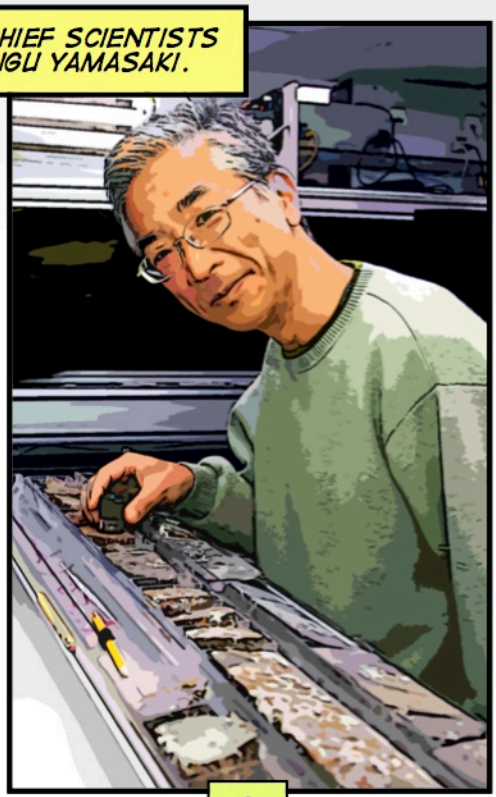

Tales of the Resolution!
EPISODE 6:
IN SEARCH OF ANCIENT LAVA FLOWS
VOL. II, NUMBER 2
APRIL 2012

FOLLOW THE CONTINUING ADVENTURES OF THE JOIDES RESOLUTION AT:

WWW.LDEO.COLUMBIA.EDU/BRG/TALES

THE JOIDES RESOLUTION IS ON A SCIENTIFIC EXPEDITION IN THE SOUTH PACIFIC. FOR EIGHT DAYS, THE SCIENTISTS AND CREW HAVE BEEN DRILLING THEIR FIRST HOLE ON A SUBMERGED VOLCANO IN THE LOUISVILLE SEAMOUNT TRAIL.

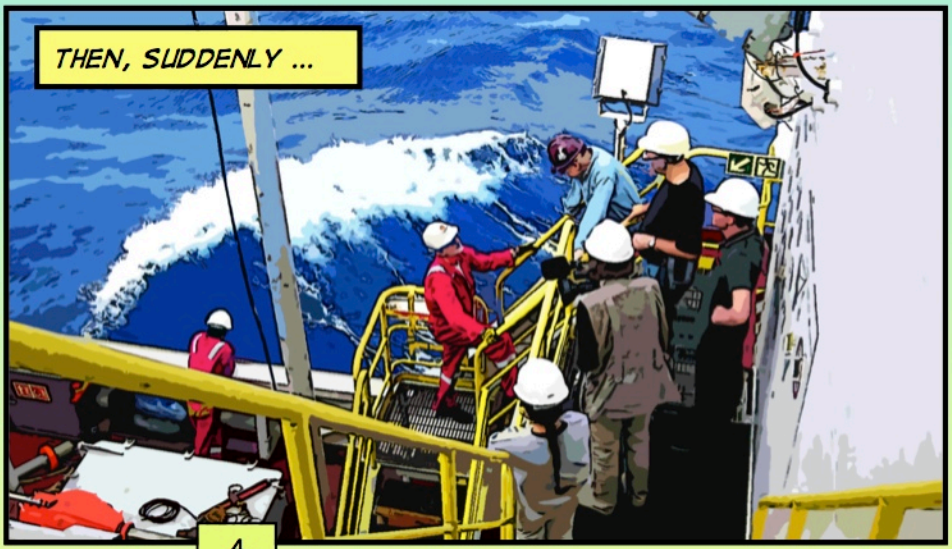
LEADING THE RESEARCH ARE CO-CHIEF SCIENTISTS ANTHONY KOPPERS AND TOSHITSUGU YAMASAKI.



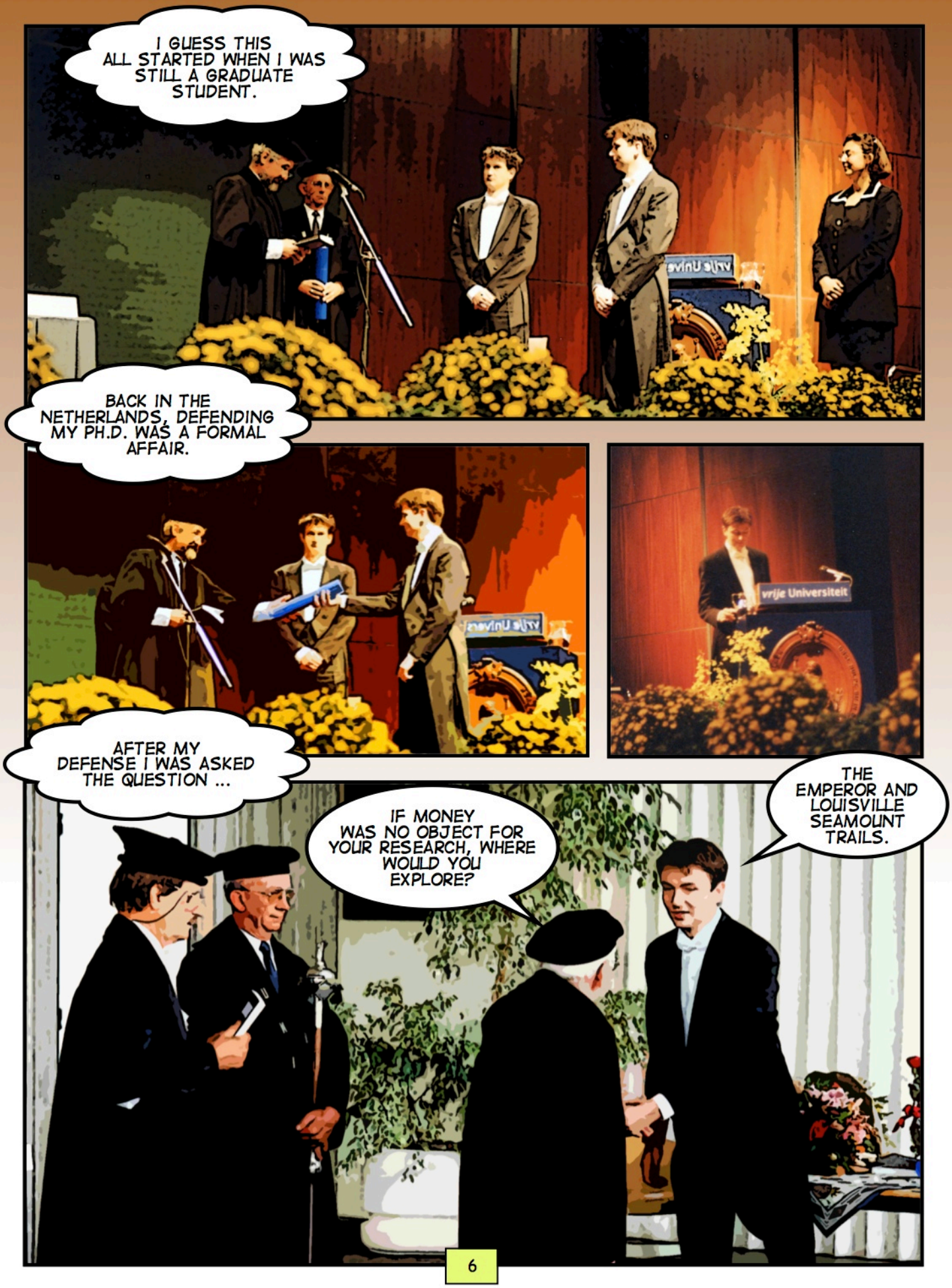
CAPTAIN TERRY SKINNER IS IN CHARGE OF THE SHIP.

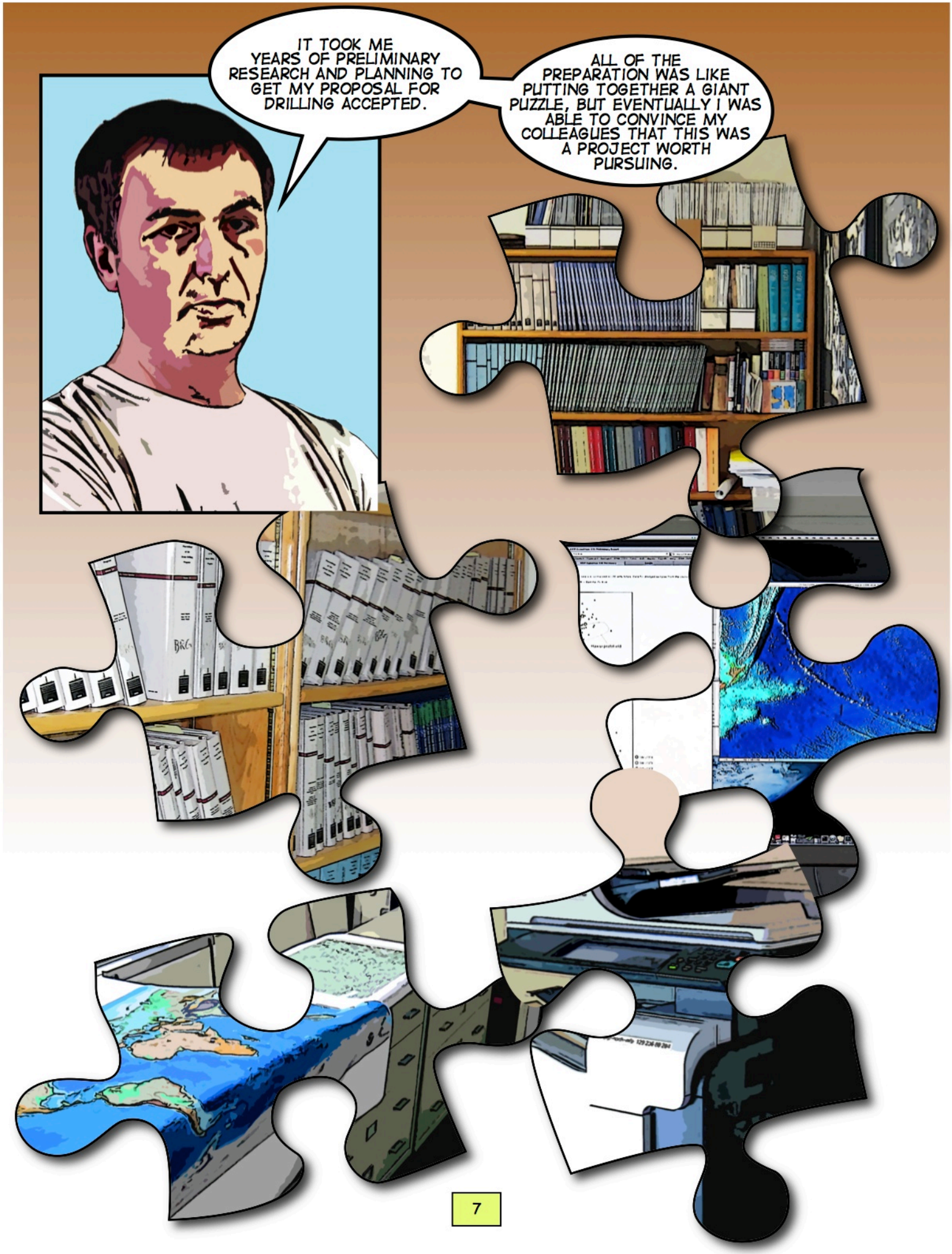
ALTHOUGH THE SCIENTISTS HAVE NOT YET REACHED THEIR TARGET DEPTH, EVERYTHING HAS GONE SMOOTHLY SO FAR. CORES ARE BEING RECOVERED, DESCRIBED AND PRELIMINARILY ANALYZED AT A RAPID RATE. EVERYONE IS OPTIMISTIC ABOUT THE MISSION.

THEN, SUDDENLY ...

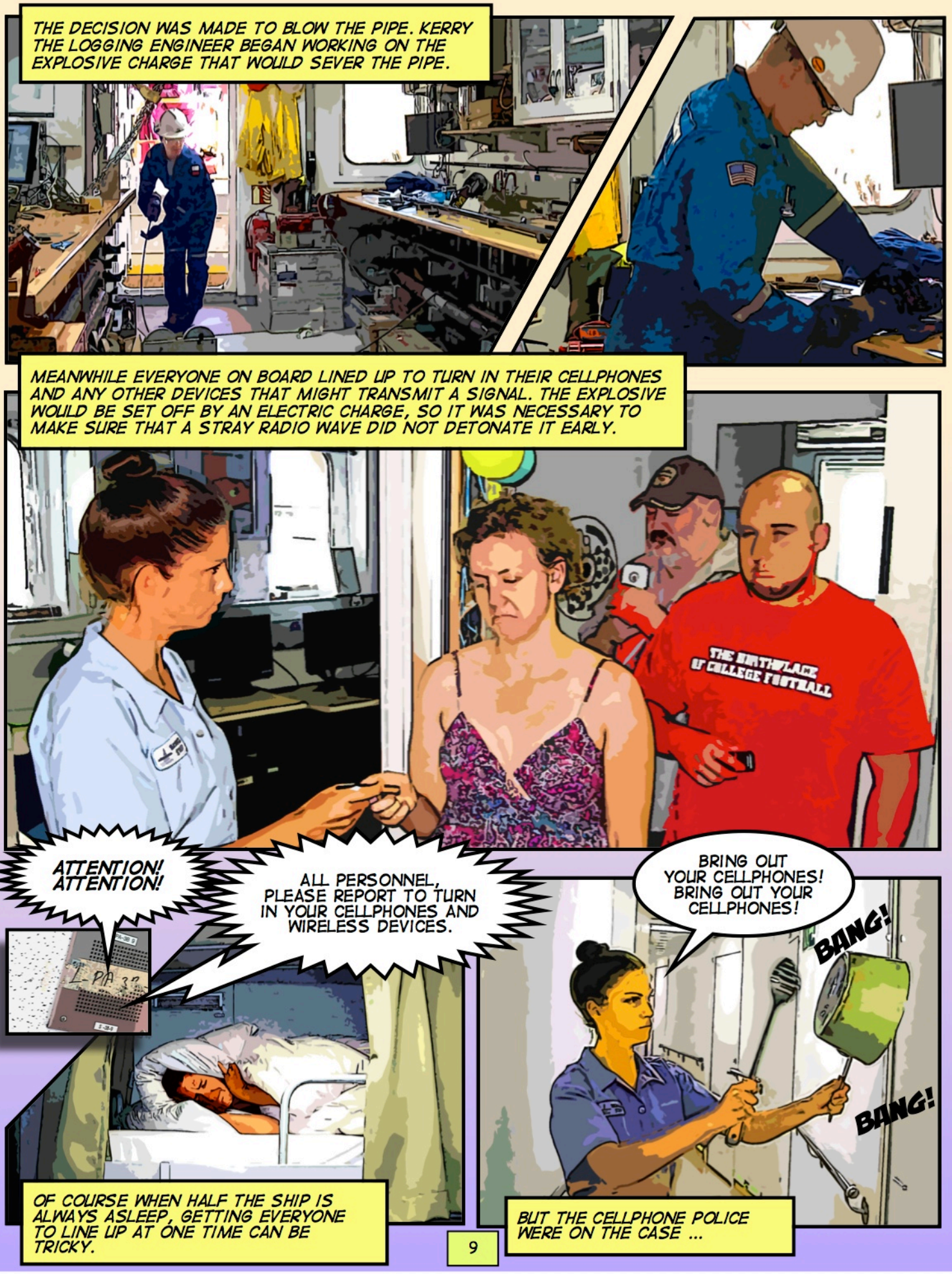



TOSHI! ANTHONY!
OPERATIONS SUPERINTENDANT RON GROUT
GUYS, WE HAVE A PROBLEM.
THE DRILL BIT IS STUCK. WE'RE GOING TO TRY A VARIETY OF THINGS TO RELEASE IT, BUT IT MAY TAKE HOURS.
CAN WE CONTINUE DRILLING ONCE WE PULL THE STUCK DRILL BIT OUT?
I DON'T THINK IT WOULD BE A GOOD IDEA. IN THE RUBBLE WE ARE DRILLING, THE NEXT DRILL BIT COULD ALSO EASILY GET STUCK.
JOERG GELDMACHER, EXPEDITION PROJECT MANAGER
THIS IS NOT THE WAY I PLANNED IT AT ALL ...


I GUESS THIS ALL STARTED WHEN I WAS STILL A GRADUATE STUDENT.
BACK IN THE NETHERLANDS, DEFENDING MY PH.D. WAS A FORMAL AFFAIR.
vrije Universiteit
AFTER MY DEFENSE I WAS ASKED THE QUESTION ...
IF MONEY WAS NO OBJECT FOR YOUR RESEARCH, WHERE WOULD YOU EXPLORE?
THE EMPEROR AND LOUISVILLE SEAMOUNT TRAILS.


IT TOOK ME YEARS OF PRELIMINARY RESEARCH AND PLANNING TO GET MY PROPOSAL FOR DRILLING ACCEPTED.
ALL OF THE PREPARATION WAS LIKE PUTTING TOGETHER A GIANT PUZZLE, BUT EVENTUALLY I WAS ABLE TO CONVINCE MY COLLEAGUES THAT THIS WAS A PROJECT WORTH PURSUING.


ONCE WE KNEW WE WOULD BE SAILING TO THE LOUISVILLE SEAMOUNT TRAIL ON THE JOIDES RESOLUTION, WE WENT TO WORK ASSEMBLING OUR WORLD-CLASS SCIENCE TEAM.
COLLEGE OF CHARLESTON
IT LOOKS LIKE WE MAY HAVE TO BLOW UP THE DRILL PIPE.
I SPOKE TO RON. THEY'RE TRYING ALL SORTS OF METHODS TO FREE THE DRILL BIT, BUT NOTHING HAS WORKED SO FAR.
NOW I'VE GOT 30 SCIENTISTS ON THIS EXPEDITION, AND WE'RE STUCK IN THE SEAMOUNT. GREAT.
OK, SO NOW WHAT?
??!!


THE DECISION WAS MADE TO BLOW THE PIPE. KERRY THE LOGGING ENGINEER BEGAN WORKING ON THE EXPLOSIVE CHARGE THAT WOULD SEVER THE PIPE.
MEANWHILE EVERYONE ON BOARD LINED UP TO TURN IN THEIR CELLPHONES AND ANY OTHER DEVICES THAT MIGHT TRANSMIT A SIGNAL. THE EXPLOSIVE WOULD BE SET OFF BY AN ELECTRIC CHARGE, SO IT WAS NECESSARY TO MAKE SURE THAT A STRAY RADIO WAVE DID NOT DETONATE IT EARLY.
THE BIRTHPLACE OF COLLEGE FOOTBALL
ATTENTION! ATTENTION!
ALL PERSONNEL, PLEASE REPORT TO TURN IN YOUR CELLPHONES AND WIRELESS DEVICES.
BRING OUT YOUR CELLPHONES! BRING OUT YOUR CELLPHONES!
BANG!
BANG!
OF COURSE WHEN HALF THE SHIP IS ALWAYS ASLEEP, GETTING EVERYONE TO LINE UP AT ONE TIME CAN BE TRICKY.
BUT THE CELLPHONE POLICE WERE ON THE CASE ...

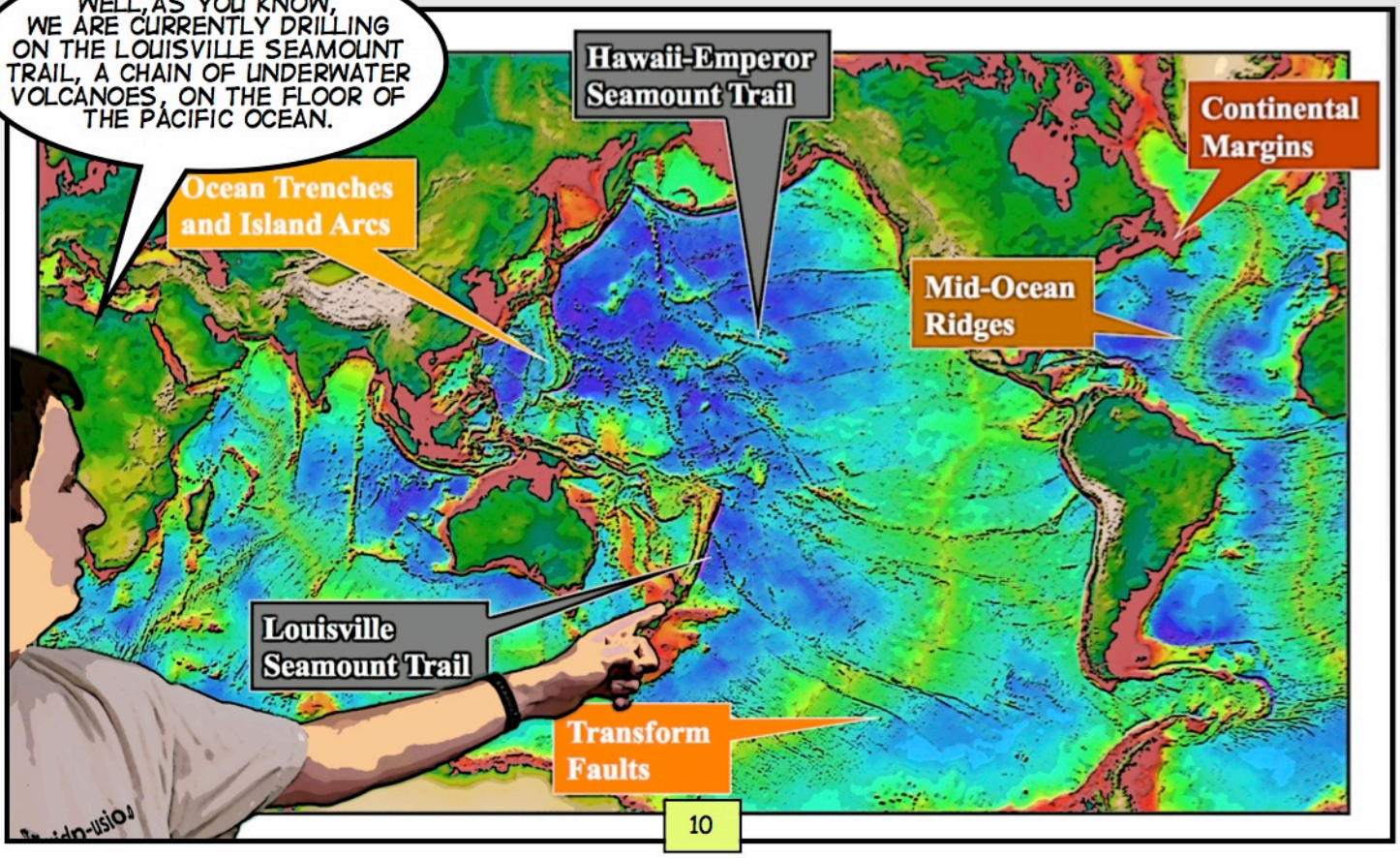
WHILE THE EXPLOSIVE WAS BEING LOWERED 2000 METERS DOWN THE DRILL PIPE, AN EMERGENCY SCIENCE MEETING WAS CALLED. IN ADDITION TO THE SCIENTIFIC STAFF, TWO VISITING EDUCATORS, LISA STRONG AND KEVIN KURTZ, WERE IN ATTENDANCE.

SINCE THE EXPLODED BITS OF THE DRILL PIPE WILL NOW BE BLOCKING THE HOLE, WE NEED TO ABANDON THIS HOLE AND CHOOSE A NEW SITE. THESE ARE THE OPTIONS.

OF COURSE, ONE OF THE THINGS WE HAVE TO CONSIDER IS THAT WE NEED PLENTY OF LAVA FLOWS ... YES, LISA?

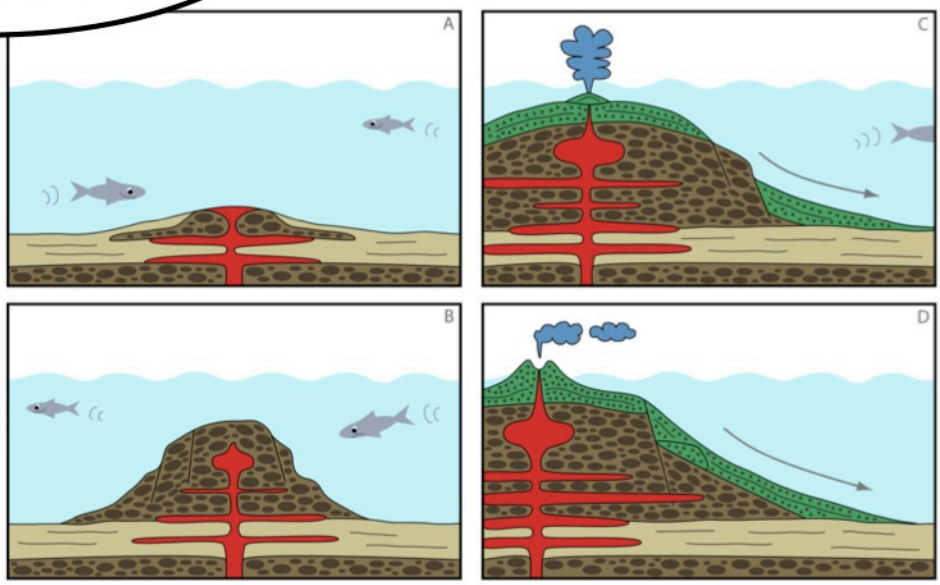
WHY ARE LAVA FLOWS SO IMPORTANT?

WELL, AS YOU KNOW, WE ARE CURRENTLY DRILLING ON THE LOUISVILLE SEAMOUNT TRAIL, A CHAIN OF UNDERWATER VOLCANOES, ON THE FLOOR OF THE PACIFIC OCEAN.

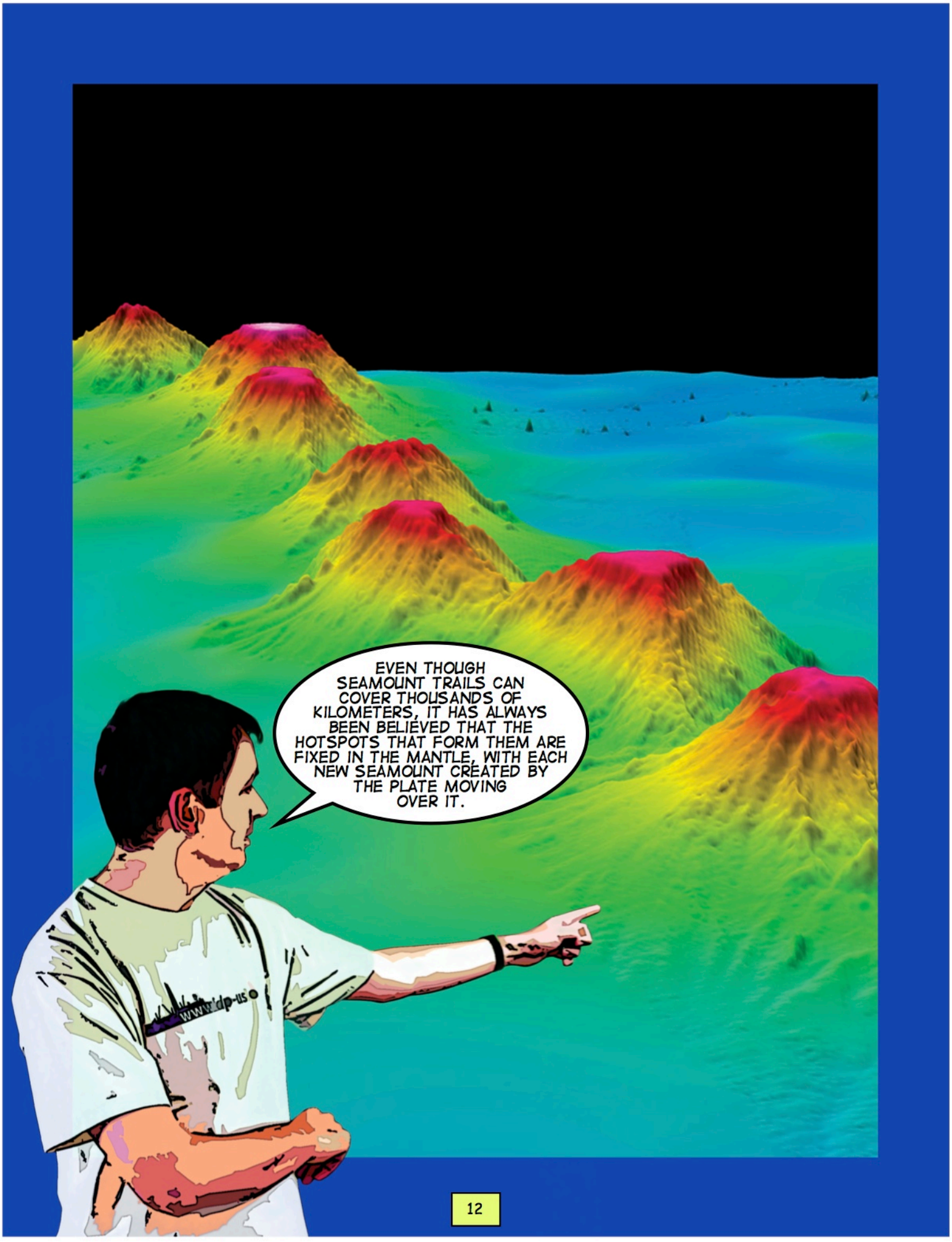


SEAMOUNTS ARE MOUNTAINS IN THE OCEAN, MOST OF WHICH FORMED AS VOLCANOES. ON SOME SEAMOUNTS, LIKE THE HAWAIIAN ISLANDS, LAVA FLOWS CONTINUE TO ACCUMULATE ON TOP OF EACH OTHER UNTIL THE SEAMOUNT BREAKS THROUGH THE SURFACE AND BECOMES AN ISLAND.

THIS ALSO HAPPENED WITH THE LOUISVILLE SEAMOUNTS MILLIONS OF YEARS AGO.



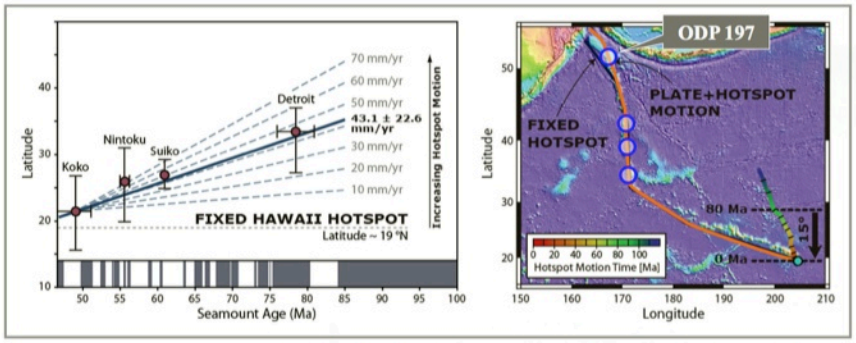
LAVA CONTAINS MAGNETIC PARTICLES THAT POINT TOWARD THE MAGNETIC POLE LIKE A COMPASS. WHEN THE LAVA COOLS INTO ROCK, THESE MAGNETIC PARTICLES STAY LOCKED IN, POINTING TOWARDS THE MAGNETIC POLE.


EVEN THOUGH SEAMOUNT TRAILS CAN COVER THOUSANDS OF KILOMETERS, IT HAS ALWAYS BEEN BELIEVED THAT THE HOTSPOTS THAT FORM THEM ARE FIXED IN THE MANTLE, WITH EACH NEW SEAMOUNT CREATED BY THE PLATE MOVING OVER IT.

BUT AN EARLIER EXPEDITION ON THE JOIDES RESOLUTION TO THE SEAMOUNTS OF THE HAWAII-EMPEROR CHAIN SHOWED THAT THE ANGLES OF THE MAGNETIC PARTICLES IN THOSE LAVA FLOWS HAD SYSTEMATICALLY CHANGED OVER TIME AND THE HOTSPOT HAD ACTUALLY MOVED.

IF THE HOTSPOT WAS FIXED, IT WOULD STAY AT THE SAME COORDINATES THROUGH EARTH'S HISTORY, AND THE MAGNETIC PARTICLES OF THE LAVA FLOWS IN ALL THE SEAMOUNTS WOULD BE POINTING AT THE SAME ANGLE TOWARDS THE MAGNETIC POLE.

ODP 197 Proves Moving Hotspots

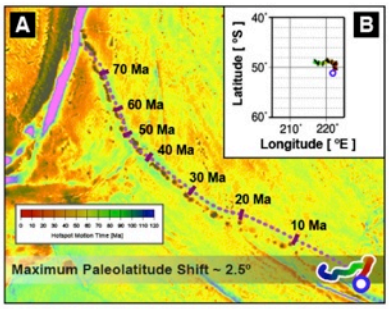


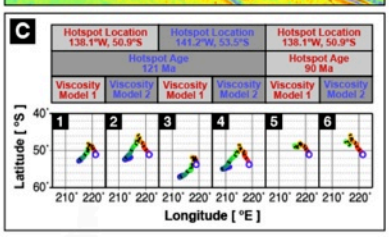
Tarduno et al. (2003) Koppers et al. (2004)

- **Paleomagnetic data collected during ODP Leg 197 shows a ~15º hotspot shift southward**
- **First ever data proofing the "mantle wind" concept**

SINCE THEN, SCIENTISTS HAVE PREDICTED THAT THE HOTSPOT THAT FORMED THE LOUISVILLE SEAMOUNT TRAIL HAS ALSO BEEN MOVING IN THE MANTLE, AND WE ARE HERE TO SEE IF THAT IS TRUE.

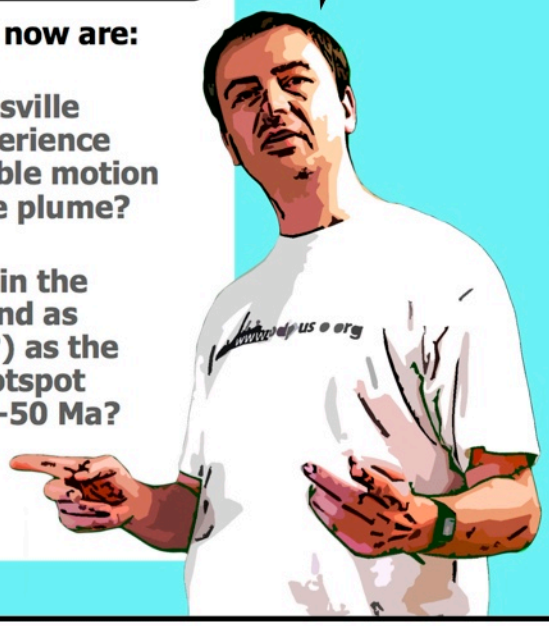
Predictions of Louisville Motion

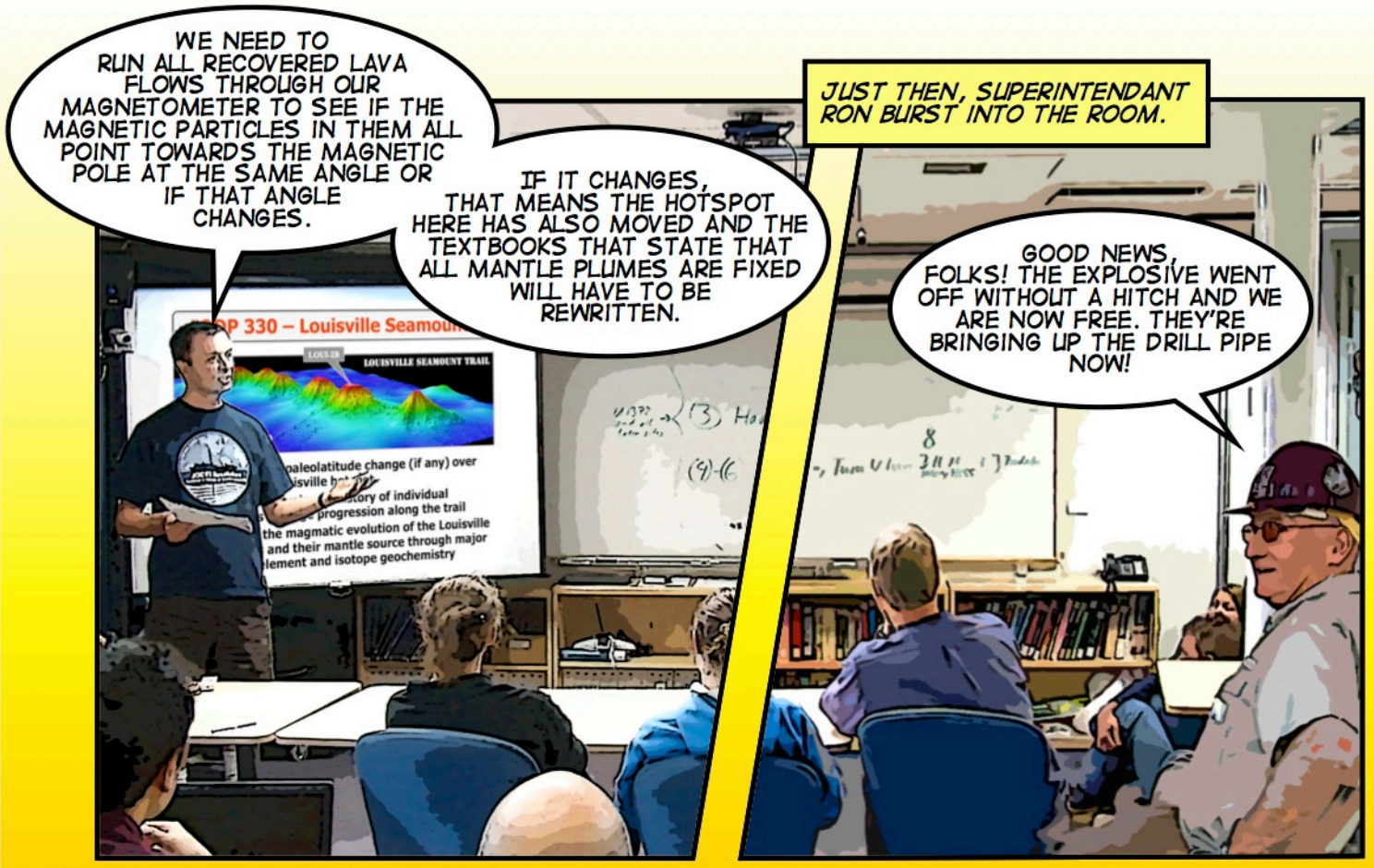




The questions now are:

- **Did the Louisville hotspot experience any detectable motion of its mantle plume?**
- **Did it move in the same way and as much (~15°) as the Hawaiian hotspot between 80-50 Ma?**




WE NEED TO RUN ALL RECOVERED LAVA FLOWS THROUGH OUR MAGNETOMETER TO SEE IF THE MAGNETIC PARTICLES IN THEM ALL POINT TOWARDS THE MAGNETIC POLE AT THE SAME ANGLE OR IF THAT ANGLE CHANGES.
IF IT CHANGES, THAT MEANS THE HOTSPOT HERE HAS ALSO MOVED AND THE TEXTBOOKS THAT STATE THAT ALL MANTLE PLUMES ARE FIXED WILL HAVE TO BE REWRITTEN.
LOUISVILLE SEAMOUNT TRAIL
JUST THEN, SUPERINTENDANT RON BURST INTO THE ROOM.
GOOD NEWS, FOLKS! THE EXPLOSIVE WENT OFF WITHOUT A HITCH AND WE ARE NOW FREE. THEY'RE BRINGING UP THE DRILL PIPE NOW!


ONCE THE PIPE WAS UP, THEY HAD TO CUT AWAY THE DAMAGED PART OF THE DRILL STRING.


LATER, BACK IN THE LAB, RON INSPECTED THE BLOWN PIPE ...
EXPLOSIONS RULE!

IT WAS DECIDED TO DRILL ON THE NEXT OLDEST SEAMOUNT AND SO THE JR SET SAIL.

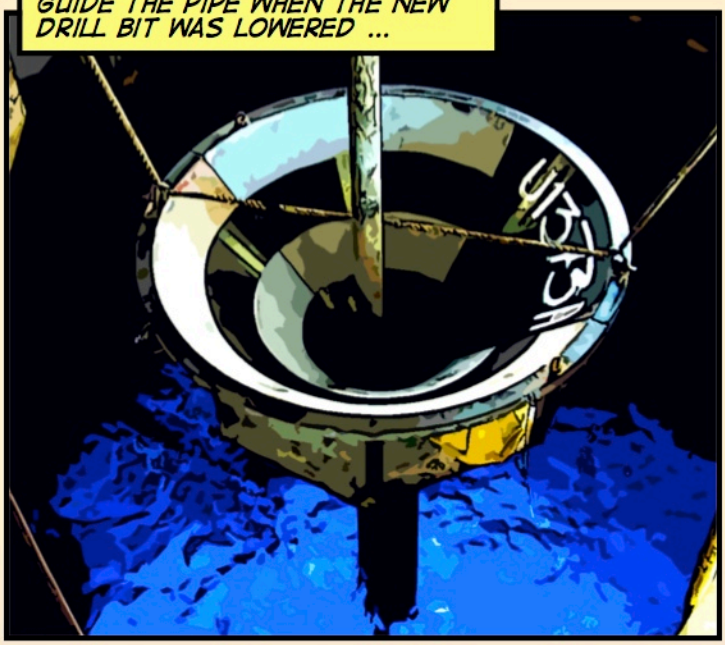
ONCE ON SITE, THE ROUGHNECKS WENT TO WORK LOWERING THE DRILL PIPE 1600 METERS DOWN IN THE OCEAN TO THE TOP OF THE SEAMOUNT.

SOON THE SCIENTISTS WERE DESCRIBING CORES AGAIN.

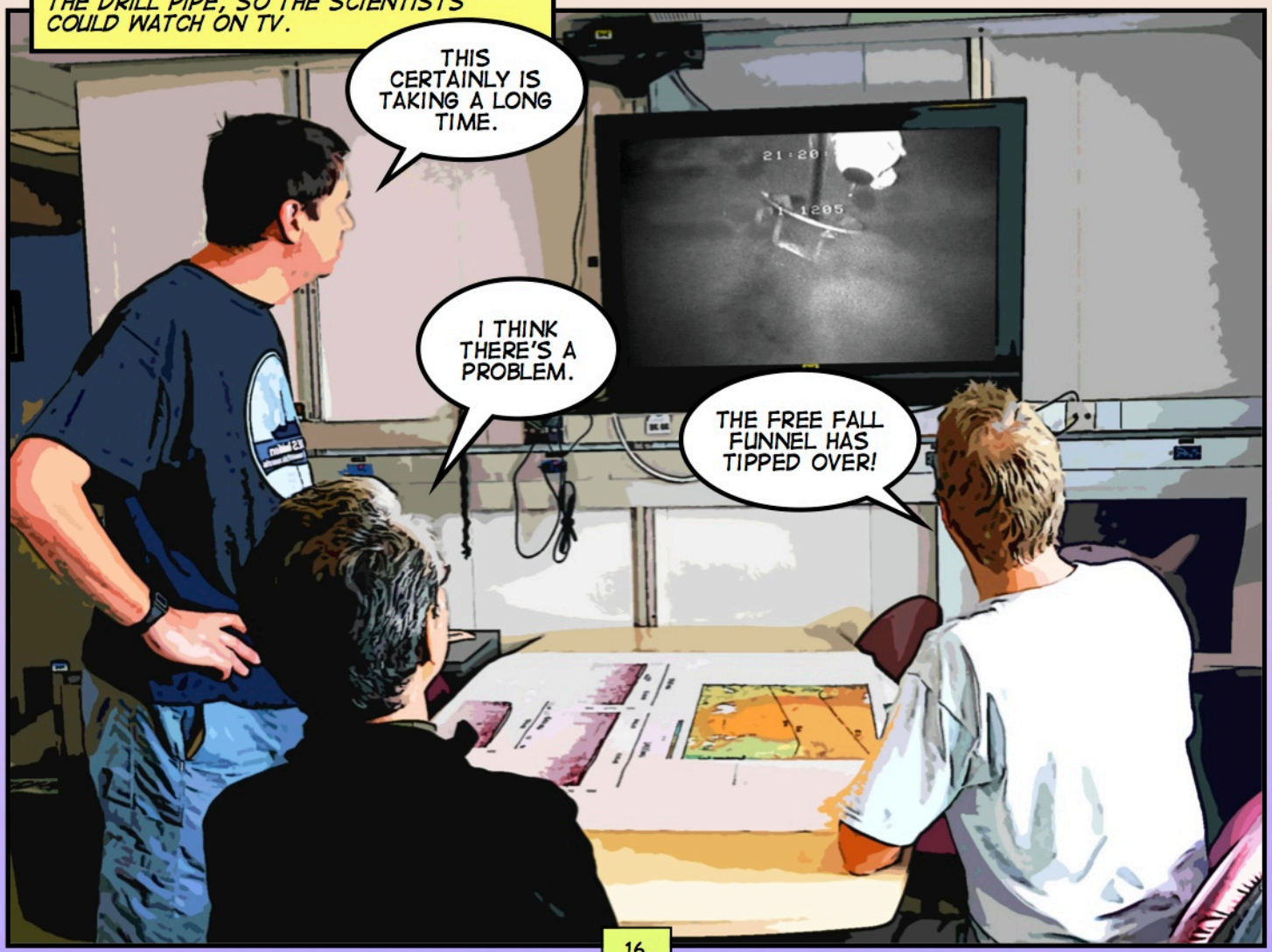
(WELL, AT LEAST MOST OF THEM WERE!)

ONCE THE FIRST DRILL BIT WORE OUT THE ROUGHNECKS BROUGHT IT UP AND BEGAN PUTTING TOGETHER A FREE FALL FUNNEL

THE FREE FALL FUNNEL WAS DROPPED DOWN THE DRILL PIPE TO MARK THE HOLE AND HELP GUIDE THE PIPE WHEN THE NEW DRILL BIT WAS LOWERED ...



A CAMERA WENT DOWN TO HELP GUIDE THE DRILL PIPE, SO THE SCIENTISTS COULD WATCH ON TV.



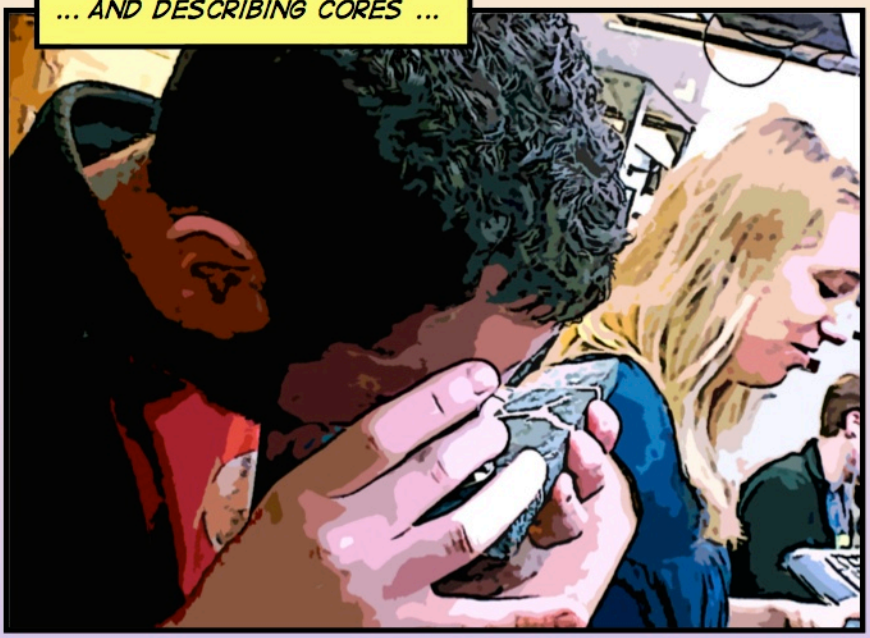
A DECISION HAD TO BE MADE!

WE DON'T HAVE ENOUGH LAVA FLOWS IN THE CORES YET, AND WE NEED THEM FROM AN OLDER SEAMOUNT LIKE THIS ONE.

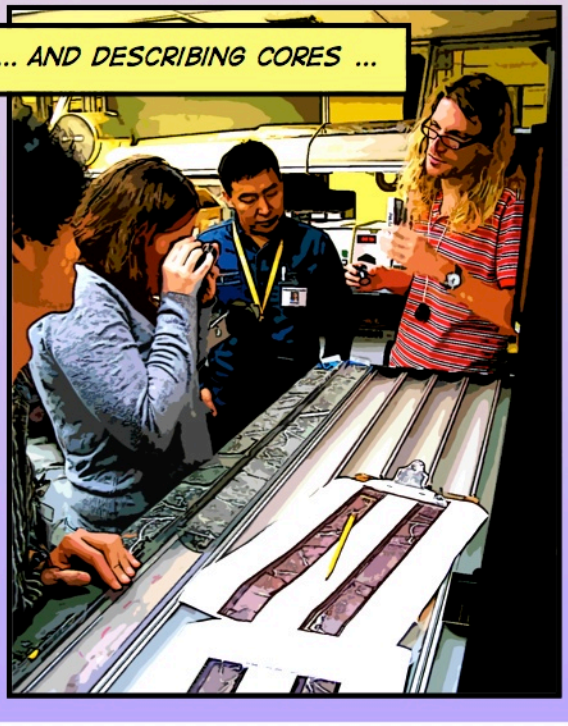
LET'S DRILL ANOTHER HOLE IN THIS ONE.

ANOTHER HOLE WAS DRILLED AND SOON ALL THE SCIENTISTS WERE DESCRIBING CORES ...

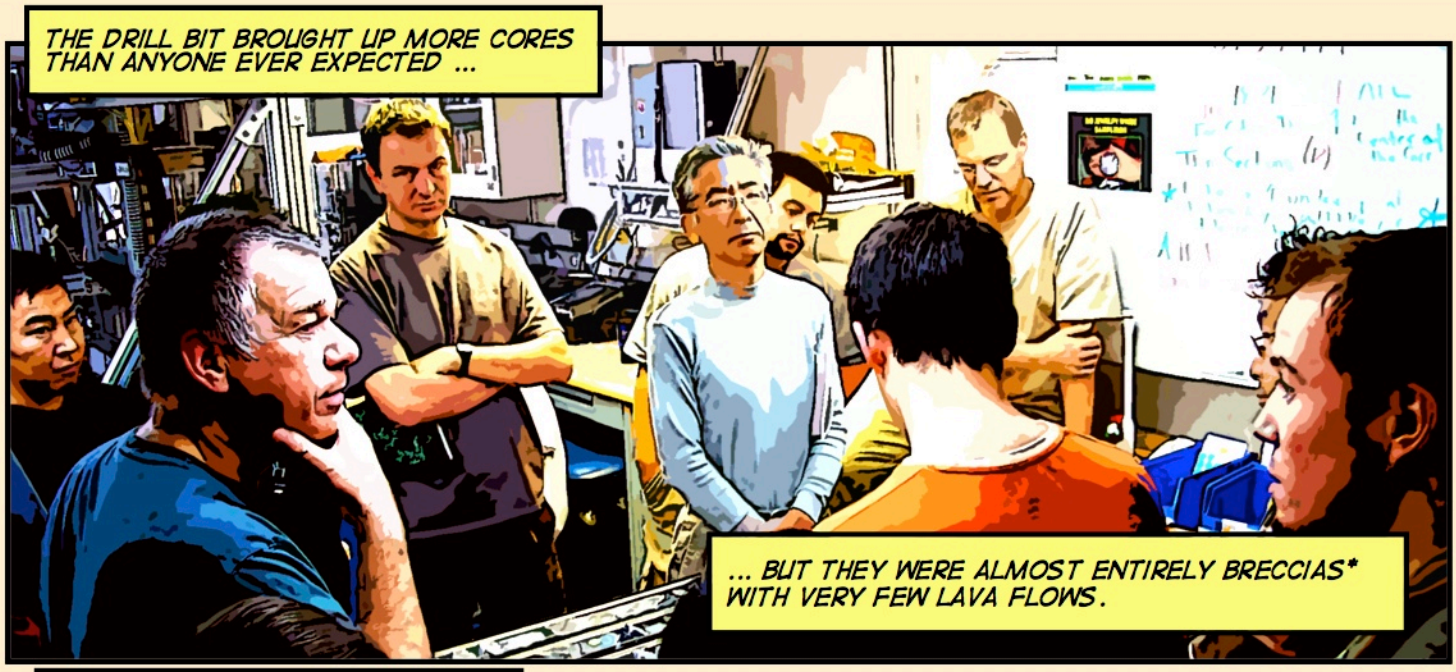
... AND DESCRIBING CORES ...

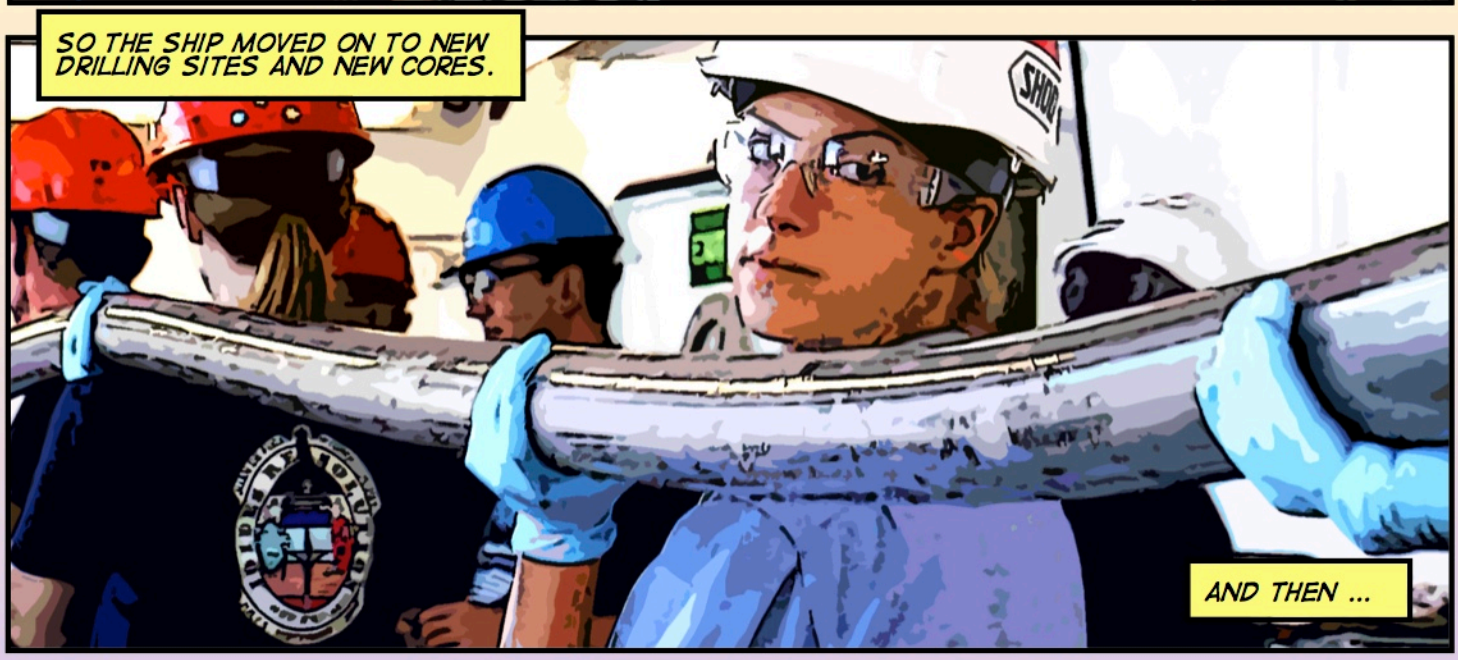


... AND DESCRIBING CORES ...



... AND DESCRIBING CORES! ...


THE DRILL BIT BROUGHT UP MORE CORES THAN ANYONE EVER EXPECTED ...
... BUT THEY WERE ALMOST ENTIRELY BRECCIAS* WITH VERY FEW LAVA FLOWS.


SO THE SHIP MOVED ON TO NEW DRILLING SITES AND NEW CORES.
AND THEN ...


EXIT
IT'S WHITE!!
* ROCKS COMPOSED OF BROKEN FRAGMENTS OF ROCKS OR MINERALS CEMENTED TOGETHER


AS THE DRILLING CONTINUED, IT WASN'T ONLY THE PALEONTOLOGISTS AND SEDIMENTOLOGISTS WHO WERE HAPPY.
IT'S LIMESTONE. THAT MEANS LOTS OF FOSSILS!
SEDIMENTOLOGISTS
FRESH GLASS!
AND I'VE GOT OLIVINE OVER HERE!
PETROLOGISTS
INTERESTING ALTERATION.
ALTERATION PETROLOGISTS
BUT NOT QUITE EVERYONE HAD FOUND WHAT THEY NEEDED, UNTIL ...
I'D GIVE ANYTHING FOR SOME LAVA FLOWS ...
ANTHONY, CHECK THIS OUT!!


WE'VE FOUND LAVA FLOWS.
IT WAS TRUE! THE PRECIOUS LAVA FLOWS HAD BEEN FOUND.
WHERE IS THE JR NOW?
DRILLING CONTINUED FOR TWO MORE WEEKS AS THE SCIENTISTS CONTINUED OBTAINING SAMPLES FOR THEIR SHORE-BASED RESEARCH.
FINALLY THEY RETURNED TO AUCKLAND. THE SAMPLING ADVENTURE WAS OVER BUT THE RESEARCH ADVENTURE CONTINUES!