ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL

EFFECTS ON THE TRANSPORTATION OF POLLEN GRAINS AND INORGANIC PARTICLES IN SEDIMENTOLOGICAL PROCESSES

M.Sc. THESIS

Dursun ACAR

Department of Climate and Marine Sciences

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İSTANBUL TEKNİK ÜNİVERSİTESİ ★ LİSANSÜSTÜ EĞİTİM ENSTİTÜSÜ

SEDİMENTOLOJİK SÜREÇLERİN POLEN TANELERİNİN VE İNORGANİK PARÇACIKLARIN TAŞINMASI ÜZERİNDEKİ ETKİLERİ

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HAZİRAN 2024

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Thanks to who always think about the rights of nature and other living or inanimate as keeping them at the center of respect... This thesis finished for support same way

FOREWORD

The subject of this thesis was chosen to test the main elements and sensitive dynamics of the science of sedimentology under the types of physical forces that which direct nature or directed by nature with living conditions. Moreover in order to make the conceptual contributions to the “nature based education system”.

I would like to thank to my advisors Assoc. Prof.Dr. Demet BİLTEKİN and Prof. Dr. Ozcan KALENDERLİ who made great contributions and efforts in my thesis. Also, I would like to thank to my teacher Muzeyyen Serbest, Prof. Celal Sengor, Prof. Namik Cagatay, Prof. Mehmet Sakinc, Prof. Erol Sari, Prof Kadir Eris, Prof. Naci Gorur, Prof. S. Can Genc, Prof. Sefer Orcen, Dr. Gulsen Ucarkus, Dr. Devrim Tezcan, Research Asistant Nurettin Yakupoglu, Cerennaz Yakupoglu and my family Ipek Acar and Ayse Acar.

Finally, I would like to remind it to young people: Everything in nature maintains solidarity even if they are rivals, and science examines internal points of universe with respect.

Development in technical and educational fields equals the evolutionary adaptation of living things and materials in nature. In the rote education system that does not prioritize respect and interpretation of nature, same in the culture of consumer societies that harm nature, all terms are a complete unity, but their concepts are erroneously separate from each other. The world is losing some species and protective habitats due to people's disrespect to living things and non-living materials other than their personalities.

The education system in the world was also damaged due to the economic race between money owners and the unconscious effort to build. For this reason, other creatures were seen as underrated. The collapse or rise of humanity may also have an impact on other living species on Earth or intelligent beings in the universe. Today's problem is human-induced damage to fragile and finite resources that have zero tolerance for return as extinction in nature. Living things and the soil and water that are the basis of our life are polluted. We must not forget that we and all living species live in solidarity in the same environment.

Animal species have been more advanced than humans and still are because they do not harm the vital system; We learned from them how can be survival but our gratitude was destroying their fragile sensitive nature.

June 2024

Dursun ACAR
(Geological Engineer)

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ABBREVIATIONS

CaCO3 **:** Calcium carbonate
CCD **:** Carbonate compansation depth
CO2 **:** Carbon dioxide
EMCOL **:** Eastern Mediterranean Centre for Oceanography and Limnology
et al **:** and others
def. **:** deformation
FTIR **:** Fourier-transform infrared spectroscopy
MISS **:** Microbially induced sedimentary structures
mm : millimeter
PET **:** Polyethylene terephthalate
PVC **:** Polyvinyl chloride
P-wave **:** Particle Wave
S-wave **:** Surface Wave
Transport. **:** Transportation
UV **:** Ultraviolet ligth
XRF **:** X-ray fluorescence
val. **:** values

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EFFECTS ON THE TRANSPORTATION OF POLLEN GRAINS AND INORGANIC PARTICLES IN SEDIMENTOLOGICAL PROCESSES

SUMMARY

Sedimentary particles can be inorganic or organic in origin. When these materials are clay or sand, the environments in which they are transported are solid, liquid, gas or their mixtures. These sedimentary particles, which are no larger than grains of sand or clay, come from both inorganic and organic sources. Remarkably, they travel with forces that propel them through a surprising variety of environments, not only water or air but also solids and even mixtures of these states. Their transport occurs in the form of creep movement under tectonics or gravity in solids, laminar flow, density flow, or discrete partial bulk or fully discrete granular flow, depending on the types of physical forces in gases and liquids. These forces, originating from inorganic or biological sources such as particles, act on the particles with or without significantly altering the surrounding environment. For example, while the interactions of pollen grains with each other during their movements in the air and the interactions coming from the atmosphere are in question, today, it is understood that the bees flying in the air have gained a positive charge, and accordingly, they collect and carry the pollen with a negative charge in the plant by static electricity attraction. Second, understanding the interactions between atmospheric electricity and other carrier environments, such as wind, water, and density currents, is essential for various fields in the natural sciences.

SEDİMENTOLOJİK SÜREÇLERİN POLEN TANELERİNİN VE İNORGANİK PARÇACIKLARIN TAŞINMASI ÜZERİNDEKİ ETKİLERİ

ÖZET

Taşınan veya taşınma ortamındaki maddeler yüksek potansiyel enerjiye sahip olduklarında birbirlerinin akış yönünü, çökelim özelliklerini değiştirirler. Akış hareketi sırasındaki sürtünme ve aşınmalar ayrımlaşma sınırlarında artıp şekilsiz ya da azalıp laminar blok akıntılar halinde düzenli olabilmektedir. Ayrıca bu akışın içinden geçtiği ortamın kendisi başka bir akış rejimidir ve yerkürenin daha büyük ölçekteki fiziksel kuvvetlerinin etkisi altında olduğu başka bir ayrımlaşma zonudur ve kendine ait fiziksel kuvvetleri oluşturabilir.

Taşıyıcı ortamlar, karakteristik mevsimsel ya da döngüsel süreçlerinde enerji kazanan katılar, sıvılar (akışlar), gazlar (atmosfer) veya bunların kombinasyonlarıdır. Gazlar ve sıvılardaki fiziksel kuvvetlerin türüne bağlı olarak, materyalin taşınması düzensiz katmansız veya katmanlı laminer akış, katılarda yerçekimi altında sürünen hareket, yoğunluk akışı şeklinde heyelan veya ayrık kütle kayması veya tamamen ayrık granüler yani parçacık yer değiştirmesi şeklinde gerçekleşir.

Sedimanter süreçlerde ayrıca derinlik ve basınca bağlı çökelimi etkileyen CaCO3 erime zonu veya daha derin bölgeler icin çözülen elementlerin yeni bağlayıcı ortam sınırı olacak ikincil fiziksel etkilerde söz konusudur. Benzeri çoklu işleyişler içinde askıda bulunan sedimanter maddenin bağıl ölçeklerde ilk etkilendiği veya yönlendirildiği etken konusunda pek çok bilimsel problem ortaya çıkmaktadır. Bu kuvvetlerin türlerine göre bireysel etkilerini araştırmak için laboratuvar ortamında hassas itme seviyelerinde uygulanan farklı türdeki kuvvetlerin, doğal ortamdaki etkileşim kaosunu ortadan kaldırarak hem sedimanter malzemeye hem de taşıyıcı ortama ayrı uygulanması gerekmektedir.

Su içinde askıda bulunan malzemenin manyetik özellikleri, uyarılarak araştırılırken suyun kendisinin içinde askıda bulunan malzemeden daha fazla benzeri tepkiler verebilecegi unutulmamalıdır. Sedimanter parçacıklar inorganik ve organik kökenli olarak ikiye ayrılır. Bu malzemeler normal şartlarda kil veya kum boyutunda olmalarına rağmen sedimanlarda doğrudan kendilerinin ya da ikincil olarak hapsettikleri materyaller ile gösterge elementlerinin kurdukları kimyasal ya da fiziksel bağlar ile tabakalarda kaydedilmesine neden olurlar.

Sedimanter havzadaki biyotürbasyon gibi çökelmiş malzemenin taşınması veya yeniden süspansiyona alınması sırasında bölgeye yönelik yardımcı gösterge elemanlarının ve ana gösterge elementlerinin yerlerini değişmesi dünyanın kaotik doğasını göstermektedir. İndikatör elementler su akıntıları ve inorganik veya organik maddelerle birlikte çökeldikleri için akıntı analizi, bioturbasyon derinliği ve değişimleri hakkinda bilgi yoksa geriye dönük element analizi yorumları zorlaşmaktadır. Bu durumlar üzerine etkileri çok fazla araştırılmamış olan atmosferik elektrik alan ya da kapasitif elektrofiziksel kuvvetlerin az ya da çok potansiyel farklarla etkileşimine ait bilimsel problemlerinin varlığı durumu daha da güçleştirir. Killerin tabakalarında iken değişen şartlarla farklı kil mineraline dönüşümü bilinen

bir durumdur, taşıma ortamı veya taşınan parçacıklar üzerindeki kimyasal ve fiziksel etkiler genellikle farklı termal ya da tuzluluk içeren bölgelere göre değişmektedir. Ayrıca bu kuvvet kaynaklarının kökeni yıl boyunca çok farklı düzen ve etki yoğunluklarında inorganik veya biyojenik etkenlerden geldiğinde bol miktarda lamina yani mm ölçeğinde katmanlar oluşturabilmektedir.

Soda göllerine örnek verecek olursak, Van Gölü'nde yıl içerisinde ikiden fazla lamina oluşumunu ve tezin polen - sodalı su sedimanter yağış birikim deneyi sonuçlarından alınan hızlı polen çökelimi değerleri benzer nedenlerden kaynaklanabilir. Deneyler arasında yüzeyden tabana en hızlı polen çökelimi soda içeren sudan elde edildi. Polenler, sodalı su hariç 4 ila 6 gün sonrasında kısmen çökelmiş ve kalanları su yüzeyinde bulunmuştur.

Klor içeren deney kabındaki suda yüzen biyofilm oluşmadı ve polen bu deneyde en hidrofobik davranışı gösterdi. Sodyum klorürlü suyun içinde klor elementi bulunmasına rağmen bu tip deneyde yüzey hidrofobik davranışı klorlu tatlı su deneyindeki kadar olmadı ve bu tuzlu suda biyofilm oluştu. Saf su içeren deney kabında yüzeyde en homojen dağılmış polen biyofilminin oluştuğu ve en az hidrofobik yatay hareketin olduğu bu deneyde gözlenmiştir.

Statik elektriğin etkisini sorgulamak için PVC ve PET plastik kaplarda hem de cam kaplarda tekrarlanan yüzdürme deneylerinde kap hammaddelerinden bağımsız olarak aynı sonuçlar elde edildi. Polenin suya düştükten sonra statik elektrikten etkilenmediği anlaşılmıştır. Ebonit cam ve pleksiglas ile yapılan statik elektrik deneylerinde polenden herhangi bir reaksiyon elde edilememiştir. Fakat polenler cam kap içerisinde yüksek turbulanslı havada serbest sürüklenmeye bırakıldığında cam ve pleksiglas çubuklara hareket etmişlerdir.

Sedimantasyonun dikey eksenindeki katmanlar arasında element yer değiştirmeleri meydana gelir. Depremler sırasındaki P-dalgası girişimleri, çökeltilerdeki parçacıkları dolayısıyla elementleri gözenek suyu (sıvılaşma) yoluyla veya doğrudan mekanik olarak taşıyabilir. Örneğin polen tanelerinin havadaki hareketleri sırasında birbirleriyle olan etkileşimleri ve atmosferden gelen etkileşimler söz konusu iken, havada uçan arıların pozitif yük kazandığı anlaşılmış Erickson (1975) ve buna bağlı olarak da şu anlaşılmıştır; arıların biyolojik polen tutturma hariç diğer bir taşıma yöntemi olarak statik elektrik çekimiyle bitkideki negatif yüklü polenleri toplayıp taşıyabilmektedirler.

Değişen atmosferik elektrik ve taşıyıcı rüzgar yönleri girişimsel olarak birbirini etkilemektedir. Ayrıca bu kuvvet kaynaklarının kökenleri inorganik veya biyojenik aktüatörlerden gelebilir ve çevredeki ortamı zaman göreceli olarak erezyona uğratıp belli elementleri taşırlar ya da çökelmeleri icin uygun işlev görürler. Inorganik ve organik kökenli Ca elementi için örnek verirsek, organizma ilişkili ya da inorganik mekanizmalar ile sediman kayıtlarında yerini alır. İnorganik kökenli olarak volkanizma ya da plutonik kayaçlarının aşınması havada ya da suda taşınmasının yanında bitki artıklarından algler, bakteriler ya da diğer organizmaların yaşam faliyetleri sırasında ve ölümleri sonucunda biomat kalıntıları ve fiziksel kuvvetlerin etkisinde her aşamada kayıtlara katkısı değişebilir.

Okyanusda belli bir derinlikten sonra $CaCO_3$ ün erimesi ve deniz suyuna karışması fiziksel etkiler nedeniyle (UV ışığı, asitlik CO_2 sıcaklık ve basınç parametrelerine bağlı) oluşmaktadır (CCD sınırı). Akıntı yönü gibi basit bir fiziksel kuvvetin sedimantasyonda etkili olması, canlı vücudunda ya da sedimanlarda kalsiyum (Ca) birikimini etkiler. Bu tezin elde ettiği diğer bir sonuç ta polenlerin literatürde yaygın

olmasa da polenlerin yayıldığı dönemden sonra Ca elementinin sedimanlardaki artışı olgusudur. Buna Ca elementinin polende bulunması Kuang (2014) Acar (2021) ve polen germinasyonu için gerekli olması Brewbaker (1963) ve germinasyon ağlarının bakteriler ve canlılar için besin ve taşıcı görev alarak sudaki +2 değerlikli Ca elementinide alarak germinasyon kalıntılarında Ca zenginleşebileceğini gösteren polen biomatının XRF element taramaları Acar (2021) destek olmaktadır. Böylelikle polen kalıntılarının bolca bulunduğu seviyelerde klastik girdi ya da inorganik kökenli Ca elementi azlığı olsa da biyojenik kökenli Ca element artışı Joannin et all (2013) çalışmasında görülmektedir.

Küçük ve sayıca fazla organizmaların fazlalığı ya da artışı deniz suyundaki sıcaklığı, ışık geçirgenliğini ya da Ca elementi ve CO2 moleküllerinin yalıtılmasına neden oldukları için mercan kalsifikasyonunu yani koloni büyümesini su asidifikasyonundan daha fazla yavaşlatabileceği Isaak (2024) tartışılmaktadır. Tüm bu hassas dengelerin yanında atmosfer elektrik alanı ya da magnetotaktik bakterilerin yer manyetik alan yönüne uyumlu magnetik mineral kalıntıları bırakmaları gibi büyük ölçekli fiziksel kuvvetlerin etkileşimleri ile partiküllerin sedimanter süreçlerde aldığı roller dahada karışık hale gelmektedir.

Paleontoloji ya da güncel biyoloji ile ilgili multidisipliner yaklaşımları buluşturan diğer örneklerse elektrik alanda ağları gergin bir şekilde göç eden örümcekler ve göl kıyılarındaki sazlıklara mekanik yıkıcı güçler olarak topluca inip ağırlıkları ile çökerten sığırcıklar ve normalden fazla organik beslemeye neden olarak göl çökeltilerini anoksik ortama getirebilme durumlarıdır, Olsun et al (2024).

Uygun şartlarda hem polenler hem de killer günlerce hem havada hem de suda çökelmeyebilir. Tüm bu mekanizmalar araştırılmaya devam ederken, geçen yüzyılda yapılan araştırmalardan elde edilelen sedimanter parçacık taşınması ile ilgili bilgiler ile son 20 yılda elde edilen bilgiler hala yer manyetiği ya da elektrik alanı ile sedimanter süreçlerle ilgili bilinmeyelere tam bir cevap olabilecek kesinliğe ulaşmamıştır. Tezde yapılan bir kısım deneylerde (elektrik alan ve elektrik akış) dinlenmiş yani üzerlerindeki fazla elektrik yükünü topraklama yolu ile kaybetmiş kil ve polen kullanılmıştır. Statik elektrik etkileşimleri uygulandığında polenler ve manyetik mineral barındırmayan göl çökellerinin killerinin hareket yönlerinde sapma ya da durağan halden hareket haline geçiş gözlemlenmemiştir.

Deneylerde statik elektrik potansiyel artışı ile yani türbülansta aktifleştirme ile hava akımında yüklenen polenler ve kil boyutlu malzeme pleksiglas çubukla hareket etmiştir. Bu pozitif yük, doğal ortamda bitkinin topraklı olması nedeniyle ona bağlı negatif yani yük eksikliği durumundaki polen tanelerini çeker. Arıların havada atmosferik koşullara göre pozitif yük kazanabildikleri anlaşılmıştır. Bu tez doğrudan arıların bu özelliklerini araştırmamıştır fakat arı kanatlarının hava ile yaptığı sürtünme sonucunda uçtukça pozitif yük alabileceği konusunda yukardaki destekleyici bilgelere ulaşmıştır. Statik elektriğin yalıtılmış arayüzlerde potansiyel farkı dengelemek için yaptığı ani akışın temel etkisinden kaynaklanan bu çekim, arıların poleni nasıl verimli bir şekilde topladığını açıklamaktadır. Bu, atmosferdeki değişen elektrik alanları ile poleni taşıyan rüzgarın yönü arasında potansiyel bir etkileşime işaret etmektedir. Bu etkileşimleri anlamak, ekoloji ve tarımdan atmosfer bilimine kadar çeşitli alanlar için gereklidir.

Ek olarak göl ve deniz killeri ile polenlerin birbirlerine göre ve gelecekte süreç etkileşimlerini inceleyen çalışmalara örnek ve bir bağlam olması açısından X ışını element analizleri yapılmıştır. Polen ve kil türlerinin analizleri İTÜ EMCOL ve

Palinoloji laboratuvarlarında ITRAX marka X-ışını floresans element tarama yöntemi kullanılarak yapıldı. Polenlerin ve kuru kil tozlarının elektrik alan deneyleri ise, partiküllerin yüksek gerilim oluşturucu kutuplar arasında hızla dizilip ara mesafedeki tüm alana dağılmış homojen direnç yapısını bozucu şekle gelerek alan dağılımı yerine direk hatta dengesiz elektrik akışına sebebiyet verebileceği için geliştirilmeye devam etmektedir.

1. INTRODUCTION

Sedimentology, the study of sedimentation and the formation of sedimentary rocks, is a fundamental field of scientific inquiry that has far-reaching implications for our understanding of Earth's history and natural environment. For example, gravity plays a crucial role in shaping the Earth's surface and is not the only factor at play in the sedimentation cycle. In fact, when tracing past events or identifying their indicators, sedimentologists must consider a complex array of physical and chemical processes that have contributed to the formation of sedimentary rocks. From the movement of tectonic plates to the chemical reactions that occur within sedimentary basins, these processes have all left their mark on the sedimentary record. As we delve into the intricacies of sedimentology, it becomes clear that understanding these processes is essential for reconstructing the Earth's past and predicting its future evolution.

In today's sedimentology science, it is generally known that gravity is of first-degree importance. However, in regard to tracing past events or identifying their indicators, many physical and chemical processes are involved in the sedimentation cycle. The study of sedimentology is a complex and multifaceted field, as it seeks to understand the intricate processes by which sediments are formed and deposited over time. One of the key challenges in sedimentology is the convenience that the same type of element can undergo different transformations and sedimentation patterns at different stages of the sedimentation cycle. This complexity is compounded by the fact that these stages often operate at different scales, from microscopic to macroscopic. To grasp these complexities, a variety of physical and chemical methods have been used to study sedimentary processes. For example, the discovery of symmetrical changes in magnetic field directions on the ocean floor, as observed in research, has provided important insights into the migration of Earth's magnetic field direction.

The development of new technologies in recent years has also greatly expanded the range of measurement methods available to sedimentologists, enabling them to gather more detailed data about sedimentary processes. The same type of element can sediment in different stages of these cycles. One of the key aspects of sedimentology is the identification of the sources and mechanisms of sedimentation,

which can be achieved through the analysis of sedimentary layers. For example, the presence of calcium (Ca) in sediments in the Black Sea is associated with pollen, unlike plankton shells. This finding highlights the importance of considering both organic and inorganic sources in sedimentary basins and underscores the need for a comprehensive understanding of the mechanisms that govern sedimentation.

By examining the physical and chemical properties of sedimentary materials, insights can be gained into the processes that shape our planet's surface. In this context, experiments using representative samples of clay and average clay, such as blue cedar pollen, can provide valuable information about the composition and behavior of sedimentary materials.

1.1 Purpose of Thesis

It is challenging to track the effects of physical forces on sedimentary particles that are transported or suspended in environments such as the atmosphere and water sphere, where chaos currents are present. Therefore, it is only possible to contribute to the solution of interactions by reducing the intensity of some physical forces and amplifying the potential of others in a laboratory setting.

Today, it is necessary to investigate all physical forces that occur in cycles because it is difficult to make a correct interpretation and identify the causes of past climate, environmental, or seismic events based only on chemical proxy elements in sediments. This is because the deposition of an element can be influenced by multiple factors and cycles. Secondary or tertiary proxy elements may also respond more strongly to the physical force type than others. Since these forces can affect deposition with or without significant potential differences, which are not fully investigated for sedimentology, further testing through experiments is required to understand complex cycles. For example, there is positive and negative charge gain and attraction at dynamic multilayers of earth, such as negatively charged pollen in plants, due to the balance of static electricity or changes in the precipitation ratio of sedimentary materials from the suspended state during nonregular floating in the air. As a result, the transportation of pollen and other particles in the air or water during the deposition cycle was two-sided influenced by the physicochemical variety of displacing floccules or fecal pellets, density currents, microbial mat deformations and their self-electric attraction and suppression potential.

The humidity and electric field, which change the depth of aeolien particles, and the lineation effects of the electric field in the widely considered cases of past and present interpretations of lake sedimentation data are limited, and it is difficult to provide accurate information from unknown past or present events. The sedimentologic literature contains no information about the regional wind interactions formed by changes in the atmospheric electric field direction and intensity. Additionally, chemical, physical, and physicochemical interactions are related to the electrical potential in the neighboring layers of water. In this case, sedimentology science requires more information about all physical forces that affect sedimentary materials. Therefore, the aim of this thesis is to gather information from the literature and make new scientific contributions by investigating the effects of physical forces on the transport, deposition, and subsequent stages of sedimentary materials through experiments.

1.2 Literature Review

Sedimentary processes play a main role in shaping the Earth's surface and preserving geological records through the processes of sediment erosion, transport, deposition, and lithification. Both internal and external physical forces drive these processes through chemical interactions. The analysis of inorganic particles and organics such as clay and pollen is a powerful tool for reconstructing past vegetation and morphological or bathymetric changes, providing more precise documentation of distribution and composition with the help of geochemical tracers such as calcium (Ca), copper (Cu), and titanium (Ti). Chemical elements are accepted as proxy elements because they provide clues to explain how sedimentary phases develop. Their characteristic seasonal arrangement is recorded by polymeric or granular layers of organic and inorganic particles. The dimensions of pollen and clay are important for the formation of stable sedimentary records whose sizes can be suitable for maintaining proxy elements by interacting with water and other chemical and physical processes, such as biogenic mat generation or inorganic clay transitions. The transportation of sand, gravel and larger-sized sedimentary materials provides information about only the type and severity of physical events, but seasonal proxy elements cannot be preserved at the appropriate time-sequential depth. The dimensions of the suspended material shown in Figure 1.1 are shown in Table 1.1, as

are the dimensions of the biogenic mat remnants and the agglunated clay and Rubey size classifications based on settling velocities (Table 1.2).

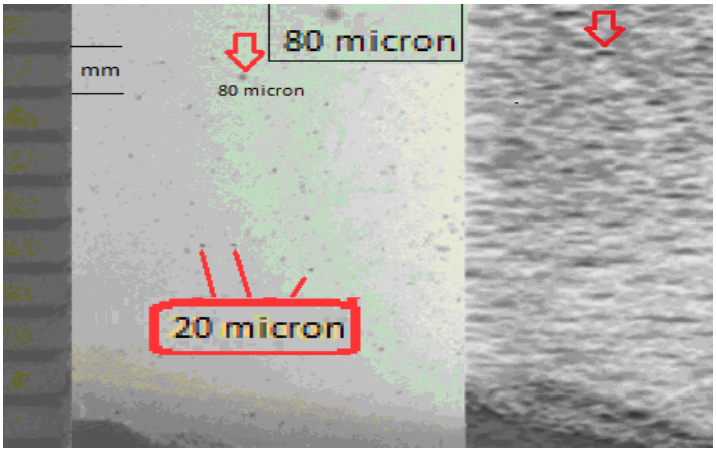

Figure 1.1 : Suspended materials at water and its size under ultrasonic tracing.

Clay dimensions Table 1.1 from oldest source Wentworth (1922) 0.0039 mm.

Table 1.1 : The grade terms from Wenworth (1922).

The Pieces	The Aggregate	The Indurated Rock
>256 Boulder.	Boulder gravel	Boulder conglomerate
>64 to 256 mm Cobble	Cobble gravel	Cobble conglomerate
>4 to 64 mm Pebble	Pebble gravel	Pebble conglomerate
>2 to 4 mm Granule	Granule gravel	Granule conglomerate
>1 to 2 mm Very coarse sand	Very coarse sand	Very coarse sandstone
>1/2 to 1 mm Coarse sand	Coarse sand	Coarse sandstone
1/2 mm Medium sand	Medium sand	Medium sandstone
1/4 mm. Fine sand	Fine sand	Fine sandstone
1/8 mm. Very fine sand	Very fine sand	Very fine sandstone
1/16 mm. Silt particle	Silt	Siltstone
< 1/256 mm. Clay particle	Clay	Claystone

Table 1.2 : Settling velocities size classification Rubey (1930).

Grade	Settling Velocity (in 1 microns/ sec.)
Very fine sand	> 3,840
Coarse silt	960-3,840
Medium silt	240-960
Fine silt	60-240
Very fine silt	15-6o
Coarse clay	3.75-15
Medium clay	0.9375-3.75
Fine clay	< 0.9375

1.2.1 Transport mechanisms of sedimentary materials

Separate, combined or conjoined (flocculation) biologic implantation; bioturbation; polymerization; or chemical transitions such as corrosion, degradation or dissolution.

Aeolian processes: Wind transports fine particles such as pollen and silt over long distances. Wind strength, particle size, and vegetation cover influence aeolian sediment transport.

Glacial processes: Glaciers transport a wide range of sediment sizes, from fine clay to large boulders. Pollen grains can be trapped in glacial ice and transported over large distances.

Marine processes: Ocean currents, waves, ridges and tides contribute to sediment transport in marine environments. Pollen grains and inorganic particles can be transported and deposited in marine sediments, providing records of terrestrial and marine interactions.

Fluvial processes: Fluvial processes: Ephemeral waters or rivers deliver sediments to basins or rest areas with density currents. The erosion and shift of fluvial bedrock provide irregular and regular element records by bed drift material at the same time.

Biogenic processes: Migration of animal biomass and implantation to shells, vertical or lateral bioturbation and specifications of seasonal or permanent vegetation provide ubrupt chaingings on sediment records.

Unstable mass displacements: Sliding or falling of rock, soil or soft sediment packages and extraterrestrial mass intakes

Deposition: When the energy of the transporting medium decreases, the particles settle out of suspension. The size and density of the particles influence their deposition rates. Pollen grains, due to their small size and low density, often remain in suspension longer than inorganic particles. Transportation of sedimentary materials via solid and ductile Solid: The movement of sedimentary materials through lateral and vertical displacements is a significant geological process that can transport large boulders or erratic rocks weighing up to 10,000 tonnes or more. These displacements occur through various mechanisms, such as glacial transport, mass wasting, and fluvial processes. Understanding these processes provides insights into the dynamics of landscape evolution and sedimentary deposition.

Transportation of sedimentary materials via atmosphere or gas drift: The transport of sedimentary materials through the atmosphere, commonly referred to as aeolian transport, involves the movement of particles by wind. This process plays a crucial role in shaping landscapes, forming sedimentary deposits, and influencing ecosystems. Gas drift, in the context of sediment transport, generally refers to the movement of particles within a gaseous medium, primarily the atmosphere. Organic materials such as pollen and organic remnants of clay silt and sand can drift due to wind and rain, and inorganic materials with clay silt and sand can drift due to weak winds. Both organic remnants and inorganic rocks, such as pebbles (2-64 mm) and cobbles (64-256 mm), can drift due to powerful storms. The clay density d =1.7 g/cm^3 and pollen d = 0.8 g/cm^3 experiment shown in Figure 1.2 reveals low-power wind-drifting pollen grains without clay displacement.

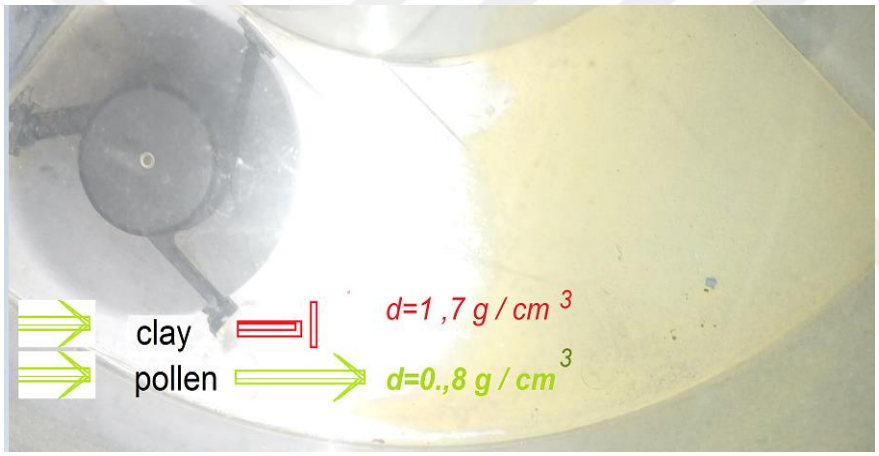

Figure 1.2 : Low power wind passage experiment with pollen and clay.

Transportation of sedimentary materials via fluids or viscous carrier: Sediment transport involves the movement of granular particles (such as sand, gravel, and soil) by fluids. These fluids can be water, air, or ice. The primary agents responsible for sediment transport include gravity, river and stream flow, wind, ice, and estuarine and ocean currents. In the rolling or traction process, particles move along a sedimentary bed but are too heavy to be lifted from it. Single grains jump over the bed, periodically losing contact with it. Particles remain permanently above the bed, sustained by the turbulent flow of air or water (Costa, 2016).

Organic materials such as pollen and remnants of organics with clay silt and sand can drift due to wind and rain, and inorganic materials with clay silt and sand can drift due to surface water. Both organic remnants and inorganic rocks, such as pebbles (2-

64 mm), cobbles (64-256 mm) and boulders (256 mm and upper size), can drift through rivers.

Surface waters such as rivers or ephemeral (after rains) waters: These are flowing bodies of freshwater that continuously move from higher to lower elevations. They are a permanent source of surface water, meaning they exist year-round. Rain, snowmelt, and groundwater contribute to the water in rivers. Ephemeral waters after rain refer to temporary bodies of water that appear only after rainfall events. These can include streams, creeks, washes, or puddles. They typically exist for short periods and dry up completely during extended dry periods.

In this experiment, since the pollen lands on wet ground, it most likely does not reach the female part of the flower (stigma) for pollination (Figure 1.3).

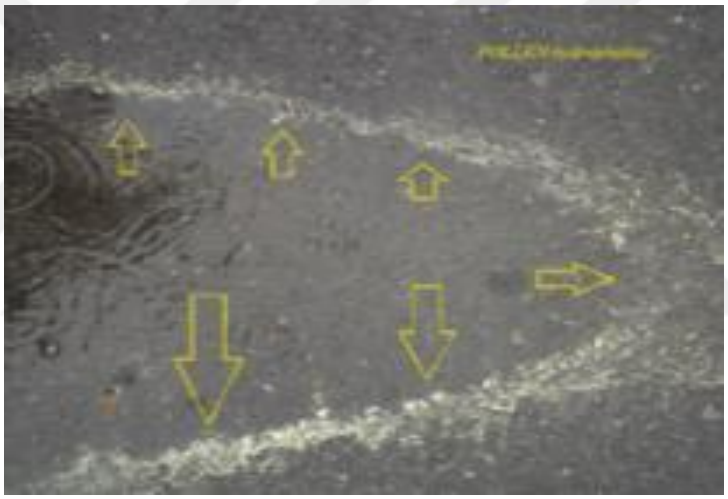

Figure 1.3 : Pollens at surface of ephemeral water (hydrofobic accumulation).

1.2.2 Physical forces affecting pollen grains

Pollen grains are microscopic structures produced by plants for reproduction. Their distribution in sediments is influenced by various physical forces:

Hydrodynamic forces: Water currents can transport pollen grains over long distances. The shape and surface texture of pollen grains affect their buoyancy and transport.

Wind forces: Wind can lift and transport pollen grains across continents. The size, shape, and surface characteristics of pollen grains influence their aerodynamic properties.

Gravitational forces: Gravity causes the settling of pollen grains from the air or water column. The rate of settling depends on the size, shape, and density of the grains.

Magnetic forces: These forces are ineffective on pollen grains but effective on magnetotactic bacteria that carry greigeite magnetic minerals

Electrostatic forces: The electrostatic attraction between pollen grains and other particles or surfaces can influence their transport and deposition.

Electric field: Friction provides free electrons and vibrations at orbital levels of atoms. The electric field lives until grounding to the earth or decharging as an electron current.

1.2.3 Physical forces affecting ınorganic particles

Inorganic particles, such as minerals and rock fragments, vary in size, shape, and density. Their transport and deposition are influenced by physical forces:

Hydrodynamic forces: Water flow can transport a wide range of particle sizes. Some of the particles float in a suspended state, and heavy grains or pebbles drift due to the water current at the river floor.

Wind forces: Winds can transport fine inorganic particles, such as dust and silt, over long distances. Particle size and density affect their aerodynamic behavior.

Gravitational forces: Gravity influences the settling of inorganic particles from suspensions. Larger and denser particles settle more quickly Rubey, W.W., (1930) than smaller and lighter particles.

Mechanical forces: Physical interactions, such as collisions and abrasion, can modify the size and shape of inorganic particles during transport. P-waves and S-waves disturb clay particles and sand grains during eartquakes and deform layers via the amplification effect of water during liquefaction.

Electric and magnetic forces: Magnetic and electric fields direct magnetic mineral grains, such as those in clay or sand, as well as water. Water is diamagnetic and can be slightly repelled by a magnet; however, since the movement of water causes nonmagnetic particles to move, this situation can be misleading. An electric current provides ionization of water and repels it Z. G. Chiragwandi, et al. (2005) with a

vortex ring Grier, D. (2003) Han Y, Grier G David (2003) at close proximity to anode cathode deployment.

Electrostatic forces: The electrostatic attraction between pollen grains and other particles or surfaces can influence their transport and deposition (Bowker G. E., Crenshaw H. C. (2007) and biological contaminants such as honeybees (Clarke D, et al. 2017)

Electric field: An electric field is caused by the movement of many small and light particles, such as pollen, spider webs and clay-sized materials, to line up along the electric field Erica L. et al.**,** **(**2018), Acar, D., et al., (2018)), and it moves with the weather front.

1.2.4 Comparative analysis

Size and Density: Pollen grains are generally smaller and less dense than many inorganic particles (Brewbaker, 1963, Cardenas et al., 2008). This difference affects their transport and deposition. Pollen grains are more likely to be transported over long distances by wind and water. Clay density d = 1.7 g/cm³ and pollen d = 0.8 g/cm³ measured as per dry uncompacted weight of volume 1 cm cubic with reference weight of pure water at the same volume (water density d = 1 g/cm³)

Shape and Surface Characteristics: The shape and surface texture of pollen grains porous with air sacks. Inorganic particles have more variable shapes and surface characteristics. Clay particles sank more quickly than the pollen grains of cedar trees.

Settling Velocity: Pollen grains have lower settling velocities than many inorganic particles. Pollen can buoy until its surface biomat decomposes and precipitate to the seafloor. Wet and dry pollen and its biomat have different element counts (Figure 1.4), and the first settling velocity size classification made by Rubey (1930) for biomat decomposition and its settling seafloor are biological conditions because biomat is a nutrient and product of pollen germination. Figure 1.5 shows a few micron diameter pollen tubes. Changes in settling velocity at borders, such as at the pynocline boundary, which separates two liquid layers of different densities in some cases, are due to conditions in which only flocculation, aggregation or fecal pellets infiltrate the other zone, such as marine snow (Figure 1.6) (Kiorboe, 2001; Bowker, 2007).

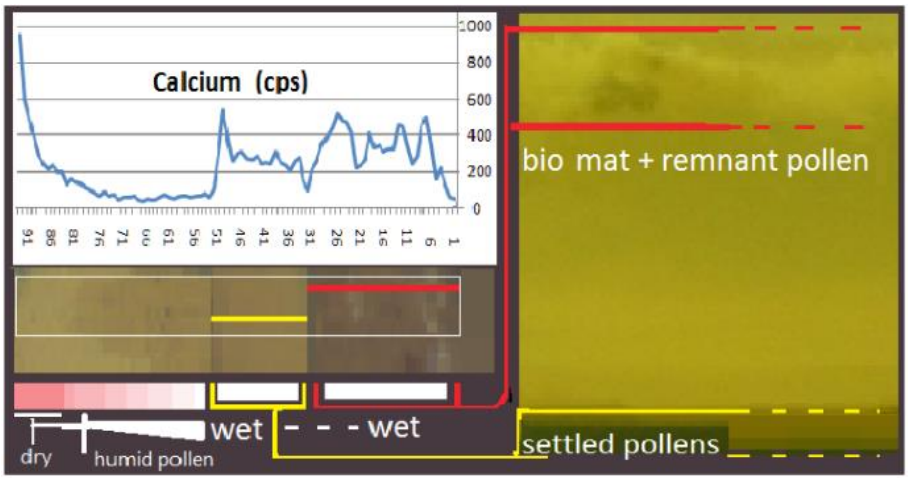

Figure 1.4 : Ca XRF element profile of dry and wet pollen grains and its biomat.

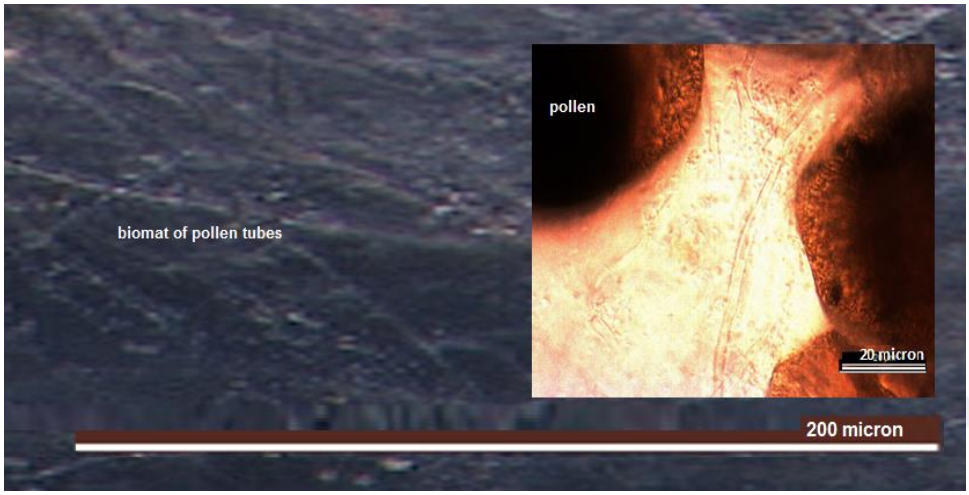

Figure 1.5 : Pollen germination tubes in pollen biomat.

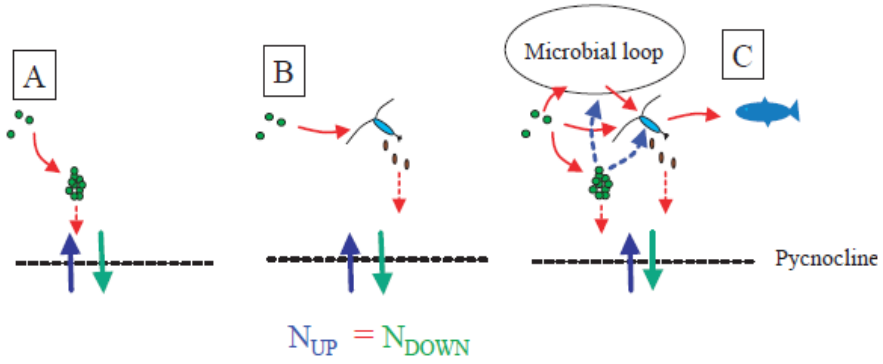

Figure 1.6 : Pynocline border for examle cases A: phytoplancton aggregates B: fecal pellets C: both sinking (Kiorboe, 2001).

2. MATERIALS AND METHODS

As an inorganic material, clay smaller than 0.002 mm or 2 μm (micron = micrometer), silt between 0.002 and 0.05 mm or 50 μm, and pollen were examined (60 μm)**.**

In the experiments, sub150-micron-thick bentonite-type casting sand surface smoothing molding clay was used. In terms of its properties, intermediate bentonite-type clay, which contains calcium and silica as well as potassium and sodium, was used. The contact of clay with water creates a very impermeable intermediate insulation zone, which greatly reduces the occurrence of electrical accidents. The following experiments were carried out to determine the properties of the clay.

They were chosen because they can remain in motion in the sedimentary cycle for a long time and provide realistic clues about the existence and location of the source rock and organism. They are suitable for creating new information for science in terms of their metamorphosis and transportation dynamics.

Sample collection: Clays were obtained from natural sea and lake sediments, and their average properties and density in their natural environment were characterized to be 1.7 g/cm3 on average. The inorganic materials included clay smaller than 0.002 mm or 2 μm (micron = micrometer), silt between 0.002 and 0.05 mm or 50 μm, and pollen (60 μm) (Figure 2.1)**.**

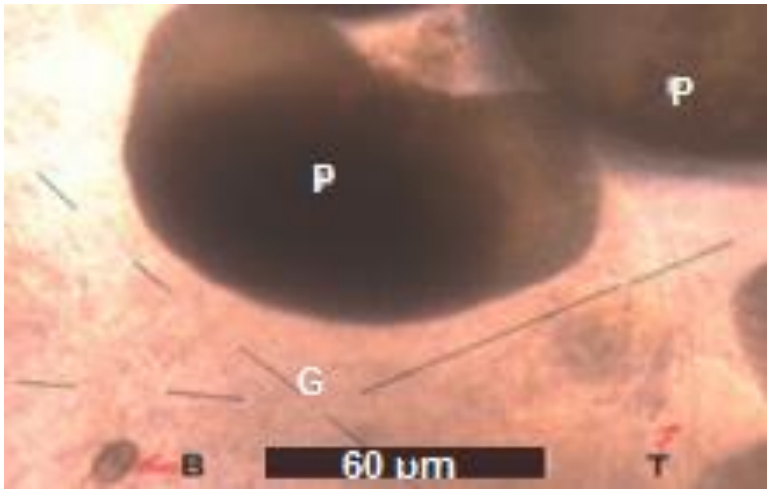

Figure 2.1 : Cedar tree pollen grains (*Cedrus atlantica*).

Samples were collected during the pollen release season, typically in spring, when blue cedar trees are most actively pollinating. Cedar pollen grains were collected using petri dishes, ensuring minimal disturbance to the collected samples from the ITU Ayazağa Campus. The blue cedar (*Cedrus atlantica*) pollen represents an important organic material for sedimentary studies due to its distinct morphological characteristics and its role in reconstructing past vegetative and climatic conditions.

Figure 2.2 : Cedar tree (*Cedrus atlantica*).

2.1 Organic Origine Materials (Pollen and Organic Carbon Remnants)

The pollen grains of the blue cedar (*Cedrus atlantica*) of this species are typically characterized by their elliptical shape, with a long axis of approximately 120 µm and

a short axis of approximately 80 μm (Figure 2.2). The hydrophobic behaviour of male pollen cones is shown in Figure 2.3 (Figure 2.4).

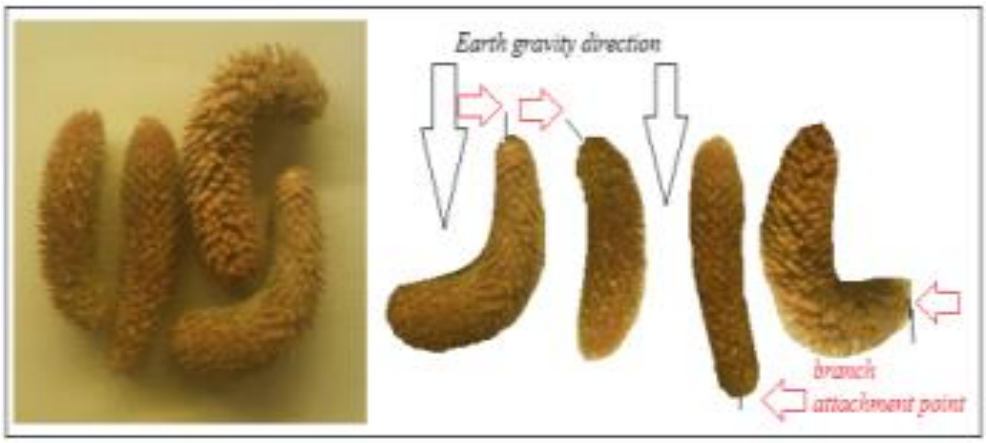

Figure 2.3 : Blue Cedar species male pollen cones.

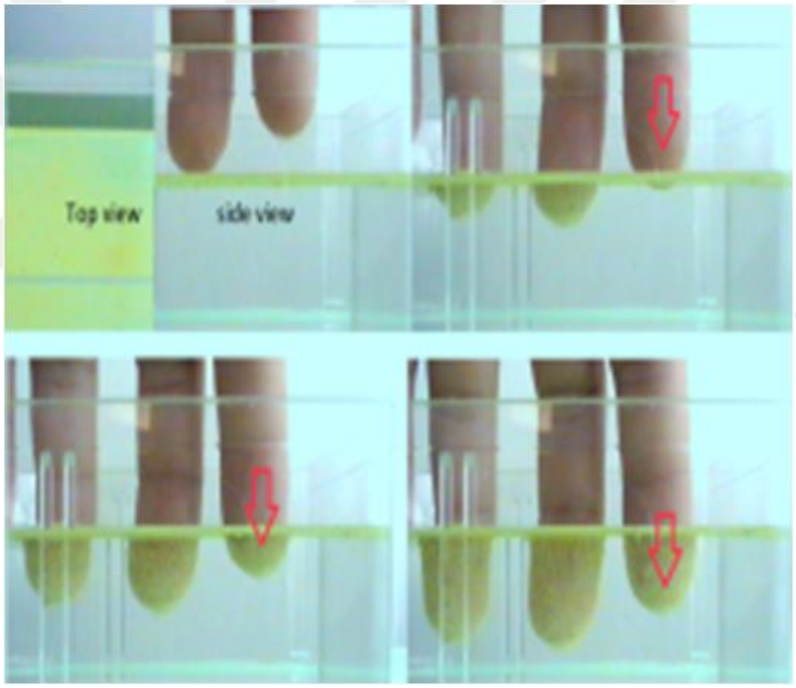

Figure 2.4 : Pollen hydrophobic behaviour and hydrophobic glove.

Table 2.1: XRF element measurement of layered dry pollen cps values.

Element	**XRF cps** point1	**Element**	**XRF cps** point2	**Element**	**XRF cps** avarage
Mg	8	Mg	6	Mg	7
Al	5	Al	13	Al	9
Si	11	Si	8	Si	10
P	17	P	20	P	19
S	0	S	0	S	0
Cl	13	Cl	12	Cl	13

Ar	0	Ar	73	Ar	37
K	802	K	561	K	682
Ca	209	Ca	81	Ca	145
Fe	353	Fe	228	Fe	291
Cu	*77*	Cu	87	Cu	82
Ga	137	Ga	54	Ga	96
Ge	38	Ge	28	Ge	33
As	70	As	79	As	75
Rb	83	Rb	161	Rb	122
Sr	41	Sr	23	Sr	32

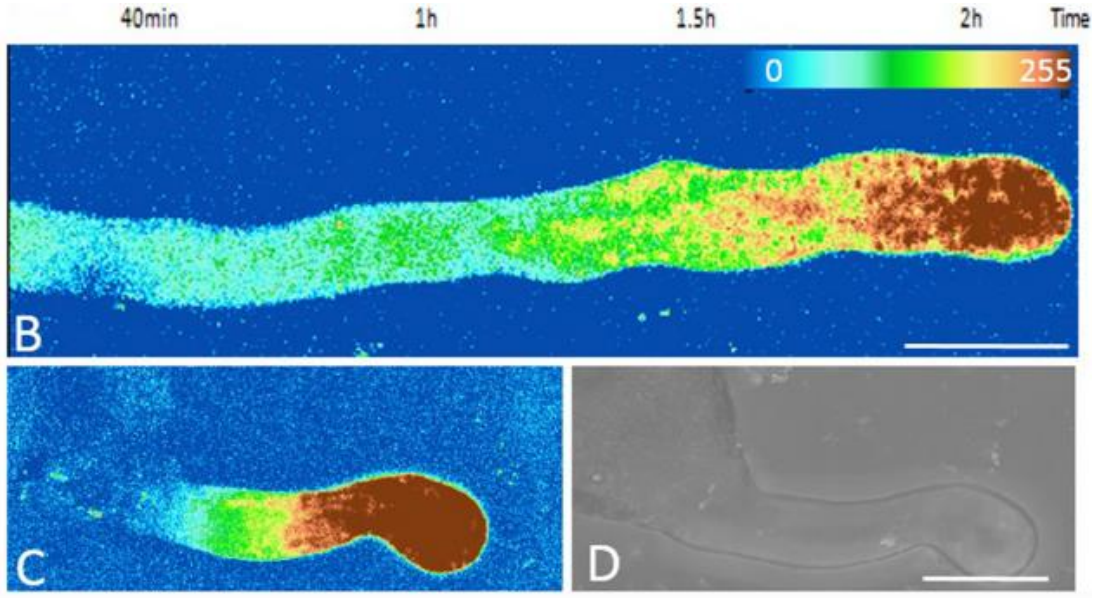

Figure 2.5 : Time depended tracing of Ca element at the apex of pollen tube with FTIR spectroscopy Scale bars = 25 µm (Fang et al., 2016).

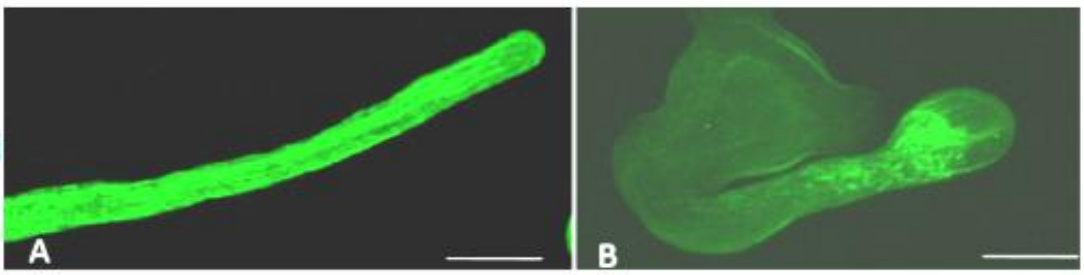

Figure 2.6 : Actin flaments in pollen tube. Scale bars = 25 µm (Fang et al., 2016).

Actin filaments direct pollen tube to exocytotic sites according to Cárdenas et al. (2008) Calcium: A Critical Factor in Pollen Germination and Tube Elongation (Zheng et al., 2019; Steinhorst and Kudla, 2013).

The Ca concentration is very important for pollen germination, as shown in Figure 2.5. Ca mobilization and actin filaments in germination tubes are shown in Figure 2.6 (Fang et al., 2016). The FTIR analysis method uses infrared light to observe chemical properties.

2.2 Inorganic Sedimentary Materials (Clay and Sand)

The transport ambiance of sedimentary materials refers to the various environmental and physical conditions that influence the movement of these materials before they settle and become part of the sedimentary record. Understanding these ambiances is crucial for interpreting the origins, paths, and eventual deposition of sediments, which can include both organic (such as pollen grains) and inorganic particles (with dimentions of clay, silt, and sand).

2.3 Experiments on Materials

2.3.1 Experiments from literature

2.3.1.1 Electric field experiments

Electric fields are invisible regions of influence surrounding electrically charged objects. These experiments allow us to visualize and understand how electric fields behave. Electric fields are generated by electric charges. Positive and negative charges create fields with opposite directions. The electric field lines are imaginary lines that depict the direction and strength of the electric field at any point. The closer the lines are, the stronger the field (Figure 2.7).

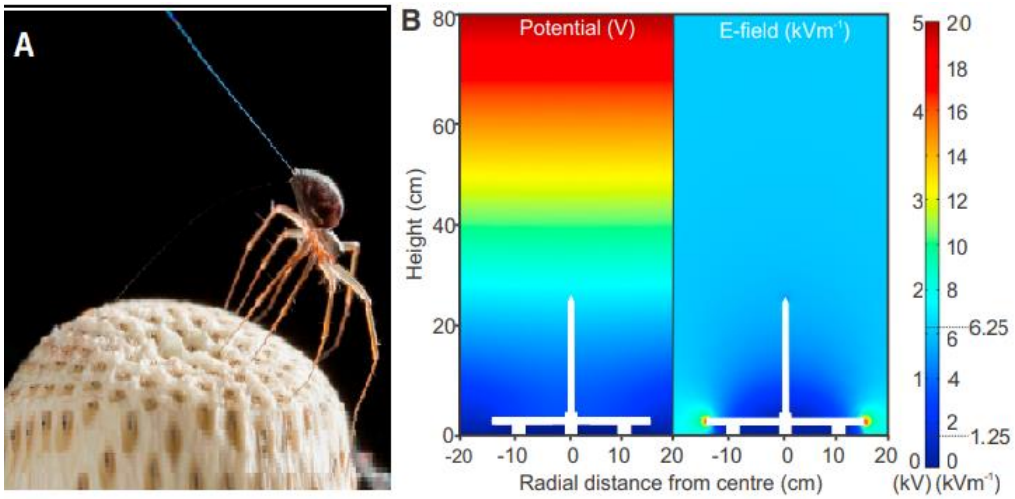

Figure 2.7 : The e-field is fairly uniform with a strength of 6.25 kV/m (blue color indicated on the scale bar) (Morley and Robert, 2018).

The paper ‘Electric Fields Elicit Ballooning in Spiders’ is one of the best experiments on an electric field and bio material with 6500 volts of energy and a low current power supply. Figure 2.10 belongs to this paper. In aquatic animals, electroception is based on the direct transmission of stimuli from a conductive medium (water) to the nervous system through conductive receptor channels (the bulbs of Lorenzini). For terrestrial animals living in air, an electrically resistant environment, the detection of electric fields must work with different principles, such as precapacitive sensory methods **(**Clarke et al., 2017).

2.3.1.2 Electrocurrent experiments (thunder sediments)

Fulgurite is melted and combined with junction materials by welding with natural high voltage. High-density rock integration, such as in clay or sand layers and aerosols in air, works as an electric decharge conductive bridge, but water has an ionic vortex bridge under low voltage according to Han & Grier (2003) (Figure 2.8).

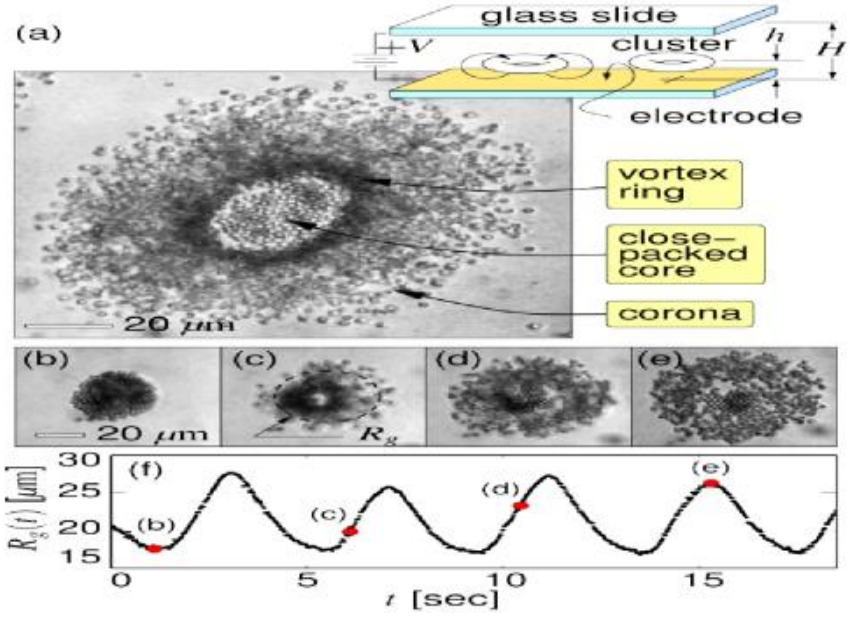

Figure 2.8 : Vortex ring of water between capacitive experiment set Hydronium ion, H3O+;hydroxide ion, OH– transition toroid (Han & Grier, 2003).

Microcurrent experiments are not suitable if water is not isolated because the water itself begins to produce and collect hydrogen and undergoes an ionic transition in sustained water repellency driven by oxygen gas leakage. For this reason, it is not

possible to observe whether the particles are affected by the electron flow but rather whether the water directs itself and therefore the particles due to the volumetric interactions of the gases formed. Figure 2.8 shows the dynamic water vortex with gas production.

2.3.1.3 Electro magnetic experiments

Electromagnetic experiments are foundational to the field of physics and electrical engineering, as they explore the behavior and interaction of electric and magnetic fields. These experiments help elucidate the principles governing electromagnetism, a fundamental force responsible for a wide range of phenomena in nature and technology.

2.3.1.4 Crystal magnetic experiments at air and water

Diamagnetic materials are slightly repelled by a magnetic field and do not retain their magnetic properties when the external field is removed. Paramagnetic materials are slightly attracted by the magnetic field and do not retain their magnetic properties when the external field is removed. Oxygen is paramagnetic and can float around powerful solid magnets. Water can change direction around powerful solid magnets because of its polar hydrogen bonds.

There is so much of an experiment at internet experiment 1:
Magnet push experiment: The magnet must be placed closer to the water-filled plastic glass during flotation on another water pool, links
Is water magnetic?
https://www.youtube.com/watch?v=Gqr5qdDDRB8
magnetic water, prove it video
https://youtu.be/YWisAnvKOvc
Experiment 2: Bringing a magnet closer to the water flowing down from the tap.

2.3.1.5 Electrostatic experiments

Electrostatic experiments explore the interactions between objects with electric charges. Pollen grains, with their unique surface characteristics, can carry a slight electrical charge, either positive or negative, depending on the specific plant species and environmental conditions (Figure 2.9). Pollen walls act as dielectric materials that can store electrical energy in an electric field.

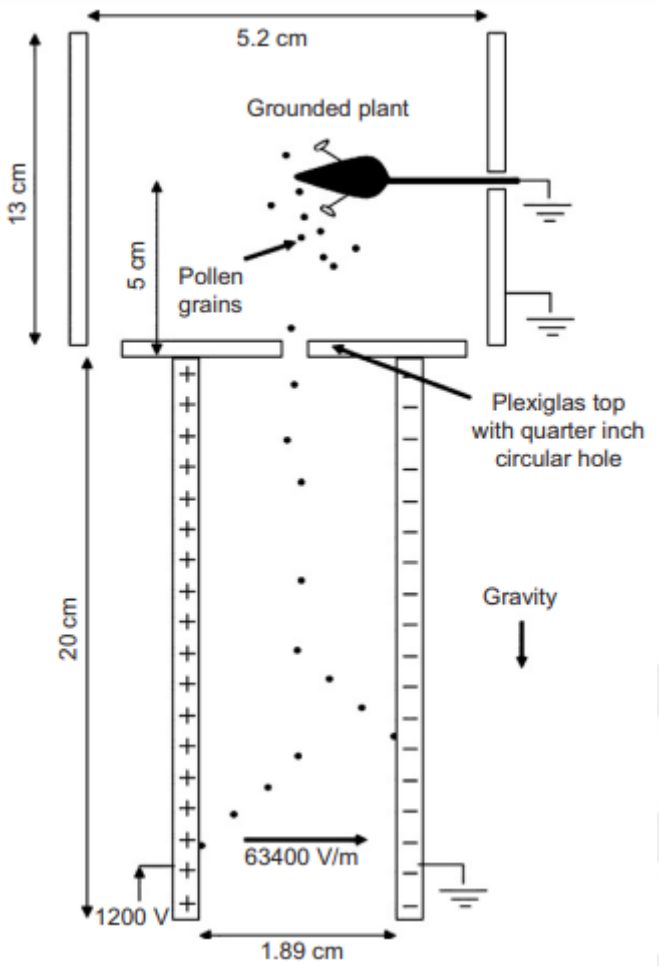

Figure 2.9 : A skecth showing the electro static experiments (taken by Bowker and Crenshaw, 2007).

Particules and water able to make current inclination under electrostatic force, visual links : Electrostatically Bending Water : https://youtu.be/T3e0_FSSHvc

Bending streams of water with a static charge // Homemade Science with Bruce Yeany : https://www.youtube.com/watch?v=yyf-lOU_I1I

Electric force between the water and the balloon - physics experiment: https://youtu.be/jkYz1WlpRSQ

2.3.1.6 Water floatation experiments

Water flotation experiments are an intriguing area of study within the fields of physics and engineering, focusing on the principles of buoyancy and fluid dynamics. These experiments investigate how and why objects float or sink in water, providing insights into the forces at play and the properties of both the objects and the fluid in which they are immersed.

2.3.1.7 Earth magnetic direction sensitibility

The sensitivity to Earth's magnetic field, also known as magnetoreception, is a fascinating phenomenon observed in both the natural world and in human-made technologies. This field of study explores how living organisms and electronic instruments detect and respond to the Earth's magnetic field.

2.3.1.8 Clay deformation with mechanical force experiments

Clay can fold under pressure. The water content of clay plays a crucial role in its deformation behavior. Drier clays are generally more brittle, while clays with higher water contents exhibit more ductile behavior and are less prone to fracturing. Seismic forces might also influence the distribution of water within the clay sample. Water could be squeezed out of some areas and migrate to others, potentially affecting the overall strength and stability of the clay.

Experiments investigating clay deformation with mechanical seismic force simulations can yield a variety of results depending on the specific clay type, force intensity, and duration. Clay can behave like a fluid under P-waves (Figure 2.10). Depending on the clay type, some clays might exhibit brittle behavior under strong seismic forces, fracturing and breaking into large pieces. Other clays, particularly those with higher water content, might show more ductile behavior, deforming plastically and forming folds or shear zones. Under high stress, deformation might not be uniform throughout the clay sample. Instead, it might localize in specific areas, forming shear bands (zones of intense shearing) or faults (planes of weakness within the clay). In extreme cases, saturated clay samples exposed to strong shaking forces might undergo liquefaction. This phenomenon occurs when the clay loses its strength and behaves like a liquid, potentially leading to ground failures such as landslides.

Figure 2.10 : A 1999 Izmit Earthquake and liquefection.

2.3.1.9 Salt deformation with mechanical force experiments

Salt can behave like fluid under pressure (Figure 2.14) and P-waves via tectonics or seismicity. Salt samples subjected to compression might show evidence of shortening and thickening. Depending on the force intensity, the salt could develop folds or even thrust faults (internal shear planes) within the material. Under extensional forces, the salt sample might exhibit necking (thinning in specific areas) and eventually rifting (formation of a central gap). Shear forces could cause the salt to develop shear bands (localized zones of intense deformation) or even lead to the formation of a detachment surface (a plane of weakness within the salt).

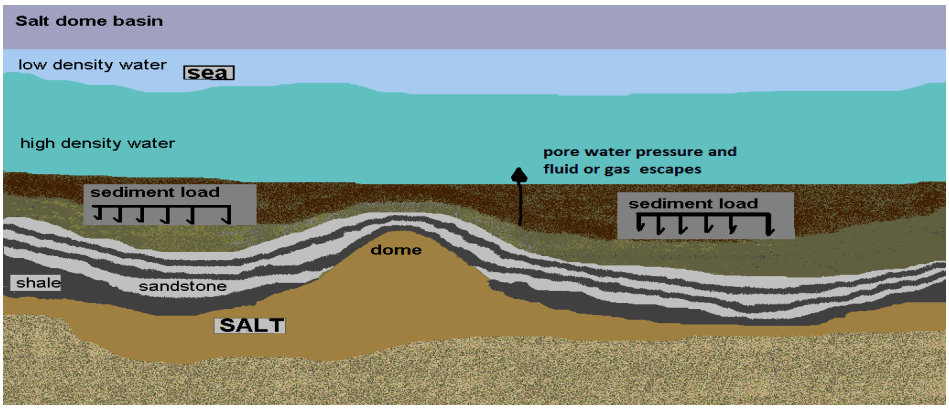

Figure 2.11 : Salt deformation with mechanical force.

2.4 Sedimentary Structures During Material Settling

Sedimentary structures are physical features formed within sedimentary rocks during the process of material settling. The sinking and deposition of particles are carried by wind, water, or ice. As the flow slows, the particles can no longer be supported and settle out (Figure 2.12, 2.13). For example, clay and inorganic sediment X-ray fluorescence (XRF) measurements were obtained (Figure 2.14).

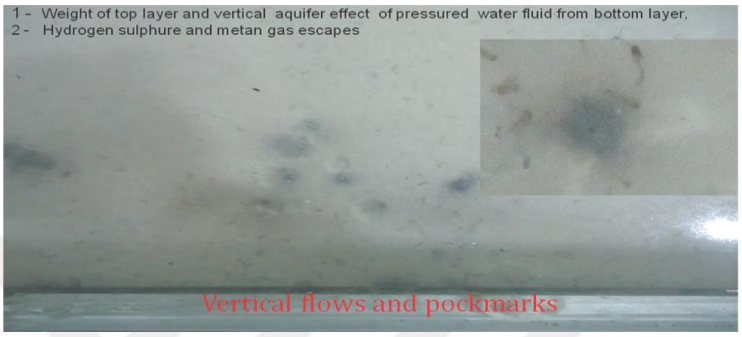

Figure 2.12 : Vertical flows and pockmarks.

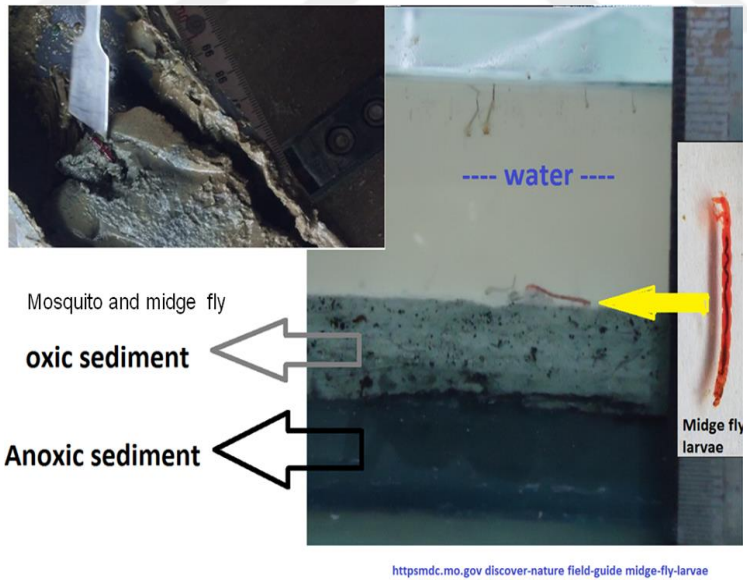

Figure 2.13 : Vertical flows in the sediments.

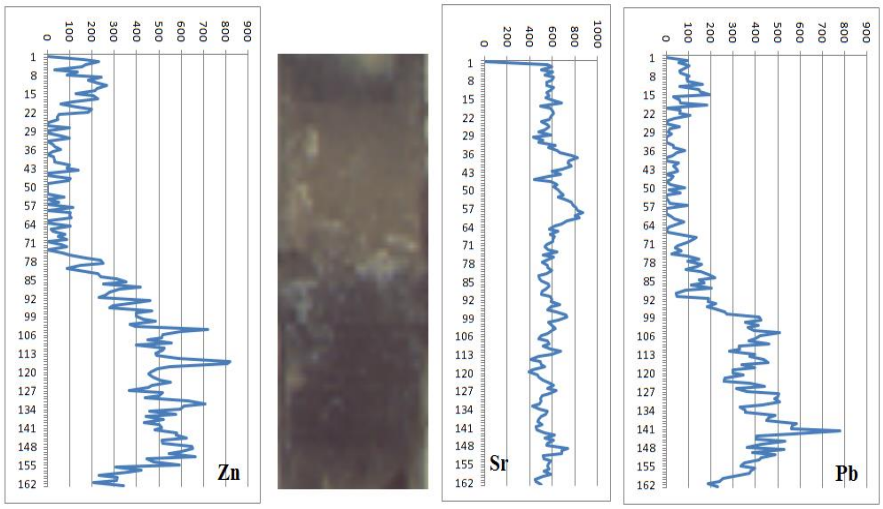

Figure 2.14 : XRF element counts of anoxic and oxic sediments.

2.5 Sedimentary Structures After Material Settling

These structures form as the material actively sinks and accumulates. The settling process itself, along with the interaction of particles with the environment, leaves imprints on the sediment. Mineral attraction caused by burial (generally a fast sedimentation rate).

2.5.1 Seismic coda wave deformations on wet sediments

Seismic coda waves are complex, lingering vibrations that follow the initial strong shaking from an earthquake. These waves are similar to the "tail end" of the earthquake signal and can last for much longer than the initial P and S waves. When seismic coda waves travel through wet sediments, they can cause deformations in the sediment. Water fills the spaces between the sediment particles, reducing the overall strength and rigidity of the material.

The complex shaking of coda waves can cause wet sediment particles to move slightly relative to each other. This can lead to liquefaction and compaction. In extreme cases, when shaking is very strong and the sediment is very saturated, the sediment can lose its strength and behave like a liquid. This can cause buildings to sink, slopes to fail, and other ground failures. Shaking can cause wet sediment particles to pack together more tightly, squeezing out some of the water and leading to a slight decrease in sediment volume. Even without liquefaction, shaking can

cause wet sediment particles to shift slightly, potentially disrupting any existing layering or structures within the sediment (Figure 2.15).

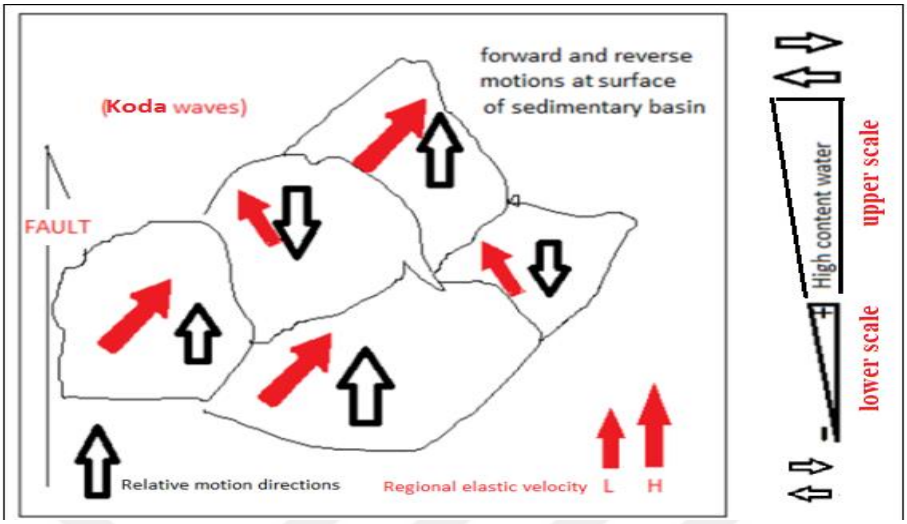

Figure 2.15 : Coda wave zonation on wet sediments.

2.5.2 Metamorphic and morphologic occurances

Some amorphous molecular accumulations or depletions occur during creep or drift deformations. Calish zonation, FeS Mineralisation at anoxia conditions, geodes, Volcanic – Thermal – Carbonate – Iron-Dolomite-Concretions

Manganese nodules and Biogenic magnetite mineral accumulations as morphologic accumulations. The poles of body remnants, such as the mineral or product biofunctional structure of gregeite, of magnetotactic bacteria allow magnetic north lineation in sediments (Figure 2.16).

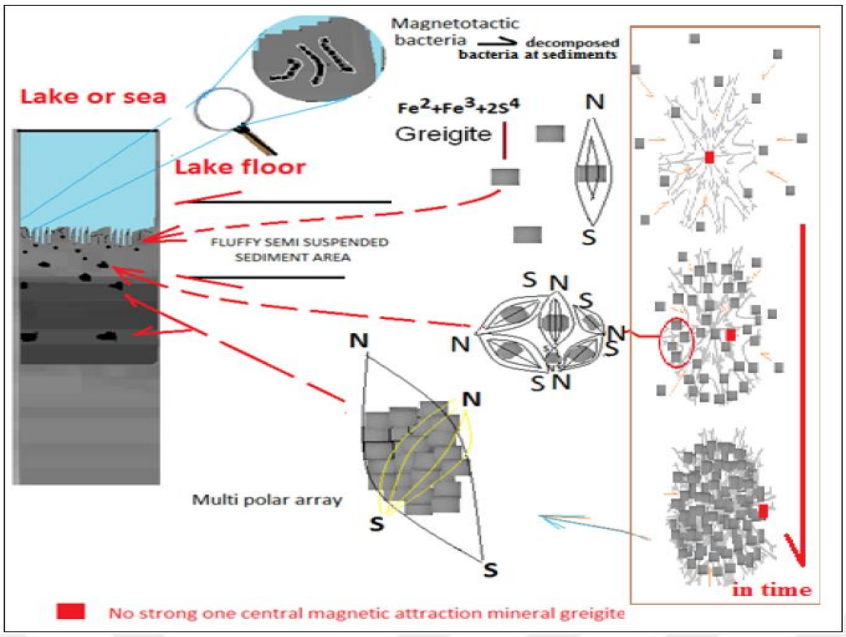

Figure 2.16 : Greigite mineral from magnetotactic bacteria.

3. RESULTS

The atmosphere has lateral or vertical layers with electric potential from incoming ions and free electrons from photonic or chemical reactions and friction. Free electrons quickly leak to the Earth's surface or slowly, resulting in low-grade continuous electrical leakage. The electric potential results in an electric field when grounding from air under highly resistive conditions because of the enormous friction on the ground thermal barier during very low humidity. In some stormy weather, while there are traces of rainfall, no rainfalls on the ground, as named "Virga" (a sound close to ergátēs arga irga from Asia to ancient Greeks as a general concept for objects or humans that adapt and connect to temporary efforts, come into act and let release again in a short time). Is a high potential electric field or evaporation responsible for dry rain or dry storm events? Humphreys (1932) is an atmospheric physenna: Anyone who has seen sheets of rain in a thunderstorm vanish wholly before reaching the surface, as they often do in arid regions.

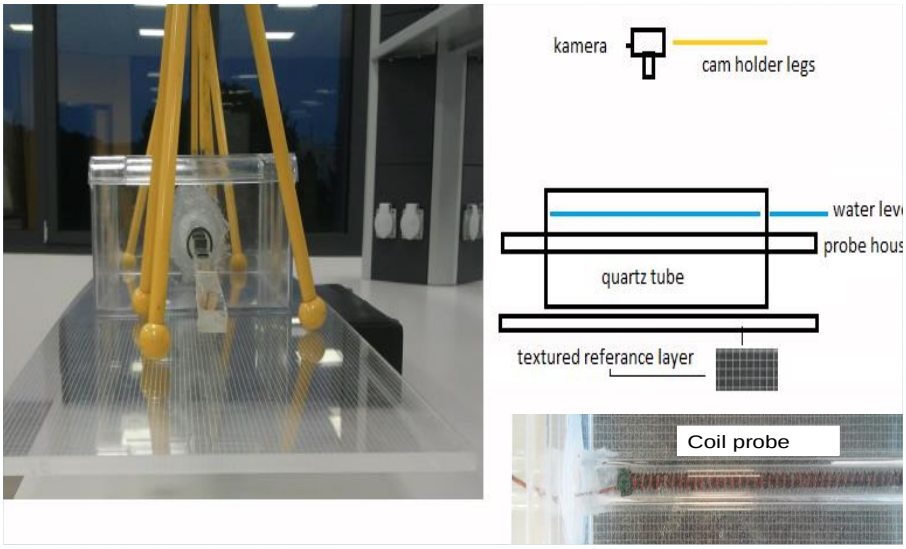

Figure 3.1 : Electric magnetic experiment setup with isolated probe housing.

Water is more conductive than air. Sudden electric loads such as electric lightening can penetrate humid sediments, sand or soil to a depth of too few meters, and as a result, unique rock can undergo welded material integration, which is referred to as “fulgurite”. A high voltage creates hydrogen (H), hydrogenium ions (H3O) and hydroxide ions (OH), similar to the methods of Han & Grier (2003); for this reason, water can be repelled by gas displacement. In this thesis, a DC voltage of 12 volts and a current of 1 amper were used because the AC voltage is a high-frequency vibration. Figure 3.1 Waterproof isolated probe housing installed in the experimental case. For well-developed experimental setups and discussions with future contributions, primer electric field experiments are designed, and technical drawings are finished, but the setup is not applied.

2.1 Elecrostatic Experiments

Pollen is not affected by static electricity after falling into water. No reaction was obtained from pollen in static electricity experiments conducted with ebonite glass and plexiglass. However, when the pollen was left to drift freely in the highly turbulent air in the glass container, it moved to the glass and plexiglass rods. Figure 3.2 shows, after 30 s, artificial air-generated pollen grains attracted by the plexyglass rod. Bee and pollen collection by staticelectric Corbet (1982) and measurements by Es'kov and Sapozhnikov (1976) indicate that the electrostatic potentials of foraging honeybees can reach hundreds of volts.

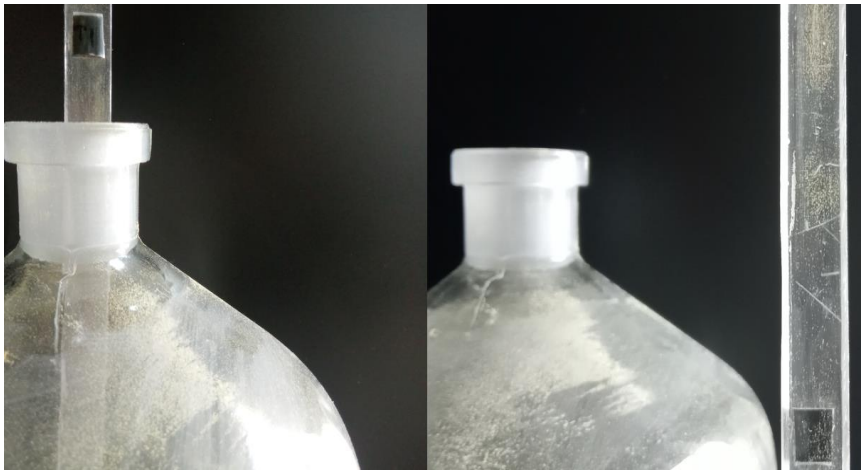

Figure 3.2 : Electrostatic attraction of pollen grains.

3.2 Electrocurrent Experiments

Electrocurrent experiments under laboratory conditions for air with low voltage are the same as those for capacitive plate setups because of the high resistance, but in water, the anode and cathode must be isolated to simulate the application of electrical currents to study various physical and chemical processes, including sedimentation and particle transport. These experiments utilize principles from electrochemistry, fluid dynamics, and micron-scale particle physics to investigate phenomena such as electrokinetic effects, electrophoresis (behaviour of charged particles under an electric field), and electroosmosis (defined as the flow effect of applied electric potential and surface charges on the flow of ions in solution). The repulsion at the same charge or the attraction at different charges creates ion movement in a general flow direction according to the principles of the Coulomb force). Electrocurrent experiments can be used to investigate the mobility of sedimentary particles in porous media under different electrochemical conditions. When investigating particle interactions, some dangerous situations can occur, such as a low-resistance chain by particles at the air mean short circuit. Rigth isolation must be installed for air or water environments with filled suspended particles. At the water between the positive and negative plates, polen movements were not observed by the experiment, or polen was hidden behind the hydrophobic pollen distribution at the water surface. The DC 12 volt 1 amper and 2 cm x 4 cm aluminum plates used in the experiment are shown in Figure 3.3.

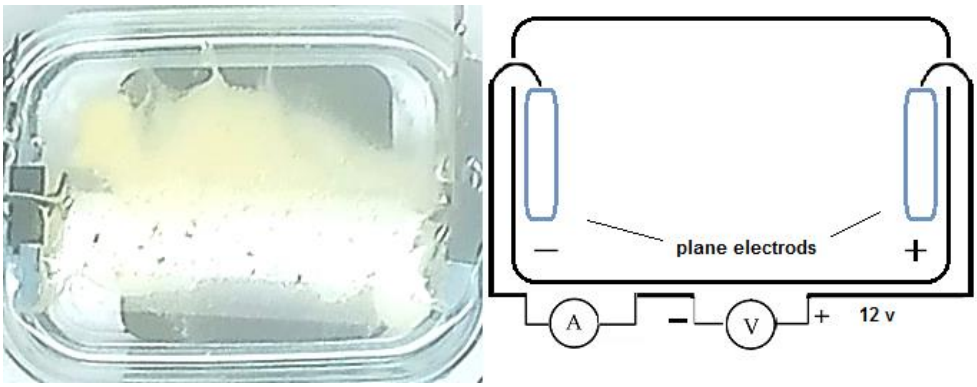

Figure 3.3 : Electrocurrent experiment and circuit plan.

3.3 Electromagnetic Experiments

Electromagnetic (EM) experiments in sediments and pollen grains involve the application of electromagnetic fields to study their physical properties, composition, and distribution. 12 Volt, 1 Amper DC electric coil and serial nonresistive load for eliminating heat and short circuits. Figure 3.3 Base electric magnetic field experiment for pollen grains and clay with coil in water.

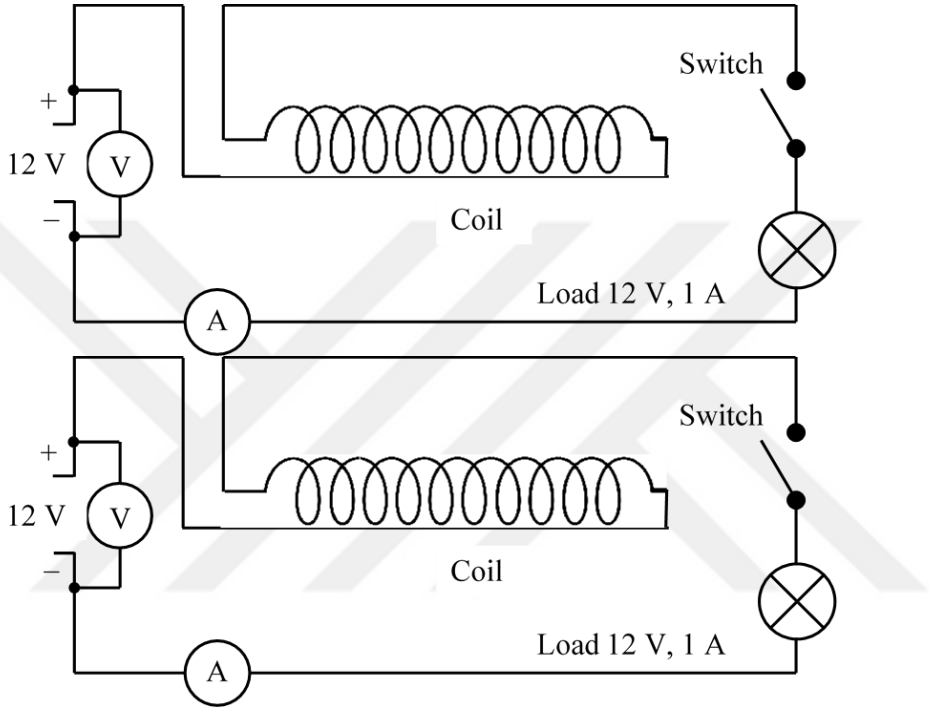

Figure 3.4 : Electric magnetic experiment circuit plan.

3.3.1 Electro magnetic experiments for pollen grains

As shown in Figure 3.4 and Figure 3.5, the coil was directly applied to water, and the fibres were not attracted to the water. The coils were placed in the dry housing and pollen never attracted to the experimental setup, as shown in Figure 3.6 and Figure 3.7.

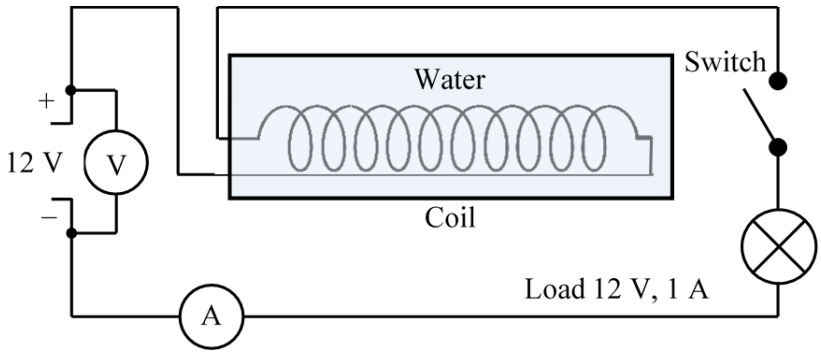

Figure 3.5 : Electric magnetic experiment for pollen grains with coil at water.

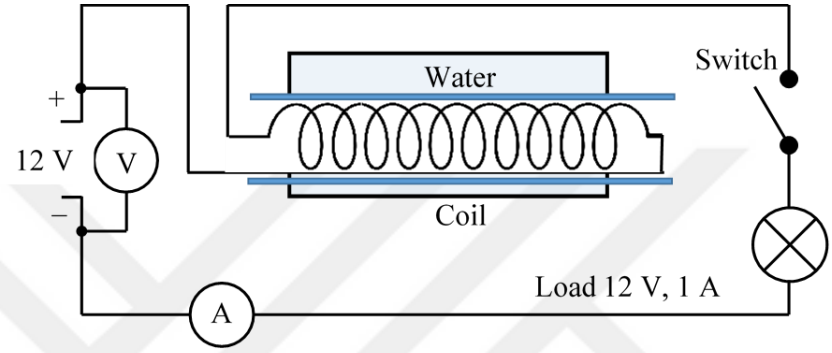

Figure 3.6 : Electric magnetic experiment for pollen grains with coil in isolated glass tube.

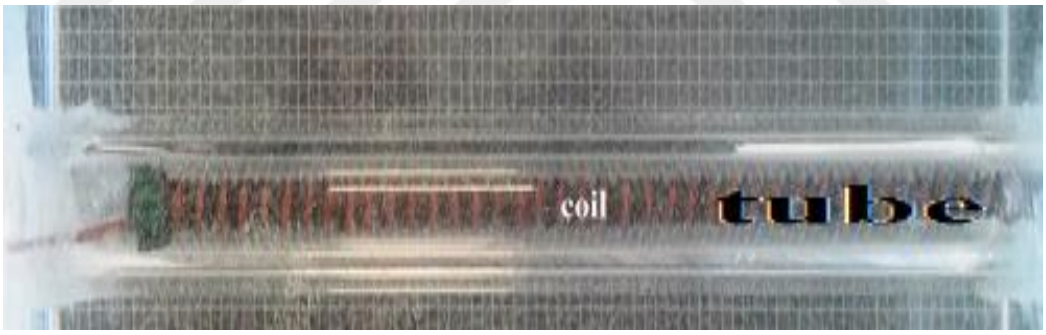

Figure 3.7 : Electric magnetic experiment for pollen grains with coil in isolated glass tube.

3.3.2 Electro magnetic experiments for clay

Clay suspensions have a continuously low velocity in water. The clay particles stabilized on the tube, and a moving coil was used in the isolated water tube in the water tank. According to the conditions of the water anti-stir isolated setup used in the experiment, the presence of a water current due to a strong magnetic field and any movement of the clay particles were not observed. Figure 3.8 (3 cm x 1.5 cm) shows that after 15 s, the clay did not contain any magnetic particles.

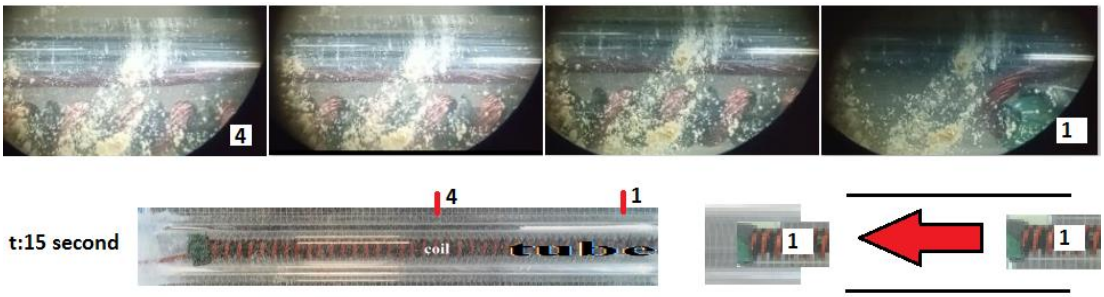

Figure 3.8 : Electromagnetic experiments for clay.

3.4 Crystal Magnetic Experiments

Water is diamagnetic (μr ≤ 1), and its magnetic susceptibility is negative. Diamagnetism: A magnetic field causes weak repelling of water. The movement of clay particles and pollen grains is not observed during the settling of the magnet to the probe housing of the examination, as shown in Figure 3.9.

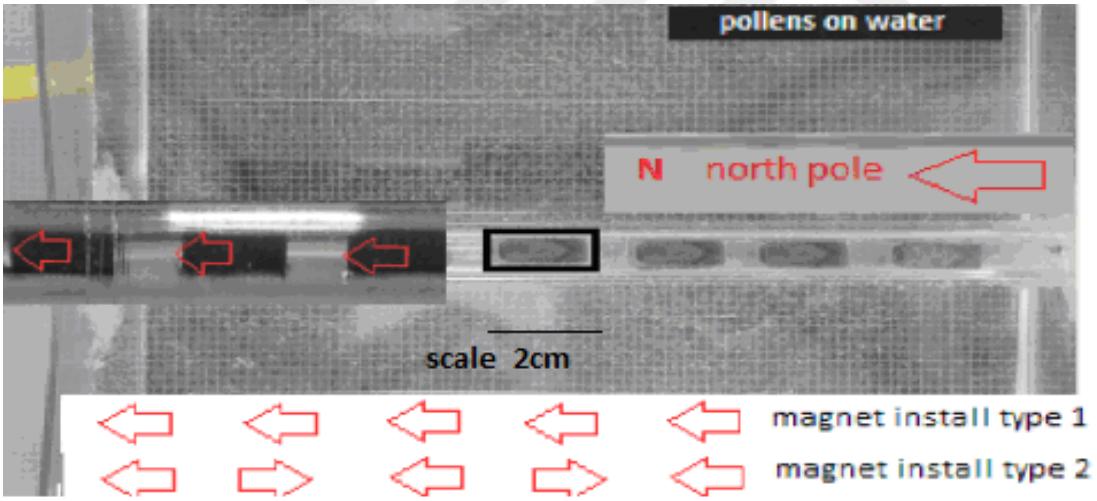

Figure 3.9 : Crystal magnetic experiments for pollen grains.

The movement of clay particles is not observed. Figure 3.10 shows pictures (3 cm x 1.5 cm) taken at 12 s, where the clay does not contain any magnetic particles. The magnetic probe was placed in an isolated tube without shaking.

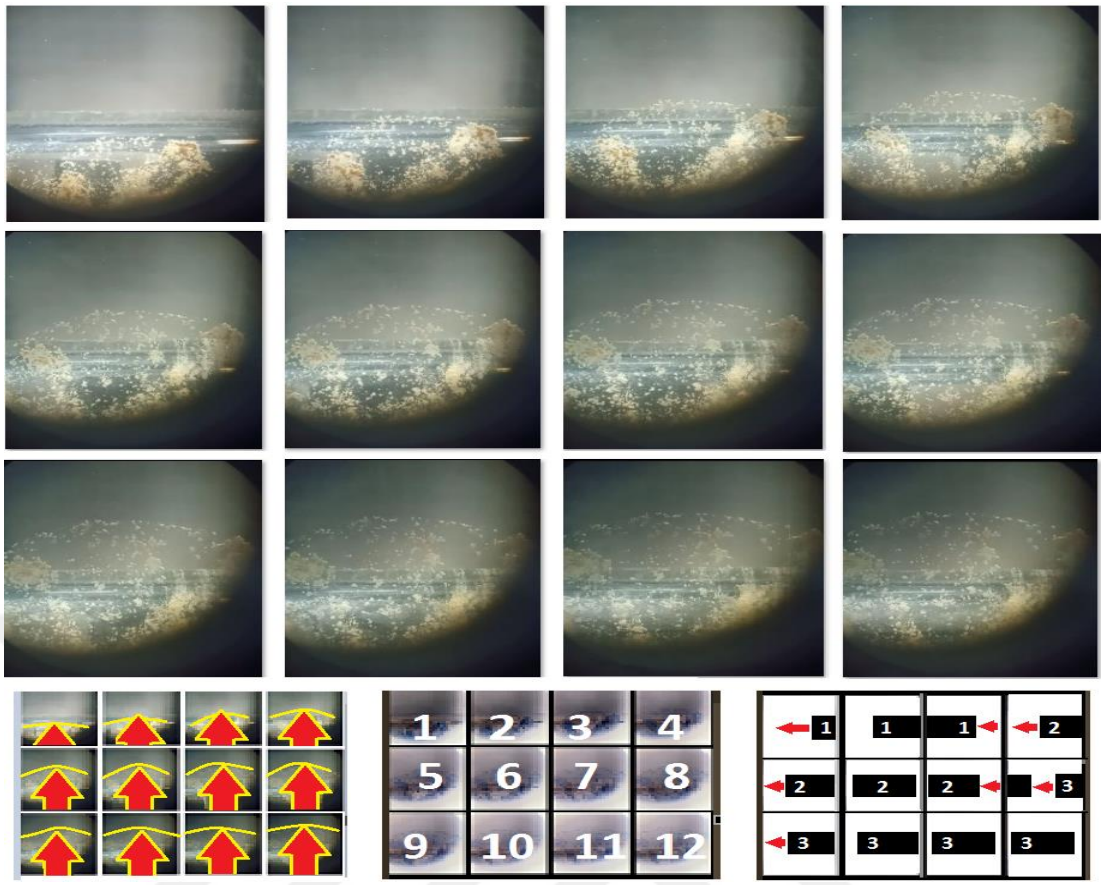

Figure 3.10 : Crystal magnetic experiments for clay. Time scale for each picture one second and length of edge of square 3 cm. Red arrows indicate reference turbiditic flow. The pilot image below on the right shows the placement of the magnet probe.

3.5 Water Floatation Experiments

Pollen has air gaps and forms a hydrophobic coating on the surface of standing water for four to six days. If the water surface is wavy and moving, the water remains on the surface as smaller mats of individual pieces or as grains suspended below the water surface. Turbulences were artificially created on the water surface to eliminate the dry surface tension of pollen grains and sticky substances such as dust. Pollen grains may exhibit different degrees of cohesion to water and wetting when submerged in water, depending on their surface morphology (Chiragwandi et al., 2003; 2005). This affects their ability to float, sink, or remain suspended in the water column. The cleaned pollen grains are gently introduced onto the surface of a water-filled container or observation chamber. The behavior of the pollen grains was observed and recorded over time.

Preparation for experiments is very difficult because water can be affected by static and magnetic forces while monitoring objects that are affected by the same forces.

Similarly, this phenomenon has not yet been proven, but the Earth's large Coriolis water gear currents may be regulated partially by magnetic polar lineation, not only by centrifugal force or atmospheric drift, such as the volume of water repelled by magnets. The surface of the water with pollen film is shown in Figure 3.11. Accordingly, in the PET plastic case experiment, mixtures of polen hydrophobic film and surface water with a proportion of 2 g of pollen to 0.5 litres of water were applied for 10 seconds in the PET rectangular case to prevent long-term hydrophobic surface film by dry pollens. After 10 s, the surface was mixed in the same way, and later, the surface state was defined after 5 h. The second remixture of the same experimental case was provided without any addition, and the last surface state of the chaos was redefined.

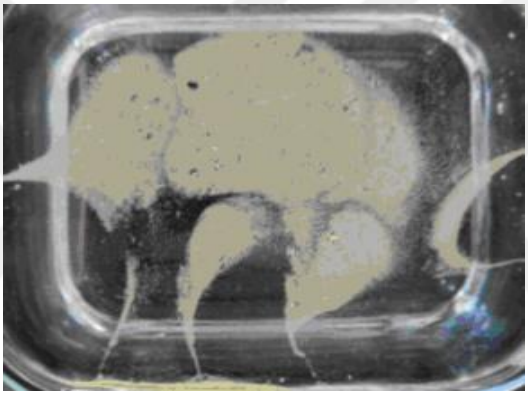

Figure 3.11 : Water floatation experiments for pollen grains of *Cedrus atlantica*.

Pollens are released into the water by gravitational fall. The air gaps of the blue cedar species Cedrus atlantica cv. Pollens form a hydrophobic coating on the surface of stagnant water for four to six days, except for brackish (Soda) water. If the water surface is wavy and moving, the particles remain as detached pieces (smaller covers) on the surface or as suspended grains under the water surface. Turbulances were artificially created at the water surface to eliminate the dry surface tension of pollen grains and sticky materials such as dust.

The experimental case was always covered by a protective layer to avoid the influence of air sources, such as microbes and dust, on the water and pollen films. The laboratory atmosphere was isolated from strong air displacement because of pollen sticking to the interior walls of the case by a wind push, but the sun daylight was never blocked. Experiments with different water chemicals, plastic types and glass case types complied with daily and daily conditions.

Figure 3.12 : Experiment type PET plastic case, mixtures of polen hydrophobic film and surface water in the proportion of 2 g of pollen to 0.5 liters of water were turbulanced along 10 second in PVC rectengular case.

Accordingly, in the glass experiment type, mixtures of polen hydrophobic film and surface water in the proportion of 2 g of pollen to 0.5 litres of water were applied for 10 seconds in the rectangular PVC case. After 10 s, the surface was mixed in the same way; later, the surface state was defined after 5 h, the second mixture was provided, and the last surface state of the chaos was redefined.

After two days, the same application (mixing of surface) was performed again. Water (lakes) with low element concentrations maintain long-term pollen drifting at the surface, and less hydrophobic behaviour is observed. Most of the hydrophobic behaviour was observed in clorine-rich water (water can also move with electric and magnetic potential).

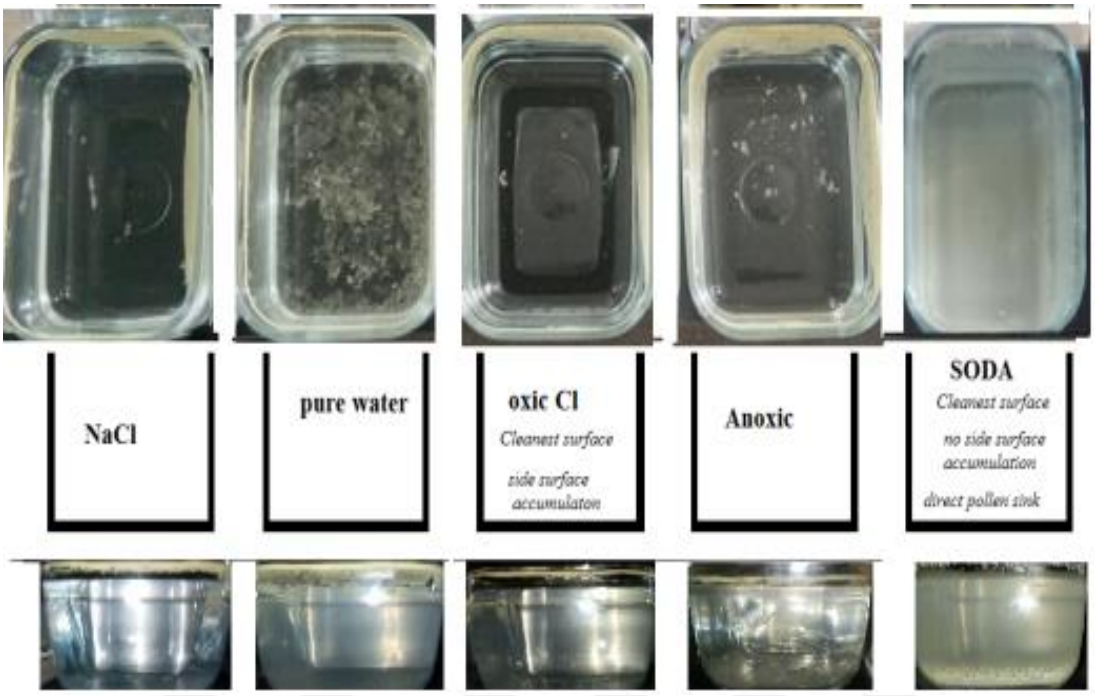

Figure 3.13 : Experiment type glass case, mixtures of polen hydrophobic film and surface water in the proportion of 2 g of pollen to 0.5 liters of water were turbulanced along 10 second in PET rectangular case.

3.6 Earth Magnetic Field Direction Sensitivity on Sedimentary materials

The effects of the ground magnetic field on the transport and sedimentation periods of materials (remnants of magnetotactical bacteria, pollen and lithologic magnetic particles) is a subject that has not been studied much. To collect information about the accumulation of particles, sinking speed and vertical sinking inclinations, an examination mechanism consisting of 8 cabins was designed with their long axes in the main geographical directions. An experimental setup that is protected from physical external factors such as wind or temperature and magnetic field. There must be flow control in the containers before and after the addition of sedimentary material.

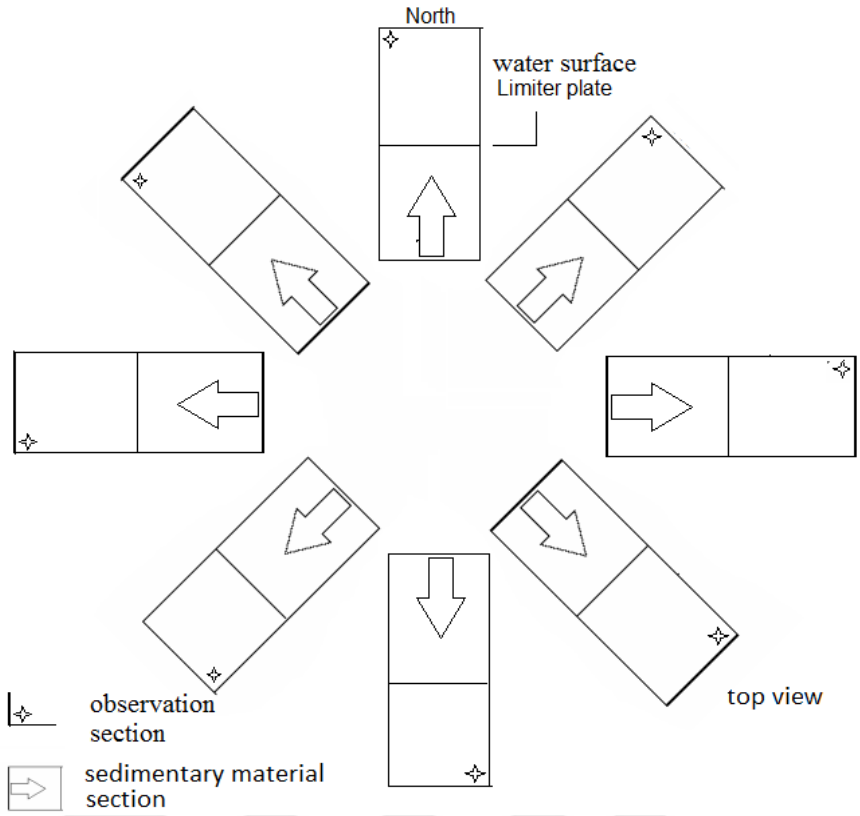

Figure 3.14 : Experiment with directed case.

3.7 P-Wave Force Application Experiment

This experiment investigated the effects of P-wave forces on pollen grains, simulating the impact they might experience during events such as earthquakes or landslides (Figure 3.15). It is expected that P-wave exposure might hinder pollen germination compared to that in the control group. The vibrations could cause some morphological changes in the pollen grains, such as slight distortions. In extreme cases, strong P-wave forces might lead to some pollen grain rupture.

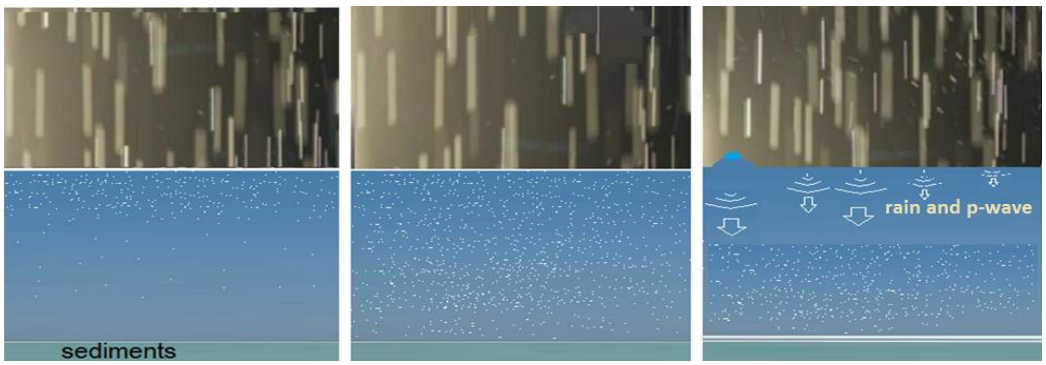

Figure 3.15 : Rain drops and their P-waves for supressing elevation of suspended sediments.

Figure 3.16 : Experiment P-wave force application.

When the acoustic P-wave generator moves directly to the water body and then a visible jet water current occurs, Hursh P-waves deform the wet sediments of the lake with the same principles, and some vertical liquefaction canals occur during seismic activity.

3.8 Clay Deformation with Mechanical Tectonic Force Experiments

These experiments use clay as an analogue material to simulate the behavior of wet sediments under stress conditions similar to those found in the Earth's crust. Clay is a good choice for these experiments because of its unique properties. Clay particles are platy and can slide past each other, allowing plastic deformation that mimics rock behaviour. Clay can be easily shaped and manipulated to create specific geological features for study. The experiments involve applying mechanical forces to the clay sample to simulate tectonic stresses. Different clay minerals (e.g., kaolinite and illite) have varying strengths and deformation characteristics. The amount of water in the clay can significantly affect its plasticity and response to stress. Figure 3.17. Extentional regime experiment with wet clay.

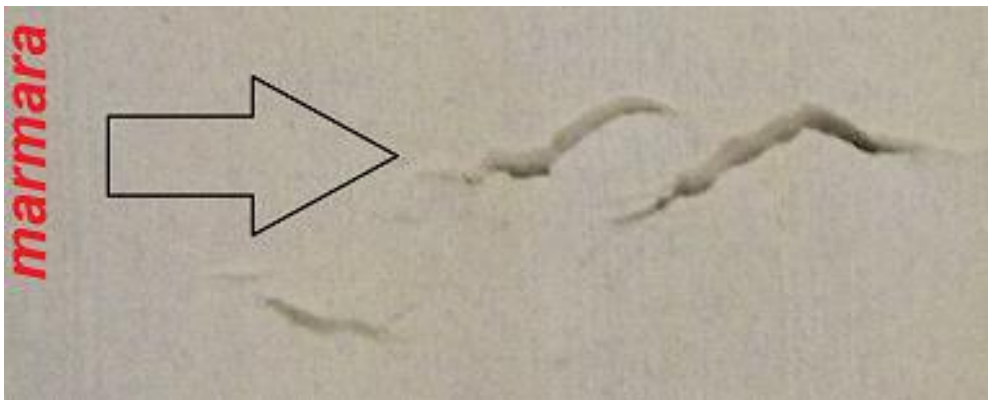

Figure 3.17 : Experiment clay deformation.

3.9 Clay Deformation with Mechanical Seismic Force Experiments

Different gel layers with different densities were prepared and processed on a shaker table. The generation of pulse-like push movements changed the lateral positions of the layers. The interface region of the sliding layers deformed during lateral displacement, as shown in Figure 3.18.

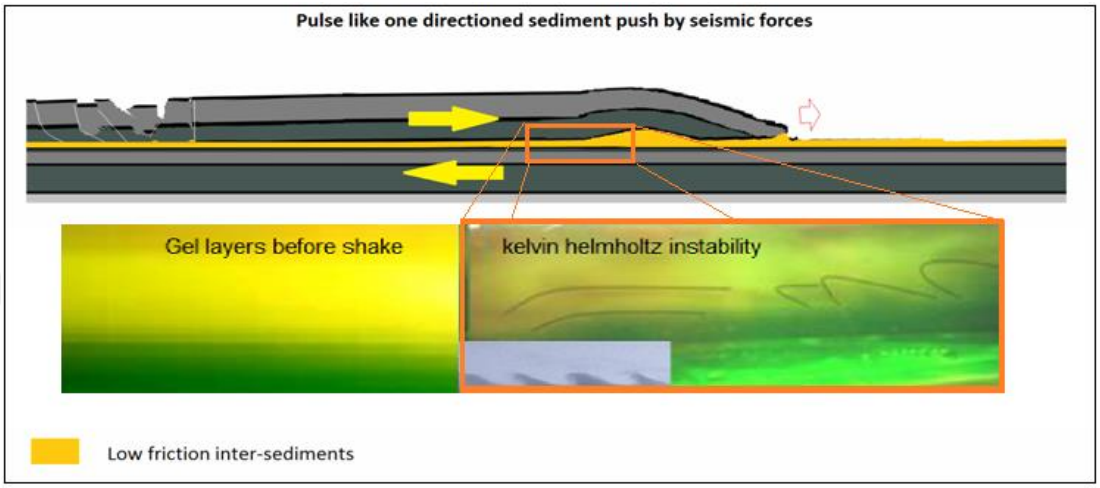

Figure 3.18 : Lateral stratigraphic displacement by coda waves.

3.10 Electric Field Experiments

1660 Otto von Guericke, 1865 Wilhelm Holtz, 1872 Augusto Righi, 1880 Robert Voss and 1929 Van de Graaff static electricity is a wearable electric field or macrostatic electric field.

Particle experiments were only planned with a macroscale static electric field. The experiments were not finished, but similar events were observed in nature, with spider silks floating at the same speed in laminar air movement as those frozen under static electrical stress on Hazar Lake Turkiye in 2011. Accordingly, the particle observation that should be made entirely within the electric field is considered, as shown in Figure 3.19.

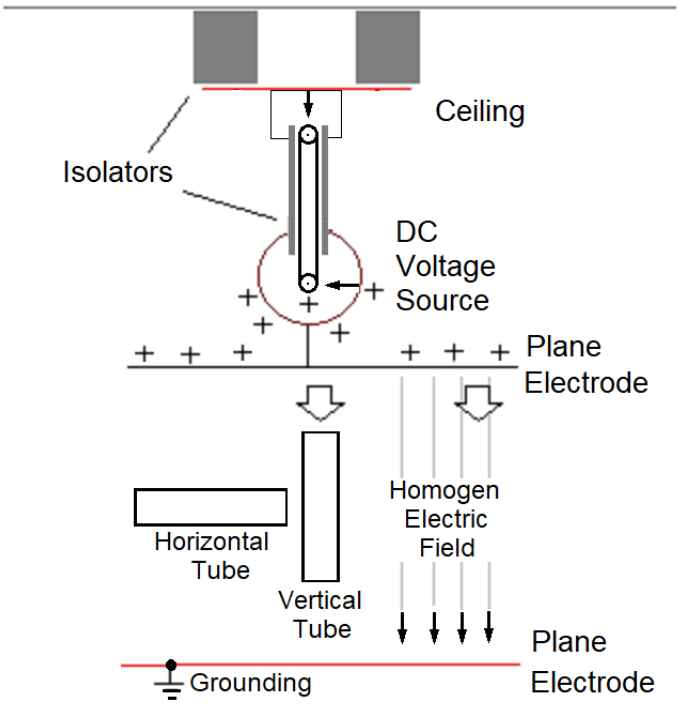

Figure 3.19: Righi or Van de Graaff type static electric field generator as part of macro scale electric field.

4. DISCUSSIONS

In this thesis study, it was understood that many connections with electric fields, such as inorganic particles, organic particles, and biological and atmospheric precipitation properties, can play important roles in sedimentological processes (Corbet et al., 1982; Durak et al., 2016; Eskov et al., 1976; Erica et al., 2018; Erickson, 1975; Grier, 2003; Han et al., 2003; Hovland et al., 2002; Isaak et al., 2024; Kineke et al., 1992; Kuang et al., 2014; Olsun et al., 2024; Ozeren et al., 2021; Sari et al., 2018; Steinhorst et al., 2013; Sternberg et al., 1991; Wang et al., 2022; Zheng et al., 2019; 2023). Free electrons quickly leak to the Earth's surface as an electric lightens or slowly as a result of low-grade continuous electrical leakage. In some stormy weather, while there are traces of rainfall, no rainfalls on the ground, which is referred to as "Virga" (a sound close to ergátēs arga irga from Asia to ancient Greeks, as a general concept for objects or acts such as adaptation and designed for continuous connection and release) Belong to Humphreys (1932) as an atmospheric physician: Anyone who has seen sheets of rain in a thunderstorm vanish wholly before reaching the surface, as they often do in arid regions. For example, in dry storms that produce rain that does not fall, the phenomenon of rapid evaporation without falling to the ground, which is generally seen as the cause of the event, may not be the only reason.

High potential electric field or evaporation responsible for dry rain (virga or dry storm) event? The electric potential dipole field formed as a result of friction between atmospheric layers may be responsible for this phenomenon. The atmosphere has lateral or vertical layers with electric potential from incoming ions and free electrons from photonic or chemical reactions and friction. The science of sedimentology needs to develop faster, and at this point, help that can have an accelerating effect needs to be provided from different disciplines. Therefore, it is necessary to include research, measurements and interpretations from different disciplines.

The application, research and measurement methods in different disciplines thus focus more on the science of sedimentology. It is understood that even extreme

examples can be binding at this point. For instance, Zheng et al. (2023) and Yu et al. (2024) found that a cavitation bubble collapse around spherical particles seems far from sedimentology but actually very close for internal debris dynamics of shoreline slides and density currents and its sedimentary processes.

The electric potential results in an electric field when ground from air under highly resistive conditions due to the enormous friction on the ground thermal barier at very low humidity.

5. CONCLUSIONS

This study underscores the challenges inherent in tracking the effects of physical forces on sedimentary particles within dynamic environments such as the atmosphere and water sphere characterized by chaotic currents. Given these complexities, our ability to understand these interactions hinges on laboratory experimentation, where certain physical forces can be attenuated or amplified.

It is evident that a comprehensive investigation into all physical forces within natural cycles is imperative, as accurate interpretations and identification of the causes behind past climate, environmental, or seismic events rely on elucidating the multifaceted influences on sediment deposition. The complexity of sediment deposition processes is underscored by the multitude of factors and cycles that can influence the deposition of proxy elements. The responses of secondary or tertiary proxy elements to physical forces may vary significantly, necessitating further experimental scrutiny to fully comprehend their impact. Notably, both inorganic and biogenic sources contribute to these forces, as exemplified by the intricate interactions observed between pollen grains and atmospheric forces during airborne transport. Understanding these dynamics is crucial, as they shape the deposition patterns of organic and inorganic sedimentary materials, leaving valuable imprints in sedimentation records.

The limited water volume of lake sedimentation data offers a glimpse into past or present events, reflecting the interplay of various physical forces. The literature mostly highlights solar winds and atmospheric electric field relationships but works less on complex events such as regional wind interactions or how changes in atmospheric electric field intensity drive these complex events. Moreover, the intricate web of chemical, physical, and physical-chemical interactions tied to electrical potential in water and surrounding environments further accentuates the need for a holistic understanding of sedimentology.

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