



Tales of the
Resolution!

EPISODE 4:

ARCTIC RAINFOREST

VOL. I, NUMBER 4
NOVEMBER 2009

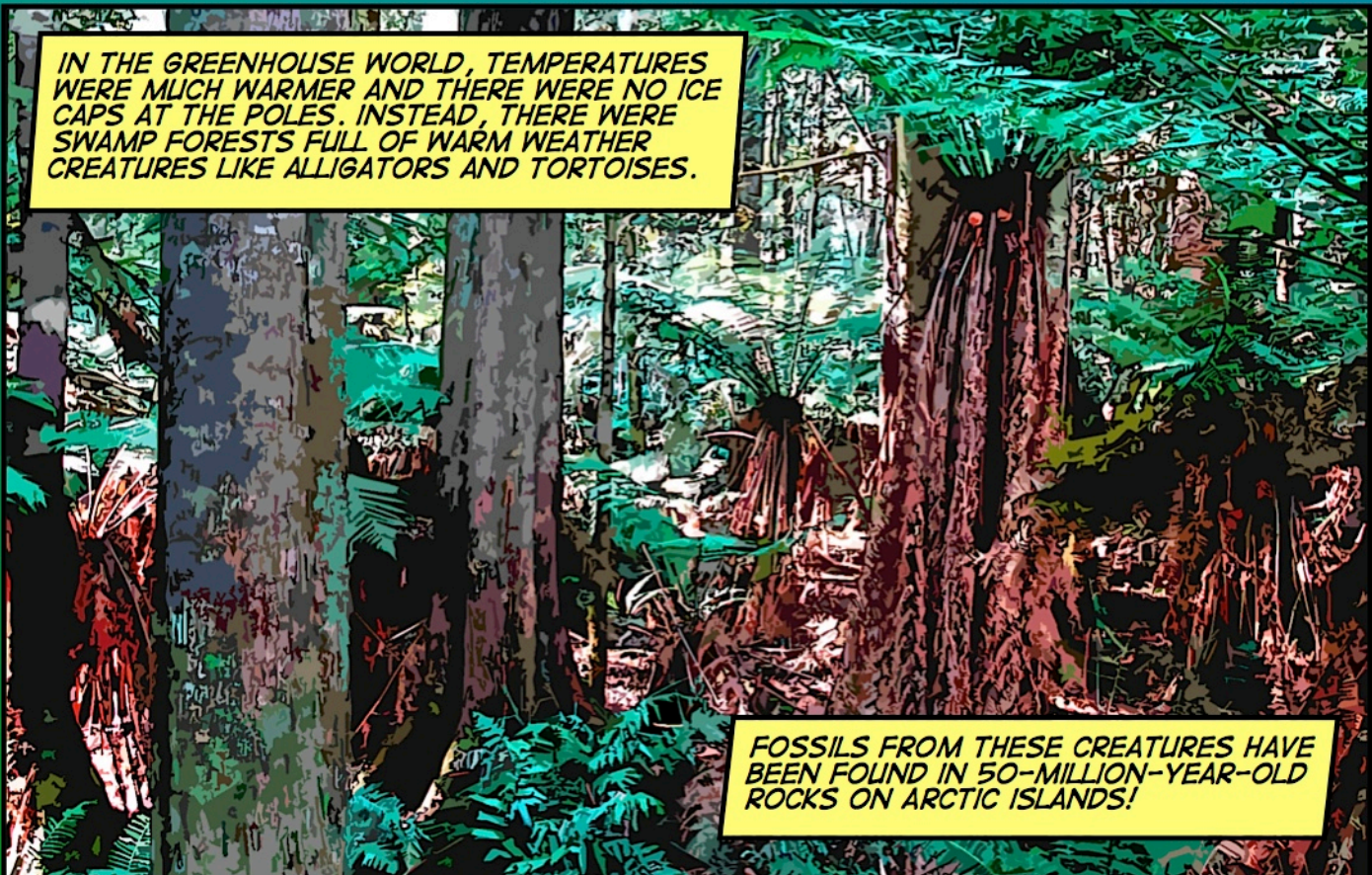
*FOLLOW THE CONTINUING ADVENTURES OF
THE JOIDES RESOLUTION AT:*

WWW.LDEO.COLUMBIA.EDU/BRG/TALES

SCIENTISTS KNOW THAT OVER THE LAST 53 MILLION YEARS EARTH'S CLIMATE HAS CHANGED FROM A "GREENHOUSE" WORLD TO AN "ICEHOUSE" WORLD. THIS IMAGE SHOWS THE MAXIMUM EXTENT OF ICE DURING THE LAST ICE AGE, AROUND 20,000 YEARS AGO.



IN THE GREENHOUSE WORLD, TEMPERATURES WERE MUCH WARMER AND THERE WERE NO ICE CAPS AT THE POLES. INSTEAD, THERE WERE SWAMP FORESTS FULL OF WARM WEATHER CREATURES LIKE ALLIGATORS AND TORTOISES.



FOSSILS FROM THESE CREATURES HAVE BEEN FOUND IN 50-MILLION-YEAR-OLD ROCKS ON ARCTIC ISLANDS!

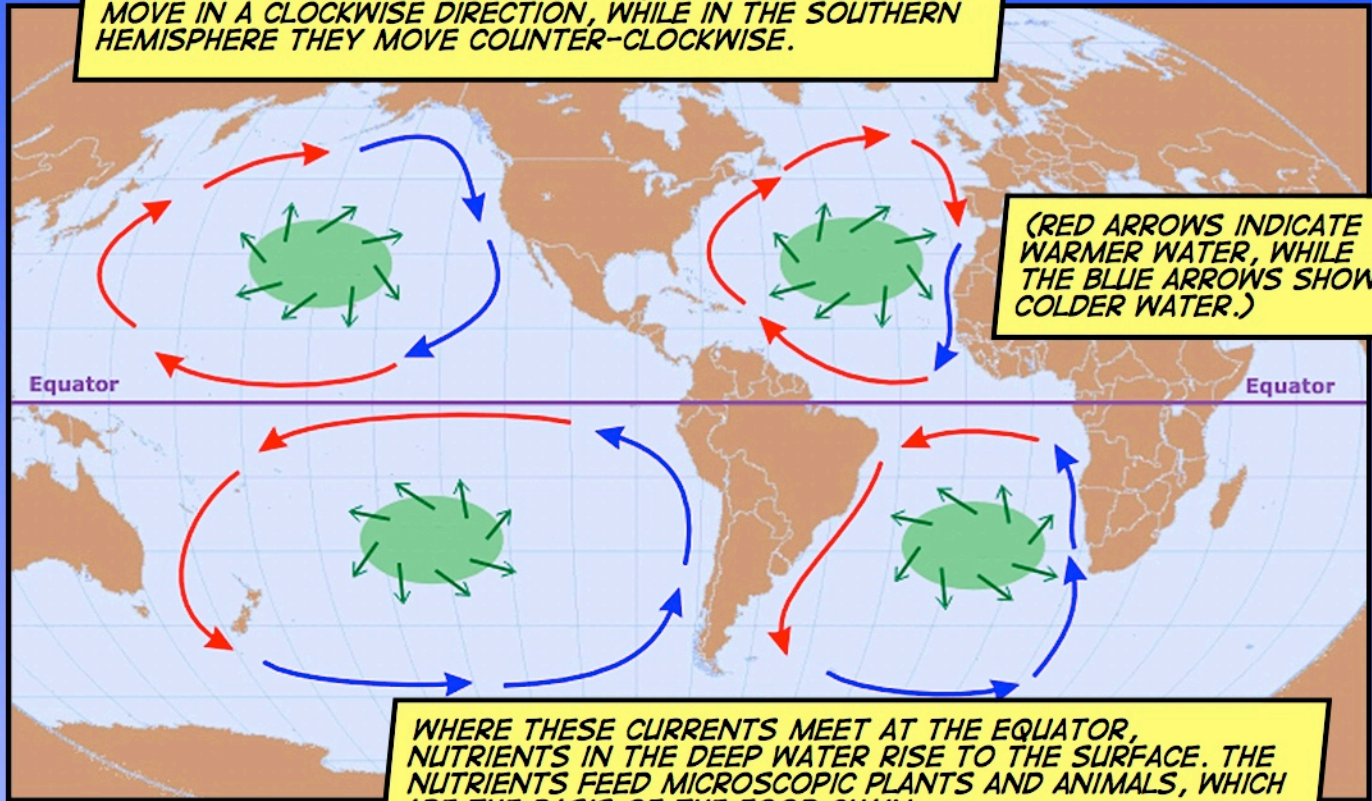
SCIENTISTS ARE INTERESTED IN THE PROCESSES THAT DRIVE THESE MAJOR CLIMATE CHANGES. AND THE BEST WAY TO STUDY THEM IS TO LOOK AT OCEAN SEDIMENTS, WHICH CONTAIN A RECORD OF PAST CLIMATE CONDITIONS.

WOW, THE VARIATION IN THESE SEDIMENT CORES IS PRETTY AMAZING.



THE PACIFIC OCEAN IS AN IDEAL LABORATORY - IT IS SO HUGE THAT MAJOR CHANGES IN GLOBAL CLIMATE ARE SURE TO BE RECORDED THERE ...

BUT WHERE IN THE PACIFIC SHOULD WE LOOK? CONSIDER THIS: IN THE NORTHERN HEMISPHERE, OCEAN CURRENTS MOVE IN A CLOCKWISE DIRECTION, WHILE IN THE SOUTHERN HEMISPHERE THEY MOVE COUNTER-CLOCKWISE.



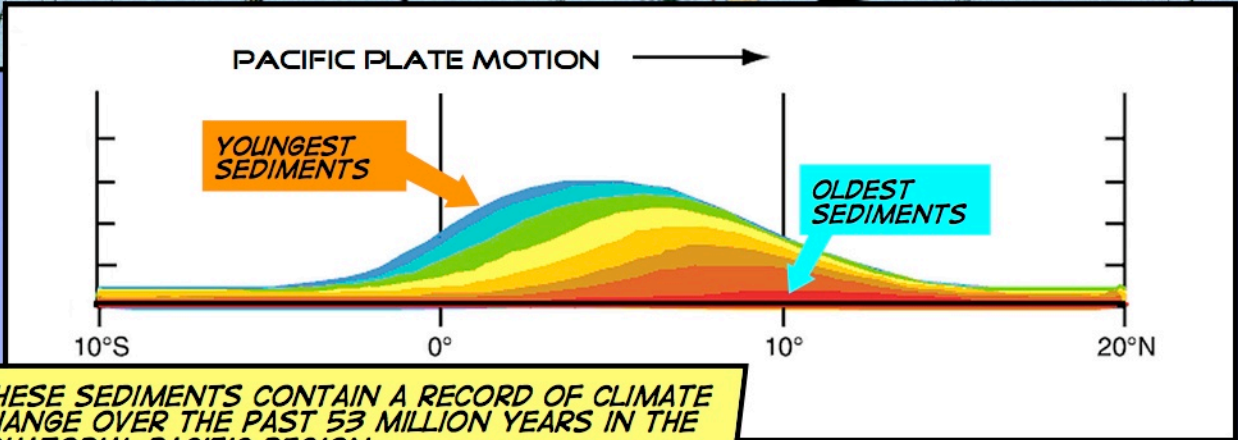
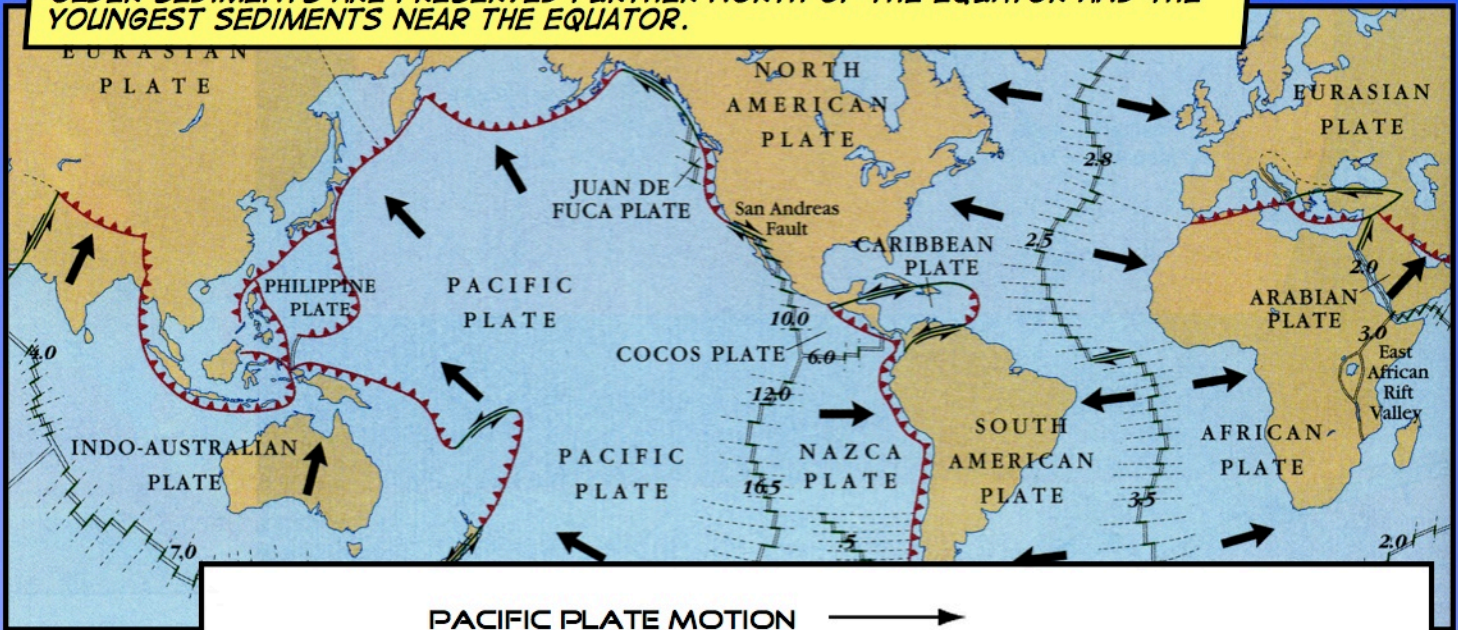
MANY OF THESE OCEANIC MICROORGANISMS HAVE SHELLS MADE OF CALCIUM CARBONATE AND SILICA. WHEN THE ORGANISMS DIE, THE SHELLS FALL TO THE SEAFLOOR AND MAKE UP THE SEDIMENT.*

SO THE SEDIMENT LAYER IS HIGHEST AT THE EQUATOR, WHERE THE MOST NUTRIENTS ARE.

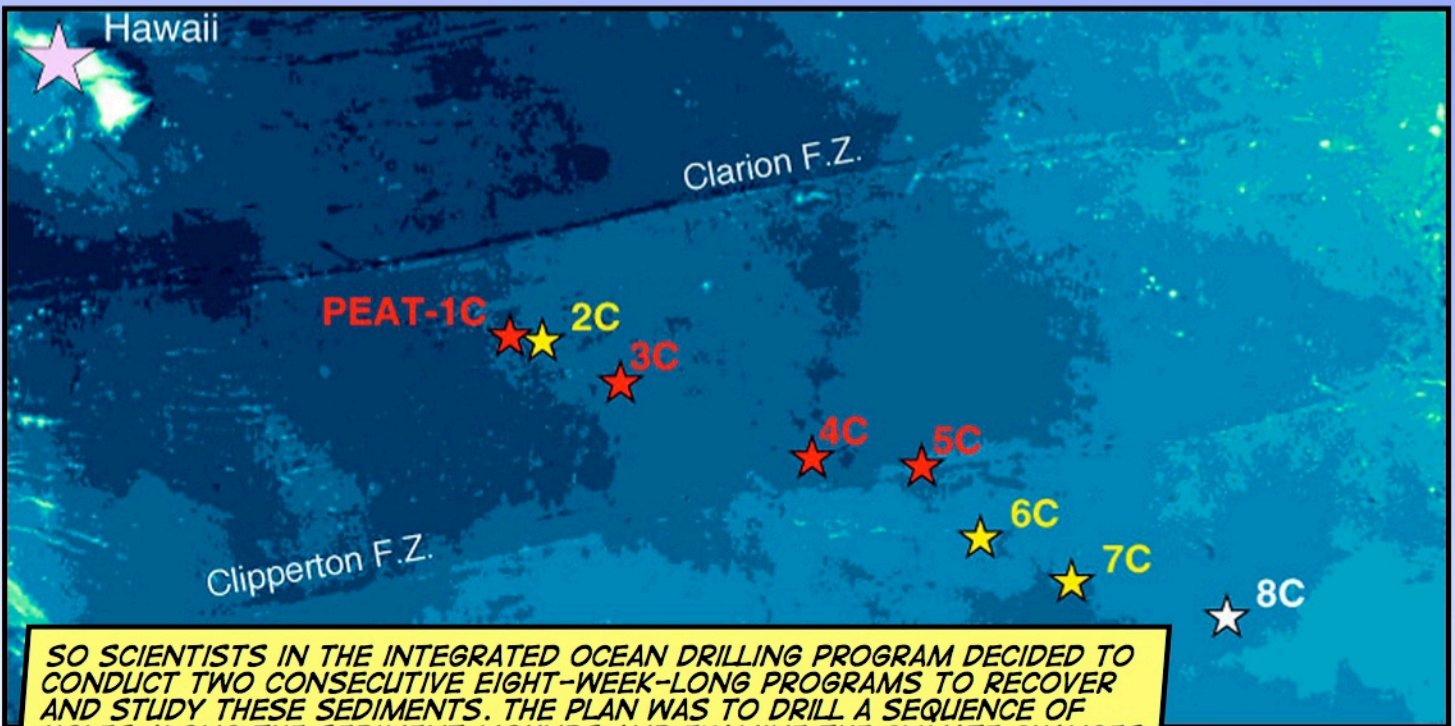
IN THIS IMAGE, THE LIGHTER BLUE COLOR REPRESENTS AREAS WITH MORE MICROORGANISMS, AND HENCE MORE SEDIMENT.

* AS WE WILL SEE LATER, THOUGH, CALCIUM CARBONATE DISSOLVES IN THE DEEP OCEAN AND SO THESE SHELLS MAY NOT BE PRESERVED IN CERTAIN SEDIMENTS.

THE EARTH'S CRUST, OR LITHOSPHERE, CONTAINS NUMEROUS PLATES THAT ARE IN CONSTANT MOTION. BECAUSE THE PACIFIC PLATE HAS MOVED NORTH OVER GEOLOGIC TIME, THE SEDIMENT MOUNDS HAVE ALSO MOVED NORTHWARDS. OLDER SEDIMENTS ARE PRESERVED FURTHER NORTH OF THE EQUATOR AND THE YOUNGEST SEDIMENTS NEAR THE EQUATOR.



THESE SEDIMENTS CONTAIN A RECORD OF CLIMATE CHANGE OVER THE PAST 53 MILLION YEARS IN THE EQUATORIAL PACIFIC REGION.



SO SCIENTISTS IN THE INTEGRATED OCEAN DRILLING PROGRAM DECIDED TO CONDUCT TWO CONSECUTIVE EIGHT-WEEK-LONG PROGRAMS TO RECOVER AND STUDY THESE SEDIMENTS. THE PLAN WAS TO DRILL A SEQUENCE OF HOLES ALONG THE SEDIMENT MOUNDS AND EXAMINE THE CLIMATE CHANGES THAT WERE RECORDED THERE OVER THE LAST 53 MILLION YEARS.

IN MARCH OF 2009, THE SCIENTISTS BEGAN TO ARRIVE IN HONOLULU FOR THE FIRST OF THE TWO EXPEDITIONS.



YUJJI AND HIDETO MADE A POINT OF HITTING THE BEACH BEFORE THE EXPEDITION STARTED ...



SOON IT WAS TIME FOR THE SCIENTISTS AND CREW TO BOARD THE JR ...



ACCOMMODATIONS FOR THE STAFF WERE SIMPLE BUT QUITE COMFORTABLE.



AND JUST FOR THE RECORD, SOCKS AND UNDERWEAR CAN GET LOST AT SEA AS EASILY AS THEY DO ON LAND.



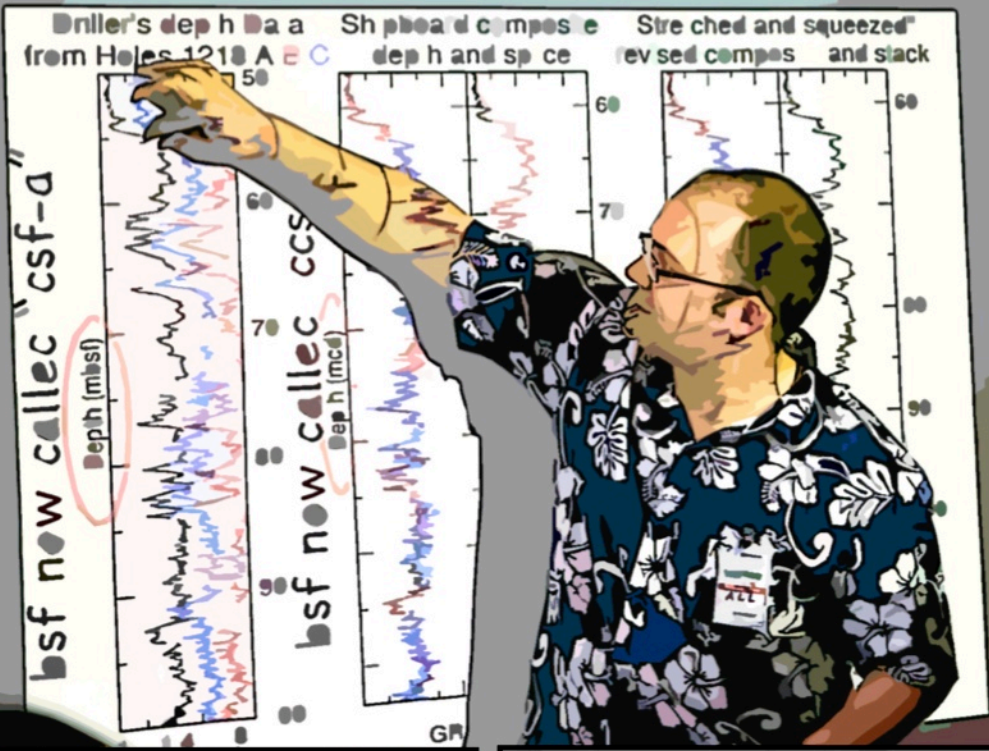
AT THE BEGINNING OF THE EXPEDITION, THE DRILLING CREW REVIEWED THE OPERATIONS PLAN ...



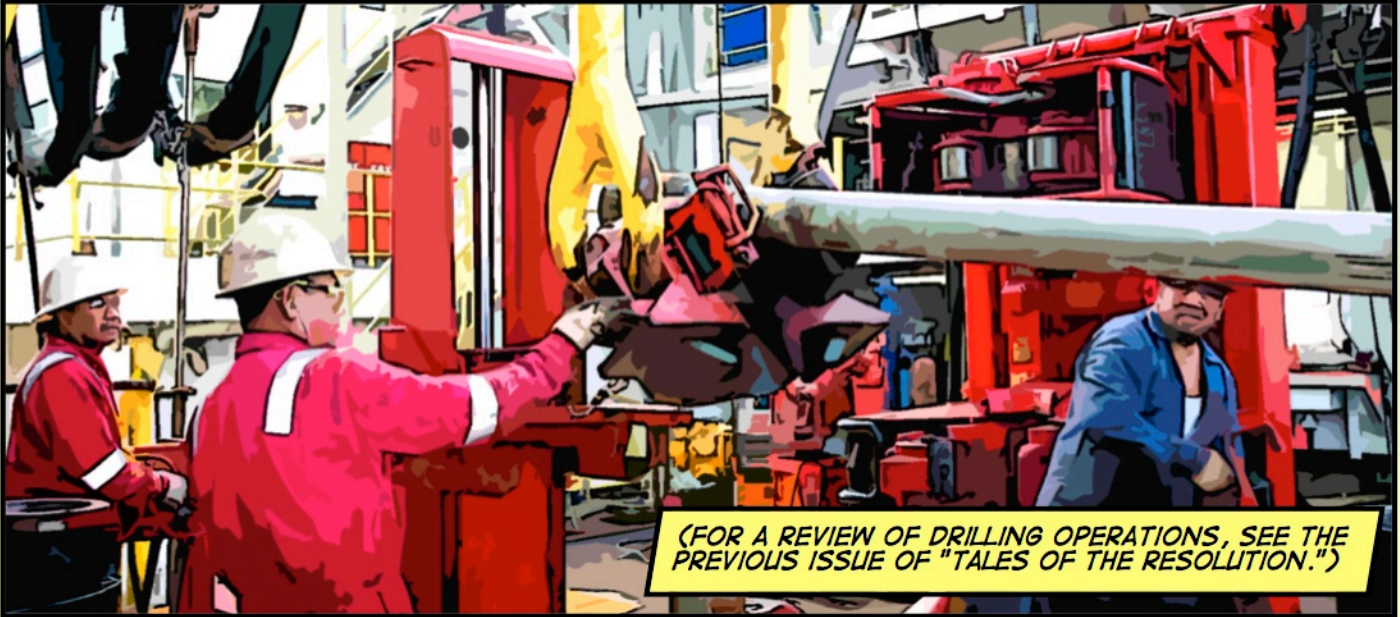
... WHILE THE SCIENTISTS HELD MULTIPLE BRIEFINGS AND DISCUSSIONS ABOUT THE OBJECTIVES OF THE EXPEDITION.



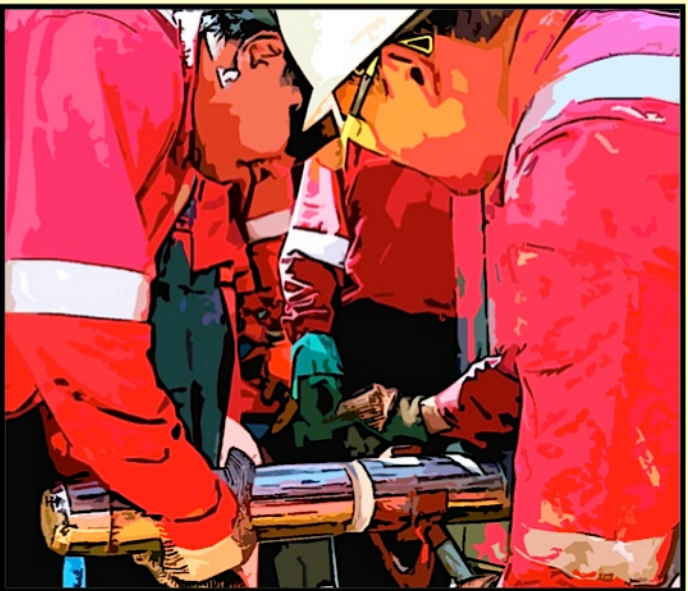
Composite depth scales



AFTER FOUR DAYS OF TRANSIT,
IT WAS TIME TO DRILL THE
FIRST CORES.



(FOR A REVIEW OF DRILLING OPERATIONS, SEE THE
PREVIOUS ISSUE OF "TALES OF THE RESOLUTION.")



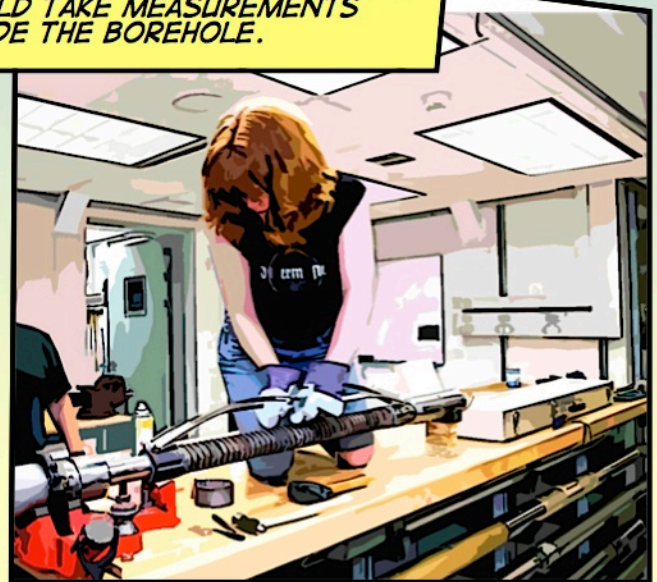
THE CORES WERE DELIVERED TO THE CORE RECEIVING PLATFORM ...



... AND SPLIT INTO SECTIONS.

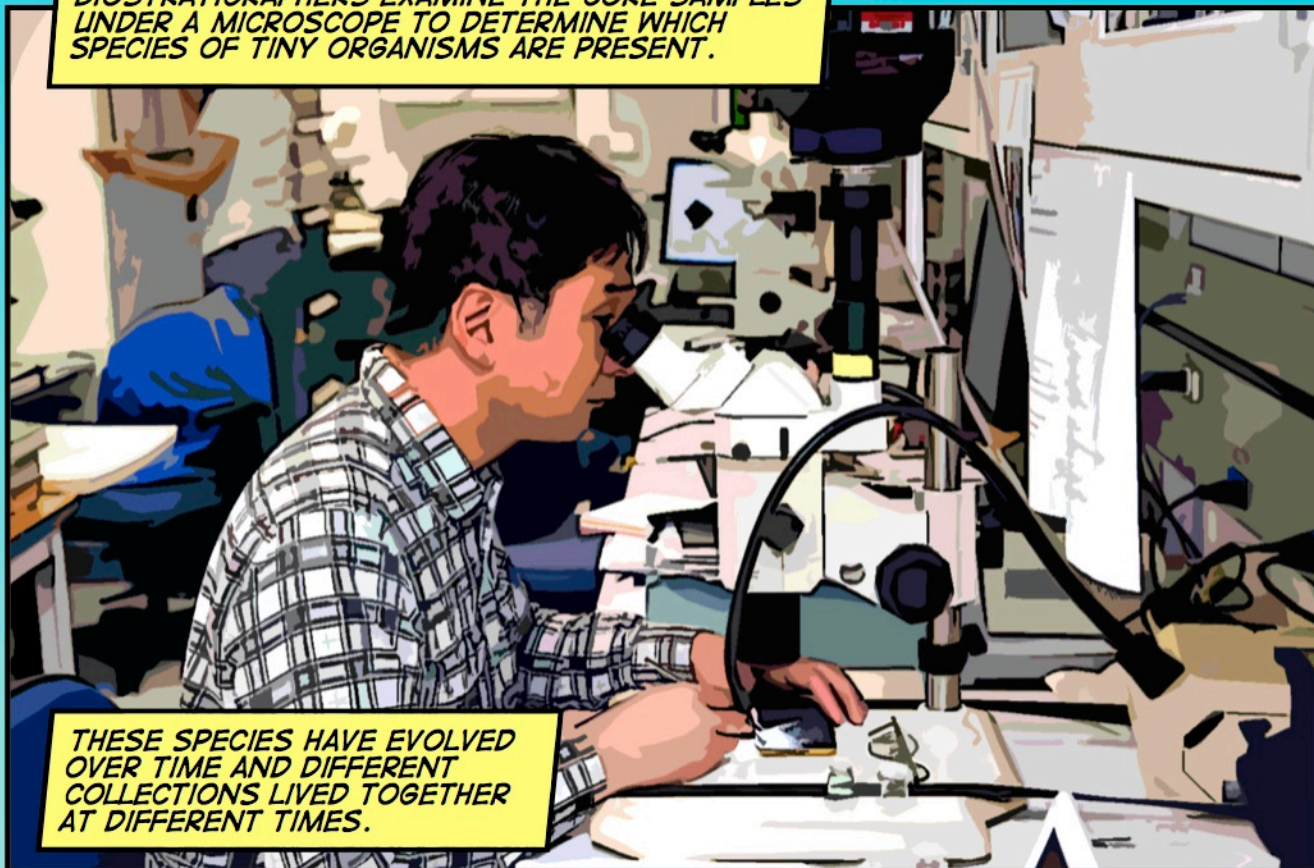


MEANWHILE, THE LOGGERS PREPARED THEIR TOOLS SO THEY COULD TAKE MEASUREMENTS INSIDE THE BOREHOLE.

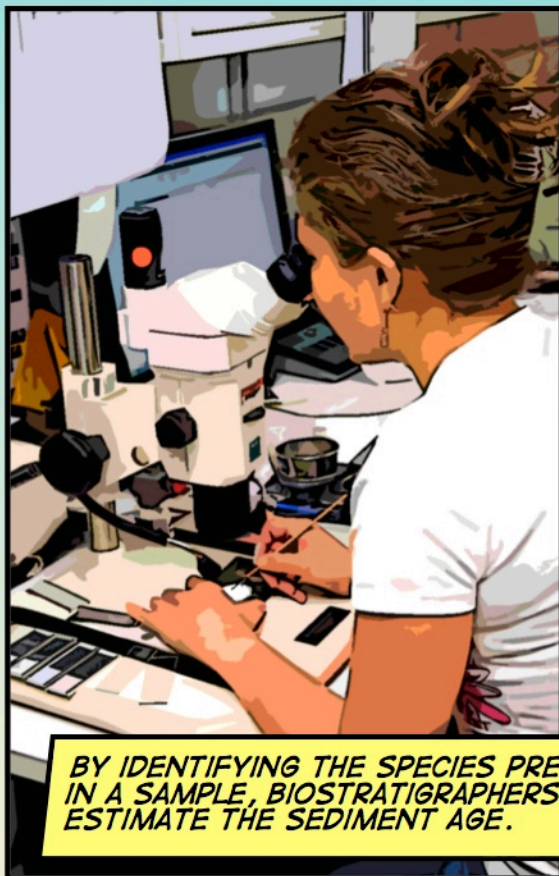


SCIENTISTS DESCENDED ON THE FIRST CORES LIKE KIDS ON ICE CREAM.

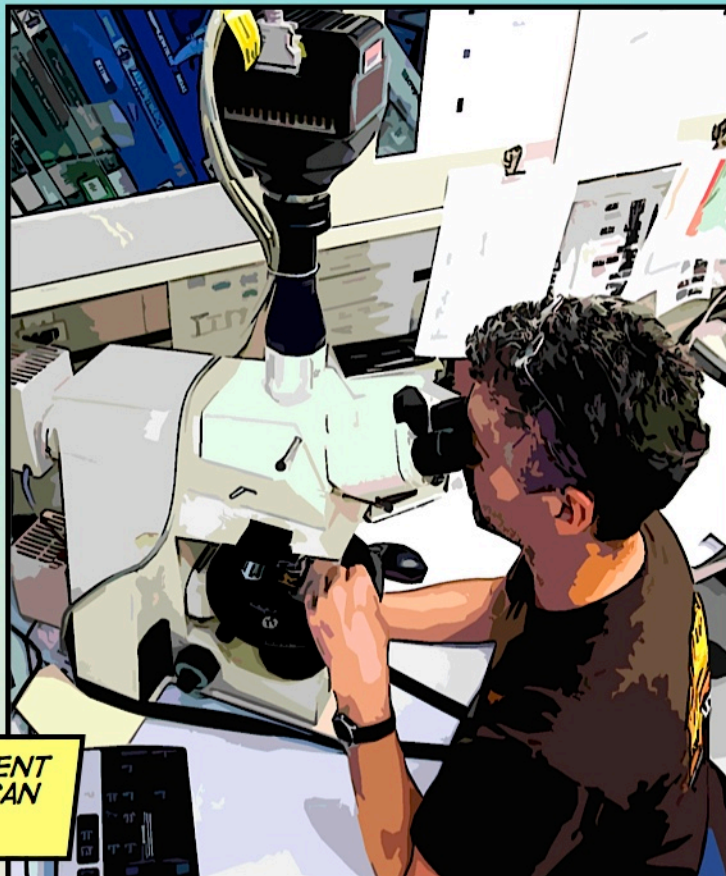
HOW DO WE KNOW THE AGES OF THE SEDIMENTS THAT WE RECOVER? SCIENTISTS CALLED BIOSTRATIGRAPHERS EXAMINE THE CORE SAMPLES UNDER A MICROSCOPE TO DETERMINE WHICH SPECIES OF TINY ORGANISMS ARE PRESENT.

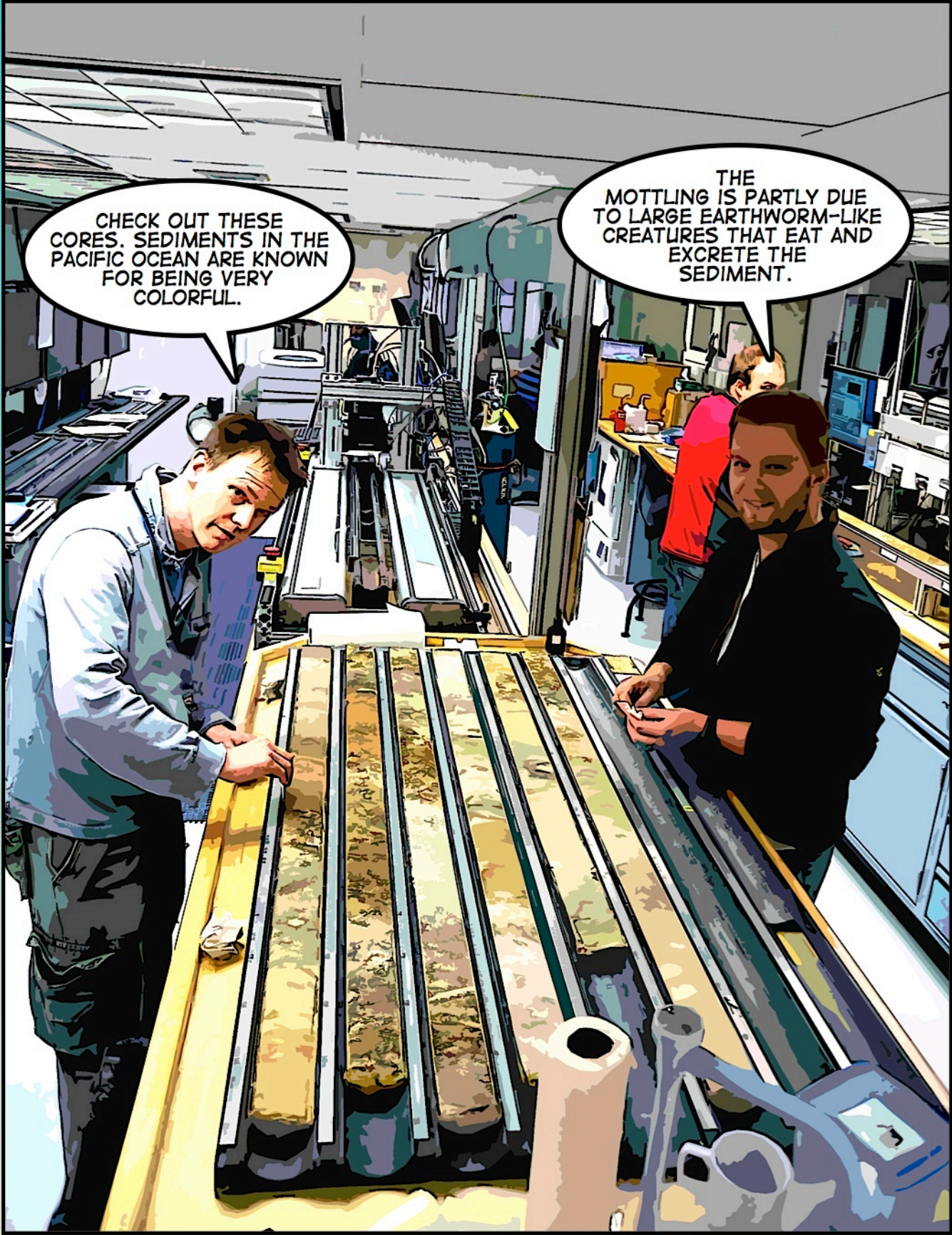


THESE SPECIES HAVE EVOLVED OVER TIME AND DIFFERENT COLLECTIONS LIVED TOGETHER AT DIFFERENT TIMES.



BY IDENTIFYING THE SPECIES PRESENT IN A SAMPLE, BIOSTRATIGRAPHERS CAN ESTIMATE THE SEDIMENT AGE.

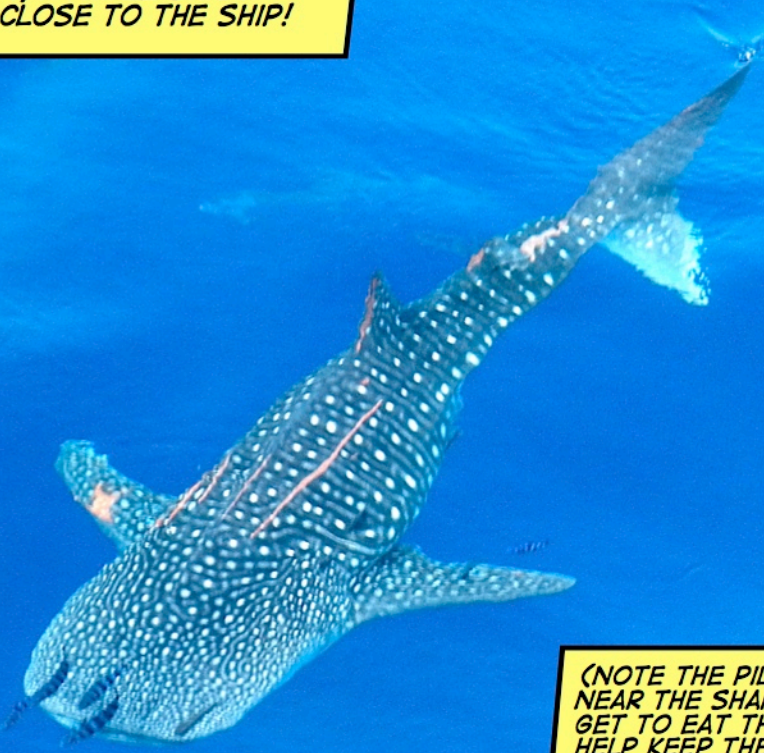




CHECK OUT THESE CORES. SEDIMENTS IN THE PACIFIC OCEAN ARE KNOWN FOR BEING VERY COLORFUL.

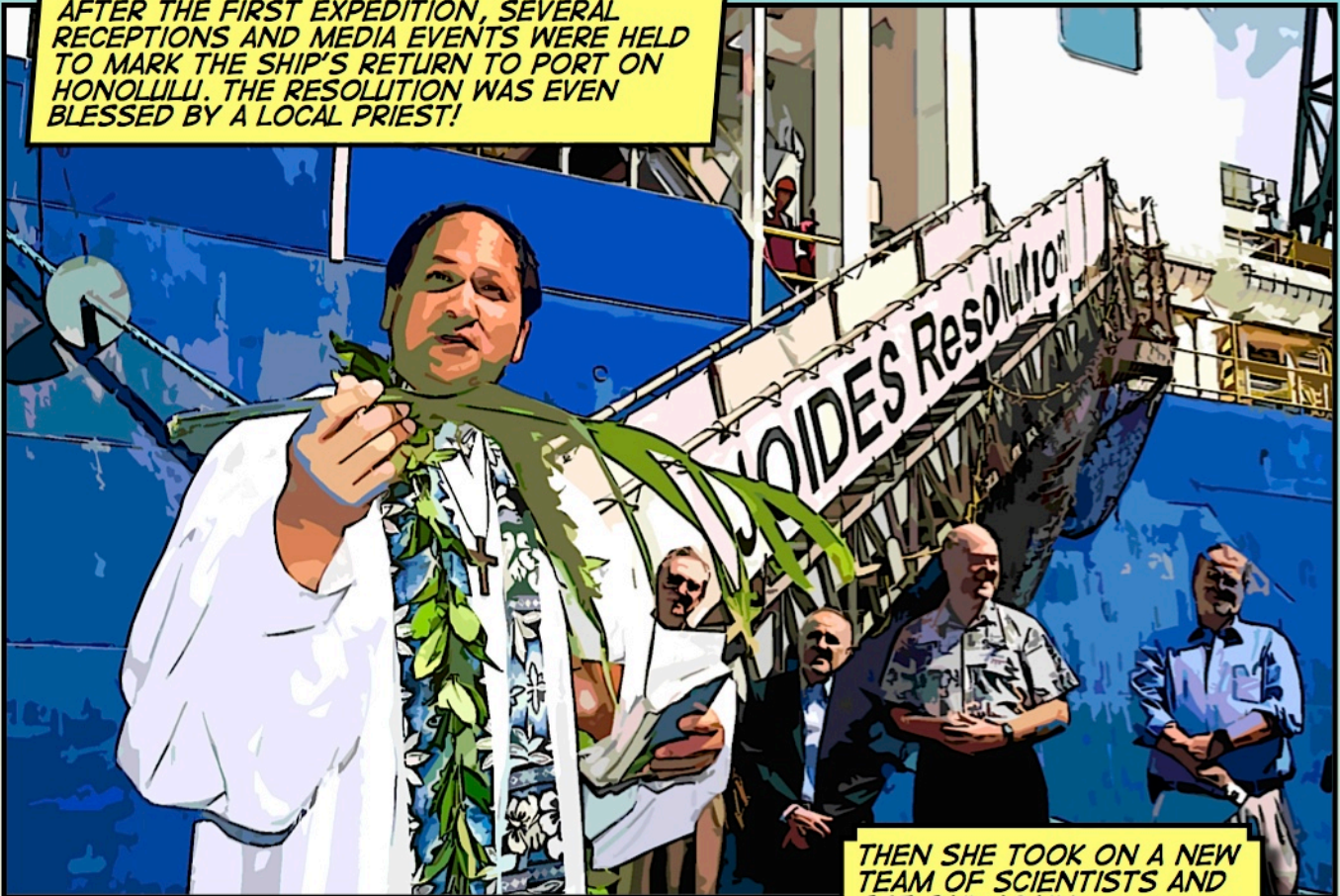
THE MOTTLING IS PARTLY DUE TO LARGE EARTHWORM-LIKE CREATURES THAT EAT AND EXCRETE THE SEDIMENT.

TOWARD THE END OF THE EXPEDITION, A WHALE SHARK SWAM UP CLOSE TO THE SHIP!



(NOTE THE PILOT FISH SWIMMING NEAR THE SHARK'S MOUTH -- THEY GET TO EAT THE LEFTOVERS AND HELP KEEP THE SHARK'S TEETH FREE FROM ORAL PARASITES.)

AFTER THE FIRST EXPEDITION, SEVERAL RECEPTIONS AND MEDIA EVENTS WERE HELD TO MARK THE SHIP'S RETURN TO PORT ON HONOLULU. THE RESOLUTION WAS EVEN BLESSED BY A LOCAL PRIEST!



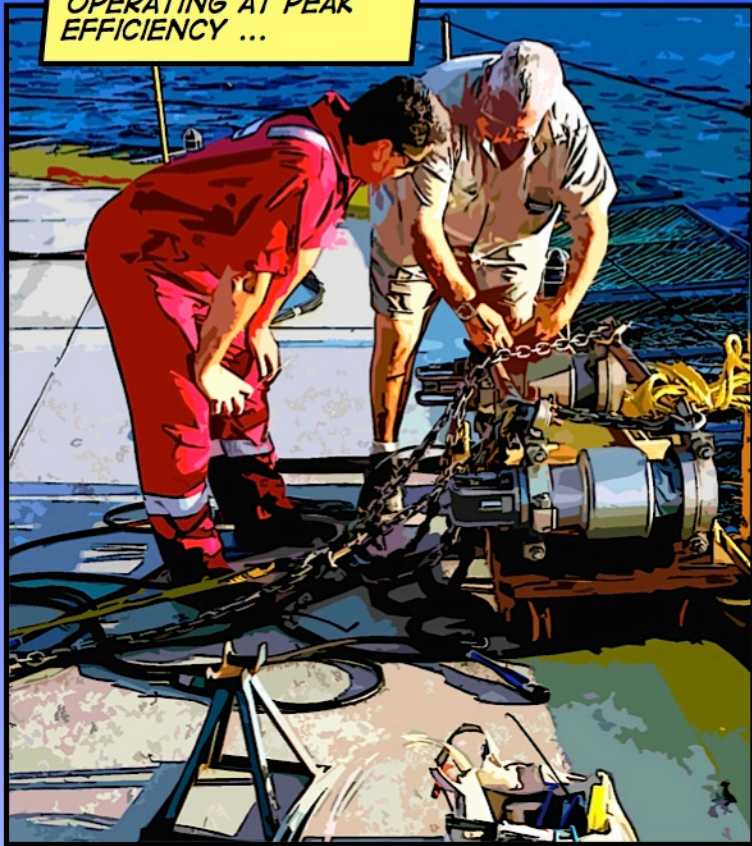
THEN SHE TOOK ON A NEW TEAM OF SCIENTISTS AND SET SAIL AGAIN ...

THE DRILLING AND LOGGING
BEGAN ANEW ...



CORE RECOVERY WAS EXCELLENT,
PROMPTING SPONTANEOUS
DANCES OF CELEBRATION.

TECHNICIANS KEPT ALL OF THE EQUIPMENT OPERATING AT PEAK EFFICIENCY ...



... AND GOOD FOOD KEPT MORALE HIGH.

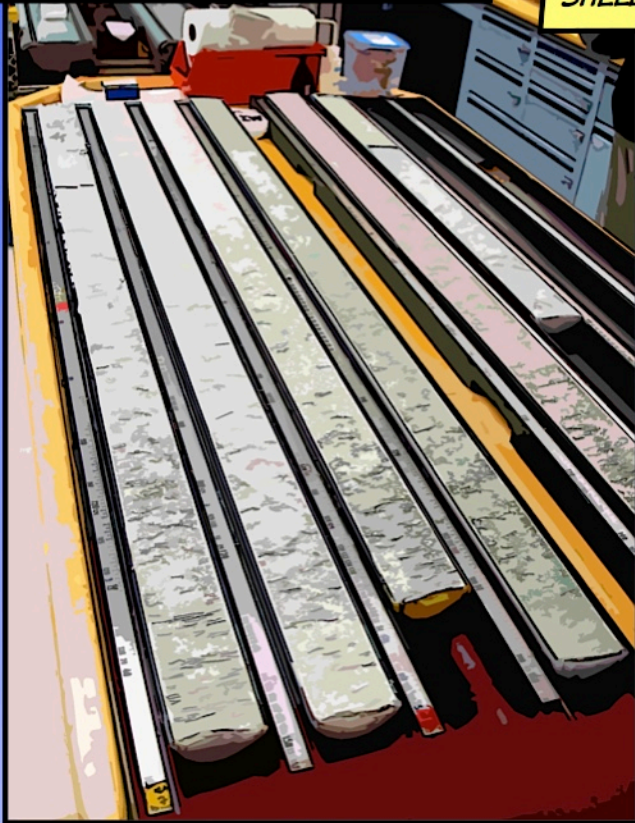


THAT DEPENDS ON YOUR PERSPECTIVE

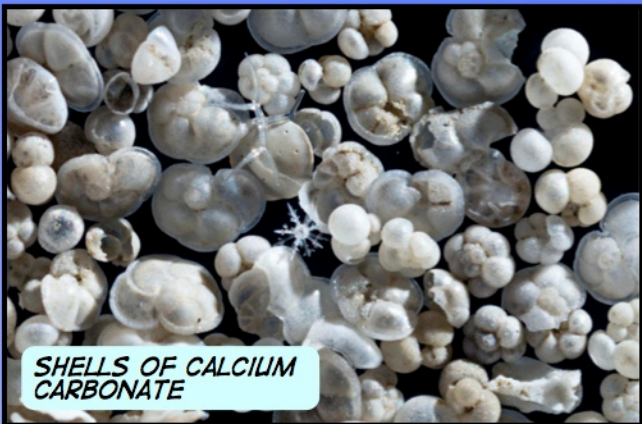


NOW, BACK TO THE SCIENCE:
SO WHAT DID THE SEDIMENTS
THAT WERE RECOVERED ON
THESE EXPEDITIONS REVEAL?

AS EXPLAINED BEFORE, WE KNOW THAT SOME
MICROORGANISMS HAVE SHELLS MADE OF SILICA,
WHILE OTHERS HAVE CALCIUM CARBONATE
SHELLS. WHEN THE ORGANISMS DIE, THEIR
SHELLS SINK TO THE SEAFLOOR.



SHELLS OF SILICA



SHELLS OF CALCIUM
CARBONATE

WE ALSO KNOW
THAT COLD DEEP WATER
HOLDS MORE CARBON DIOXIDE
THAN WARM SHALLOW
WATER ...

... FORMING
CARBONIC ACID IN
THE PROCESS.

SO BELOW A
CERTAIN DEPTH, THE
WATER BECOMES MORE
ACIDIC, DISSOLVING THE
SHELLS MADE OF CALCIUM
CARBONATE.



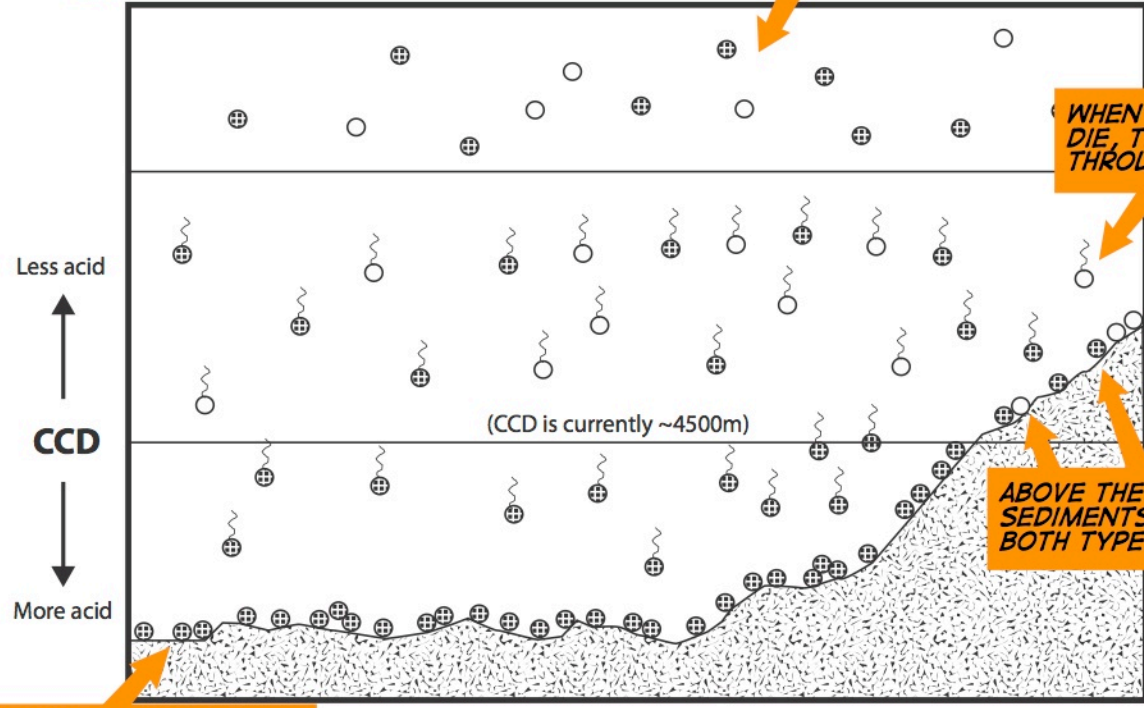
IF YOU
GOOGLE "THE FATE OF
CALCIUM," YOU'LL FIND A
COOL EXPERIMENT FROM
THE AMERICAN CHEMICAL
SOCIETY THAT
ILLUSTRATES
THIS.

WHEN GLOBAL CLIMATE CHANGES, THIS WATER DEPTH, CALLED THE CARBONATE COMPENSATION DEPTH (CCD), CAN CHANGE DRAMATICALLY. THE DEPTH OF THE CCD IS RECORDED IN THE SEDIMENTS.

THIS IS THE SEA SURFACE

IN THE UPPER PART OF THE OCEAN LIVE ORGANISMS WITH BOTH TYPES OF SHELLS

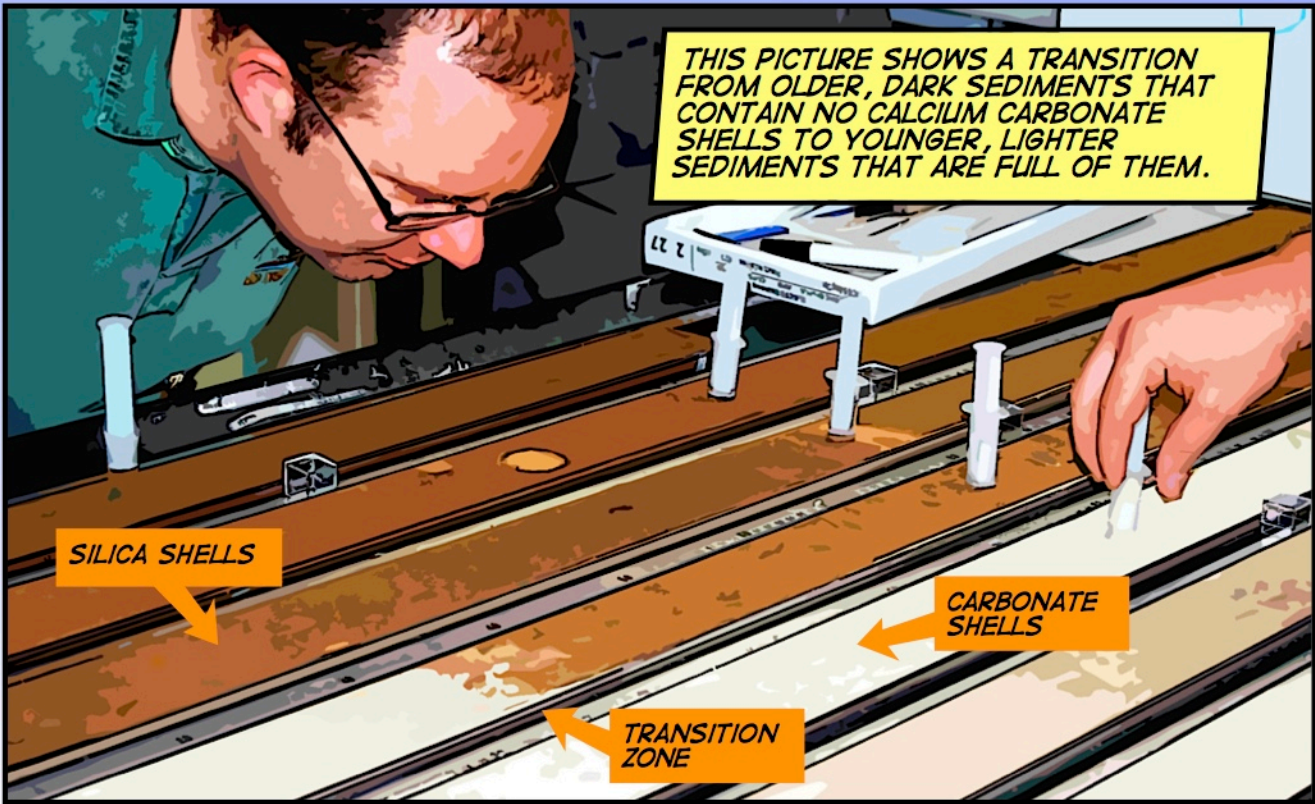
WHEN THE MICROBES DIE, THEY FALL THROUGH THE OCEAN



ABOVE THE CCD, THE SEDIMENTS CONTAIN BOTH TYPES OF SHELLS

BUT BELOW THE CCD, ONLY THE SILICA SHELLS SURVIVE THE MORE ACIDIC ENVIRONMENT

- organisms with carbonate shells
- ⊕ organisms with silica shells



THIS PICTURE SHOWS A TRANSITION FROM OLDER, DARK SEDIMENTS THAT CONTAIN NO CALCIUM CARBONATE SHELLS TO YOUNGER, LIGHTER SEDIMENTS THAT ARE FULL OF THEM.

SILICA SHELLS

CARBONATE SHELLS

TRANSITION ZONE

THIS PARTICULAR TRANSITION OCCURRED ABOUT 34 MILLION YEARS AGO, A TIME WHEN LARGE ICE SHEETS BEGAN TO DEVELOP IN ANTARCTICA.



IT WAS AN IMPORTANT MILESTONE IN THE OVERALL COOLING OF THE CLIMATE FROM THE GREENHOUSE WORLD OF 50 MILLION YEARS AGO.



SCIENTISTS WILL CONTINUE TO STUDY THESE CORES AT THEIR SHORE-BASED LABORATORIES FOR YEARS TO COME.

MEANWHILE, THE JR WILL CARRY OUT EXPEDITIONS IN OTHER LOCATIONS - SUCH AS THE BERING SEA AND THE ANTARCTIC SHELF - THAT WILL ALSO EXAMINE ANCIENT CLIMATE.



**SO DON'T FORGET TO CHECK BACK
FOR NEW ISSUES OF "TALES OF THE
RESOLUTION"!**



**For more information on these expeditions, check
out the PEAT News Network reports here:**

<http://joidesresolution.org/node/2110>

Make sure you start with PNN Report !!