# Types of Fossil Plant Preservations and Paleobotanical Techniques Employed

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# What are Fossils

- Fossils are the preserved remains or traces of living things.
  - Fossils provide evidence of how life has changed over time.
  - Fossils also help scientists infer how Earth's surface has changed.
  - Fossils are clues to what past environments were like.

# Fossils

- Most fossils form when living things die and are buried by sediments.  The sediments slowly harden into rock and preserve the shapes of the organisms.

# What do fossils tell about how organisms have changed over time

- The fossil record provides evidence to support the theory of evolution.
- A scientific theory is a well-tested concept that explains a wide range of observations.
- Evolution is the gradual change in living things over long periods of time.
- The fossil record shows that millions of types of organisms have evolved.
  - But many others have become extinct.
  - A type of organism is extinct if it no longer exists and will never again live on Earth

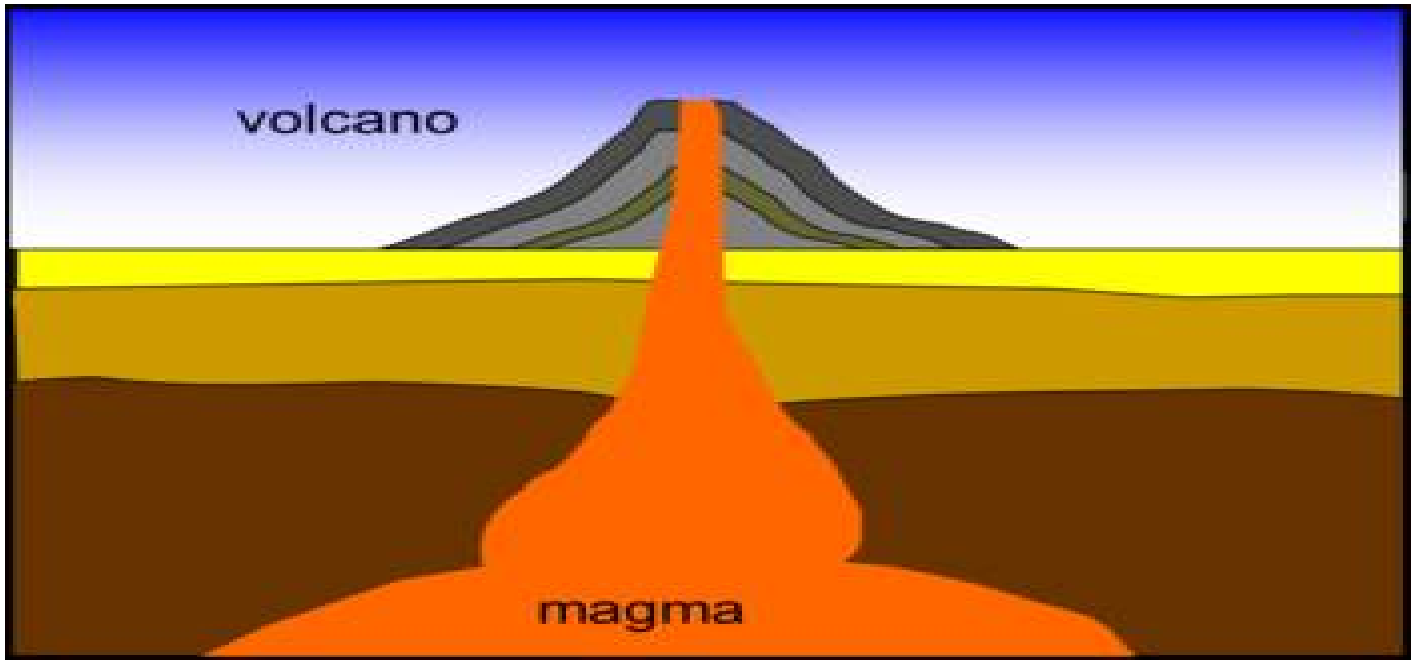
# Types of Rock

- There are three main types of rocks:
- Igneous - formed when molten rock cools.
- Sedimentary – formed by the “cementing together” of small grains of sediment.
- Metamorphic – rocks changed by the effect of heat and pressure.

# Igneous Rocks

- These are rocks formed by the cooling of molten rock (magma.)
- Magma cools and solidifies forming igneous rocks

# Igneous Rocks



# Sedimentary Rocks

- Sedimentary rock is formed by erosion
- Sediments are moved from one place to another
- Sediments are deposited in layers, with the older ones on the bottom
- The layers become compacted and cemented together

# Sedimentary Rocks

- Sedimentary Rocks are formed at or near the Earth's surface
- No heat and pressure involved
- Strata – layers of rock
- Stratification – the process in which sedimentary rocks are arranged in layers

# Metamorphic Rocks

- Metamorphic rocks are formed by the effect of heat and pressure on existing rocks.
- This can greatly affect the hardness, texture or layer patterns of the rocks.

# Fossil Types and Techniques Of Study

Types of Fossil Preservation

1. Impression
2. Compression
3. Permineralization (petrifaction)
4. Cast
5. Mold
6. Unaltered plant remains
7. Chemical fossils

# Impression

- *An Impression is a fossil showing the negative imprint of parts of an organism in rocks. No organic matter is present, but the line of external features of the parts of the organism is discernable.*
- An Impression fossil is the commonest form found in various types of sedimentary rocks , such as shales, sandstones, limestone's etc.
- These fossils represents only an imprint of the plant part. The original organic matter has been completely destroyed.
- Impression fossils are found along the bedding planes of sedimentary rocks.
- When a plant part fell near the site of sedimentation or it was immediately covered by a layer of

# Impression

unconsolidated sediment or mud which protected it to some extent and undergoes compression due to overlying sediment.

- Early cementation of the surface configuration of the organic parts by iron and carbonates compound before they decay.
- The most common example of Impressions are the leaves of *Glossopteris*.
- Surface features in the negative impression can be studied be examined in unilateral light and by artificial casts from negative impressions,

# Compression

- *It is a fossil in the form of a compressed opaque black carbonaceous film in the rock retaining the original outline and external features of the organism* .
- In case of compression fossils the organic matter of the plant part was preserved. When a plant part fell near the site of sedimentation or it was immediately covered by a very fine grained sedimentary layer with no opportunity for fungal and bacterial decomposition of the plant material.The plant part underwent compression due to overlying sediment and expelled water and other gases resulting in flattening of material.
- Well preserved in shales or clays

# Compression

# Techniques for the study of Compressions

- Maceration for the study of cuticles, walls of spore and pollens, mechanical and vascular tissues.
- A layer of coal is picked up with a needle and and put in a glass tube containing Schultz's solution i.e. nitric acid to potassium chlorate crystal are added. It is left in this mixture for some hours. This oxidizes coal to humic acid, which is then removed by with an alkali usually with ammonia solution or potassium hydroxide. It is then centrifuged or differential filtering. A host of identifiable fragments can be recovered from this like spores, pollens etc. and then embedded in transparent media like glycerin jelly.
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# Permineralization (petrifaction)

- *Petrifaction is a type of fossil which is formed by complete or partial replacement or infiltration of the organic material by mineral matter followed by precipitation, crystallization and hardening.*
- Petrified means “turning to stone”
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# Techniques to study Petrifactions

Preparation of thin ground sections

A) A small portion of the petrified material is is ground on one surface

B) This surface is then cemented to a glass slide with canada balsam

C) With the aid of a special saw that has flat steel disc blades with diamond dust pressed into the cutting edge, as much as possible of the specimen is cut away, leaving a moderately thin slice adhering to the slide.

D) The section is then ground thinner and thinner on revolving lap until it becomes transparent enough to permit transmission of light

E) Using mounting medium the section can be sealed with cover glass for being examined in a light microscope

# Ground Section

Cemented to a glass slide with canada balsam

Cutting with rock cutting machine

Ground thin section after grinding

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# Peel technique

A) Grind the cut surface

B) Etch the surface with hydrofluoric acid

C) Etching with acid removes the mineral matter from the cell cavities

D) Wash gently with running water and air dry the etched surface

E) Flood the etched surface with acetone and before the acetone evaporates lay a thin sheet of clear transparent cellulose acetate on the surface, with care taken to avoid aie bubbles.

F) Acetone partially dissolves lower surface of the cellulose acetate film converting it to a liquid that flows in and out around the cavities., and it now envelops the cell walls projecting from the surface.

A) Acetone being volatile evaporates quickly , once again rendering the lower surface of the cellulose of the cellulose acetate into solid form.

B) The cell walls are now partially embedded in the sheet of cellulose acetate

C) Allow it to dry for at least eight hours.

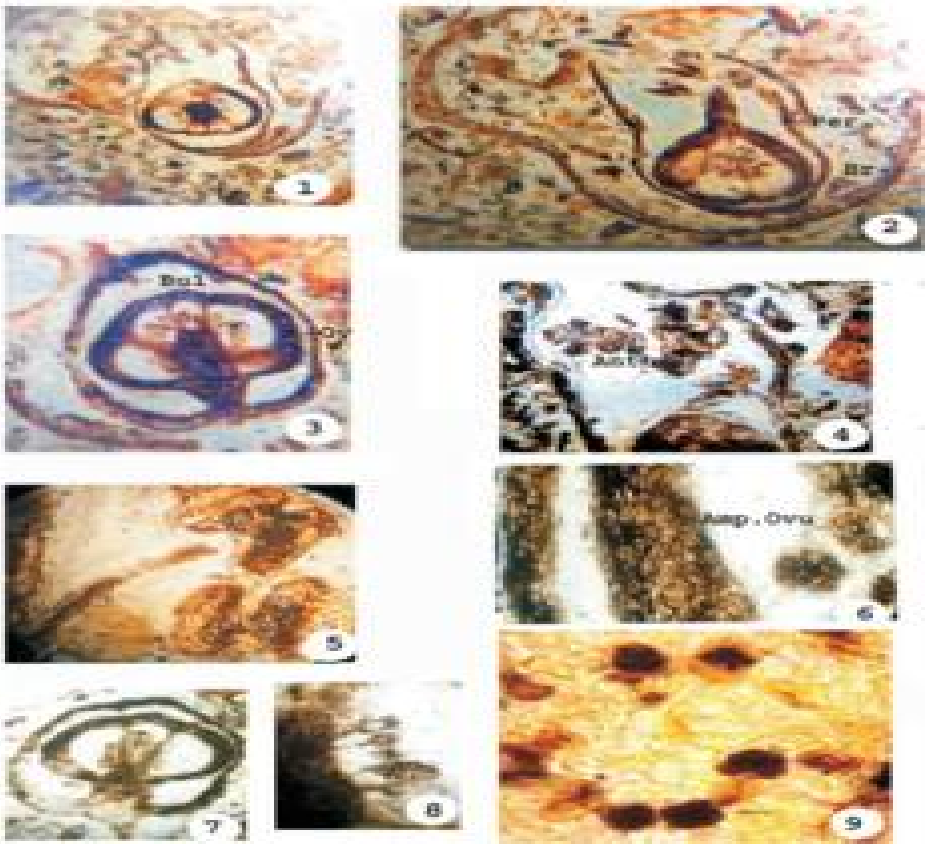
D) Pull away gently the hardened filmfrom the surface of the specimen.

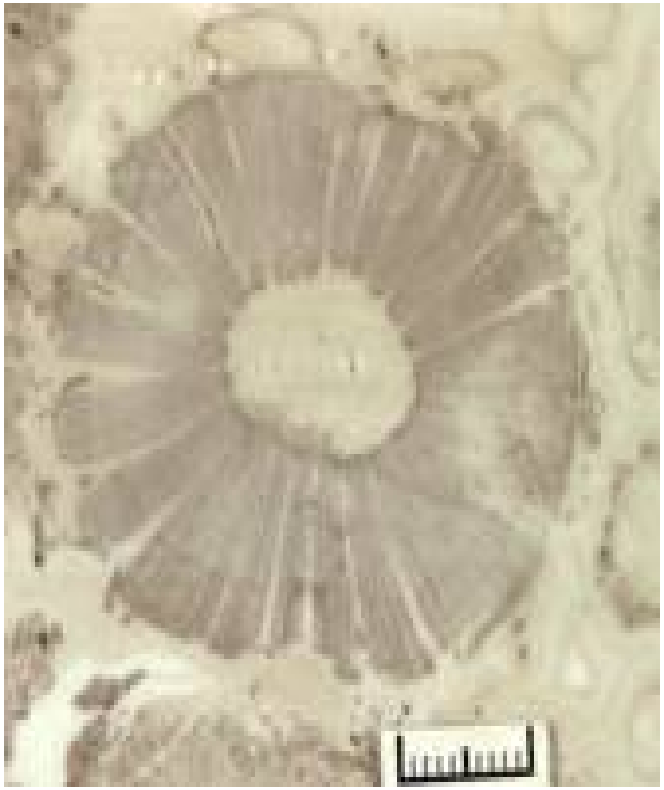
E) The resulting film which is actually a thin transfer carries with it a very thin section of .5 to 1..0 microns of the petrified material. This type of preparation is called a “Peel”

F) Instead of sheet we can also use the peel solution

G) Made up of celloidin flex, the procedure is same only difference instead of sheet we have to pour the the peel solution.

# Peel sections





# Mould

***Mould*** *is a negative impression of a three- dimensional organ or organism when it is trapped in the surrounding material which has hardened and the organic substance is lost leaving a cavity of its shape.*

- Mould has the overall form of the original plant material.
- The original organic matter is not preserved in this type
- Usually three dimensional plant parts such as stem, seeds and fruits are ideal for preservation.
- When these plant parts were carried to the site of sedimentation they became burried in the sediments and during this process coated with sedimentary layers that hardened rapidly, thereby preventing crushing of the inner plant parts
- Eventually the plant part disintegrated and left a cavity i.e  Mould.

# Moulds

This type can be studied by the preparation of artificial cast from moulds by filling the the latter with plaster of paris.Latr the mould is dismantled and the the cast is removed

From this we can study the size, shape and external features of the original plant parts.

Examples are several isolated seeds of pteridospermsand Chara

# Cast

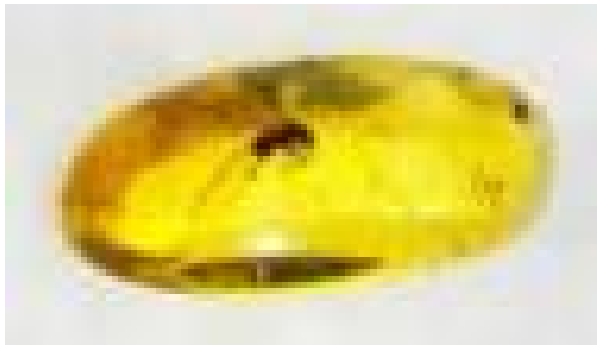
***Cast*** *is a positive three dimensional replica of organic remains of original organism or organ resulting from the filling of the cavity of the mold by mud, sand or mineral matter which subsequently hardens, i.e casts are filled in-moulds.*

Examples are *Calamites* and *Cordaites, the pith cast of Calamites shows the position of the nodes of the stem.*

# Technique

Surface features can be studied under scanning Electron microscope.

# Mummification



- Coprolites – fossilized excrement; usually preserved by replacement

# Questions??

- End your presentation with a simple question slide to:
  - Invite your audience to ask questions
  - Provide a visual aid during question period
  - Avoid ending a presentation abruptly