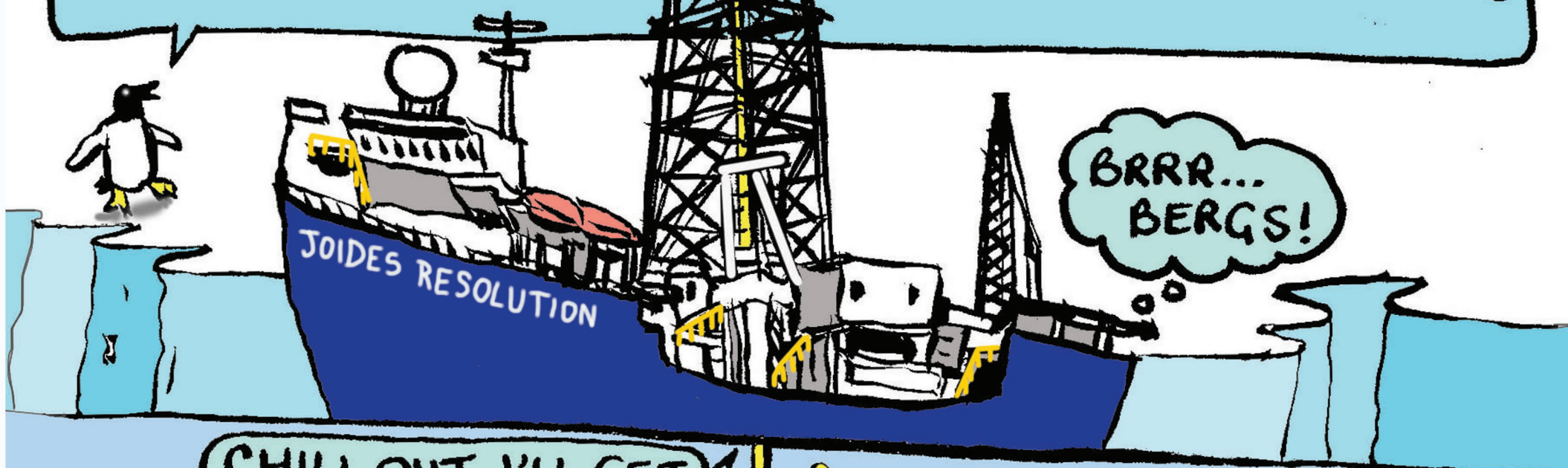


Q. WHAT'S A DEEP-SEA DRILL SHIP DOING IN AN ICE CONTINENT LIKE THIS?



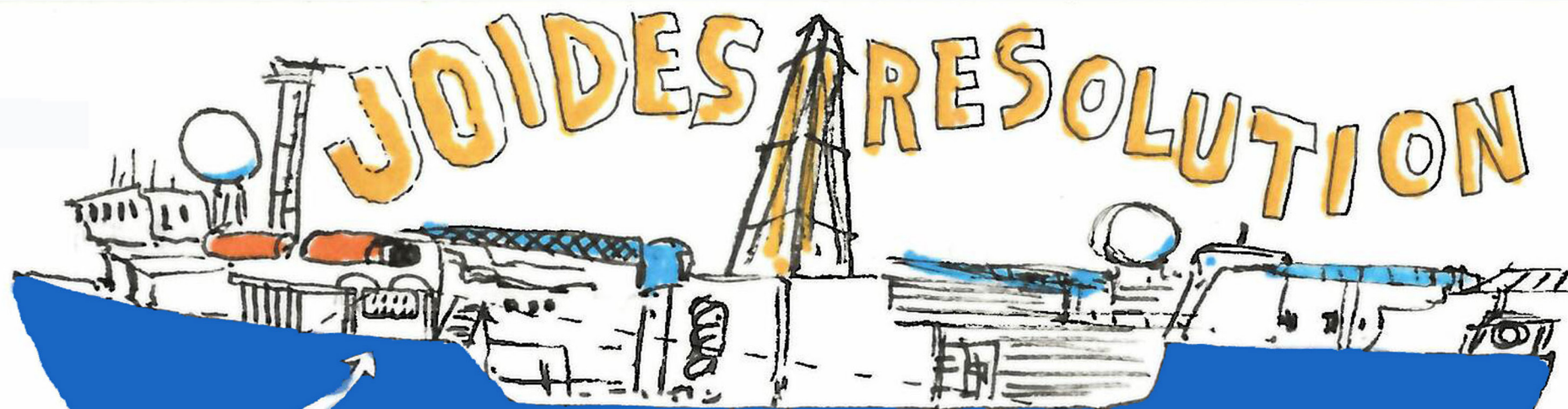
CHILL OUT. I'LL GET MY DRILL OUT...

A. DIGGING UP THE DIRT ON (AND UNDER) ANTARCTICA!

#ANTARCTIC
LOG

JOINS the
JOIDES Resolution
to the Amundsen Sea
for EXPEDITION #379.

◦ KAREN ROMANO YOUNG ◦



My studio for the next two months: Wow.

This is me.
I'm on a boat.

↙
I'm here to tell you about it. (That's my actual job!)

My job is to be outreach officer for #Exp379

It's an expedition to get samples from the seafloor,

in the Amundsen Sea in western Antarctica.

We'll drill to get "cores" - the samples.

It's an International Ocean Discovery Program mission.

I'm here to write and draw and tweet

Yay!



and Instagram and Facebook about it

and yes, to do my Antarctic-Log comics.

There's a book coming too from me.

I'm breathing sea air and dreaming of ice.



And learning. So much to learn.

Science is everything!

Just a dot away from the JR's expedition to the Amundsen Sea is the expedition of Norwegian explorer Roald Amundsen, who led the first men — and dogs — to the South Pole.



West
Antarctic
Ice
Sheet

WAIS of TIME

The WAIS is Earth's most vulnerable major ice sheet. Its collapse could raise world sea levels ELEVEN FEET.

JR scientists will use cores drilled under the Amundsen Sea to "reconstruct" the timeline in this rapidly-changing place.

MAKING HISTORY IN THE AMUNDSEN SEA, ANTARCTIC

48 **scientists** on 2 ships are scooping up brand-new data-ingredients that add up to slices of past **LIFE** that explain **HOW** Antarctica got this way, **HOW** it works now, and **HOW** it will respond to future change. **Manmade** change?

ANY CHANGE.

Julia Wellner, a principal investigator on both missions, is a sedimentologist at the University of Houston. She studies the mud, muck, and rocks that fall to the seabed year after year, sealing in clues to the conditions in their times.

NO ONE HAS EVER GATHERED DRILLING DATA HERE; ALL WE HAVE COMES FROM SATELLITES. NOW IT'S BOOTS ON THE GROUND. IT'S THE **FRONTIER**.

Elephant seals wearing satellite transmitters bring data from the seafloor each time they return from a deep dive.

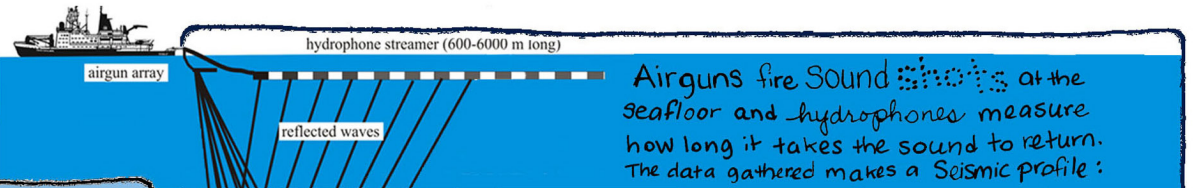
The **JOIDES** Resolution, 100 miles from land on the continental shelf, drills up **CORES** of these sediment layers in open seas once covered by glacier. The cores tell chronological stories going back beyond 35 million years, when the shifting tectonic plates opened the fierce, frigid **Drake Passage** around the newly-formed **Antarctic** continent — and cut it off from the warmer north. As the sea ice nears its annual minimum over the next few weeks, the **JR** will venture nearer shore and today's **West Antarctic Ice Sheet** — the world's fastest-changing.

Meanwhile, the JR keeps a close watch on icebergs that look like the Kraken.

The **Nathaniel B. Palmer**, an icebreaker working inshore, is focused on the ice shelf, the **Oversea** lip of the **West Antarctic Ice Sheet** (which, if it collapsed, could raise global sea levels 14 feet). Its researchers will interpret under-ice sediments and piece together the story told by the **Shape** of the seafloor — whose troughs and ridges may impact warm water currents below the **ice** and affect the **flow** of glaciers such as the **Pine Island** and **Thwaites** Glaciers. (The Thwaites, Florida-sized, was recently found to have an internal cavity the size of Manhattan.)

"Ran," a robot submarine run by scientist **Anna Wahlin**, will inspect the point where the glacier "grounds" on the seafloor.

Karsten Gohl and the Case of the Missing Paleorecords



The JR's drill whirls and grinds its way deeper into hole U1532, our site (★) off the continental shelf, in an iceberg-strewn Amundsen Sea.

The Quest: To understand how the WEST ANTARCTIC ICE SHEET responds to natural climate change - ADVANCING and RETREATING - so we can anticipate what it will do next.

On the Case: Expedition 379 co-chief scientist **Karsten Gohl** of the Alfred Wegener Institute

The Clues: CORES of sediment whose layers represent millions of years, back to the time before Antarctica froze - before glaciers.

Amundsen Sea
Amundsen Sea Embayment
Thwaites Glacier
Pine Island Glacier

But how do we know where to drill - and how deep to go - in search of clues from long ago - the paleorecords?

U1532

392 m

A seismic profile shows a drift of sediment layers in colored lines called horizons. They're time horizons showing where each layer fell, across the line the ship drew.

Why? Sediments of different materials reflect sound at different strengths.

You can follow the horizons all along the seismic line.

But what is the material that makes the horizons different?

THAT'S WHY WE DRILL.

Karsten and his colleagues collected these seismic lines through the Amundsen in 2006 & 2010.

He hoped he would get the chance to drill along these drifts to see **WHAT** made them, **WHEN**, and **HOW**.

Marie Byrd Land
Marie Byrd Seamounts
Wrigley Gulf
Getz Ice Shelf
HOBBS COAST
WALGREEN COAST
Pine Island Glacier

IODP Proposal 839
● primary sites
● alternate sites
— seismic lines

● KAREN ROMANO YOUNG ● THE JR ● 2019 ●

Up on the bridge at 2 am: the JR picks up the lights of the Russian research ship Akademik Karpinsky. Aboard is Karsten's colleague, Rachel Lamb - off to run seismic lines in another unexplored part of Antarctica.

HI, KARSTEN!
NICE TO SEE YOU AND THE JR!

HELLO, RACHEL!
I CAN SEE YOU ON THE HORIZON.

JR scientists will analyze every grain of sediment the drill brings up. **Chemistry!** **Fossils!** **Minerals!** **Density!** **Magnetism!** And more...

All these clues let them match the horizons in the seismic profile with specific times in Earth's climate history - and build a story of the **forces** that shaped this environment. The seismic horizons represent big change. The Missing Paleorecords will show what happened.

#ANTARCTIC

CORE SCIENCE

Scientists with diverse specialties come together to observe what they see in the core. Interpretations—the cores' story—come after data is gathered.

Steel-toed boots, hard hat, eye and ear protection, and gloves to keep the core clean. After 30 years and 20 expeditions, I feel so privileged to be among the first to see sediment core and add it to what we know about Antarctica.

ADAM KLAUS
Expedition Leader
Texas A+M University



We're asking the question of layers in the core, what they mean, and where they came from. Are the changes in input from the channel through the Amundsen Sea Embayment or from further away, or were they carried here by the bottom currents?

SANDRA PASSCHIER, sedimentologist
Montclair State University

I'm a bit concerned because the big stones in this core are a disadvantage. That's because our magnetic particles occur in fine grains as they drift to the sea floor. Coarse grains carry a magnetic signal acquired before they fell, so they can throw off our dating!

THOMAS FREDERICH, paleomagnetist
University of Bremen

How does what we see in the core relate to what the West Antarctic Ice Shelf was doing at the time this sediment formed on the sea floor. It's as if I'm looking at Antarctica through binoculars. Usually when we're around the table like this, we do talk about preliminary interpretation—are we all seeing the same thing?

CLAUS-DIETER HILLENBRAND,
Sedimentologist
British Antarctic Survey



How did THIS get here? What deposited it?
How can I read this core like a book?
I'm a newbie. Knowing what everything
means helps you know what to observe;
What you observe is what you think is
important. No interpretations! Just see.

RUTHIE HALBERSTADT
glaciologist | modeler | geologist
University of Massachusetts, Amherst

We need consistency among the
core description group to describe
sediment in the same terms. We talk
among ourselves, deciding, say, what to
call the color. For myself, I'm taking
what I see on the table down to the
microscopic scale, deciding what part I
want to look at in "thin sections,"
where there could be hidden information.

BENEDICT REINARDY, glacial geologist
Stockholm University

We're debating "facies"—
core characteristics such
as colors, structures, types
of grains—and then we
can build "motifs," patterns
that show how bits of core
work together.

JULIA WELLNER
Sedimentologist
University of Houston

I generally sample from the
green part. In my work I'm
trying to find diatoms from
3.2 to 5.2 million years ago.
I carefully choose a key "horizon"
where they were deposited in
the past: Fine grains, light or
olive green, or bluish-greenish.

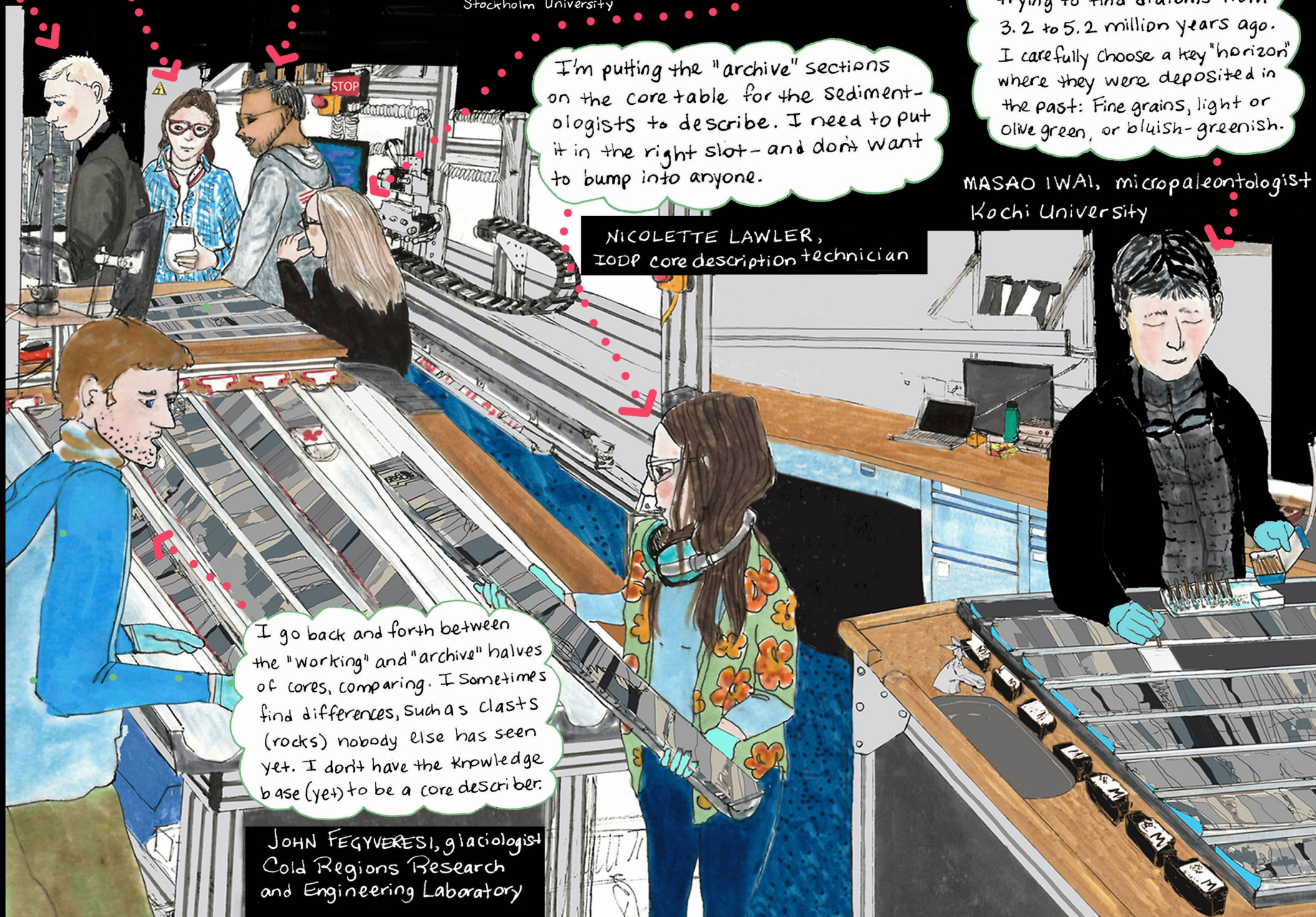
MASAO IWA1, micropaleontologist
Kochi University

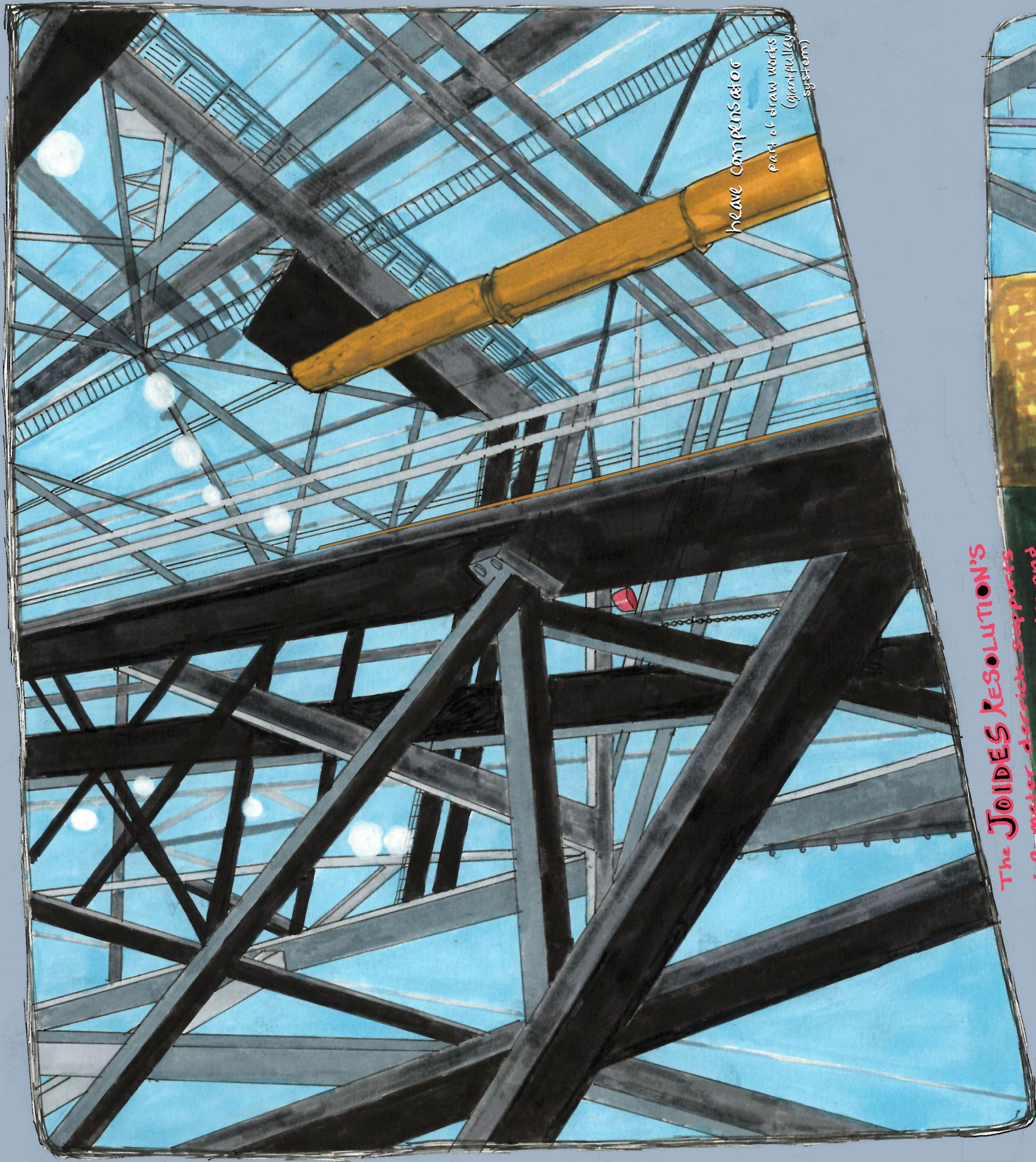
I'm putting the "archive" sections
on the core table for the sediment-
ologists to describe. I need to put
it in the right slot—and don't want
to bump into anyone.

NICOLETTE LAWLER,
IODP core description technician

I go back and forth between
the "working" and "archive" halves
of cores, comparing. I sometimes
find differences, such as clasts
(rocks) nobody else has seen
yet. I don't have the knowledge
base (yet) to be a core describer.

JOHN FEGYVERESI, glaciologist
Cold Regions Research
and Engineering Laboratory



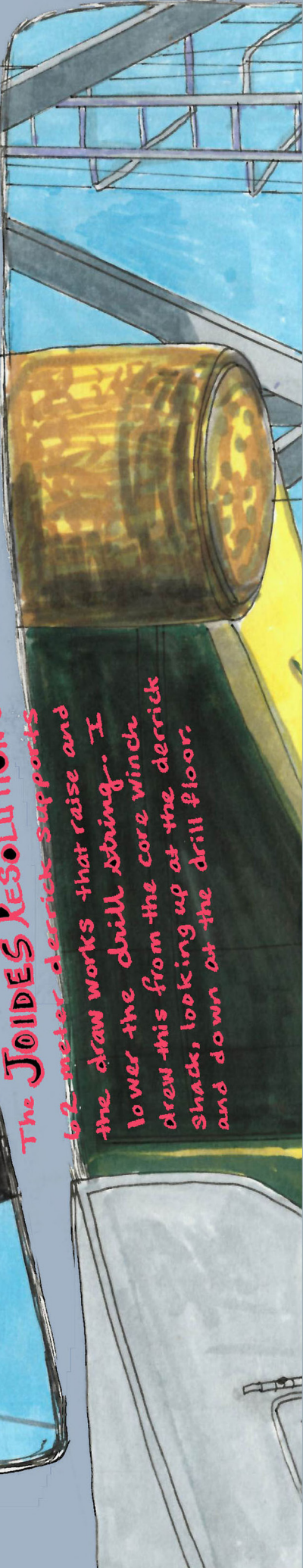


heave compensator

part of draw works
(giant pulley system)

The JOIDES RESOLUTION'S

62-meter derrick supports the draw works that raise and lower the drill string. I drew this from the core winch shack, looking up at the derrick and down at the drill floor.



CORE WINCH
CALIBRATION
1 AFT: 2692
2 FWD: -----

blocks hoist the
drill pipe

winch operator's shack

Schlumberger

logging winch

umbilical
for iron roughneck

bales

connect bales to elevators

tugger
(winch)

iron roughneck
handles pipe

drill pipe

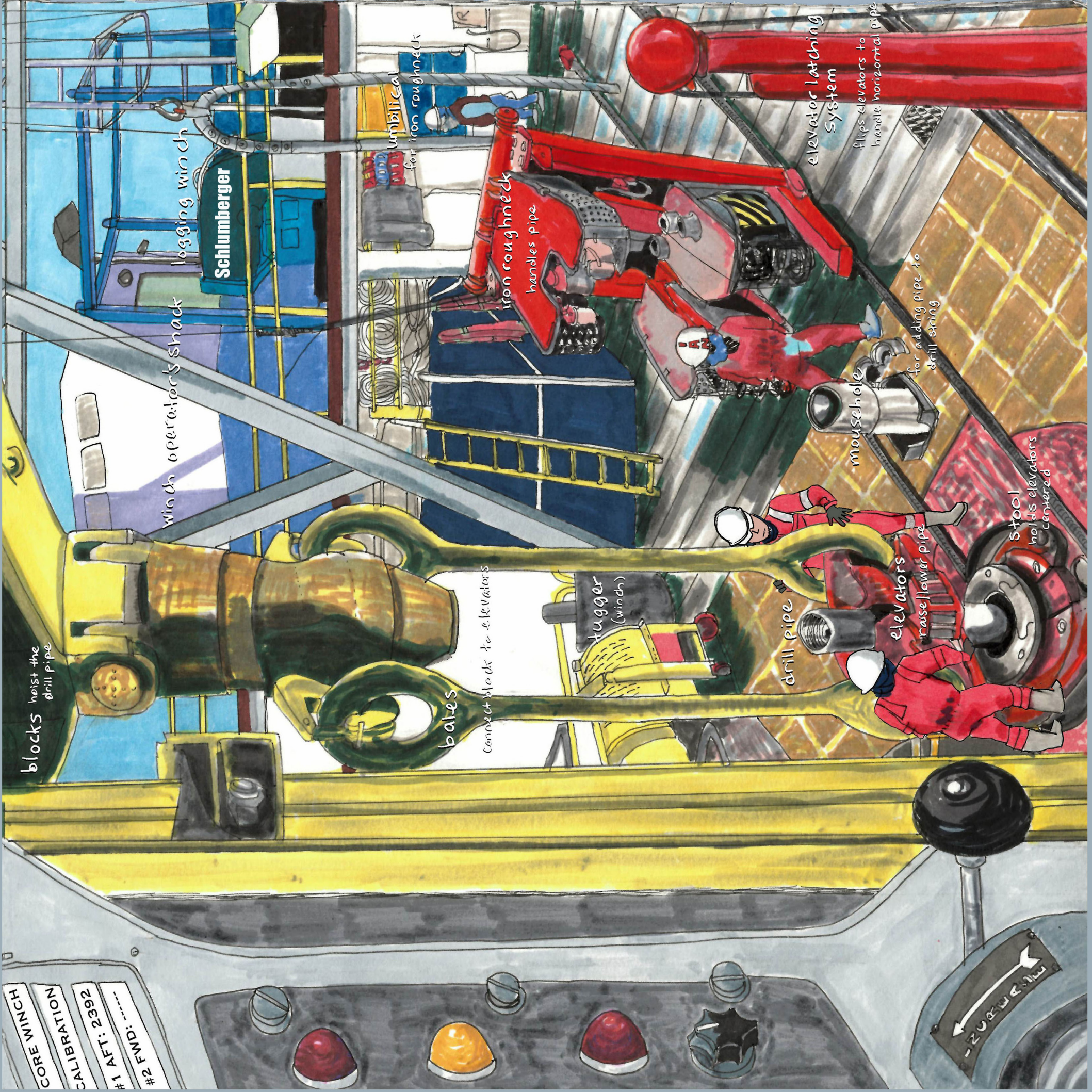
elevators
raise/lower pipe

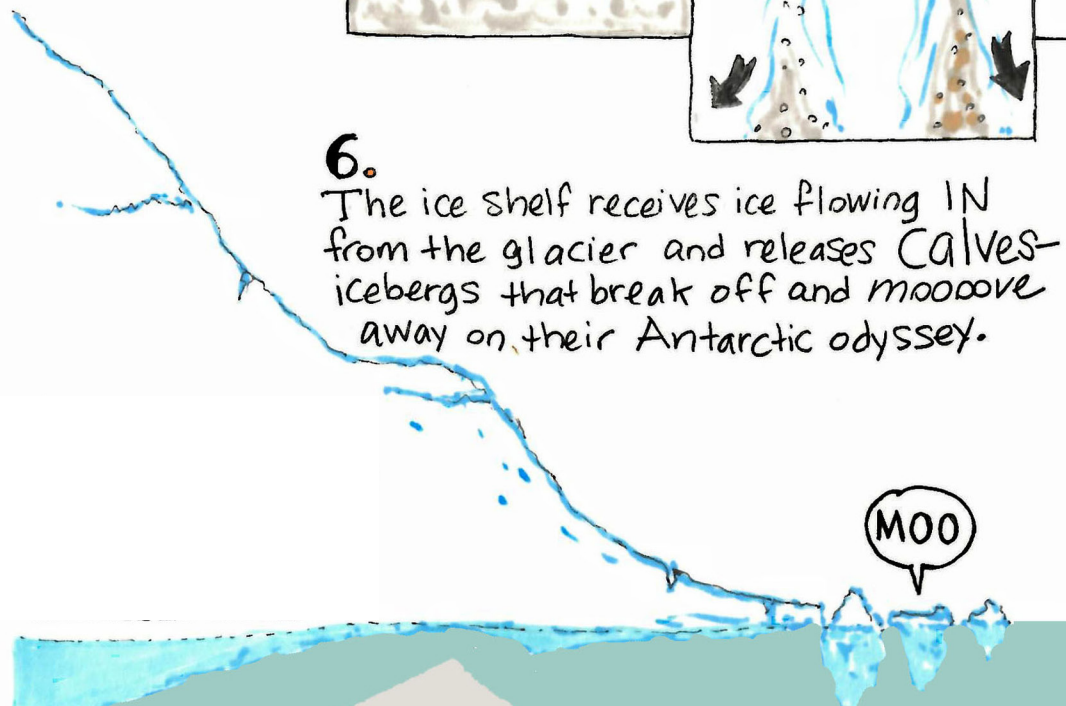
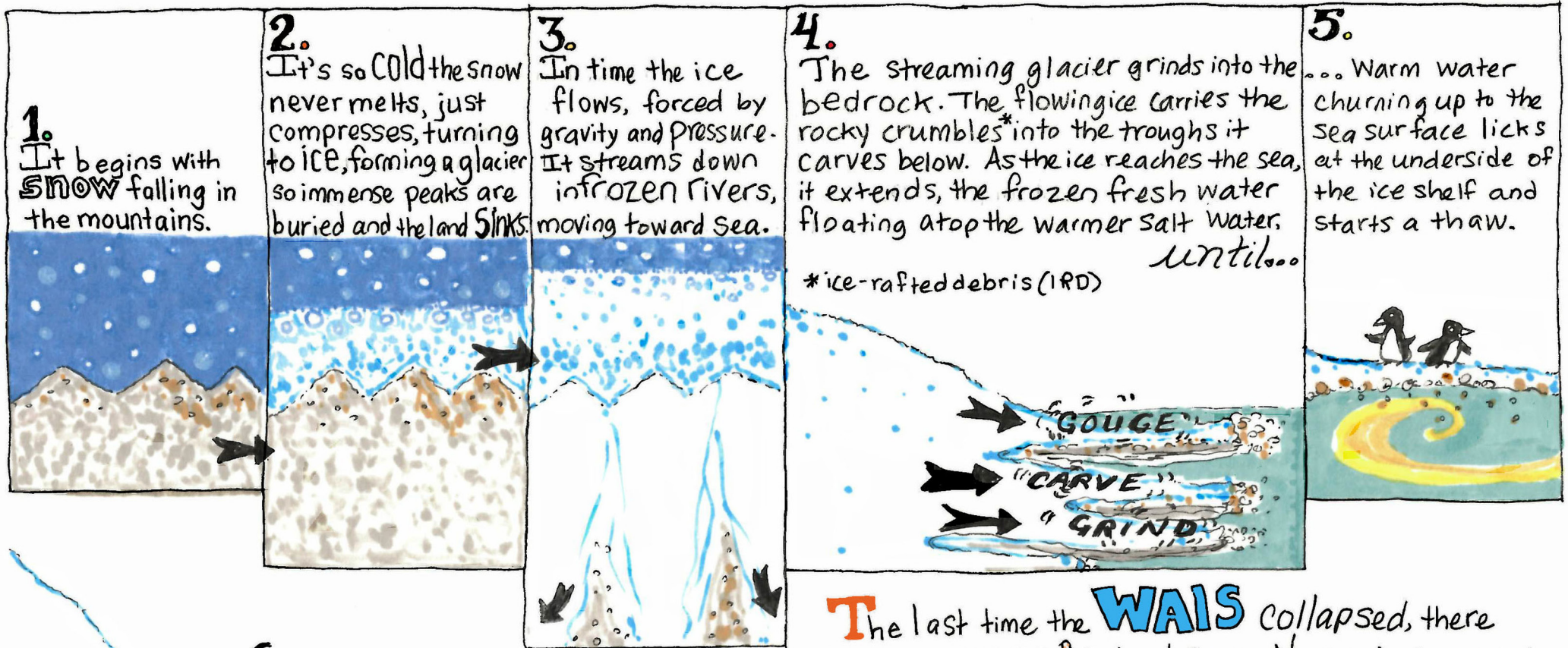
mousehole
for adding pipe to
drill string

elevator latching
System

flips elevators to
handle horizontal pipe

stool
holds elevators
centered





6. The ice shelf receives ice flowing IN from the glacier and releases CALVES-icebergs that break off and mooove away on their Antarctic odyssey.

1. It begins with SNOW falling in the mountains.

2. It's so COLD the snow never melts, just compresses, turning to ICE, forming a glacier so immense peaks are buried and the land SINKS.

3. In time the ice flows, forced by gravity and pressure. It streams down in frozen rivers, moving toward sea.

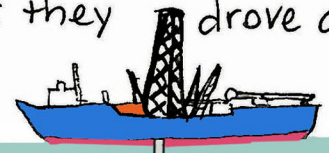
4. The streaming glacier grinds into the bedrock. The flowing ice carries the rocky crumbles* into the troughs it carves below. As the ice reaches the sea, it extends, the frozen fresh water floating atop the warmer salt water. *until...*

*ice-rafted debris (IRD)

5. Warm water churning up to the sea surface licks at the underside of the ice shelf and starts a thaw.

The last time the **WAIS** collapsed, there were no people to observe. Now we're in a new **warming** trend. Because of human activity, glaciers are retreating at an accelerated pace.

Enter the **JOIDES RESOLUTION**, into the space between the glaciers and bergs, to drill down into the hard evidence left by the glaciers as they drove debris seaward.



Lowlying areas of West Antarctica sit below sea level. That's what makes the West Antarctic Ice Sheet the least stable of the big three - with the East Antarctic Ice Sheet and the Greenland Ice Sheet.

Limestone caves and midcontinent fossils are evidence that global sea level was once higher. We assume the **WAIS's** glaciers collapsed in the past and disintegrated. But **When? How? Why?**

Expedition #379 scientists examining **cores** found evidence that the ice sheet retreated further inland than today, and that more ice was lost.

THE AMOUNT OF ICE-RAFTED DEBRIS IN SOME OF THE PERIODS OF TIME REPRESENTED IN OUR 750 METERS OF CORE SHOWS THE CONSEQUENCE OF WARMING AND **GLACIER** RETREAT. IT'S A **BIG** CONCERN ABOUT THE POTENTIALLY **HUGE** IMPACT FOR LOTS OF REGIONS ON THE PLANET IN THE EVENT OF A **COLLAPSE**.



Johann Klages, sedimentologist

#ANTARCTIC

LOG

my JR sketchbook



THE TRAVEL IS A BENEFIT! MY T-SHIRT INCLUDES WHALES, ICEBERGS, AND SNOWFLAKES. IT WAS MY FIRST TIME TO SEE ALL OF THESE THINGS.

WE DO LOTS OF TRAINING - CPR, SWIMMING, SAFETY AT SEA. I'D LIKE TO DO THE HELICOPTER TRAINING. IF I FEEL INSPIRED I WORK ON ART (I WON THE T-SHIRT DESIGN CONTEST FOR EXP 379.)

Leslie Olac is a shipboard steward responsible for doing laundry, keeping the cabins tidy, and assisting in the galley. In two years she has seen Guam, New Zealand, Hong Kong, Australia, and now Antarctica.

Where's Home?

Dumaguete City, Negros Oriental, Philippines

BASICALLY THE ROUGHNECK'S JOB IS TO RUN THE IRON ROUGHNECK AND MOVE THE BALES FROM ONE ELEVATOR TO THE OTHER. THIS WAY THEY ASSEMBLE THE DRILL PIPE AND LAY OUT THE CORE BARRELS FOR SCIENTISTS.



Ian Cortez is a floorman or "roughneck" aboard the **JOIDES RESOLUTION**, following in the footsteps of his father, a derrickman who worked here for 33 years. He says the JR crew is like family to him.

Where's Home?

Luzon Pampanga, Philippines

FOR ME, WORKING HERE IN ANTARCTICA IS REALLY DIFFERENT BECAUSE OF THE TEMPERATURE, THAT'S THE FIRST THING. BUT EVERYTHING YOU SEE IN ANTARCTICA IS **priceless**: THE DIFFERENT KINDS OF ICEBERGS, THE WHALES, THE SUNSETS. (IF YOU SEE THE SUN, IT'S PRICELESS!)

I FELL IN LOVE WITH THE JR'S WORK! WE'RE DISCOVERING THE WORLD. WE'RE REACHING AN AREA THAT NOBODY ELSE HAS MANAGED TO REACH, AND COULD HELP SCIENTISTS MAKE A HUGE ADVANCE IN THE WORLD ONE DAY.



Chang Liu is a chemical technician who manages the JR's chem lab. He has a Ph.D. in marine geology; his dissertation topic was deep-sea drilling. He came aboard first as a student, and now works here.

Where's Home?

Hohhot, Inner Mongolia, China / College Station, Texas

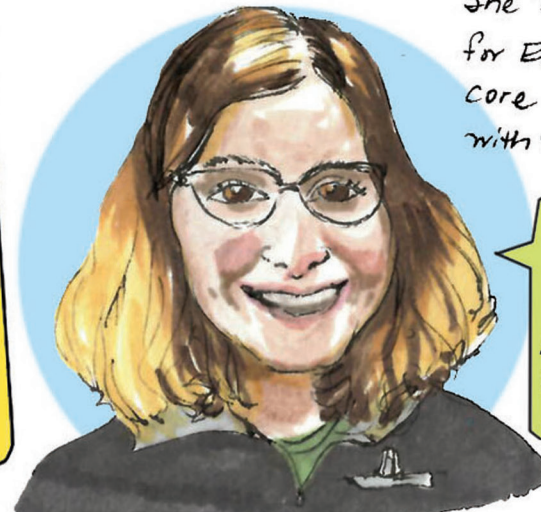
YOU HAVE TO TALK TO EACH SCIENTIST AND FIND OUT WHAT DATA HE WANTS, WHAT HIS BACKGROUND IS, WHAT HE'S TRYING TO PURSUE, THEN HELP HIM ACHIEVE IT.

WHEN I WAS IN HIGH SCHOOL I SAW A VIDEO FROM THE BRITISH ANTARCTIC SURVEY. SOMEONE WAS TALKING ABOUT GLACIERS AND GLACIOLOGY AND I WENT, WOW, I WANT TO DO THAT.

Where's Home?

Hoylake, Wirral, UK / Tromsø, Norway

Mariana Esteves has a Ph.D. in marine geology. She's a researcher at the Arctic University of Norway. She worked as a core describer for Expedition 379, and wants to core the Arctic's Barents Sea with the West Antarctic Ice Sheet.



IN HIGH SCHOOL I SAW A BRITISH ANTARCTIC SURVEY VIDEO: I REALIZED I COULD MAKE A CAREER STUDYING ICE SHEETS AND GLACIERS OF THE PAST - FASCINATING!

Karen Romano Young

is an award-winning children's author and illustrator, deep-sea diver, and polar explorer, an outreach and education specialist for ocean science.

antarcticlog.com wrenyoung@gmail.com  @doodlebugkry  @antarcticlog



EXPEDITION #379 ABOARD THE JOIDES RESOLUTION:
A team of 116 ship crew, scientists, technicians, and communicators took to the Amundsen Sea, Antarctica's fastest-warming sea. Over the course of their two-month mission, they drilled two sites beneath the seabed to bring home sediment samples that are millions of years old, in order to recreate the history of the West Antarctic Ice Sheet (WAIS).

joidesresolution.org

