Hello! We're Oliver and Francesca and we're aboard a scientific research ship called the *JOIDES Resolution*. We're looking for tiny microfossils of creatures called dinoflagellates, which can help us understand what Antarctica was like millions of years ago!

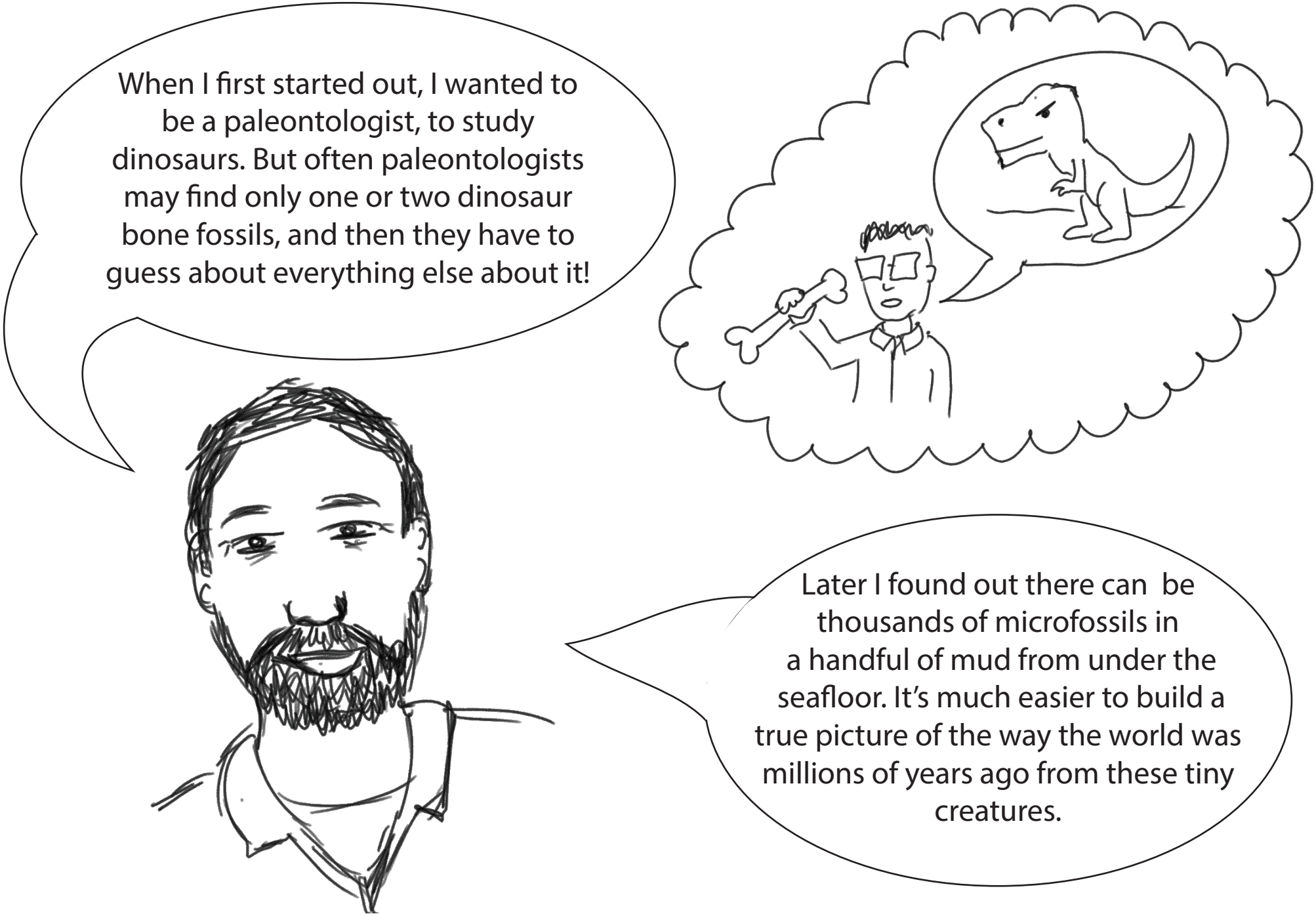
What's happening on *JOIDES Resolution* Expedition 374

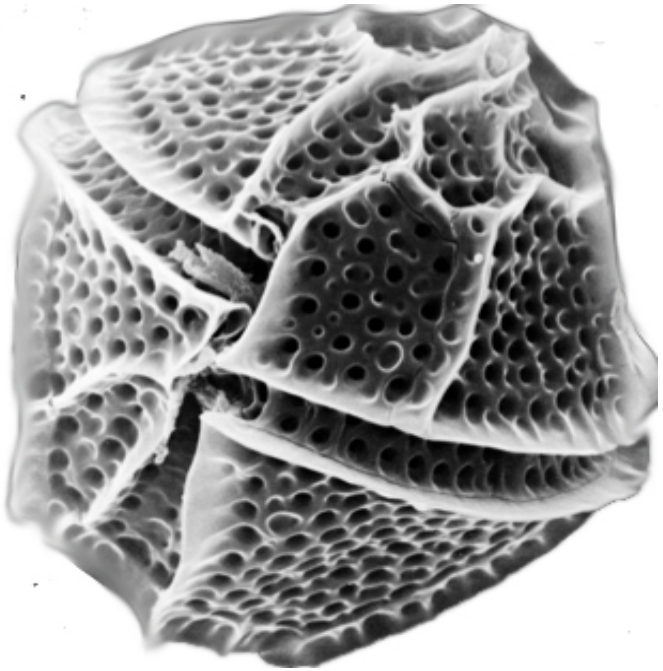
Dinoflagellates!

IODP
INTERNATIONAL OCEAN DISCOVERY PROGRAM

Australian and New Zealand International Ocean Discovery Program Consortium

By R. Hughes-Currie


When I first started out, I wanted to be a paleontologist, to study dinosaurs. But often paleontologists may find only one or two dinosaur bone fossils, and then they have to guess about everything else about it!
Later I found out there can be thousands of microfossils in a handful of mud from under the seafloor. It's much easier to build a true picture of the way the world was millions of years ago from these tiny creatures.

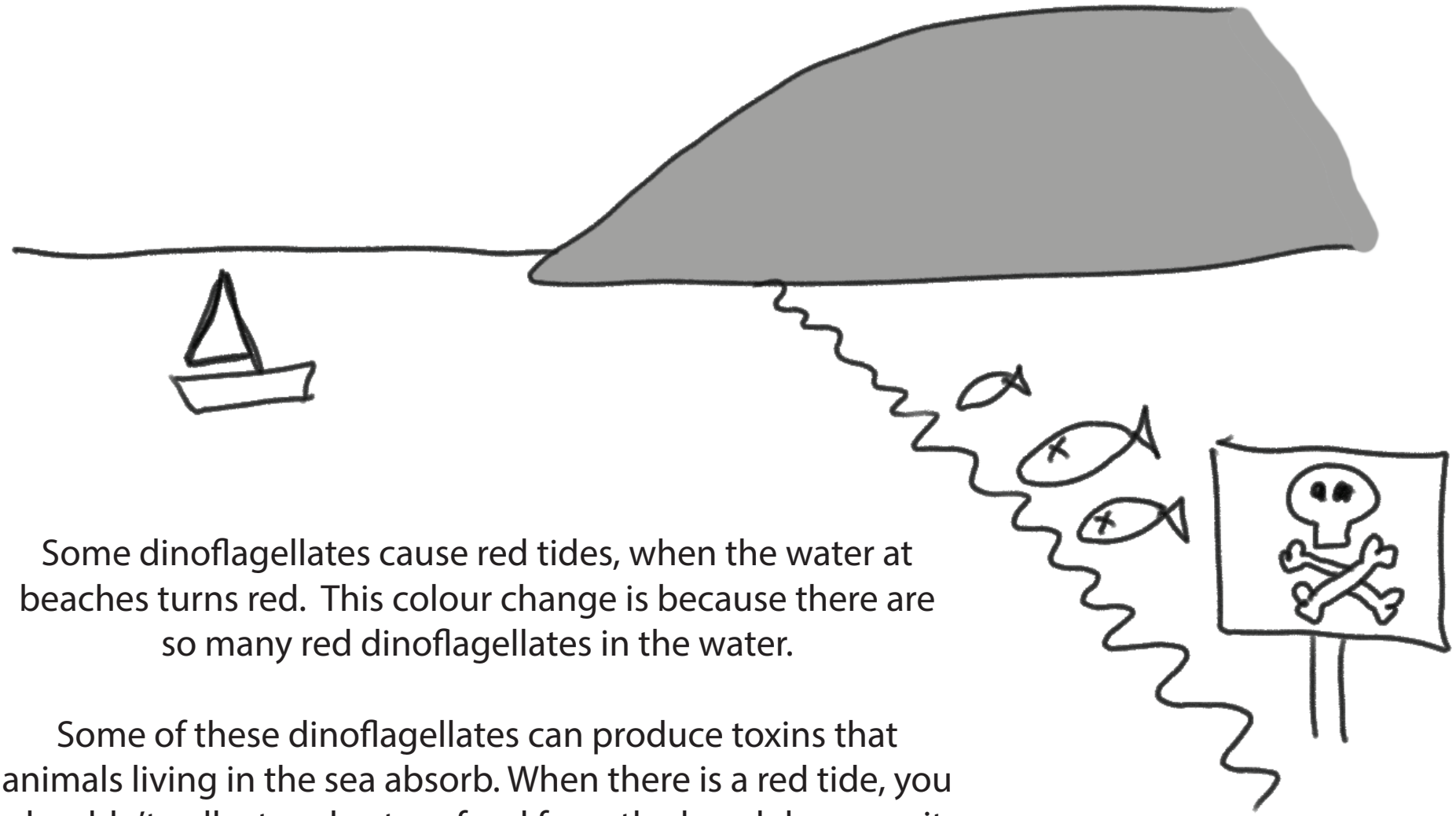


Dinoflagellates are tiny organisms. They are between 20 to 200 micrometres in size, which is close to the width of a human hair. They mostly live in the sea and sometimes in fresh water.

Even though they are so small they can move about 5 to 10 metres per day. Now you may not be impressed by that, but scaled up that would be like you swimming about 35 kilometers each day, which is 700 lengths of an olympic swimming pool.

Some dinoflagellates are producers. The producers get their energy from photosynthesis. Other dinoflagellates are consumers. The consumers get their energy from hunting and eating other small organisms.

Different dinoflagellates hunt in different ways. Some kinds throw a net over their victims. Others shoot a hollow spear into their prey and sucks them up, as if through a straw.



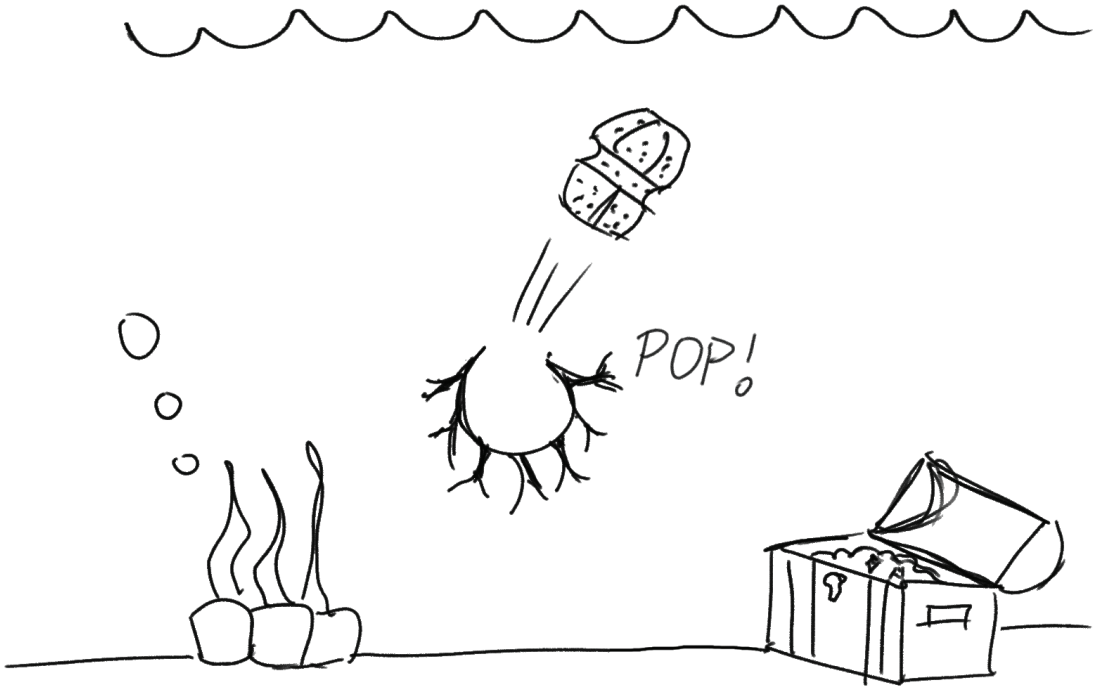
Some dinoflagellates cause red tides, when the water at beaches turns red. This colour change is because there are so many red dinoflagellates in the water.

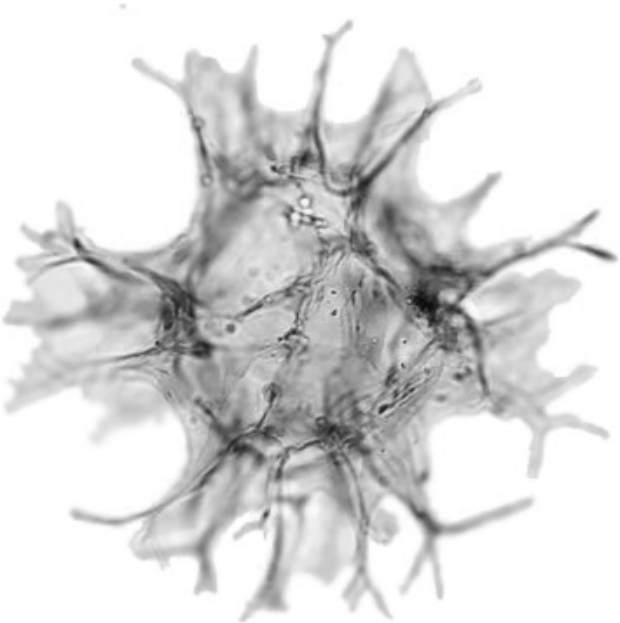
Some of these dinoflagellates can produce toxins that animals living in the sea absorb. When there is a red tide, you shouldn't collect and eat seafood from the beach because it may have become toxic.

Dinoflagellates can also be nice. They create bioluminecense which makes the water glow at night in some places.

When things are getting tough for a dinoflagellate, it can form a kind of a covering called a cyst. Its cyst is almost like a clear plastic bag wrapped around the dinoflagellate. The dinoflagellate can remain in suspended animation inside its cyst for up to a hundred years.

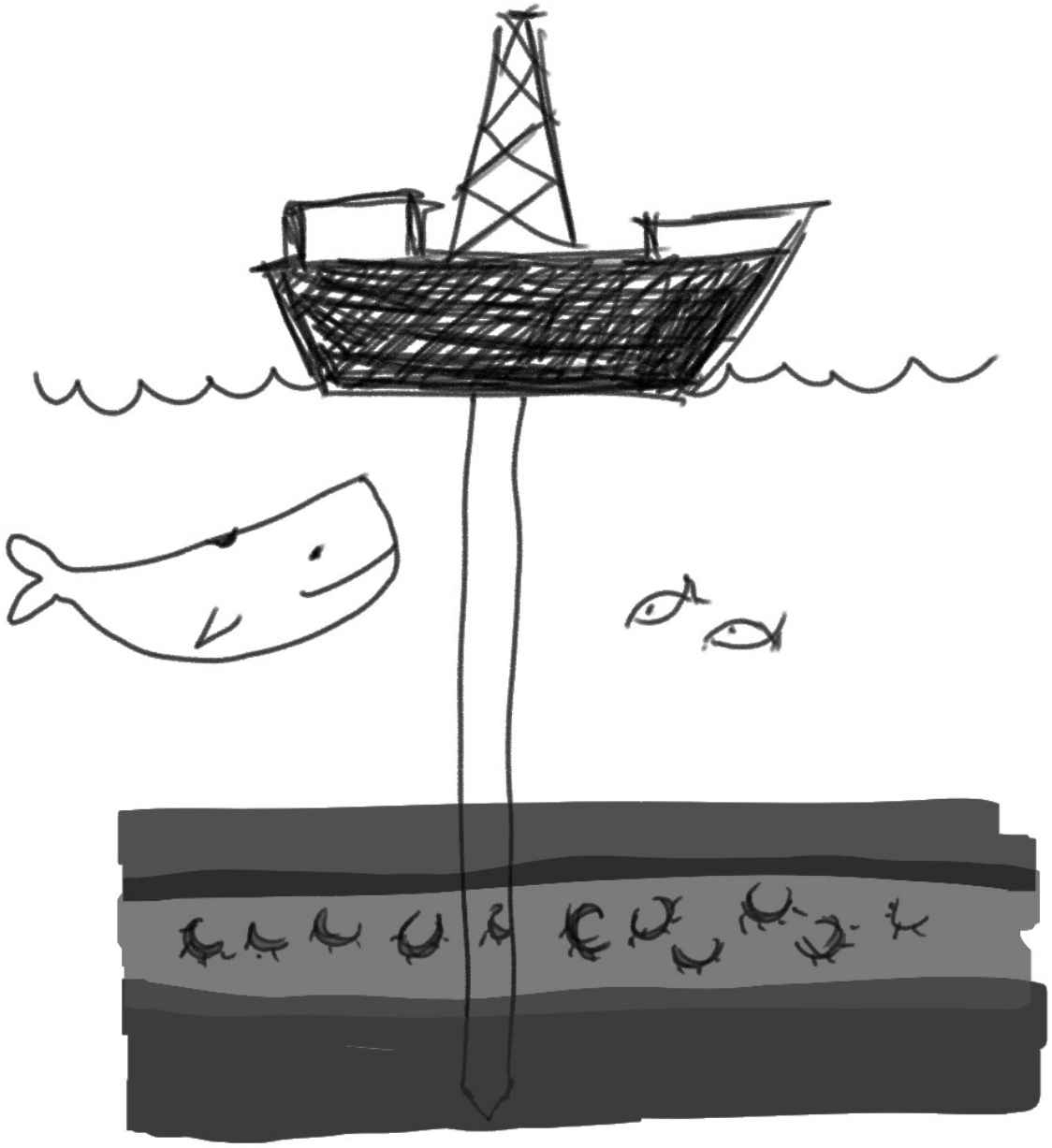
Once things in the outside world seem better, the dinoflagellate can pop out of the cyst and continue its life. It's kind of like if humans could be cryogenically frozen!





Some dinoflagellates drift to the bottom of the ocean while they are inside their cysts.

Slowly over millions of years, the cysts of billions of dinoflagellates are layered up with mud, sand, stones and other creatures.



The *JOIDES Resolution* is a scientific research vessel, which sails across the world looking for, among other things, these dinoflagellate cysts which have drifted to the bottom of the sea in ancient times.

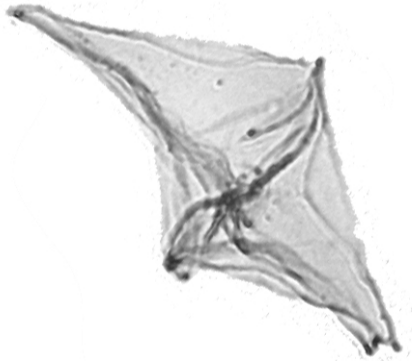
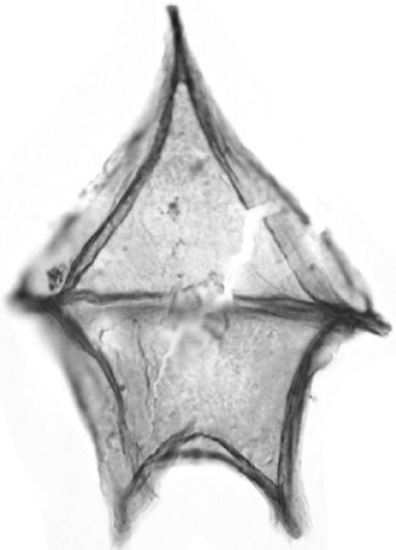
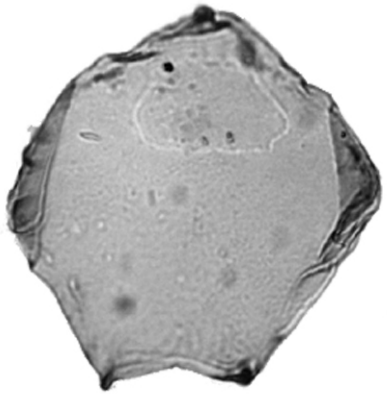
The ship has a huge drilling system, and it drills down hundreds of metres below the sea floor and into the layers of mud, sand and rock beneath. Long thin cores are brought up to the surface for scientists on board the ship to study.

The further down below the seafloor the drill gets, the more it is travelling into the distant past. The JOIDES collects mud that is millions of years old. Inside that mud are the cysts of the dinoflagellates.

To get the dinoflagellates out of the mud the ship has dug up, Francesca and Oliver use hydrofluoric acid to eat away the stuff they don't want and leave the dinoflagellate cysts behind.

Hydrofluoric acid is very dangerous because it is an extremely strong acid. The fluorine in the acid loves to attach to the calcium in a human body, causing very bad burns, and in the worst cases can be fatal. Francesca is wearing a lot of safety gear to make sure she doesn't get burnt by the acid.

Dinoflagellate cysts are very tough, so they don't get damaged by the acid.

Different kinds of dinoflagellates lived at different times in the past, and liked different ocean conditions. By looking under a microscope at the dinoflagellates, Oliver and Francesca can figure out how old the mud they were buried in, and what the enviroment was like at that time. Francesca found some dinoflagellates off the coast of Antartica that were similar to ones that live in New Zealand today -- so she can tell that millions of years ago Antarctica used to have warmer seas, more like New Zealand.