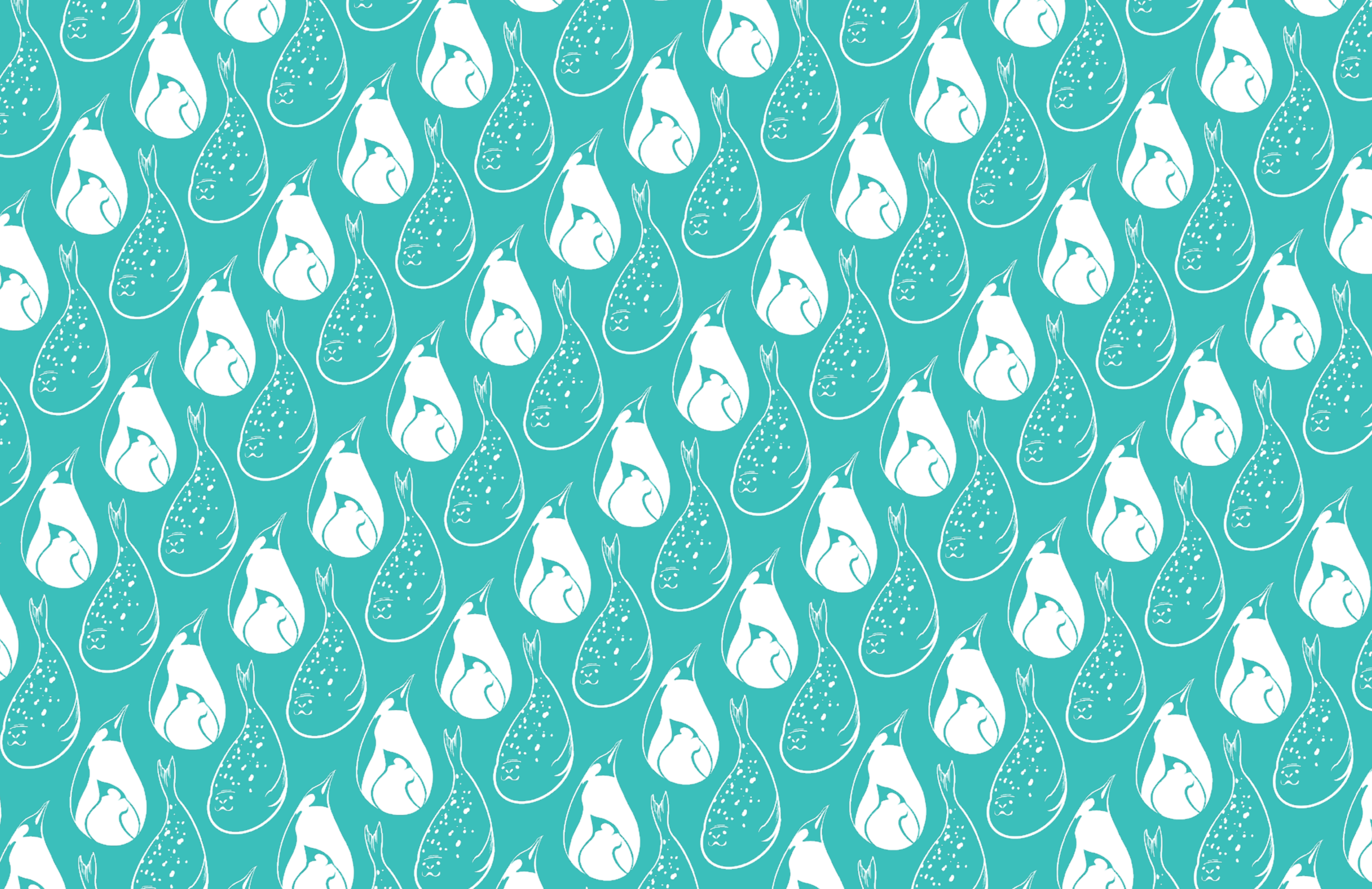

ANTARCTICA
THE MELTING CONTINENT
By Karen Romano Young
Illustrated by
Angela Hsieh
WoEB



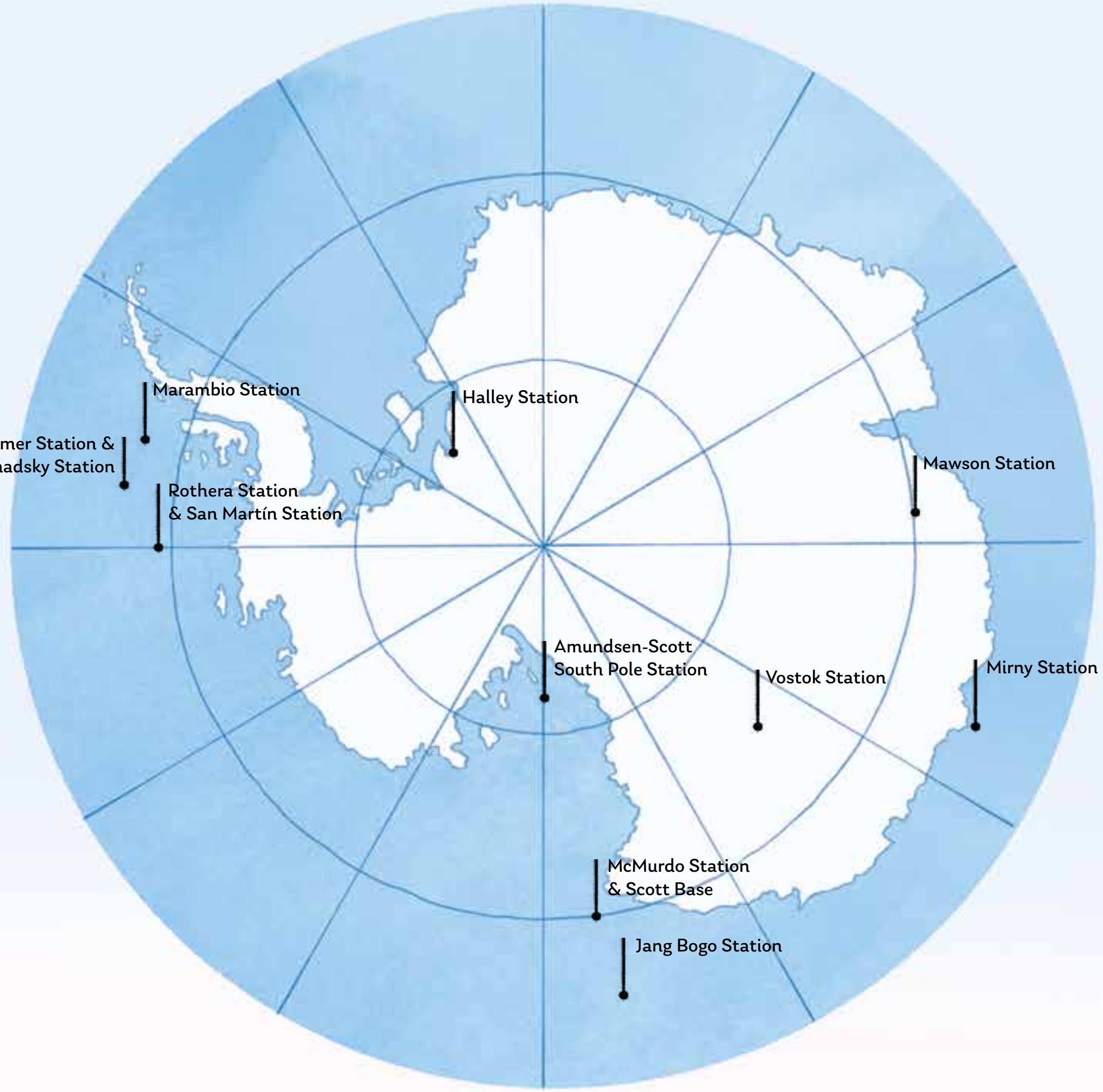
Far had we come and long had we travelled, from Scotland, Ukraine, Korea, China, France, Japan, North America – from north.

We had flown as far south as we could go, and boarded our ship in Punta Arenas, Chile. We had barely entered the fearsome Drake Passage when a stormy blast threw a scientist from his berth, breaking his bones. The ship turned back, to the nearest point in Argentina, to send him to a hospital, then home back north, to Boston.

Six days ago, we left the cliffs of Tierra del Fuego – the foot of South America – behind us. Since then our ship's bow, and our faces, turned only south. Now, at last, the captain said, we were near. Near what? The portholes showed only gloom, thick dark cloud that hid any hint of destination.

We passed the radar dot of Brabant Island and turned into the Gerlache Strait, a deep groove of sea along the Antarctic Peninsula. Gray. Mist. Fog. Cloud. Moving on south.

'Let's go out on deck', said Pete. I followed him, with the other scientists on our team: Paty and Carlton. We pulled on thick parkas, quilted trousers and heavy boots, over layers of warmer, thinner clothes and faced the cold wet outside.



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What on Earth Books

For Pete Countway – **KRY**
For my mum, whose love of travel let me see the world – **AH**

What on Earth Books is an imprint of What on Earth Publishing
Allington Castle, Maidstone, Kent ME16 0NB, United Kingdom
30 Ridge Road Unit B, Greenbelt, Maryland, 20770, United States

First published in the United Kingdom in 2022

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Karen Romano Young has asserted her right to be identified as author of this work and Angela Hsieh has asserted her right to be identified as illustrator under the Copyright, Designs and Patents Act 1988.
Staff for this book: Patrick Skipworth, Editor; Andy Forshaw, Designer

ISBN: 978-1-913750-52-7

Printer Code: TK
Printed in India
10 9 8 7 6 5 4 3 2 1

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Paper from responsible sources
FSC® C016779

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INTRODUCTION

I'd never sensed such deep stillness. Only the thrumming of the ship's engine and the hissing of icy waters could be heard. Passing through fields of ice chunks and broken-up icebergs, we peered into the foggy veil. Was anything there?

Suddenly a ray of sun broke through, then another. A patch of blue sky, then another. Within minutes, the ship chugged out of the low cloud into the most incredible panorama I'd ever seen: foaming aquamarine sea, floating icebergs layered with all the blues of heaven and earth, walled in by monumental white mountains that seemed to exhale sprites of icy wind. And – there! – the spouts of humpback whales, fellow migrants from the north. They'd come all the way from equatorial waters to feed in Antarctica. And – there! – a flock of Adélie penguins 'flying' through the water, arcing like dolphins. Everyone broke out in smiles; I burst into tears: here at last!

Pete leaned over my shoulder, pointing out what looked like a thin stick at the foot of a mountain. 'That's a British weather station,' he said. The 'stick' was an antenna the size of a city skyscraper, our only clue to the scale of the mountains that surrounded the Strait.

It was my first lesson in understanding Antarctica: how huge it is and how hard to size up. That and the slogan people are always saying jokingly: 'It's a harsh continent'. They mean, be careful here. They mean, we are very far from help. They mean, this environment is not designed to be hospitable to humans. On the contrary, it often seems to be designed to destroy us. And yet, the future of Antarctica's ice – so vital to maintaining our planet's balance – depends more than anything on our actions.

Chapter 1

THE UNKNOWN LAND

Today, Antarctica is Earth's most inhospitable continent, the coldest and driest place on the planet. Only a handful of plant and animal species survive here. But Antarctica used to be different: Not cold. Not isolated. Not a deathtrap. At one time, Antarctica was ice free and covered instead in – wait for it – dinosaurs!

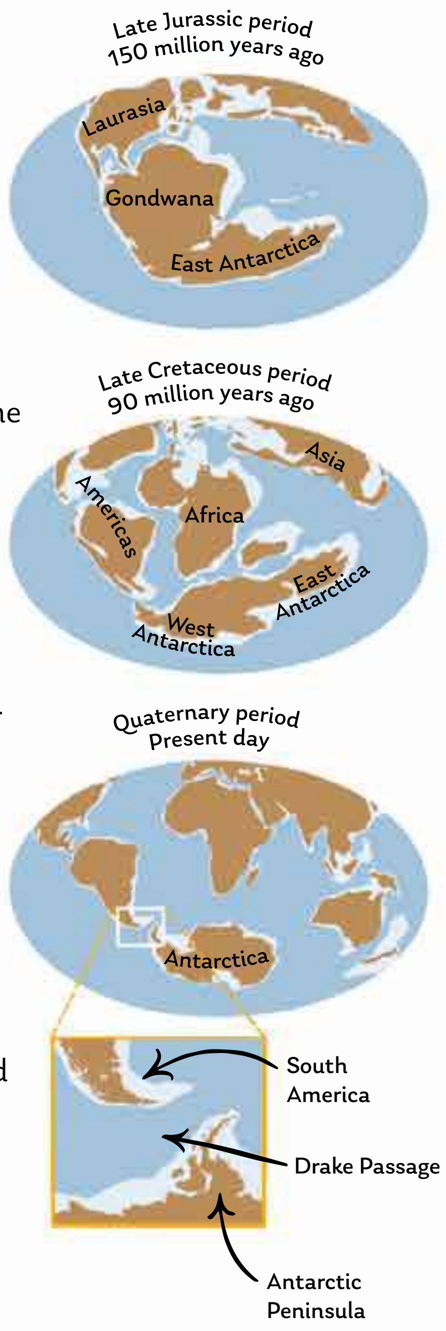
The remains of dinosaurs have been unearthed in Antarctica since the 1960s and are still being discovered today. The oldest among them lived during the early Triassic period, 250 to 245 million years ago; these were the same species of dinosaur as those found on other continents – because in early dinosaur times pieces of Antarctica were joined to other pieces of land to form much larger continents than those we have today. Later species were particular to Antarctica, showing that Antarctica had separated from the other continents by this time, causing those later dinosaurs to adapt to the now-unique environment. These included relatives of *Brachiosaurus* and *Titanosaurus*, but, unlike the giant examples found in other parts of the world, the Antarctic species were as small as retriever dogs.

In early dinosaur times and before, Antarctica wasn't even here, at the very bottom of the world. All of Earth's continents ride atop plates that make up the planet's outer layer, called its crust, and are constantly moving. These plates glide over molten rock heated by energy from the centre of Earth. This motion is incredibly slow: at its quickest it's about as fast as your fingernails grow. As the plates move, continents crash into each other, new lands are created and other land sinks under the water. Today, Antarctica is made up of West Antarctica and East Antarctica. And how each of them ended up at the bottom of the world is a different story.

East Antarctica was once part of a large continent called Gondwana, as were Africa, India, Australia and South America. But Gondwana began to break up around 200 million years ago, and the part that became East Antarctica eventually became more solid, stable and frozen than the land that makes up West Antarctica today. Among its secrets is a buried mountain range, the Gamburtsev Mountains, hidden under the East Antarctic ice sheet. During the Jurassic period 180 million years ago (the middle of dinosaur times), the movement of the continents pushed East Antarctica south. Eventually, over the next 100 million years, it shifted to its current position over the South Pole. As East Antarctica moved south, it slid over another plate and, where the crust sank, lava bubbled up in volcanoes. This formed both the Andes Mountain range that runs the length of South America and the Antarctic Peninsula (the long arm extending northward).

West Antarctica developed later, in the Cretaceous period (the end of the dinosaur times), around 100.5 million years ago, when shards of an uplifting plate split into pieces. You can see those same forces are still at work today in active volcanoes, including Mount Erebus, which towers, smouldering, over Antarctic research stations that edge the Ross Sea.

As the massive pieces of Antarctica's puzzle – East and West Antarctica – crunched together at the bottom of the world, a channel of ocean broke through the thinning strip of land that still connected the Antarctic Peninsula to the southern tip of South America and formed the Drake Passage. Now Antarctica was separated from the other continents, and a current of cold water – known as the Antarctic Circumpolar Current – formed a ring around it, forever cutting Antarctica off from warmer seas. In 'just' 20 million years, Antarctica froze.

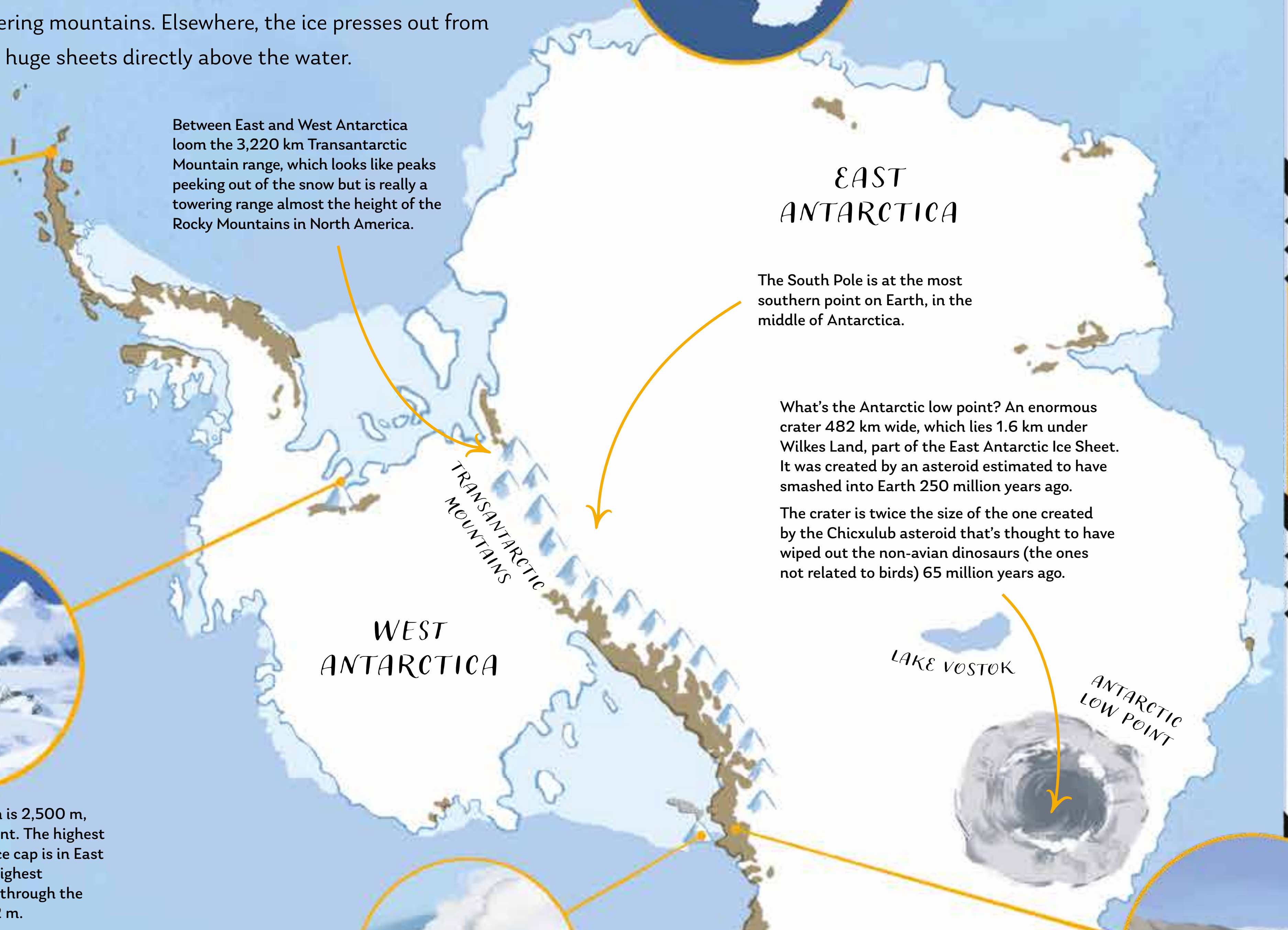


WHAT MOTION?
The motion of plates, known as plate tectonics, is ongoing. Millions of years in the future, the shapes and sizes of Earth's continents will have changed again.

MOUNTAINS OF LAND UNDER MOUNTAINS OF ICE

Antarctica may be covered in ice today, but beneath most of it is solid ground. In some places the underlying rock stays hidden under massive glaciers; in others it breaks through as towering mountains. Elsewhere, the ice presses out from the shore and over the ocean in huge sheets directly above the water.

The East Antarctic Ice Sheet and West Antarctic Ice Sheet are the two biggest ice sheets in the world. The thickest point of the East Antarctic Ice Sheet, which is the larger of the two, is nearly 5 kilometres thick – over fifty times as tall as the Statue of Liberty.



Between East and West Antarctica loom the 3,220 km Transantarctic Mountain range, which looks like peaks peeking out of the snow but is really a towering range almost the height of the Rocky Mountains in North America.

The South Pole is at the most southern point on Earth, in the middle of Antarctica.

What's the Antarctic low point? An enormous crater 482 km wide, which lies 1.6 km under Wilkes Land, part of the East Antarctic Ice Sheet. It was created by an asteroid estimated to have smashed into Earth 250 million years ago.

The crater is twice the size of the one created by the Chicxulub asteroid that's thought to have wiped out the non-avian dinosaurs (the ones not related to birds) 65 million years ago.

The Antarctic Peninsula extends into the Southern Ocean. It is over 1,000 km across the Drake Passage from its tip to the closest point in South America – Tierra del Fuego in Chile.

Antarctica's average elevation is 2,500 m, making it the highest continent. The highest point above sea level on the ice cap is in East Antarctica at 4,093 m. The highest mountain, where rock breaks through the ice, is Mount Vinson at 4,892 m.

Mount Erebus is the most active volcano in Antarctica. Inside its crater is a glowing lake of lava.

Most of Antarctica may be covered in ice and snow, but the driest spots on Earth are also found here. The McMurdo Dry Valleys receive less than 100 mm of precipitation per year.

ICE VOCABULARY

- **BERGY BITS** – broken up icebergs
- **BRASH ICE** – floating chunks of ice up to 2 m wide that form when other bits of ice break up
- **CALVING** – the breaking away of a giant chunk of ice from the edge of a glacier
- **FIRN** – dense, granular ice that forms as snow ages and compresses as the air is squeezed out of it
- **FRAZIL** – soft ice that forms in turbulent water
- **GLACIER** – a river of moving ice formed over many years as falling snow compresses
- **GROWLERS** – small icebergs or big blocks of ice that float underwater and pose an invisible danger to boats
- **ICE SHEET** – a huge, permanent layer of ice covering land
- **ICE SHELF** – a floating sheet of ice attached to land
- **ICEBERG** – a chunk of glacier that calves off and gets carried out to sea
- **NILAS** – thick, sludgy ice that forms as salt water freezes
- **PACK ICE** – an expanse of sea ice made up of lots of smaller pieces that drift because of wind or water
- **PANCAKE ICE** – discs of ice that form when wind blows through sludgy ice

FROM ICE HOUSE TO GREENHOUSE

Before the Southern Ocean tied its cold knot around Antarctica, conditions there were pleasant enough not just for dinosaurs but for many other warmth-loving forms of life. Ferns and freshwater fish, snails and sharks all flourished there. But once the cold loop of the Antarctic Circumpolar Current closed around the continent, snow fell, ending those warmer conditions. Over aeons, snow accumulated on Antarctica's surface, compressed into layer upon layer of ice, and began its ongoing slide to the sea in the form of frozen rivers called glaciers. When a glacier reaches the sea, it 'calves' – yes, like a cow – into smaller pieces, which fall into the water. These pieces are called icebergs. They melt as they move away from land, floating north across the ocean. Their melting affects sea levels worldwide.

Antarctica's glaciers have melted and refrozen, melted and refrozen, as Earth has warmed and cooled in natural rhythms. Take the Pleistocene era, which began 2.6 million years ago, for example. It was the start of a series of up-and-down temperature swings that caused Earth to freeze and thaw in 40,000-year cycles, following a pattern created by Earth's orbit around the Sun. Right now, Earth is in another ice age – the latest 'Ice House' period – which began when the Pleistocene ended, 11,700 years ago. The glaciers we see today have been building up and sliding down into the ocean in a delicate balance since then – until recently.

Since the mid-20th century, Earth has been steadily warming. The cause of this change started earlier, during the Industrial Revolution. This period, which began in about 1760, marks the moment when engines fed by fossil fuels – coal, oil and natural gas – began to be used for heat and power. When fossil fuels are burned, gases called carbon dioxide, methane and nitrous oxide are produced. Human activities, such as farming and disposing of waste in landfills, also create these gases, and they all began to build up in Earth's atmosphere. These 'greenhouse gases' have created a blanket effect that continues to warm Earth today. They keep the cold out and heat in. This increases water vapor in Earth's atmosphere – clouds and rain – adding further to what's called the greenhouse effect.

While all of this has been going on, the glaciers in Antarctica have continued to grind into the seabed and slide out over the ocean as ice shelves. The warming sea nibbles upward and the glaciers flow downward. In a balanced system, iceberg calving balances with the snowfall, so new ice is created at the same rate as it falls into the ocean. But now, the greenhouse effect is accelerating glacial melting, and the snowfall on top can't keep up with the calving below, so an excess of icebergs are calving into the sea.

Antarctica's glaciers are storehouses for Earth's fresh water. As the glaciers melt, sea levels are rising, sinking coastlines and making them part of the sea. Worldwide, people and their burning of fossil fuels are causing global warming and sea levels to rise. In Antarctica scientists are rushing to learn about the past to help everyone understand what's happening now and what could happen, for better or worse, in the future. If Antarctic ice shrinks, what will happen to the rest of the world? But, wait. The question, scientists say, is not *If*. It's *When?* and *How soon? How much? How fast?* Humans in Antarctica are working to find out. But we are still new to this continent; there is much to learn and time is tight.