The photograph below shows a National Treasure — the Addyman Plesiosaur — in the South Australian museum.

The Addyman Plesiosaur is the finest known opalised skeleton on Earth. The prepared fossil is 6m long and is about 15-20% complete. These opalised bones are the remains of a marine reptile that swam and hunted in the icy Eromanga Sea 110 million years ago. The bones were found in the Bulldog Shale, which is a thick accumulation of grey-green mudstone deposited in this sea.
The Addyman family discovered the fossil in 1968 and excavated it from the Andamooka opal fields. In November 2000, *The Advertiser* acquired it for the South Australian Museum. Sponsorship by Origin energy enabled the skeleton to be restored for presentation to the public.

Skeletons like this are now less likely to be recovered from Andamooka, since machines have replaced the pick and shovel. The new mining processes sometimes break the fossils.

Although the Eromanga Sea was very cold, a wide variety of animals lived in it. Some of them still exist, but many of them became extinct at the same time at the dinosaurs.
Although they lived at the same time as dinosaurs, were reptiles like the dinosaurs, and became extinct at the same time as the dinosaurs, the animals that lived in the Eromanga Sea were not dinosaurs. They were marine reptiles and they were carnivorous. Examples of the marine reptiles that have left some opalised remains are plesiosaurs, pliosaurs and kronosaurs.

Plesiosaurs

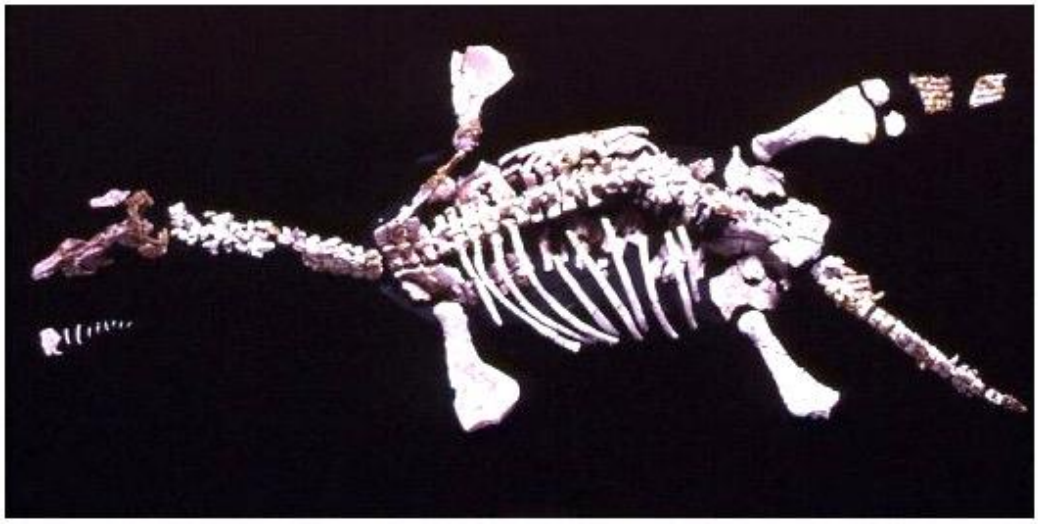
The picture below shows a reconstruction of the Addyman Plesiosaur shown in the above photograph. It is suspended above the glass case containing the opalised skeleton.

Plesiosaurs were large marine reptiles with limbs shaped like flippers, very long necks and relatively small heads. They travelled through the water using their flippers in a similar manner to the way birds use their wings and sea lions and sea turtles use their flippers.

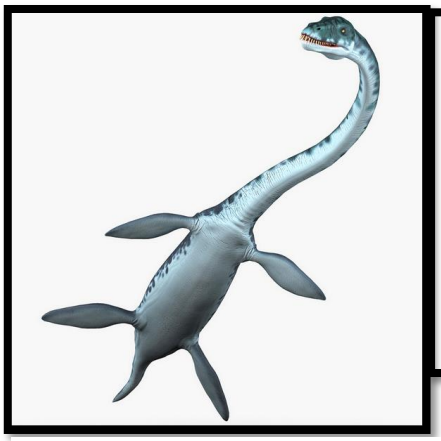
Pliosaurs

Pliosaurs existed in a range of sizes and differed from plesiosaurs in not having long snake-like necks. The large pliosaurs were as big as whales, but unlike whales, they were aggressive carnivores with sharp teeth. It is thought that they even attacked the big slower moving plesiosaurs.

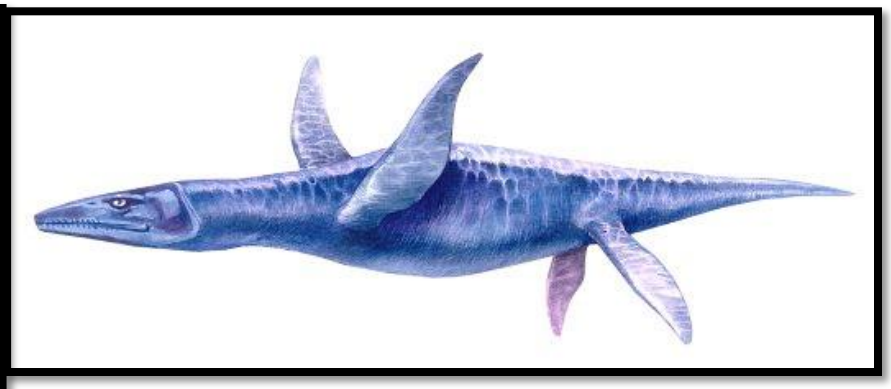
An opal miner discovered a small, short-necked pliosaur at Coober Pedy in 1987. It has been named 'Eric', and it is one of the most complete opalised vertebrates known. In 1993, it became part of the fossil collection of the Australian Museum in Sydney after the schoolchildren of Australia had raised money to purchase the specimen. 'Eric', shown in the photograph below, is now on display at the Australian Museum.



The pictures below illustrate the structural differences between plesiosaurs and pliosaurs. They do not indicate relative sizes.



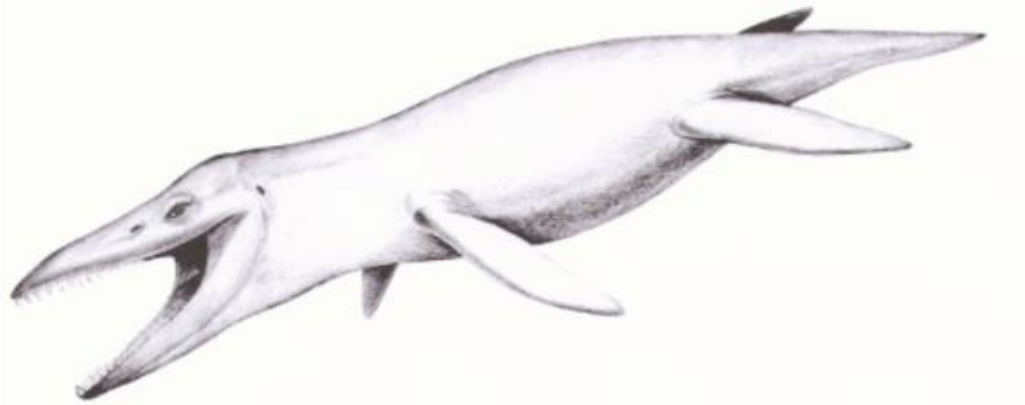
Plesiosaur



Pliosaur

Kronosaurus

Kronosaurus queenslandicus was the largest known pliosaurid. These huge marine carnivores plied the oceans and inland seas, using both pairs of limbs to 'fly' underwater. Kronosaurus Kronosaurus would have hunted large fish, invertebrates such as giant squid and ammonites, and even other large reptiles.

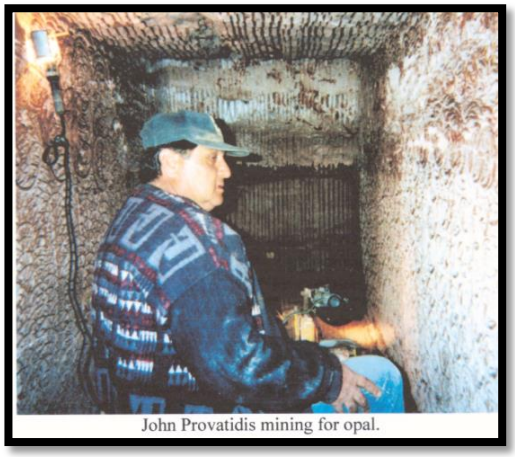


The above diagram illustrates the resemblance between Kronosauris and the smaller pliosaurs.

There is some disagreement as to exactly how big Kronosaurus was, with estimates ranging from 8m to 12m long. Whichever figure is accurate, this creature was about the size of a bus and was for a long time regarded as the world's largest marine reptile. Its skull was at least 2.4m long, implying that it had a particularly large head. Its conical, crushing, teeth were roughly the same size and shape as a small banana.

Kronosaurus queenslandicus was named in 1901 from a jaw fragment with 6 teeth that was found near Hughenden in north-central Queensland.

The big teeth of the Kronosaurus enabled it to crush the shells of the huge shellfish called ammonites that lived in the same sea and its sheer size meant that it could have eaten almost anything smaller than itself, including other plesiosaurs and pliosaurs. The skull of a specimen of long-necked plesiosaur, *Woolungasaurus glendowerensis*, an animal that was 8 metres long, has tooth marks on it. No other creature yet found would have been capable of inflicting such damage. Opal miner John Provaditis (shown in the adjacent photograph) found a Kronosaur tooth at Coober Pedy in 1988. He found it at a depth of about 20m in an existing open-cut mine in an area known as 15 Mile Field. Explosives were used to blast into the side of the side of the open-cut mine and a bobcat was used to remove the dirt, which was then checked for opal.



John Provatidis mining for opal.

The area also yielded large numbers of opal belemnite pipes and opal shells of quality ranging from potch to full colour gems.

When the tooth was found, it was in three pieces, and some of it could not be recovered.

The photograph below shows several views of the tooth after it had been repaired.

An opalised Kronosaurus tooth

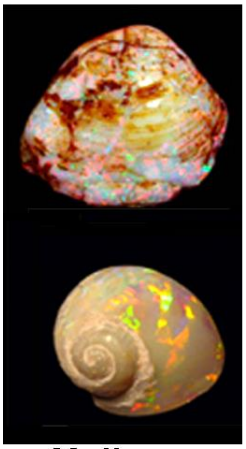
Survivors

However, some of the sea creatures that lived in the Eromanga Sea are familiar to us today. The Eromanga Sea supported fish, turtles, echinoids such as starfish and many varieties of molluscs (shellfish) that still exist. Reasons why those organisms survived and the marine reptiles vanished are still not completely understood.

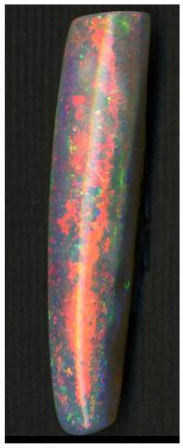
Many of the mollusc shells have been opalised and can often be made into beautiful jewellery.

Opalised shells of belemnites are also used for jewellery, such as in earrings and pendants.

The photographs below show examples of opalised shells, both unpolished and polished, as well as a polished belemnite and an example of the jewellery made from such shells.



Mollusc shells



Belemnite (red pipe)

Polished mussel shells (front and back)

Opalised Mussel Brooch

5.Seeking and Mining

Mining licenses

Opal is one of the few minerals that can be extracted economically by a miner working alone. The majority of opal miners are self-employed, operating as a small business and renting or purchasing equipment as needed. Miners often prepare and sell the opal they find, eliminating a middle man in the jewellery trade and allowing the miners to maximise the amount of money they can make.

Miners, with a Mining Permit, can peg a claim either 50m x 50m or 50m x I00m to mine for opal, but of course, sinking a hole in recognised opal country offers no certainty of finding what is sought.

Today in New South Wales an application costs $1700 to the mines department to test drill an area. Labour and other costs total about $6000 for 28 days. So if a miner finds nothing it is an expensive operation but that is the game they love playing.

Searching for Opals

Opal mining is conducted blindly — a miner may know the general location of an opal deposit (like the area around Coober Pedy), but there are no advanced techniques for narrowing down the location, since the opals are hidden within similarly structured but worthless rock.
A simple, hand-held black (i.e. ultra violet) light helps to point out opals with refractive properties, but these surfaces still need to be exposed by digging. The adjacent photograph shows opals embedded in the side of a tunnel that ultra violet light has exposed.

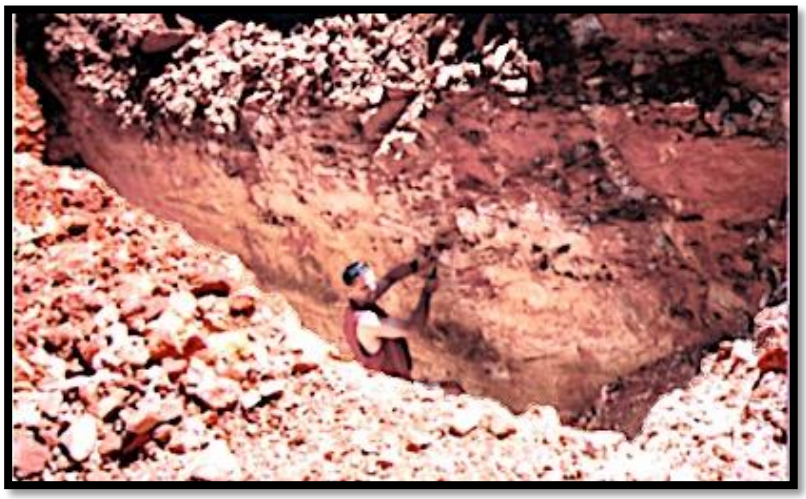
Many procedures are used in the search for opals. These include: drilling and tunnelling, trench searching, opal divining and open cut

Drilling

This involves using a drilling rig, similar to the one shown in the adjacent photograph, with a 15 or 20 centimetre drill to test drill an area to see if their are any traces of opal. Once a miner finds a good area he drills a metre wide hole down to the opal-bearing dirt level to begin mining.

Trench Searching

An excavator digs a trench 3-4m deep or until it finds bedrock. The trenches are usually about 15m long. The prospector enters the trench and specks the sides for any opal bearing potch. In the adjacent picture you can see brown rocks to the right of the miner's head and this is opal-bearing dirt that can be picked out to see if it is worth digging. If the trench does not show opal colour potential it will be filled in.



Opal divining

This is similar to divining for water where a miner has a rod and they can feel moving in the presence of water. In this case some people will search in areas where certain scrub grows as an indication of opals underground. Many people have tried scientific instruments to find opal or slips in the earth but none have been commercially successful.

Open Cut Mining

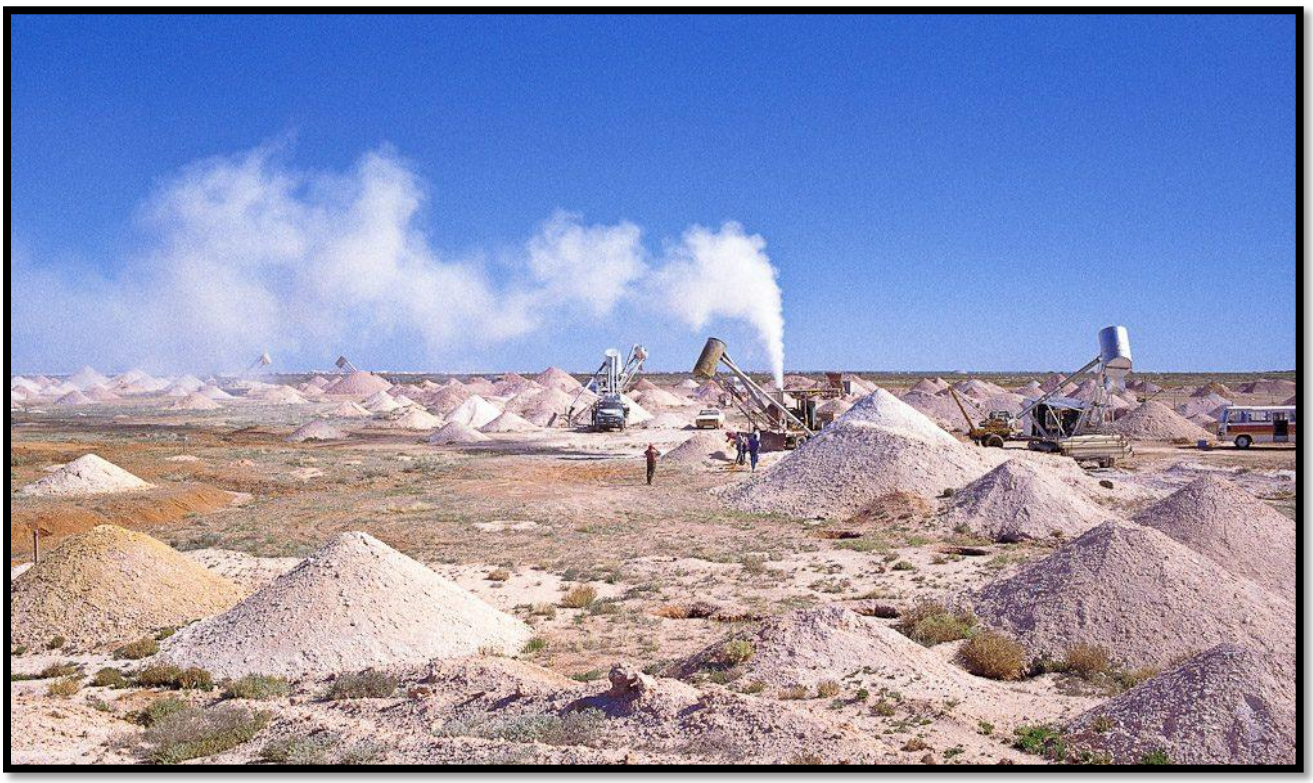
The photograph above shows a large open cut opal mine, such as those in use at Mintabie Open-cut opal mining is very expensive because all the surrounding rock must be removed. However, it means that hidden pockets of opal are never missed.

Some Mining Processes

The simplest form of mining, carried out in the early days of opal mining, was by shaft sinking with a pick and shovel. A shaft was sunk straight down until some promising 'opal dirt' was discovered. The miner would then branch out sideways, following the 'level' of opal. Driving along the level was carried out using picks and explosives. A handpick or screwdriver was used to delicately extract any opal found, due to the frailty of the stone. Most mining was a two-man operation, one man in the hole and another up top to wind the windlass and haul out the dirt.
The photographs below show examples of the original miners' mining processes and their tools.

Nowadays a Calweld-type drill is used to make most prospecting and mining shafts. This drill is mounted on a truck for mobility and used to excavate holes about one metre in diameter using an auger bucket. It can sink a 20m hole in about two hours, and can dig to a maximum depth of approximately 28 to 30m.
The photograph below shows a typical Calweld-type drill in operation.

As shown in the photograph below, the opal fields are pitted with thousands of abandoned Calweld shafts.



Waste material, or mullock, from the shafts and drives was originally lifted to the surface by hand windlass, later being replaced by power winches or automatic bucket tippers. Today truck-mounted blowers, which operate like vacuum cleaners, are more commonly used for bringing mullock to the surface. The blower sucks up dirt and rocks from the mine and deposits it on the sur face. This unique Coober Pedy invention saved miners many days of backbreaking work carting rubble.

The adjacent photograph shows a blower dumping dirt from a mine onto a mullock heap.

Opal miners often built their own blowers from old car parts, but local engineers also started producing blowers and blower parts for sale. Blower technology quickly moved beyond Coober Pedy to other opal fields and to other industries.
Tunnelling machines with revolving cutting heads and small underground front-end loaders, called boggers, have been introduced.

Bulldozers are employed to remove overburden and expose the level where it is shallow. Spotters follow behind watching for opal and the seam is then worked over by handpick.
Professional miners operate underground tunnelling machines, some of which act like giant corkscrews, boring into the walls of the shafts to make horizontal tunnels, known as drives. The dirt is carried away on big steel trolleys along railway lines and taken to the surface by mechanical escalators to be dumped into the blowers.

The photographs below show a miner operating one type of tunnel digger.

The adjacent photograph shows the pattern made on the rock's surface by a tunnel digger excavating a drive and the marks made by a miner's pick.