17	14	18	12	13	20	21	15	17	14	15	15	19	15	15	1
*Ti	5101	2162	4237	5620	3199	5188	4323	2594	8300	5188	2767	864	2594	2767	1816	605	951	605	4323
Major elements																			
Base/Al	0,50	0,51	0,59	0,61	0,64	0,60	0,73	0,65	0,76	0,58	0,71	0,77	1,12	0,75	0,70	0,74	0,72	0,72	0,68
clayeynes	0,26	0,24	0,23	0,23	0,20	0,15	0,20	0,24	0,23	0,24	0,24	0,19	0,16	0,18	0,18	0,17	0,18	0,18	0,26
salinization	0,28	0,26	0,34	0,29	0,40	0,22	0,39	0,35	0,40	0,33	0,41	0,64	0,89	0,61	0,57	0,70	0,66	0,68	0,30
calcification	0,22	0,25	0,24	0,32	0,23	0,39	0,34	0,30	0,36	0,24	0,31	0,13	0,23	0,15	0,13	0,04	0,06	0,05	0,38
provenance	0,04	0,02	0,03	0,04	0,03	0,06	0,04	0,03	0,07	0,04	0,04	0,01	0,04	0,05	0,02	0,01	0,01	0,01	0,03
Redox	4,06	0,76	2,93	3,15	2,10	3,86	2,91	2,79	5,87	3,95	4,37	1,25	1,25	1,11	1,21	1,00	1,19	0,92	5,50
CIA-K	78,54	80,13	75,64	72,27	73,92	74,84	68,71	70,84	70,52	74,99	68,52	79,81	76,85	80,97	81,20	76,23	72,77	72,92	78,35
Trace element																			
leaching	2,68	2,85	2,56	2,24	2,44	2,81	2,71	3,00	2,96	2,68	2,28	2,54	3,33	3,40	3,22	4,64	18,18	2,76	4,48
Major elements and trace element																			
immobility	0,028	0,056	0,029	0,023	0,039	0,024	0,030	0,049	0,017	0,027	0,045	0,146	0,050	0,049	0,078	0,106	0,075	0,195	0,046
immobility	0,004	0,008	0,004	0,003	0,005	0,003	0,005	0,008	0,003	0,003	0,006	0,020	0,005	0,007	0,013	0,035	0,014	0,028	--
P p 221e0.0197(CIA-K)	1038,288	1071,468	980,7729	917,7635	948,0714	965,455	855,549	892,2306	886,6499	968,1944	852,4302	1064,669	1004,276	1089,218	1094,231	992,2475	926,8261	929,5383	1034,494

Element %	D23(c)	D24(f)	D25(p)	D26(i)	Ls	Oph,	NASC*
SiO2	29,79	58,83	56,01	73,9	2,87	38,45	58,3
TiO2	0,35	0,19	0,5	0,24	0,02	0,01	0,5
Al2O3	8,28	12,79	13,9	10,04	0,41	0,95	15,2
∑Fe2O3	5,28	5,01	5,98	1,51	0,25	8,2	5,5
MnO	0,05	0,03	0,09	0,06	0,01	0,13	0,06
MgO	1,95	2	4,27	0,48	2,54	41,52	2,6
CaO	30,61	6,3	3,01	1,53	51,34	0,93	3,2
Na2O	1,26	1,2	0,29	2,89	0,05	0,01	1
K2O	0,42	1,43	1,25	4,31	0,06	0,65	3,6
P2O5	0,01	0,02	0,01	0,05	0,14	0,03	0,1
Cr2O3	0,12	0,01	0,01	0,01	0,01	0,46	0,01

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LOI	21,89	12,19	14,72	5	42,3	8,61	10												
Total	100,01	100	100,04	100,02	100	99,95	100,07												
TOT/C	6,12	0,09	0,09	0,02	10,45	0,2	--												
TOT/S	0,01	0,02	0,01	0,02	0,01	0,01	--												
Ppm																			
Ba	302	326	159	687	29	10	636												
Cu	12	17	9	40	<5	24	--												
Zn	85	30	46	12	<5	56	--												
Ni	3	10	12	15	<5	1865	58												
Co	4	12	10	20	<5	102	26												
Sr	156	249	150	132	120	9	142												
Zr	180	142	96	120	5	7	200												
Ce	32	42	26	52	<5	8	68												
Y	21	10	21	21	<5	12	--												
Nb	9	6	9	9	<5	6	--												
Sc	12	5	15	10	<5	9	15												
Ta	10	205	10	15	<5	15	1												
*Ti	3026	1643	4323	2075	173	86	4323												
Major elements																			
Base/Al	4,14	0,85	0,63	0,92	131,68	45,38	0,68												
clayeynes	0,28	0,22	0,25	0,14	0,14	0,02	0,26												
salinization	0,20	0,21	0,11	0,72	0,27	0,69	0,30												
calcification	3,93	0,65	0,52	0,20	131,41	44,68	0,38												
provenance	0,04	0,01	0,04	0,02	0,05	0,01	0,03												
Redox	5,29	5,01	5,99	1,52	0,27	8,34	5,50												
CIA-K	20,62	63,04	80,81	69,43	0,79	50,26	78,35												
Trace element																			
leaching	1,94	1,31	1,06	5,20	0,24	1,11	4,48												
Major elements and trace element																			
immobility	0,059	0,086	0,022	0,058	0,029	0,081	0,046												
immobility	0,003	0,004	0,002	0,004	--	0,070	--												
P p 221e0.0197(CIA-K)																			
	331,77	765,07	1085,94	867,83	224,47	594,89	1034,49												
P p 14.265(CIA-K) 37.632																			
	256,55	861,58	1115,18	952,83	-26,34	679,39	1080,04												

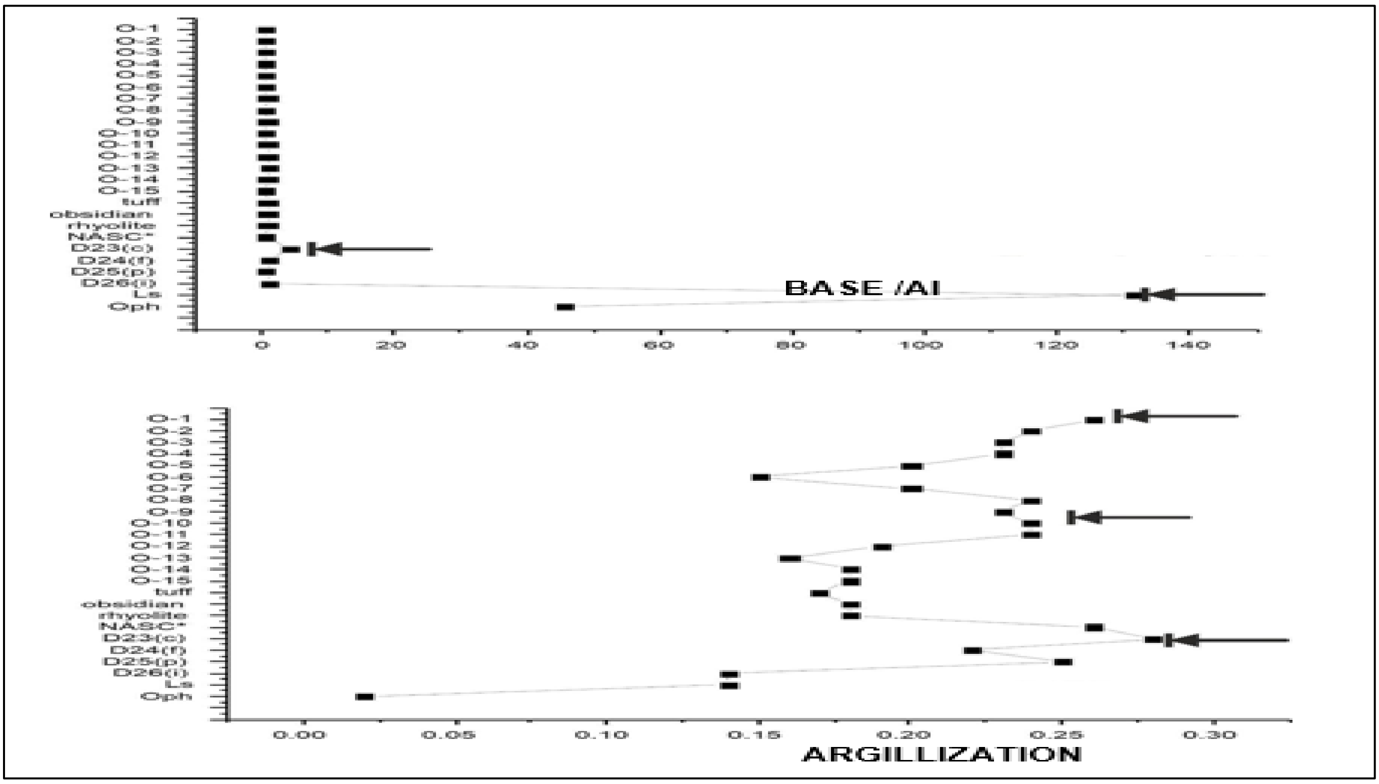

Fig 1: Some Selected Molecular Weathering Indices (Bases / Al and Argillization) of Ovalıbağ Region, NASC, Ophiolite, Gabbro Bedrock and Soil Horizons Developed Over it.

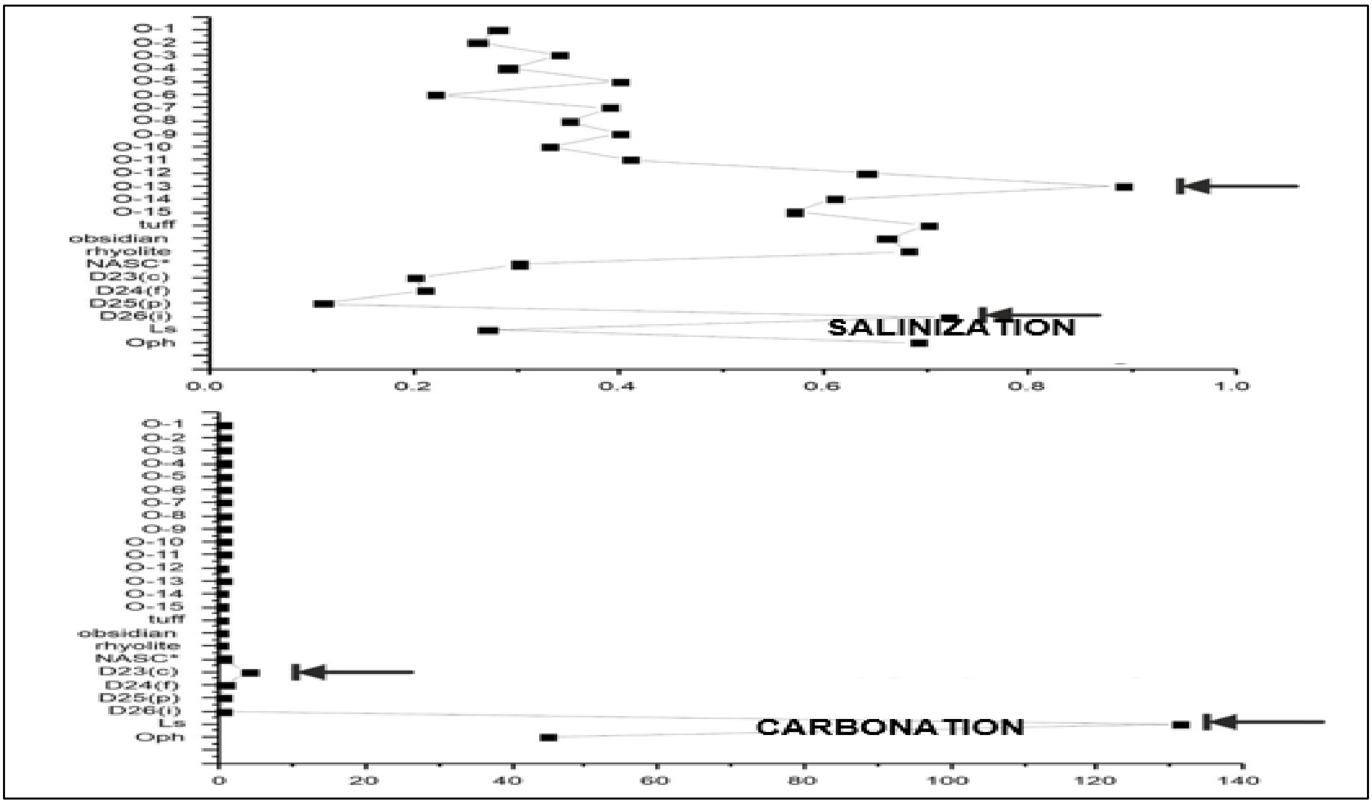

Fig 2: Some Selected Molecular Weathering Indices (Salinization and Carbonation) of Ovalıbağ Region, NASC, Ophiolite, Gabbro Bedrock and Soil Horizons Developed Over it

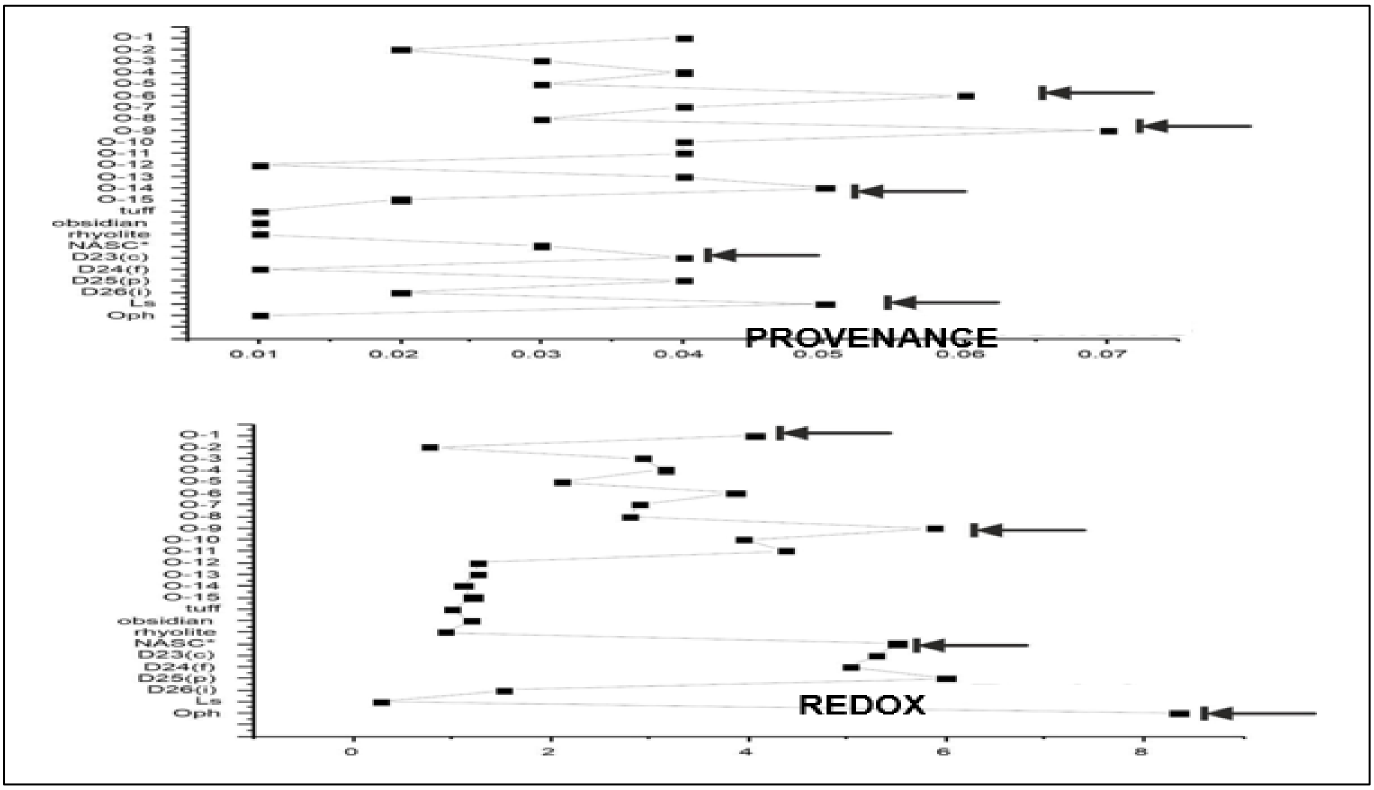

Fig 3. Some Selected Molecular Weathering Indices (Provenance and Redox) of Ovalıbağ Region, NASC, Ophiolite, Gabbro Bedrock and Soil Horizons Developed Over It.

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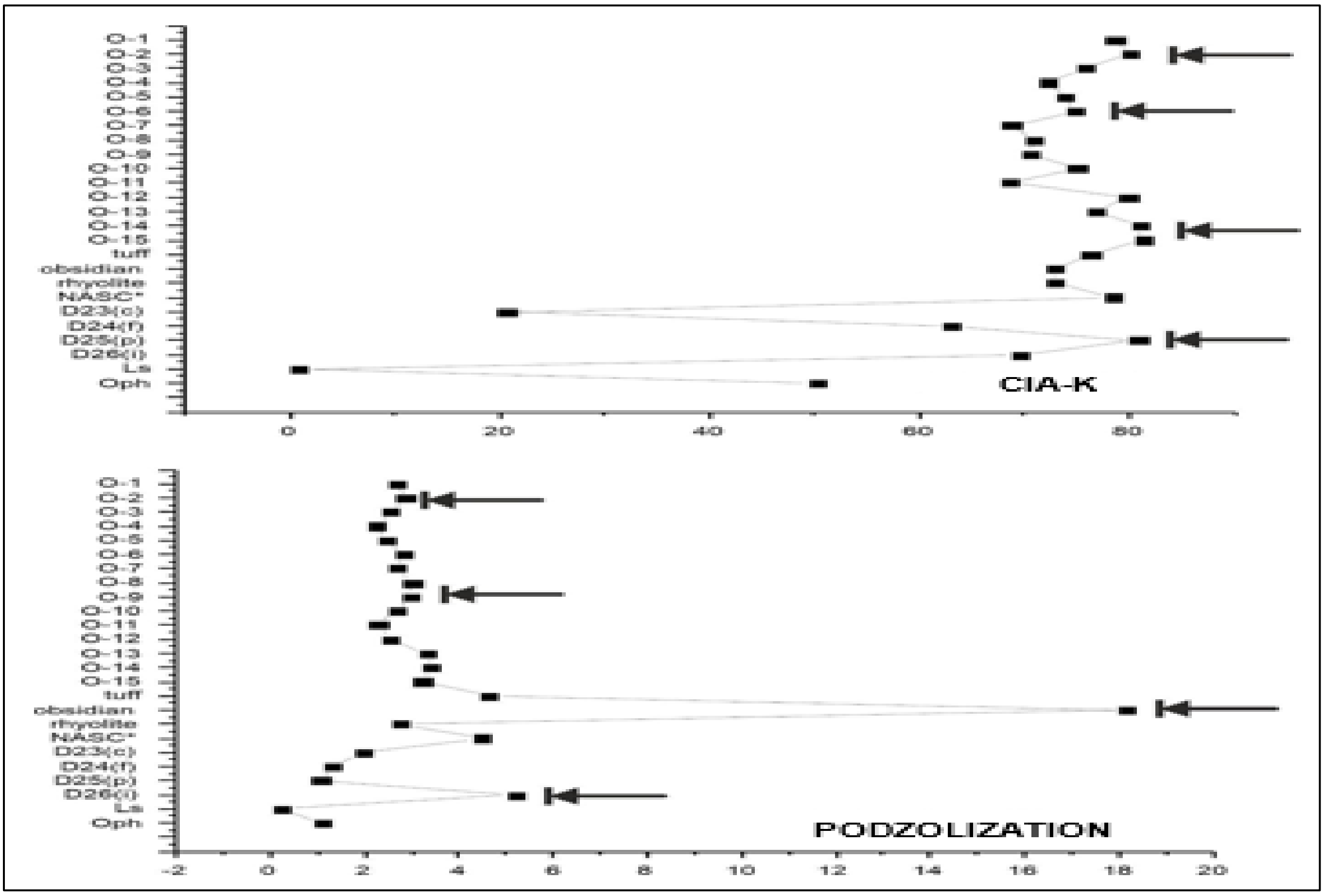

Fig 4. Some Selected Molecular Weathering Indices (CIA-K and Podzolization) of Ovalıbağ Region, NASC, Ophiolite, Gabbro Bedrock and Soil Horizons Developing Over it

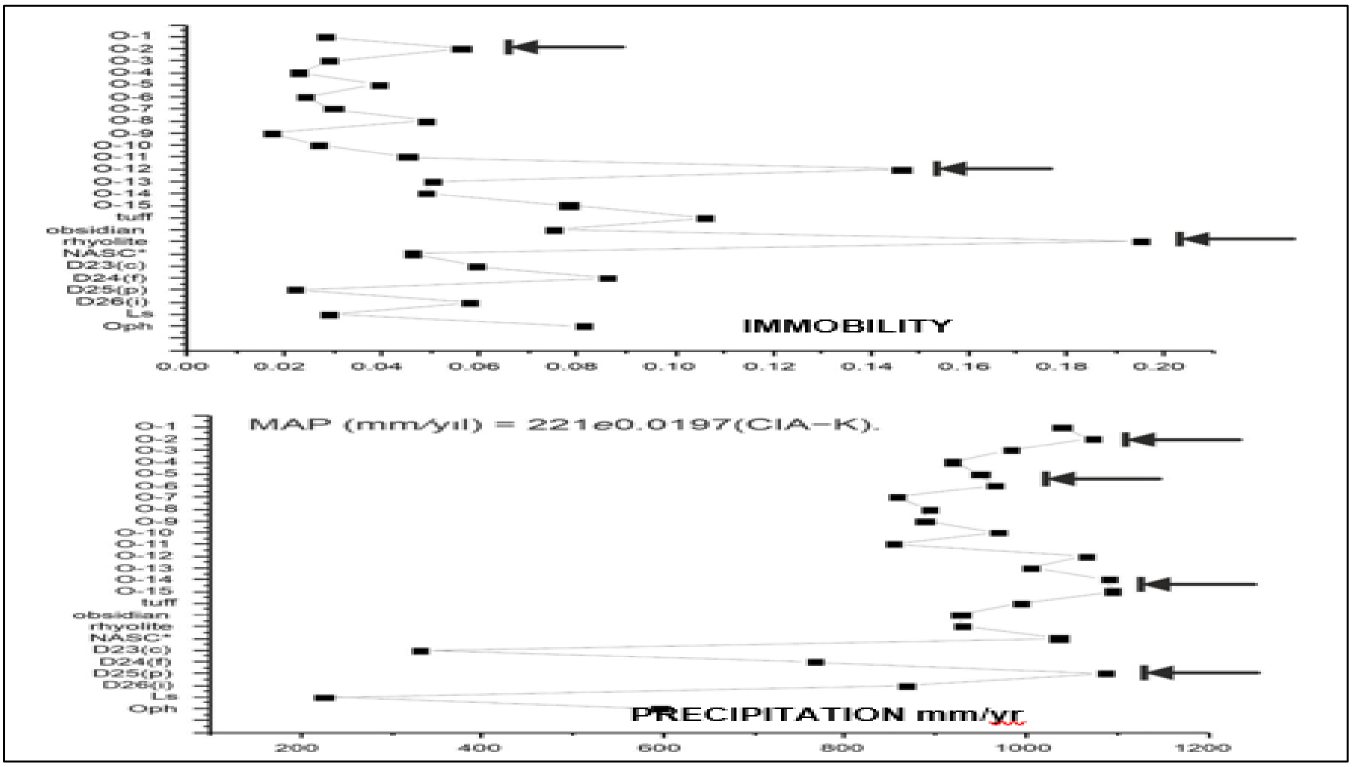

Fig 5: Some Selected Molecular Weathering Indices (Immobility and Precipitation) of Ovalıbağ Region, NASC, Ophiolite, Gabbro Bedrock and Soil Horizons Developed Over it.

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IV. DISCUSSION AND CONCLUSIONS

A. Geochemistry

The main element percentages of the Ovalıbağ profile made in Niğde Ömer Halisdemir University laboratories are in the form of increase and decrease in their vertical distribution, and when these values compared with NASC (North American Shale Components), ophiolite or gabbro bedrock here, changes and differences are evident in Çiftlik plain profiles. The reason for this is the lithological and mineralogical changes in the vertical change as mentioned above. Trace element distributions were also determined in the same profile and evaluations were made considering three different features. These trace elements were separated according to their mobile, semi-mobile and immobile properties and their vertical distribution was followed. In trace elements, increases and decreases are observed in the profile mentioned, such as the percentages of main elements. The reason for this is the lithological changes observed in the profile, mineralogical changes and properties specific to trace elements. Various molecular dissociation indices were applied on Gürel and Kadir, 2006, 2008 and 2010 Quaternary soils. In this study, various molecular dissociation indices, which are frequently used in the world literature, were selected by taking this study as an example. In these molecular weathering indices profile levels, changes in ΣBases/Al, argillization, salinization, carbonation, provenance, redox conditions, weathering, new element distribution, podzolization, immobility and precipitation rate values can be observed. Since each profile has a different sedimentary dynamic, facies changes were possible at short distances (1200- 1400 m) in Çiftlik plain. What directs this dynamic is roughly sedimentary functions, sedimentary feeding, climate, lake level changes, biological activities, water chemistry, volcanism and tectonic conditions. It has been determined that there is no active tectonics in Çiftlik plain and it behaves like a closed basin. On the other hand, it should be known that every year desert dust from Libya and/or Syria causes some crumbs to enter the plain as dust rains. On the other hand, the existence of only volcanic rocks, which do not have very different rock inputs, ensured the formation of very homogeneous sedimentary aggregation levels in this region. On the other hand, some parts of the plain were eroded like high mountain levels and other parts were differentiated, and as a result of water resources discharges, small but fertile areas continued in some parts of the plain (swampy lake and its shores). In the light of all this information, each profile offers its own unique geological, sedimentological and geochemical features (Gürel, 2017). These differences make future aging of the plain and similar projects and plans very valuable for scientific studies. Çiftlik plain climate records and their comparison with Bor plain climate records

Since the main discussion on this issue was made in the findings section above, the climate records are presented below only in summary form.

Climatic records of Çiftlik plain were made using lithological features, facies separation, mineralogical content and geochemical molecular weathering indices. However, since aging could not be done due to financial difficulties, a full climate sorting based on the past time could not be made. However, these sediments are records of sedimentary agglomeration after the last ice age and for the last 10 thousand years. With this study, climate records for the last 10 thousand years, which are relatively specific to the plain, are detailed. On the other hand, within the scope of this study and the Central Anatolia project carried out by Kuzucuoğlu, radio carbon age analyzes were made for the stratigraphic strut section examinations on twelve (12)selected sediments belonging to the Bor plain, for which radiocarbon age analysis wasperformed, and according to this, the profiles of the Bor plain were late Glacial, Beginning Holocene, early Holocene, middle Holocene and young Holocene periods have been separated (Kuzucuoğlu et al. 2017, Gürel, 2021).

LIMITATIONS

While the abstract mentions the use of geochemical signatures to reconstruct paleoenvironmental controls on paleosols and terrestrial sediments, there may be a gap in our understanding of the specific geochemical controls and processes shaping these sedimentary deposits. Further research could aim to elucidate the geochemical mechanisms driving mineralogical composition variations and their implications for paleoenvironmental reconstruction.

Although the abstract discusses the distribution of major and trace elements, there may be a gap in terms of the detailed geochemical analysis required to fully characterize the mineralogical composition and chemical concentrations of the sedimentary deposits. More comprehensive geochemical analyses, including elemental mapping, isotopic studies, and geochemical modeling, could provide deeper insights into the sources, weathering processes, and provenance of minerals within the sedimentary sequences.

The abstract highlights the influence of regional changes on sedimentation and erosion processes, as evidenced by differences in sediment thickness, color, and material composition. However, there may be a gap in our understanding of the specific regional controls and their interactions with climate variability. Future research could investigate the role of tectonic, climatic, and geomorphic factors in shaping sedimentary patterns and landscape evolution within the study area.

Addressing these research gaps could enhance our understanding of Quaternary sedimentary dynamics, paleoenvironmental changes, and their implications for regional geology, climate history, and environmental evolution

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