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Preparing Fossil Leaves

By Robert Rosé

Lakes are the most likely place for plant material to be preserved. This material includes leaves, flowers, cones, scales, reproductive structures and pollen. Non-plant fossils would include diatoms, ostracodes, fish, insects, and the odd vertebrate. The sediments that encase the fossils are generally bedded and fine grained. Mudstone, claystone/shale, siltstone, and sandstone occur in order of decreasing abundance. In many Cenozoic deposits airborne volcanic debris will be a noticeable component of the rocks. In some deposits, silicification will alter the original rock and create chert or opalized claystone.

When you look at your leaf specimen or are at a deposit that is yielding plant fossils it is important to recognize the type of rock they are in. You do not need to know the particular names of the rock; just be aware of the hardness of the rock and what is the type of fossil preservation. Are the fossils impressions in siliceous rock, are they delicate carbon films, are they clean or covered by fine modern rootlets, have they been leached, are they covered by mud/dirt? Are the rocks light weight and fragile, hard and siliceous, bedded or massive? All these conditions will have an impact on how you approach collecting, storing, cleaning, and eventually displaying your fossil plants.

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The tools needed to prepare fossil plants are varied and can range from inexpensive to very expensive. Hand tools are on the less expensive end and include dental tools (ask your dentist for broken ones they no longer need), Exacto-like knives, scalpels, pliers, small chisel, small brush (artist brush with 20-30 bristles). The more expensive tools include a microscope, air scribe and air-powered pneumatic devices.

Less expensive magnifiers include the Opti-Visor or a lense attached to a stand.

SOFT ROCK EXAMPLES

Now that we have all this equipment and plant fossils what do we do? Look at the leaves carefully with a magnifier of some sort to see if there is any part still beneath the rock. I am assuming that any fossil worth preparing is a “keeper”. The approach to exposing the remaining fossil depends on how much rock is covering the fossil and how hard the rock is. Let’s start easy and say the rock is soft (like diatomite) and not very thick. Pick up a sharp blade and slide it parallel to and just above the fossil to try and separate the excess rock from the fossil. While doing this always maintain an upward pressure away from the fossil. Don’t pry with the blade or it will break. What you want to do is cut the rock away in such a way as to not ever have the sharp part of the blade aimed toward the fossil. Try and estimate the direction the leaf (plant part) is going and where the margins will be.

The next step is to turn the sharp edge of the blade vertical to the rock surface and try and cut down just beyond the edge of the fossil. You are trying to separate the remaining rock on the fossil from the matrix the fossil is in. Do this carefully as the plant impression is delicate. Might want to practice on a throw-away piece to built up your confidence before working on the “keeper”. Another thing to keep in mind is that many times the edge of a leaf fossil can be turned up or down in relationship to the rest of the fossil making the job of exposing it more challenging. If you see that the specimens from a particular site have a tendency to do this then take care when preparing. It is quite easy to cut through the end or edge of a leaf while trying to expose it because it was higher than you thought it was going to be.

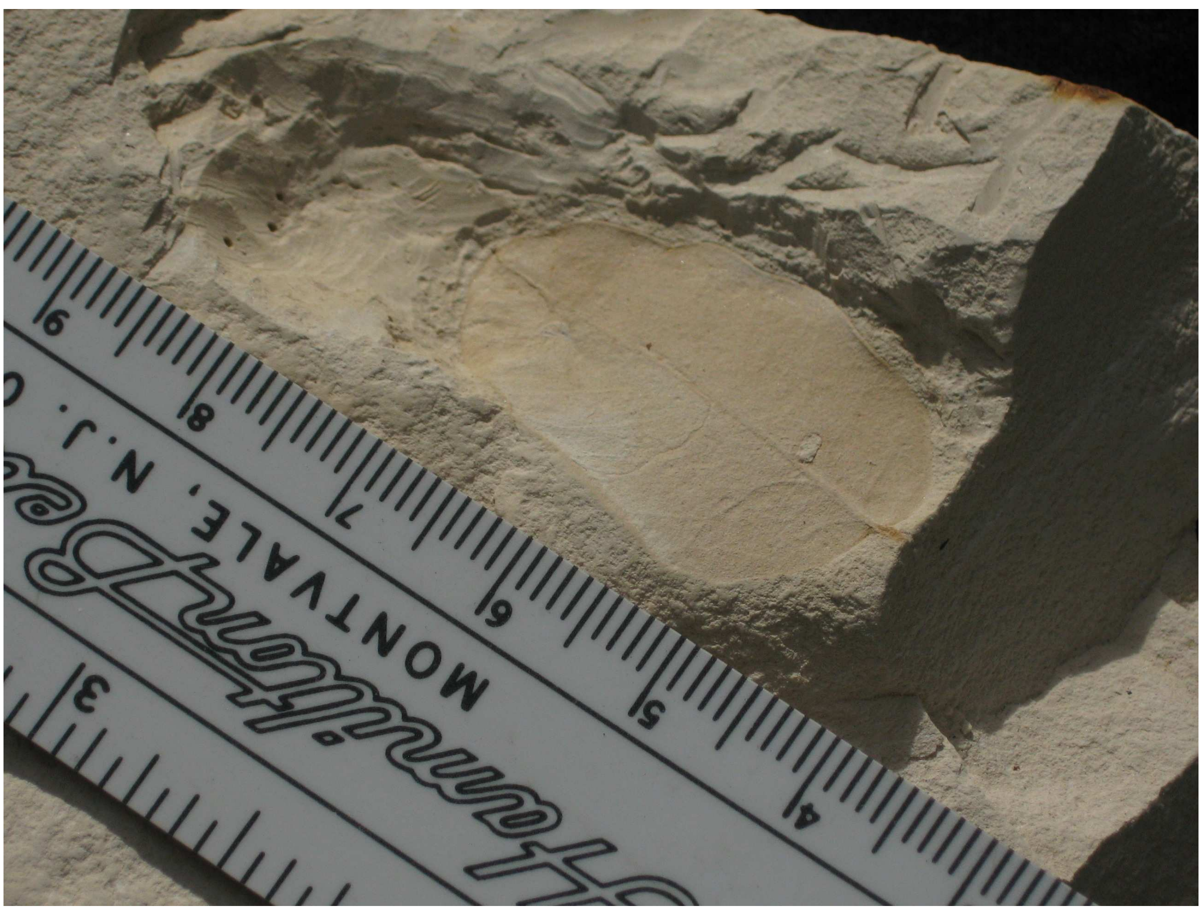
In a soft rock where the amount of rock above the fossil is quite thick (more than a inch) you must decide what type of tool(s) to use. If there is bedding, a small chisel may be useful to remove much of the rock. If it appears massive then you might want to take a sturdy blade and slice off thin sheets of rock until you get near the fossil. Once near the fossil, apply the procedures described above.

HARD ROCK EXAMPLES

When the rock is hard (generally siliceous) then different tools and techniques should be used. First thing to do is look to see if there are parallel bedding planes and vertical fractures. If there is bedding then you will be able to split the rock along the bedding. Often times if you let the rock sit out over the winter, siliceous rocks will split naturally along those bedding planes that have fossils. Letting this happen naturally will sometimes negate the effects of fracturing. Because siliceous rocks are brittle they are commonly fractured and more often than not this will ruin a nice plant fossil. It can be very frustrating to be working on a nice fossil and suddenly have it break into several pieces. If the leaf-bearing rock does not have noticeable bedding then you will have to experiment and find out how the leaves lie in the rock. If you are at the outcrop chances are that you will be able to determine the bedding of the rocks. First assume that the fossils in your rock will be parallel to the bedding of the outcrop. Next, try and split the rock parallel to the inferred bedding and see where the plant fossils are. If you are at home and don't know, use a chisel and try and split the sample in half. Proceed based upon what you find. Plant fossils from the Lyons locality are commonly in opalized rock and commonly fracture across the fossils even though there is bedding. Here, the siliceous nature of the rock today is overriding the normal habit of opening along the bedding.

Once you find leaves/plant parts worthy of preparing, look to see how much rock is obscuring the fossil. If it is thin then you might only have to use a small dental tool or a small pneumatic device. Try and always work away from the fossil. Sometimes you can slide a thin sharp blade between the fossil and the thin rock cover always keeping upward pressure on the blade so you do not scrape the fossil. This upward pressure will probably lead to the rock popping off, exposing the fossil. Again as in the soft rock example try and expose the margin of the plant fossil. This will give you an idea as to the shape of the fossil and guide further tool placement. The brittleness of the hard rock matrix is an advantage in that it normally will easily pop off the fossil if the correct pressure is applied. Sometimes this pressure is applied from the top, sometimes from the side and sometimes from underneath (between the fossil and the matrix above). The tricky part is applying enough force to break the matrix away and not either breaking the tool or damaging the fossil. Only practice will teach you what is most reasonable. When using a sharp blade to cut the rock place the cutting surface on the rock and gently apply pressure. Rock the blade slowly up and down and sometimes swivel it side to side trying to apply force in many directions. The unwanted rock will eventually break off. Remember to do this slowly because if you use too much force chances are you will put a knife mark on the fossil. This technique is best used just outside the margin of the fossil.

The larger leaf to the left is Fagus sp. from my locality in the old cascades and it is in hard, siliceous rock. The small leaf below is from Buffalo Canyon in Nevada and the rock is light, tuffaceous claystone.



Sometimes when you have a large sample and you hit it the first time a part of a nice leaf will show. The rest of the leaf remains in another part of the block separated from the piece in your hand by a fracture. If you want to try and expose the remaining leaf look closely at the edge of the block and look for a thin dark line indicating the leaf edge. If there is more than or a small pneumatic device. Try and always work away from the fossil. Sometimes you can slide a thin sharp blade between the fossil and the thin rock cover always keeping upward pressure on the blade so you do not scrape the fossil. This upward pressure will probably lead to the rock popping off, exposing the fossil. Again as in the soft rock example try and expose the margin of the plant fossil. This will give you an idea as to the shape of the fossil and guide further tool placement. The brittleness of the hard rock matrix is an advantage in that it normally will easily pop off the fossil if the correct pressure is applied. Sometimes this pressure is applied from the top, sometimes from the side and sometimes from underneath (between the fossil and the matrix above). The tricky part is applying enough force to break the matrix away and not either breaking the tool or damaging the fossil. Only practice will teach you what is most reasonable. When using a sharp blade to cut the rock place the cutting surface on the rock and gently apply pressure. Rock the blade slowly up and down and sometimes swivel it side to side trying to apply force in many directions. The unwanted rock will eventually break off. Remember to do this slowly because if you use too much force chances are you will put a knife mark on the fossil. This technique is best used just outside the margin of the fossil.

Sometimes when you have a large sample and you hit it the first time a part of a nice leaf will show. The rest of the leaf remains in another part of the block separated from the piece in your hand by a fracture. If you want to try and expose the remaining leaf look closely at the edge of the block and look for a thin dark line indicating the leaf edge. If there is more than half an inch of hard rock above the fossil take a small chisel and remove as much rock as you dare. Do not place your chisel on the black line indicating the leaf because you will damage the unexposed fossil. After chiseling, work down from the flattish surface you have created using either hand tools or a small pneumatic device. I am now using a Micro Jack #4 (Paleo Tools® device) for this delicate work. In hard rock this process can be difficult but the rewards are worth it. When you have exposed the leaf and are satisfied that no more preparation is needed, glue the two pieces together.

GENERAL INFORMATION

Sometimes you will find a deposit of leaves/plant parts that are not lying flat. This creates a challenge to the preparer for two reasons. Firstly the leaf could be enrolled, ripped, or only partly preserved. Secondly the preparation might uncover a leaf that just does not create a nice specimen to look at. Often in localities like this there are some very unique specimens. Look at the matrix and the leaf material and see if the two contrast enough to produce an attractive specimen. Proceed from there.

One problem a preparer can experience when working with hard matrix is the dust created when using power tools. This dust can be created while trimming the sample or when removing material from the fossil with pneumatic tools. The best way to avoid getting this dust on the fossil is to cover the fossil with a piece of cloth. Remember, it is always easier to take precautions at the outset than to clean up a mess afterwards! If the fossil surface is delicate to the touch try to keep the dust off as it will be almost impossible to remove. If the fossil surface is not too delicate, dust can be removed by using a small brush saturated with Butvar or Vinac and gently moved across the dusty area.

A tip on exposing the petiole. It is best to start removing matrix from both sides of where you believe the structure to be. If the overburden is more that one-quarter inch thick, remove all but 1/16th inch along the top of where the petiole is thought to be located. Then carefully remove the remaining rock from one side of the petiole and then other, rotating the specimen 180 degrees to expose each side of the petiole. This rotation places the area to be worked-on in the most advantageous position.

Kid's Corner: Swimming with Trilobites

By **MacKenzie Smith**

They died about 36 million years before the dinosaurs even existed and yet they are the most diverse class of extinct animals. They were jewelry 15,000 years ago and they still are today. These are the trilobites (try-low-bites) and are related to crabs, lobsters, insects and spiders.

You may have seen one at a museum before or even bought one at a gift shop. They look like bizarre cockroaches from another planet but trilobites originated on earth over 521 million years ago (abbreviated "mya") in the Cambrian period and lasted another 270 million years before going extinct 251 mya in the Permian period.

The parts of a fossilized trilobite can be recognized horizontally and vertically. When the parts are looked at horizontally we see a head, middle and an end, like in insects. These three parts each have their own special name on a trilobite. The head is called a cephalon (seh-fa-lawn), the middle a thorax and the rear a pygidium (pie-ji-dee-um). Divided vertically, the trilobite's parts are called lobes. This is where we get the name "trilobite" because trilobite means three lobed. The lobe down the center of the trilobite is called the axial lobe. You can remember this by thinking of an axis on a graph that divides the left and right sides (y-axis). The other two lobes are the left and right pleura lobes. Trilobites could grow up to two feet or be as little as one twenty-fifth of an inch.

What else makes trilobites totally awesome? They were some of the first animals to evolve antennae and compound eyes! Compound eyes are eyes with many lenses. Have you ever gone to a birthday party and received a "party favor" that when put up to your eye makes you see like a bug? That is an example of a compound eye. Because both antennae are fine structures they are rarely preserved.

What would life as a trilobite be like? Well for starters if you were a trilobite you would be crawling around on the ocean floor on your many little legs or swimming looking for delicious dead meat and "soft" live prey, plankton or algae (depending on your species) and eat it using your gnathobases (nath-oh-base-es) which are spines that bring food to the mouth.

Time to grow! Because you have an exoskeleton it must be shed by twisting a little and swimming out. "Oh no! A two foot long anomalocaris (ah-no-mall-oh-care-is) is coming to eat me!" Quick roll up into a ball by placing your cephalon on your pygidium (like an armadillo) to protect yourself. After the threat is gone you would resume feeding. This would probably be your normal day.

In prehistoric times trilobites lived in water. So when you turn over a rock in your backyard and find potato or "pill bugs", know that they are not trilobites because they are not aquatic. If you put them in water they will drown and ultimately die. Please do not try this. Also you may see some creatures similar in appearance to trilobites in the water on the coast but those are classified differently than them. Today we only find trilobites dead and fossilized on land world wide because of the Permian Mass Extinction. Well noted localities include the Burgess Shale (British Columbia, Canada), Oklahoma, Morocco and China.

All fossils have a story to tell. In the case of trilobites, if we find them we know there was an aquatic environment. With trilobites we could also date the rock, possibly determine the depth of water and predict the discovery of other organisms in that locality. Since trilobites have produced a 270 million year record we can compare their evolutionary trends to other organisms.

So in short, trilobites can tell us a lot about the past! When you stumble upon one here are some web sites to help you identify what you have: http://www.trilobites.info/ and http://www.westernta.com/WTA.htm. Remember you can always ask any NARG member for help on identification on any fossil.

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UCMP Berkley. Trilobita: Life History, and Ecology. UCMP Berkley. May 6, 2009. http://www.ucmp.berkeley.edu/arthropoda/trilobita/trilobitalh.html.

UCMP Berkley. Introduction to the Trilobita. UCMP Berkley. May 6, 2009. http://www.ucmp.berkeley.edu/arthropoda/trilobita/trilobita.html.

NEVER TURN YOUR BACK ON THE OCEAN!

By Charles Hunt

How many times and for how many years have we been to the beach and told our kids and friends unfamiliar with the ocean to “NEVER TURN YOUR BACK ON THE OCEAN”!!

Well about a week after the second WAMS trip to the Newport area to look for agates, fossils etc., Barb and I decided to drive down and spend a couple of days at the coast. Now Barb isn’t able to walk up and down those trails at the beach parks like Moolack or Lost Creek Beach Park, but since we were at the beach she wanted me to get my time out there looking for the allusive “Newport Blues”.

It was a nice afternoon with little wind and no rain when we pulled into the parking lot at Lost Creek Park. I look down the beach each way and saw about 100+ people up and down the beach. Low tide was still two hours away but I hustled down there to find some of those agates. After hunting for about a half hour I stopped and talk to a family that was also looking for agates. I went on my way and found quite a few small agates but I was trying to make the best of it. Then I heard that call that you don’t want to hear, “Oh no, watch out!” I turned and looked at the ocean and about two feet from me was

about a three foot wave with another 12” wave on top of that. As I turned to head up to the dry beach, the sand and gravel under my foot gave way and so did I. The wave goes over me and momentarily I am under water. As the wave heads back out to the ocean it would like to pull me out too. I dug in my hands into the sand and the toes of my boots too. The water ran out and I staggered up the beach. The young lady, who had hollered was with her mother and daughter. She asked me if I was O.K. and I told her that I had just broken one of the most firm rules about beachcombing. She said, “Are you sure you are O.K.?” I said, “Yes, my wallet miraculously was dry, and so were my cigarettes, but my lighter was soaked. Then she said, “I bet that wasn’t too good for your cell phone either!” I checked my cell phone and sure enough it was dead.

I told to my 8 year old granddaughter in Ohio about it and she told me, “You know Papa I even know when you go to the beach you never turn your back on the ocean!” About a week or two later two boys were lost further up the coast to the ocean. A lot of lessons there but the biggest was, “NEVER TURN YOUR BACK ON THE OCEAN!”

Insects and Aquatic Taphonomy

By Mike Santino

Taphonomy is the study of the transformation of organic remains after death. The diagenesis (sum of all processes, chiefly chemical, by which changes in a sediment are brought about) to fossil preservation of insects, as with all organisms, is directly related to the degree of mineralization of the skeleton.

But Paleontologists generally consider insects soft body organisms because of the delicate exoskeletons, so how is it possible for insects to preserve with so much detail?

Chiton is the primary component of the insect exoskeleton and is more resilient than protein, but is usually transformed to other organic matter during diagenesis. Chiton is the most abundant biopolymer on earth. Biopolymers are a class of polymers produced by living organisms. Cellulose and starch, proteins and peptides, and DNA and RNA are all examples of biopolymers, in which the monomeric (a small molecule that may become chemically bonded to other monomers to form a polymer) units, respectively, are sugars, amino acids, and nucleotides. Chiton is more likely to preserve in terrestrial strata than in marine deposits.



Before fossilization can occur, there are processes affecting insects from death on the water surface until it arrives on the bottom. They include transport (currents), surface tension, wind, rain, predation, decay and decomposition. Surface tension is one reason moths and butterflies are rarely preserved.

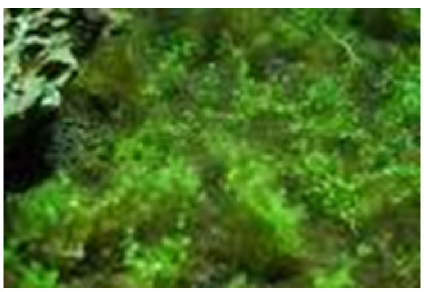
It is very important for transport to take place during or just after death for a specimen to be articulated. If transport takes place during decomposition, the insect will be disarticulated. When insects finally arrive on the bottom, it is necessary for them to be buried rapidly.

The processes which insects become fossilized may exceed that of all other organisms except plants. Insects are commonly preserved as impressions and compressions but also as 3D replicas in carbon, phosphate, pyrite and oramorphous silica produced by geyser activity. Original skeletal remains are often preserved in tar pits, bogs and mummified human and ice age frozen mammoth remains (louse) and as inclusions in chert, onyx, gypsum, and amber. Insects are also preserved in lacustrine and marine diatomites (rocks formed by the accumulation of siliceous algal skeletons (phyytoplankton = (***cocoliths, diatoms***)) commonly known as chalk.

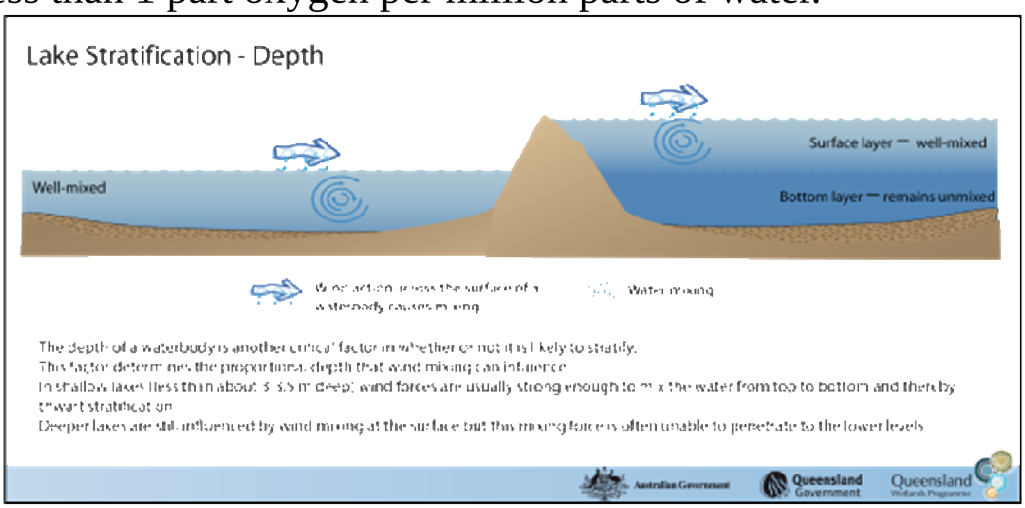
Sometimes terrestrial insects are transported into lagoon or marine sediments such as the upper Jurassic Solnhofen, which has high concentrations of cocoliths.

The composition of sedimentary rocks is also very important for fossil preservation. In general, sediments forming under tranquil, hydrodynamic and anoxigenic aquatic conditions related to cyanobacterial mats (algae) are best for insect preservation. Finer grain sediments will frequently preserve more detail.

Cyanobateria or blue-green algae, blue-green bacteria or Cyanophyta, is a phylum of bacteria that obtain their energy through photosynthesis. They are a significant component of the marine nitrogen cycle and an important primary producer in many areas of the ocean, but are also found in habitats other than the marine environment; in particular cyanobacteria are known to occur in both freshwater, and hyper saline inland lakes and in arid areas where they are a major component of biological soil crusts.



Water is also a very important component of preservation in unique conditions. Anoxic conditions refer to the parts per million of oxygen in water. Oxygen is not very soluble in water and under normal circumstances, 12 parts of oxygen can dissolve in a million parts of water. Anoxic levels are roughly 5 parts per million oxygen in water and disoxic water is a condition of less than 1 part oxygen per million parts of water.



Anoxic/disoxic conditions are very important to preservation because predators (primarily fish) avoid the water (they can't breath), allowing time for sediment accumulation, and the rate of oxygen dependant bacterial decay is greatly reduced.

Sediments formed in anoxic and disoxic conditions are usually black to grey in color. Sediments formed in normal oxygenated conditions are usually red.

My first examples of insect preservation are preserved in Iron Pyrite (fool's gold) from the Devonian period about 385 million years ago. These specimens are from Bundenbach Germany quarried from the Hunsruck slate to use as roof shingles. The quarry has long since closed and the only way to get specimens is from old collections or when a house is torn down or a roof replaced.

The Germans used soft brass brushes to expose irregularities in the surface of the slabs and found incredibly well detailed specimens of fauna including starfish, trilobites, coral, crinoids and marine spiders. The first terrestrial spiders may have emerged from this fauna.

The flora and fauna from Bundenbach is entirely marine and were preserved as a result of a stratified water column in disoxic conditions (<= 1 part per million oxygen dissolved in water) in the presence of sulfur reducing cyanobacteria.

Pyrite specimens can require special care for storage. Continuing diagenesis of Iron pyrite can lead to the oxidation of pyrite into a yellow white powder. The reaction is triggered by exposure to air and moisture and is an exothermic reaction, meaning that the reaction releases heat. Recent research indicates the percentage of partially decomposed organic matter or C_{13}, an isotope of Carbon, may be responsible for rate of oxidation of iron pyrite.

When exposed to air, the FeS_2 will oxidize, producing iron oxide and sulfur dioxide (rotten egg smell) along with other iron-sulfur-oxide compounds.

Paleontologists are just coming to grips with the fact that fossilization diagenesis can be a very complicated long term process that is not fully understood.

Hunsruck slate pyrite is fairly stable at one end of the spectrum of stability and pyrite fossil specimens from the Albian Gault (London) clay in the Parisian basin, and the Russian platform Callovian period are the most unstable and oxidize more rapidly.

In these cases, special storage solutions are required to prevent decomposition. These include the use of moisture absorbing desiccant salts (A desiccant is a substance that induces or sustains a state of dryness (desiccation) in its local vicinity in a moderately well-sealed container) like those used in small packets stored in new electrical components. For very delicate and/or rare specimens, silicon oil can be used.

A gentleman I work with in the U.K. has a unique process for preserving his Gault (London) clay material. He says he has specimens he treated 30 years ago with no visible damage. First, he soaks his specimens in fresh water to remove chemicals in sea water that are corrosive. He then uses a food dehydrator to remove the water (a very low temperature oven can work). After this you should not touch the specimen with your hands, use rubber gloves. (Bacteria and moisture on your skin can accelerate oxidation).

He puts the specimens into a jar attachment for a food vacuum sealer with melted paraffin wax and removes all the oxygen. This sucks the paraffin into open spaces in the specimen. After blotting off excess paraffin and drying, he seals the specimen with clear finger nail polish.

Some sealers are porous and oxygen can pass through the seal. The gas (Sulfur dioxide) that forms from oxidation has a larger molecular structure than oxygen and gets trapped inside the seal and can explode from the trapped gases.

I keep small specimens in a Humidor (cigar box) for constant humidity control and add desiccant packets. Some of these desiccant salts can be heated to remove the moisture and reused.

My next examples of taphonomy are from the mid Cretaceous (Aptian) Crato member of the Santana formation. Significant insect fauna include the oldest known silverfish, the earliest Blattid roaches with egg cases, early Praying Mantis, the only know southern hemisphere snake fly and remarkable long tongued Horse flies, house flies and fruit flies (the earliest specialized pollinators), and the earliest alliances between insects and flowers. The diverse insect fauna includes 384 species (264 adults and 120 larvae) from 18 orders and approximately 100 families of insects.


The Santana formation formed after the separation of South America and Africa. There were shallow seas in a near shore environment that later became a lagoon, a brackish (mix of salt and fresh) water environment.

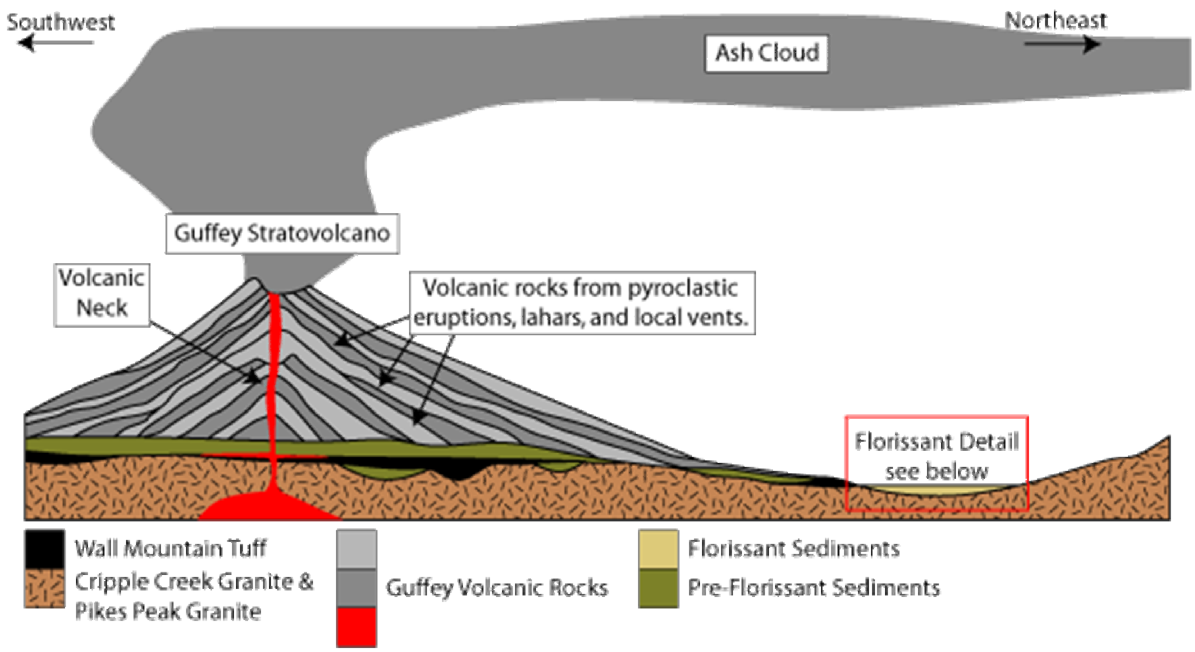
Insects are preserved completely articulated as permineralized replicas with outstanding relief with microscopic sub cellular detail from bacterially induced calcium phosphate crystals. Phosphorous is a byproduct of the oxidation of organic matter by sulfur reducing bacteria. Most insects are preserved in Iron Oxyhydroxide. Iron and oxygen are not generally good preservation agents, but the matrix was a calcium rich limestone mud that made preservation possible.



The next examples are from the older mid/ late Jurassic through early cretaceous Jehol biota of the Yixian formation from N.E. China. The formation name is assigned to a lake system somewhat similar to the Eocene Florissant formation and Okanogen highlands (Stonerose in Republic Washington, Cache creek, near McAbee and, Quilchena, Allenby, Tranquille and Princeton locations in British Columbia).

Despite different lithological similarities between members (different lakes and layers), each has yielded distinct fossil assemblages. The lakes probably belong to the same cycle of volcanism and sedimentation.

The ecosystem was dominated by wetlands and numerous lakes (no rivers, deltas or marine habitats) with seasonal rainfall and a temperate climate. The Jehol ecosystem was interrupted periodically by ash eruptions from volcanoes to the west, like the Florissant and Okanogen Highlands ecosystems.



The Yixian formation fossils are abundant, highly diverse and very well preserved often including articulated skeletons, soft tissue, color patterns, stomach contents and twigs with leaves and flowers attached. The Jehol fauna and flora include the earliest known angiosperms (flowering plants) earliest advanced birds and the smallest and largest known birds from the Mesozoic era (250 to 65 mya).

The lacustrine environment sediments were composed of ash with lake bed sediments and occasional high concentrations of Ostracods, a subphylum of Crustacea, the same subphylum as crabs and lobsters. Ostracods live both in freshwater and in the ocean.

Preservation here stems from quick burial, occasionally from ash clouds and subsequent erosion runoff of ash fall, creating anoxic conditions.

The final examples of insect preservation are from the 54 to 48 mya Green River formation (recently re-dated). This lacustrine environment was composed of 3 main lakes spanning Wyoming, Colorado and Utah. The lakes varied in depth, volume, drainage, salinity and states of overfilling, underfilling and balanced filled over a six million year period.

The data concerning the depth and chemical makeup of the lakes is so far inconclusive, because there are no definite independent environmental indicators (An environmental indicator is a parameter, or a value derived from parameters, that points to, provides information about and/or describes the state of the environment) in the micrite beds, which are beds of very fine (1-5 microns) carbonate crystals (either calcite or aragonite). Micrite can precipitate from seawater or form from the breakdown of larger carbonate grains.

The sedimentary composition of the Green River locality includes many layers. The major sedimentary types are primarily oolitic grindstones (grains consisting of multiple coatings of carbonate, usually calcite and/or aragonite, that precipitated on a nucleus; they are round and smooth, and form in shallow water depositional environments), packstones (porous sedimentary rocks), oil shale (fine-grained sedimentary rocks composed of particles consisting of silica-containing minerals) and mudstones. The occurrence of these different sediments varies depending on the depth from the surface. The fossil distribution also varies with the depth.



Preservation here is from seasonal anoxic conditions. During winter months, there is little temperature variation in the water column allowing complete (top to bottom) water circulation and reoxygenation. Solar heating causes thermal stratification, leading to seasonal bottom water anoxia in the summer and winds circulate upper warmer waters which “float” on a cooler uncirculated lower layer of water that is anoxic. This summer condition coupled with high sedimentation rates and cyanobacterial activity, that create calcium carbonate precipitation, set the stage for outstanding preservation.

Rice Northwest Museum of Rocks and Minerals

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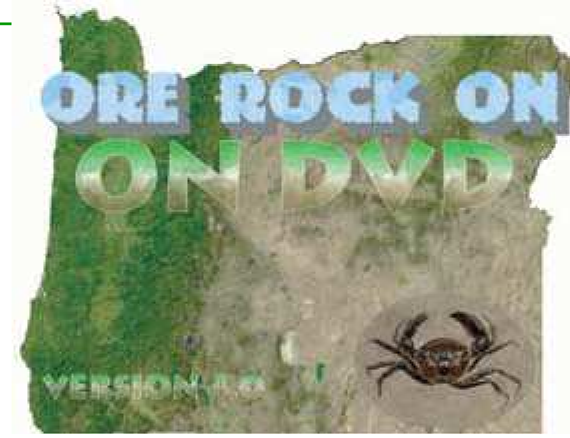
Hillsboro, Oregon 97124-9315
Phone: 503-647-2418

Stonerose Interpretive Center & Eocene Fossil Site

Stonerose Interpretive Center: Stonerose is the name of a fossil site, a place where impressions of plants, insects and fish that lived in and around a large lake nearly 50 million years ago can now be found in a large shale deposit. These fossils are the result of events that happened long before there were people to observe them.

Stonerose Interpretive Center is located at 15-1 N. Kean Street, on the corner of Kean Street and Highway 20 W., across from the city park in beautiful Republic, Washington. The fossil site is just a short walk from the Interpretive Center. For more information please contact us at: (509) 775-2295, or visit us on the web at: www.stonerosefossil.org



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