

WGBH/NOVA

#4221

Making North America: Life

KIRK JOHNSON (*Sant Director, Smithsonian National Museum of Natural History*): *North America, the land that we love: it looks pretty familiar, don't you think? Well, think again! The ground that we walk on is full of surprises, if you know where to look.*

As a geologist, the Grand Canyon is perhaps the best place in the world. Every single one of these layers tells its own story about what North America was like when that layer was deposited.

So, are you ready for a little time-travelling?

I'm Kirk Johnson, the director of the Smithsonian National Museum of Natural History, and I'm taking off on the fieldtrip of a lifetime,...

Look at that rock there. That is crazy!

00:53

...to unlock the secrets of our continent's incredible past.

In this episode we jump back a million years, to a North America full of all kinds of unusual creatures, turning up in the most unexpected places.

Fourteen-foot-long fish, in Kansas. That's what I'm telling you.

It's a time when much of the Midwest was under water.

01:29

I'm on the hunt for clues to the amazing connection between our land and everything that's ever lived here, from the rise of early life,...

NOAH PLANAVSKY (*Yale University*): *What I'm holding in my hands is a fossil that's two-billion years old.*

KIRK JOHNSON: *...to the destruction of the biggest, baddest beasts of all time.*

It doesn't look like much, but this layer is Armageddon. Making North America: Life, right now, on NOVA.

North America today is filled with gleaming cities, almost half-a-billion people and still some spectacular wildlife.

03:53

But if we could rewind the clock, and travel back in time millions of years, life on our continent gets a whole lot wilder.

Yikes! That makes a grizzly bear look like nothing.

This land is filled with the bones of some mind-blowing ancient creatures that once roamed and swam across a continent that was completely different from the familiar place we call home today.

4:32

And when you dig deep and follow the clues, you uncover an incredible fact: that powerful forces, in the ground beneath our feet and the rocks all around us, have shaped every plant and animal that's ever lived here.

You just have to look to follow the twists and turns, the ups and the downs of North America's incredible life story.

05:22

Wow. Look at that seam down there. That's amazing.

In an empty corner of Utah lies a very special landscape.

Wow. Look at that rock right there. That thing is a crazy thing! That's cool.

I'm flying over a remote region called the Kaiparowits Plateau. There's some seriously rugged terrain out here. The only way in or out of here is by helicopter, but for a geologist like me, this is one of the most exciting places on the continent.

I love this place, because its rocks contain a record of one of the most important chapters in the history of life in North America. My guide for the day is paleontologist Joe Sertich, an old friend from the Denver Museum of Nature & Science.

JOSEPH SERTICH (Denver Museum of Nature & Science): Pretty good place to be a paleontologist, huh?

KIRK JOHNSON: *Oh, yeah, this is awesome.*

06:36

What makes the Kaiparowits so amazing, for paleontologists, is that it's jam-packed full of dinosaur fossils. They're sticking out everywhere.

Look at that: all sorts of chunks of little bone, it looks like.

This is a great place for using my favorite little trick for testing fossils. It sticks on the end of the tongue. It actually sticks really hard when you have a piece of bone. The little pores of the bone will try and pull the

water out of your tongue, and a real piece of fossil bone will stick really hard to the tip of your tongue.

07:16

But Joe hasn't brought me all the way out here to suck on a few broken bones. He's got something much cooler to show me: the cast of a skull belonging to a new species of dinosaur, discovered right here, that Joe helped identify.

JOE SERTICH: I bet you're going to like this.

KIRK JOHNSON: *Whoa, look at that.*

JOE SERTICH: Yeah.

This is a lower jaw.

KIRK JOHNSON: *Well, there's no doubt that guy's a meat-eater. Look at that, little steak knives in his face.*

<JOE SERTICH?>: Exactly.

KIRK JOHNSON: *Yikes.*

That makes a grizzly bear look like nothing.

07:58

JOE SERTICH: This is a dinosaur called "Lythronax."

KIRK JOHNSON: *Lythronax?*

JOE SERTICH: Lythronax is a pretty cool name. It actually means the "King of Gore."

KIRK JOHNSON: *The King of Gore?*

JOE SERTICH: Yeah.

KIRK JOHNSON: *Who came up with that name?*

JOE SERTICH: I did.

KIRK JOHNSON: *You did? That's one of the things about finding dinosaurs, you get to name them.*

<JOE SERTICH:?> Exactly.

KIRK JOHNSON: *The really exciting thing about the King of Gore is that, when you put flesh on the bones, Lythronax looks a lot like the much more famous and*

fearsome Tyrannosaurus rex. But it's 10-million years older. Maybe he was T. rex's great-great-great-granddaddy!

Eighty-million years ago, all of North America, not just the Kaiparowits, was home to creatures like Lythronax. And for the next 14-million years, our continent was like a dinosaur movie set, with a cast featuring some of the biggest superstars, like T. rex, hadrosaurs and my favorite dinosaur, Triceratops.

09:25

We know this, because we found their fossils all over the place. In fact, of all the dinosaur species discovered worldwide, fossils of more than a quarter of them have been found here, in North America.

So the big question for me is, why? What was it about North America that made it such a dinosaur factory? What was the continent like back then, that it could produce such a diverse cast of dino characters?

Well, before we can unravel this mystery, we need to understand the intimate connection between life and the land.

It's a process that's been going on since life first emerged more than three- and-a-half-billion years ago, long before the dinosaurs roamed the land, in a time before North America even existed, and the earth was covered almost entirely in ocean.

10:33

There's some intriguing evidence for this link, in an unexpected corner of the North American plate, the Bahamas.

I've come here to see a rare living fossil, one that helped change the earth itself. Without it, life as we know it might not even exist.

My guides are marine scientists Noah Planavsky and Pamela Reid.

So what did you think when you first saw these things?

PAMELA REID (University of Miami): You feel like you've stepped back in time, to early Earth. It's another world. You'll see.

KIRK JOHNSON: *I've been waiting my whole life to see these things.*

11:22

But to see anything, first we've got to dive down about 20 feet, where we'll have a brief window of time, before powerful currents threaten to sweep us away.

We're looking for one of the oldest organisms on our planet, but as we descend, there is not much sign of life.

Could it be hiding behind these strange rocks?

Actually, these rocks are the very things I've come to see. They're called "stromatolites," and, believe it or not, they're alive.

You can't see them, but just beneath the surface of these boulders is a thin coating of bacteria. Over thousands of years, these microbes accumulated layer after layer of mud and sand to build mounds up to eight feet tall.

Today living, growing stromatolites like these are extremely rare.

12:50

But these precious examples hold the key to the evolution of virtually all complex life.

I could stay down here for hours, but the current is getting stronger and we don't want to get pulled out to sea.

That was amazing down there. The current really picked up. It was ripping through there, too.

PAMELA REID: And that is actually why, an important reason why we have stromatolites.

KIRK JOHNSON: *What's special about this spot that allows them to be here?*

PAMELA REID: Well, you noticed a very strong current?

KIRK JOHNSON: *We were being hauled along by that current.*

PAMELA REID: And you also notice that there were sand waves that were going over the stromatolites? That sand will actually bury the stromatolites, for months at a time.

KIRK JOHNSON: *And then unbury them again?*

PAMELA REID: And unbury them again; and that burial is really important to the existence of the stromatolites.

13:47

KIRK JOHNSON: *When the sand is swept away, the stromatolites are vulnerable to seaweed and corals that block the sun. The sand protects them.*

PAMELA REID: It keeps away the higher organisms, the seaweeds and the corals. And in early Earth there were no corals and seaweeds to compete, so they actually had **<A MUCH BIGGER TERRITORY?>** much a bigger territory, and they dominated the planet. For about 80 percent of Earth's history, stromatolites were kings.

KIRK JOHNSON: *That's a long, long time to rule.*

Stromatolites are the earliest fossilized form of life we've ever found.

NOAH PLANAVSKY: What I'm holding in my hands is a fossil, a stromatolite from northern America. It's almost two-billion years old.

KIRK JOHNSON: *So how old do these things actually get?*

NOAH PLANAVSKY: The oldest examples we find are 3.5-billion years old.

KIRK JOHNSON: *Three-point-five-billion, I love that. Wow, that's time, man. That's almost three-quarters of the entire history of the planet.*

So, these organisms have seen it all.

NOAH PLANAVSKY: They're a continuous record of life thriving on our planet.

14:55

KIRK JOHNSON: *So, why were stromatolites so successful? Three-billion years ago, our planet was almost unrecognizable. Covered by enormous oceans, there were no continents, just hundreds of small, volcanic islands, belching out huge amounts of carbon dioxide and even toxic substances, like sulfur dioxide and arsenic.*

Most creatures today would suffocate in these conditions, but the microbes that built stromatolites used them to their advantage.

NOAH PLANAVSKY: The really clever thing about these organisms is they developed a way to thrive in the conditions back then, in an atmosphere that would have been toxic to life as we know it today.

15:52

KIRK JOHNSON: *But how did they do it?*

To find out, Noah and I wade into the slime of this shallow lake.

This stuff is slippery, man.

This place is teeming with bacteria, similar to the ones that live on stromatolites.

NOAH PLANAVSKY: The same type of organisms that form the stromatolites are forming these mats.

KIRK JOHNSON: *Looks like, kind of, nasty black lasagna; smells bad too. There's also some bubbles coming off here.*

NOAH PLANAVSKY: Let's see what they are. So, I have a gas probe here. Let's bury it in the microbial mat and see what we get.

You just to <"GO TO" RATHER THAN "TO TO?">to the top of the mat. The very uppermost portion.

KIRK JOHNSON: *And it's what gas?*

NOAH PLANAVSKY: Oxygen.

KIRK JOHNSON: *This is coming out of the mat?*

NOAH PLANAVSKY: Exactly. So the waste product that transformed our planet is oxygen.

KIRK JOHNSON: *Oxygen a waste product? That's what we breathe.*
16:58

But these little microbes do the opposite: they take in carbon dioxide and water and release oxygen. It's called "photosynthesis," the chemical reaction at the heart of every green plant alive on Earth, today.

This was the contribution of the stromatolite bacteria to early Earth. In a place filled with volcanoes and water, over the course of more than two-billion years, they pumped out so much oxygen that the atmosphere changed, from what would have been a deadly poison for us, into something that made it possible for life, as we know it, to exist.

So, these things didn't only just live in their environment, they actually transformed the environment and made it livable for other things?

NOAH PLANAVSKY: Absolutely.
18:02

KIRK JOHNSON: *It was a critical turning point. Now, a new kind of life form could finally join the party: creatures that didn't produce oxygen but instead consumed it. About 640-million years ago, complex life took off, with the evolution of primitive animals like sponges, followed a little later by a group of jellyfish-like creatures called "Cnidaria," the first animals to possess nerves and muscles.*

18:46

Over millions of years, life grew ever more complex. Fish got a skull and backbone 420-million years ago. By this time, land had emerged, and so, it wasn't long before the first amphibians hauled themselves out of the water and onto the shore.

This led to the evolution of the reptiles, and then, more than 200-million years ago, to the dinosaurs, which brings us right back to where we

started: the big mystery. What was it about this continent that allowed so many kinds of dinosaurs to thrive?

19:45

You can find one clue right smack in the middle of the U.S., in the Great Plains of central North America. For most people, a drive across the Great Plains is an exercise in boredom. For me it's just the opposite. As a geologist, I think about what's beneath the Plains, the stories that lie beneath the prairie.

Just outside the town of Oakley, in Western Kansas, some strange but spectacular shapes burst up out of the plains. They're called "Monument Rocks."

This place is so cool. The story goes that early settlers, crossing the plains, used these as landmarks to help them navigate. One of the most amazing things about this place is how much time it represents. Just one inch of this chalk is 700 years. That means that a foot of the chalk is 8,400 years, or roughly, the entire duration of human civilization.

There's about 40 feet of this stuff above me. But there's about 300 feet below me. There's literally millions of years represented in this one place.

21:49

It's a snapshot of a time when North America was going through some major changes. This place is filled with fossils.

Hey, Chuck. Long time, no see.

<IS THIS KIRK OR CHUCK?> Good seeing you.

KIRK JOHNSON: *And nobody is better at finding them than Chuck Bonner and Barbara Shelton, who've hunted for fossils in these rocks, for over 40 years.*

Let's go find some fossils.

When I told them I was coming by, they offered to show me their newest discovery.

So Chuck, how did you find this thing, Chuck?

CHUCK BONNER (Fossil Hunter): I was just searching along on these slopes and found some big bones sticking out.

KIRK JOHNSON: *That's cool. What did you think when you first saw this, Barb?*

IS THIS BARBARA RESPONDING?<BARBARA SHELTON (Fossil Hunter):> Lot of digging, that's what I think.

22:45

<WHO IS THIS?> Let's put a little water on, huh?

<WHO IS THIS?> Let's bring it to life...

KIRK JOHNSON: *A little water reveals a skull with some major league teeth; no question, a vicious predator. But this was no dinosaur. These jaws belong to an 80-million-year-old fish called Xiphactinus.*

This jaw is huge. This must have been an immense fish.

<WHO IS THIS?>: Probably close to 14 feet long.

KIRK JOHNSON: *Fourteen-foot-long fish, in Kansas?*

Name me a living 14-foot-long fish.

<WHO IS THIS?>: Well, if you count the bill on marlin, maybe.

KIRK JOHNSON: *We're in Kansas, Chuck.*

So, a 14-foot-long fish, in Kansas?

CHUCK BONNER: Yeah, sure.

23:35

KIRK JOHNSON: *What is this ancient marine predator doing 750 miles from the nearest ocean? Well, it turns out, 80-million years ago, the ocean was here, right on top of Kansas. It was teeming with mighty sea creatures like Chuck and Barbara's 14-foot Xiphactinus. But it wasn't just Kansas that was covered in water.*

24:18

About 130-million years ago, the ocean began to invade North America. Water flooded in and formed a massive inland sea, up to a thousand miles wide. It split the continent into two landmasses: Laramidia, in the west, and Appalachia, in the east. The big inland sea would have huge consequences for life on our continent, especially North America's dinosaurs.

25:08

Back in the Kaiparowits, in Utah, where scientists have discovered an amazing new collection of dinosaurs, paleontologist Joe Sertich shows me his latest find, from this extraordinary dinosaur graveyard.

Oh, look at that. That's pretty clearly a horn.

JOE SERTICH: Yep. So, here you can see where the eye would have been. There's a large section of the horn coming off. There's the tip of the horn there.

It's starting to look more and more like a brand new species.

KIRK JOHNSON: *This so Jurassic Park.*

JOE SERTICH: It is.

KIRK JOHNSON: *The new dinosaurs, here, are remarkably different from other dinosaurs that lived farther north, at the same time. So what is it with all this diversity?*

25:58

From around a-hundred-million years ago, our continent was split down the middle by the inland sea. Over time, sea levels changed, shifting the coastline back and forth, all the time, and keeping the dinosaurs of North America on their toes.

With their home turf constantly changing, groups of dinosaurs evolved over time and adapted to their local surroundings. Joe and his colleagues have collected an amazing variety of dinosaurs and fossil plants, showing how different environments drove dinosaur diversity.

So, what you're saying is that these different environments along the coastline create different landscapes for dinosaurs to evolve in?

JOE SERTICH: Exactly. We suspect that these different ecosystems are driving dinosaur diversification, as dinosaurs and other animals adapt to their local conditions.

KIRK JOHNSON: *And that makes North America a dinosaur factory?*

<IS THIS JOE?> Exactly.

KIRK JOHNSON: *As a paleontologist, it's really exciting to think that 75-million years ago, this land was full of dinosaurs of every description.*

27:30

They all lived along this huge inland sea that split America down the middle and created a whole bunch of different habitats. But 70-million years ago, something dramatic happened. The great North American seaway began to drain away. So, what happened to make this enormous body of water totally vanish?

To solve that mystery, I've got to head east, from Utah to Colorado. This place was also once covered by the vast inland sea.

With a big sky overhead, you can see for miles. It's really <A?>great view up here, 360.

28:28

But I didn't climb this hill just for the view. I'm on the hunt for some strange-looking objects that I'm hoping to find right under my feet.

That's what I'm looking for, but it's not a very good one. These hollowed out rocks are clues that help explain why North America's giant inland sea disappeared.

Here's a pretty good one.

After a rain, the water pools in them, like this. And the birds come and bathe in these things, and the locals call these things birdbaths, but they're actually something much more interesting than that.

These rocks once contained fossils of ancient shellfish called "ammonites." You can pretty clearly see the shape of the shell, if you start in the center, here. And the spiral goes all the way out. And, in the middle, there would have been a series of chambers. The fleshy part of the animal would have stuck out of the shell here, and it would have looked something like a squid or an octopus.

29:49

For more than 40-million years, North America's inland sea was filled with giant ammonites like these. But it's one thing to find marine fossils in the flatlands of Kansas, it's another to find them in the mountains, high above Denver.

The big question here is what's going on? I've got an altimeter here, and the altimeter says that I'm 7,703 feet above sea level. That means that something took marine creatures and brought them to an elevation that's more than a mile above sea level.

30:33

It's the same thing that made North America's inland sea disappear. And driving it all is the constant motion of the ground itself, because the surface of our planet is broken up into pieces that slowly slide along a conveyor belt of hot rock, miles beneath us, at about two inches a year.

Around 70-million years ago, a piece of crust, under the Pacific Ocean, was diving down, at the western edge of North America. We think that it then began to slide right under the continent, making it rise, forcing it up, inch by inch, to create an icon of the North American landscape: the Rocky Mountains.

The birth of this majestic mountain range was the death of North America's great inland sea.

37:56

As the Rockies began to rise, the land under the inland sea was forced up, and all of its waters drained into what is now the Arctic Ocean and the Gulf of Mexico. This left the marine creatures living in the inland sea literally “high and dry.”

It’s mind-boggling to think that the bottom of the sea could be found at the top of a mountain range, but here are all these fossils that say that it’s so.

The forces under the earth are so slow, but so relentless.

32:38

Over millions of years, they completely altered the shape and form of the continent and changed the fates of the millions of plants and animals that were living there.

From the very beginning, rocks and life have been intertwined. But this process doesn’t always move slowly, and change doesn’t always come from below, as our old friends, the dinosaurs, were about to find out.

So I pack my bags and head north, ...

Hello!

...to track down a 66-million-year-old smoking gun.

Thanks, so much.

33:50

These are the North Dakota badlands, thousands of square miles of arid gullies and buttes. I’m driving deep into the badlands here, on what is called the state highway, but it’s actually a gravel road. And right around us, here, is what’s called the Hell Creek Formation. It’s a 300-foot thick layer of rock that stretches over four states. And it’s a spot I just keep coming back to, again and again.

And here’s a cow I’m about to hit.

I just can’t get enough of this place, because, hidden in these hills, is evidence of an earth-shaking, life-changing event.

To find it, I’m going to have to do a little digging.

I actually got a couple of pieces of fossil charcoal here. And that’s pretty common in these layered rocks. You find evidence of the ancient world, whether it’s the mud at a bottom of a lake, coal from a swamp, charcoal from a forest fire. And every layer used to be the surface of the earth at a certain point in time.

36:08

Now, there's a stack of these layers, and I'm looking for one layer, in particular: one very thin, one very special, one very scary layer.

After a few minutes of digging, I find the 66-million-year-old layer I've been searching for. Here it is, right along here. It's a little rusty-orange color.

It doesn't look like much, but this layer is Armageddon. To show you why, I need to get in closer. What I'll do is set up my handy dandy field microscope.

I'm looking at this layer under the microscope, and what I'm seeing is that it's actually composed of little round balls, about a millimeter in diameter. And these things are what used to be little glass beads. So what you've got, basically, is some sort of geologic phenomenon that's dropping beads of glass onto an ancient landscape.

So what could have happened here?

One way you get a layer of glass beads on a landscape is to have a violent event that melts rock and blasts it into the air. And as the molten rock flies through the air, it cools into glass and rains down on the landscape as glass beads.

37:46

If all we found in this layer were glass beads, then the most likely explanation might be a massive volcanic eruption, but there's something else hidden within this layer that changes the story: tiny crystals called "shocked" quartz.

Quartz is an extremely common mineral. You can find it all over the planet, but when it shows up with these parallel lines, as shocked quartz, that means it's been exposed to huge amounts of energy, like you get at nuclear test sites.

But, when this layer of Earth was laid down, there were no atomic bombs. There was only one thing that could have made a big enough bang to shock quartz.

38:50

About 66-million years ago, an asteroid the size of Mount Everest was headed for Earth. It entered the atmosphere at over 20 times the speed of a rifle bullet and exploded, with more power than a billion atomic bombs, sending a superheated plume of vaporized rock shooting across North America and over a hundred miles up into space.

This cloud of doom carried droplets of molten glass and shocked quartz, all the way to where I found them in North Dakota, and beyond, bringing death and destruction to our planet.

39:42

But what effect did it have on the dinosaurs?

For the last 30 years, it's been pretty widely thought that one of the main groups of animals that were the victims of this event were the dinosaurs. If this is the case, it's useful to have some real scientific data.

Thirty miles down the road is a guy who can help me with this.

Hey, Tyler.

Tyler Lyson is a paleontologist, who's been digging up dinosaur fossils in these badlands for more than 20 years.

TYLER LYSON (Denver Museum of Nature & Science): What's going on, man?

KIRK JOHNSON: *Great to see you. Are you good?*

TYLER LYSON: Always good in dinosaur land.

KIRK JOHNSON: *What we got going?*

40:34

Tyler and his crew have pulled dozens of dinosaur skeletons from these rocks, among them big names like Triceratops and Tyrannosaurus rex.

All told, how many different kinds of dinosaur have you found in this area?

TYLER LYSON: Two dozen? We've found all the major the players here. Just happens to be one of the best places in the world to find dinosaurs. It's a rich, rich area.

KIRK JOHNSON: *But where do we find these dinosaurs? Are they below the impact layer or above? Before the asteroid struck or after?*

So where is the asteroid impact layer here?

TYLER LYSON: It's right at the level of that boulder, right there.

KIRK JOHNSON: *So what do you get below that?*

TYLER LYSON: We get some really big dinosaurs. We have the big plant-eating dinosaurs, Triceratops, Edmontosaurus, Thescelosaurus.

41:28

And then the thing<S?> that ate those dinosaurs, like T. rex.

KIRK JOHNSON: *So, above the asteroid impact layer, what do you get?*

TYLER LYSON: Well, we get a few turtles, we get crocodiles, some birds, a few lizards and fish.

KIRK JOHNSON: *You find any dinosaurs at all above there?*

TYLER LYSON: No dinosaurs above that black line, right there.

KIRK JOHNSON: *So, below is dinosaurs and above is no dinosaurs?*

TYLER LYSON: Absolutely right.

KIRK JOHNSON: *Nobody has ever found <A?>dinosaur above the asteroid impact layer, in North America or anywhere else on the planet.*

42:21

To me, that's pretty convincing evidence that this catastrophic collision wiped out the dinosaurs.

And they weren't the only living things to suffer. This amazing fossil leaf just popped out of this rock.

Tap a little bit more, expose it.

There's a leaf that hasn't seen the sun for 66-million years. You can even see holes in the leaf where cretaceous insects fed on the leaf, while it was growing in a forest that was full of dinosaurs. And it's this world that was terminated by the impact of the asteroid.

We lost more than half the species of plants and more than half the species of insects. It was truly an ecosystem-wide, devastating event. But even with all this global destruction, among the survivors was one special group of animals that managed to hang on: the mammals.

It was little mammals, not unlike these chipmunks, that survived the asteroid impact. And they survived because they had small body size; a large population size; they could reproduce fast; they lived in burrows. They were almost pre-adapted to survive an event like the asteroid impact.

And once the dinosaurs were gone, they'd had the world to themselves. In the millions of years that followed, mammals evolved and changed, spread and diversified.

44:26

They filled every available niche on land, sea and air, here in North America, and all over the planet. But it's the evolution of one particular group of mammals, the primates, that's of special importance to us. But there's a huge mystery.

Today, except for some monkeys in Central America, the only primates native to our continent are us human beings. If you want to see other primates, like gorillas, baboons and monkeys, you have to visit a zoo or come to a place like this: the Duke University Lemur Center.

45:35

Whoa! Look how high that thing is going.

It's an 80-acre site dedicated to the study and preservation of lemurs, a group of primates that evolved in Madagascar.

Here they come. There's a bunch coming at me right now. He's eating one peanut in each hand, looks like he's eating ice cream cones.

It's awesome to be so close to these things. It's incredible how well they move through the forest. And to see them moving around the trees...they'll go straight up a tree, 30, 40 feet, and jump 20, 30 feet between the trees.

Seeing these little guys leap from tree to tree, you quickly realize that almost everything about primates is perfectly adapted to a tree-filled environment. And that kind of makes you wonder: we've got plenty of forests here in North America, why don't we have primates, like these lemurs, jumping through our trees?

47:01

Well, the fact is, we did. And paleontologist Doug Boyer can show us.

One example is now a jumble of bones, encased in a block of sandstone, from Wyoming. This particular accumulation of bones happens to be about 48-million years old.

There's still a lot of rock on it though.

<IS THIS STILL KIRK OR IS IT DOUG BOYER? IN WHICH CASE, MOVE IDENTIFIER TO HERE.> Well, instead of extracting every bone physically, we can scan it.

KIRK JOHNSON: *As the scanner gets to work, a faint image comes into view.*

DOUG BOYER (Duke University): Now, we can see something starting to come through.

KIRK JOHNSON: *Oh, wow. Look at that. There's the elbow coming into view. It's so tantalizing. There's <ALL SORTS?>sort of shapes in there.*

48:01 *From the scan data, Doug builds up a full 3D image of the fossil.*

It reveals an amazing feature.

DOUG BOYER: We have some of the hand here; here, some the finger bones.

KIRK JOHNSON: *<LOOK?>How long those fingers are. They're really long.*

DOUG BOYER: This animal had incredibly long fingers. If we were to scale the animal to your size, your fingers, freakishly long fingers, would be about nine inches long.

KIRK JOHNSON: *Wow!*

Those long fingers, perfect for grasping, are a telltale sign of a primate. And thousands of early primate specimens have been found, all over America. These little guys were about two feet long. Like the lemurs, they were great tree-climbers and probably lived on fruit.

When you watch these guys moving around the forest, you realize what all these adaptations are for: the long fingers, the long toes, the tail, the ability to jump. When you look at the fossils, it's the same features, preserved in bone. It doesn't take an expert to realize that those fossils belonged to animals that were like these animals and lived and moved in forests.

49:34

So, how did all these ancient primates get here? Where did they come from?

56-million years ago, a huge fiery rift opened up in what's now the North Atlantic, an event with dramatic consequences for North America and our entire planet. Volcanic eruptions poured huge amounts of lava into the ocean for thousands of years, releasing colossal amounts of greenhouse gases, like carbon dioxide and methane.

50:22

Like a blanket in the atmosphere, they kept in the heat, leading to an intense period of global warming that changed the vegetation across North America. The cool forests, covering the north, turned into dense subtropical rainforests, stretching all the way to Alaska. These trees kept their leaves all year round, providing food and shelter for primates, so they could make the leap from Asia, across a land bridge, a leafy highway to North America.

They hung around for more than 20-million years, spreading all over our continent.

51:09

But then temperatures dropped sharply, wiping out the subtropical forests and their leaping inhabitants. For millions of years, nearly all of North America would remain primate-free. Then, around 14,000 years ago, almost a blink in geological time, a certain two-legged primate made its entrance.

That primate, of course, was us, and our arrival changed everything. The first humans to arrive in America found a land full of untold riches. They'd really have a whole new world open in front of them. They could move down the coast full of resources: fish, whales, seals, deer. And the coastline is like an open pathway, a gateway into a continent four-billion years in the making, providing us with an enormous geological bounty. Gifts of the earth, hidden in the landscape: gold, iron, oil and more, harnessed to build the vast civilization that surrounds us today.

52:39

For the first time in the history of life in North America, here was a species that would not just adapt to the landscape, but transform it.