VOYAGE OF THE CONTINENTS

AFRICA ORIGINS

Script - 52’

10 00 03 00 : Narration

Since its formation, our planet has undergone constant transformation.

10 00 12 00

Stupendous collisions have created continents. Colossal forces have raised up ocean floors, forming dramatic mountain ranges.

10 00 27 00

These movements on the Earth’s surface can be seen today in (the form of) volcanic eruptions, earthquakes and tsunamis.

10 00 38 00

Tectonics sculpt our landscapes, modify the climate, displace oceans, and can even influence the living world.

10 00 53 00 : (Teaser episode)

In Africa, this story begins early in our planet’s existence.

The first African lands form…

10 01 01 00

…only to be imprisoned in the center of a vast supercontinent. They are freed later as the result of intense upheavals…until forming the African continent we know today.

10 01 15 00

This tumultuous past is still legible in the heart of the rock. From the depths of the Earth to the highest mountain peaks, scientists the world over attempt to pierce the mystery of the birth of the African continent.

10 01 31 00

Thanks to their insights, Africa becomes an open book on the story of the earliest ages of planet Earth… An exceptional testimony to the never-ending voyage of the continents.

10 01 40 00

Opening titles

Sequence 1 – Impurities in the diamonds – The 1st land masses

10 01 59 00: Commentary

At its birth 4.5 billion years ago, the Earth is a gigantic ball of fire. Then it cools, making way for the appearance of the first oceans… And the first embryos of continents.

10 02 12 00

In the course of time, these emerging lands moved closer to one another. The oceans that separated them disappeared into the depths of the Earth's mantle. This phenomenon generated colossal forces.

10 02 28 00

Under the surface, the temperature and the pressure shot up like an arrow. In these extreme conditions, carbon crystalized in certain areas… and was transformed… into diamond.

10 02 48 00

In South Africa, geologist Steve Richardson takes a great interest in these diamonds, a precious legacy of those past collisions.

10 03 04 00

His research zone is located in Kimberley in the province of Northern Cape, South Africa.

10 03 12 00

On this site we find what is called a 'craton'. A zone which has not undergone any major change for several million, or billion, years.

10 03 23 00

The Kimberley region is one of the oldest lands in all of Africa… And most importantly, it's precisely in this area that during our planet's infancy, two fragments of the Earth's crust collided.

10 03 39 00

Steve Richardson

This is a glacial pavement on the heart of the Kaapvaal craton. Deeper done underline the lavas are even older granites. They are produced by vertical differentiation of even earlier volcanic plateaus. Which automatically lead to the production of granites and the formation of early archean continental nuclei, which popped around on the earth surface by lot of vertical movements. It was only when the earth crust had cooled sufficiently to make the crust more rigid that horizontal tectonics could take over.

10 04 27 00

Steve Richardson

We have here, in a Kaapval craton, the first good evidence of the onsite of plate tectonics when the Kimberley bloc and the Witwatersrand bloc collided at some 2.9 billion year ago.

10 04 46 00: Commentary

2.9 billion years… The estimated age of the first lands of the African continent.

10 04 55 00

A number that Steve and his colleagues try to confirm with the help of diamonds present in the sub-soil.

These mythic precious gems brought fortune to Kimberley in the late 19th century.

10 05 07 00

The story begins in 1867.

A young farmer discovers a strange rock on a hillside. It is, in fact, the first diamond ever unearthed on South African soil.

Baptized EUREKA, it forever marked the history of the country.

10 05 26 00

For years, prospectors from all over the globe set up shop in the region, and dig the soil in search of riches.

10 05 38 00

Today, a vast gaping hole attests to that scramble of olden days.

Big Hole, 500 meters in diameter. The largest hole ever dug entirely by human labor.

10 05 52 00

Steve Richardson

So this mine was started in 1871 and it took some 12 years for them to dig this hole down to a depth of around 200 meters. And it was a rich diamond pipe and so the grade of diamonds and the quality of diamonds were very good and so they decided that they needed to dig a shaft underground to further exploit those diamonds.

As the hole deepened, it started to reveal the deep argent of diamonds which until then was not understood. Prior to that time diamonds were found mostly in alluvial workings. Here as a hole when down it's started when through the layers of geology and started revealing the outlines of a volcanic pipe which comes from automatically from some depth of a hundred to two hundred kilometers down. And so this hole eventually was recognized as a volcanic pipe which would

have been erupted some 19 million years ago and breach the surface which at that time was some 1 kilometer above where we are now.

10 07 05 00: Commentary

The discovery of a volcanic pipe on the mine site gave scientists a unique opportunity: to dive into the bowels of the Earth, thanks to diamonds.

These precious stones formed 100 kilometers underground… Much later, a volcano was born on this exact same site.

10 07 25 00

The gemstones were thus pushed up, transported by a lava with a distinct makeup called kimberlite.

10 07 33 00

Erosion then did its part, and over the course of centuries, the volcano disappeared completely…

10 07 44 00

The diamonds are thus invaluable witnesses to past geological phenomena. Knowing their age means knowing the age of the rocks they were born from. The latter being inaccessible as they are buried in the depths of the Earth. Only a few rare specimens have been gathered from the volcanic pipe.

10 08 03 00

They are carefully preserved here, at the Big Hole Mine.

10 08 10 00

Steve Richardson

These are slices of the two main mantle rock types: eclogite et peridotite. There are very different compositions. If you look closely, in the eclogite the granit are beautiful orange colour whereas in the peridotite they are purple colour. And the reason why the peridotite's garnets are so purple it that these are residual compositions from the move of lava melt that allowed for the stabilization of the Kaapval craton (keel). Now these mantle rocks are being carried from the depth of hundred and fifty to 200 kilometers, that was the host rocks in which diamond formed. So we can talk about peridotite diamonds and eclogite diamonds.

And it's the disaggregation of these rocks that allows for the diamonds to be found in the kimberlite at the surface. And here is a specimen of a diamond, an octi-hydral crystal of diamond larged in a piece of the original kimberlite magma from this volcanic pipe.

Some of these diamonds have inclusions of garnet. Is there an orange garnet or a purple garnet inside the diamond. So the kimberlite is simply the train that brought the diamonds to the

surface as accidental passengers after they were disaggregated out of the mantle host crust the peridotite and the eclogite.

10 09 42 00: Commentary

It's at the University of Cape Town in the Geological Sciences department that Steve Richardson studies these diamonds in an effort to date them.

10 09 58 00

The stones that interest the geologist are not the most precious. On the contrary, he only analyzes those that contain impurities. Infinitesimal slivers of rock, inherited during their formation.

10 10 16 00

Steve Richardson

My ultimate aim is to date these diamonds based on the mineral inclusions that I'm looking for in these diamonds. It turns out that you can't date the diamonds directly for example by the carbon-14 dating technique because that technique only applies to the last 50000 years also, whereas we're talking about diamonds that are around 3 billion years in age.

So I'm looking for mineral inclusions in these diamonds, particularly garnet, which I can identify on the bases of color, has being from either eclogite, where the garnet is orange in color or peridotite where the garnet is purple in color. Once I've made those identifications I'm then can to proceed to crack the diamonds to release the inclusions which are then dissolved to extract the trace elements that we used for dating. Prior to introducing the samples into the mass spectrometer.

10 11 20 00: Commentary

Steve and his team have already studied more than 3000 diamonds. For the moment, all the analyses concur: the stones are 2.9 billion years old. The Kimberley region does indeed lie on one of the oldest of African lands, the skeleton of the future continent.

<u>Sequence 2 – A crater 250 km wide</u>

10 11 39 00: Commentary

After it was formed, this first African territory grew little by little. Other islets of the Earth's crust collided with the craton, and joined one to another over millions of years.

But 2 billion years ago, a sudden and tremendous impact jolted the entire region.

10 12 01 00

It took place in South Africa, where the little town of Vredefort is today located.

10 12 14 00

Here, the landscape looks as though it's been tousled by a hands of giant.

10 12 26 00

Geologist Roger Hart has studied these rocks for years, decrypting the clues of the ancient disaster.

10 12 48 00

Roger Hart

The rocks here are granites. This is a rock that is common throughout the world.

But here in Vredefort this is another component that indicate to us that something catastrophic has happened here. What we see here, all these black veins around the bouldersof granites which are knows pseudotachylite breccias.

The composition of pseudotachylite is excactly the same as a granit. What we now believe is that pseudotachylite in the breccias were formed trough heat and friction.

These pseudotachylite breccias are generally regarded as indicative of the impact processes. And we've found most craters worldwilde but in Vredefort they are particularly well developed suggesting to us that Vredefort is a particularly large and violent impact.

10 13 54 00: Commentary

Such a violent impact could only be caused by an object fallen from space:

10 14 01 00

A gigantic meteorite, more than 10 kilometers in diameter.

10 14 07 00

Roger Hart

What happens when a meteorite of this size strike the earth? Well firstly, you form a big hole. Secondly this is immediately followed by a rebound uplift in the center of the crater. Mostly when you throw a stone into a pound of water and you get the same uplift. So if the criteria was 30 km deep you have a central uplift of about 30 km.

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10 14 43 00

Roger Hart

What happens to the meteorite? Well it generally vaporises specially in the crater of this size and with this amount of energy. How big are they? What kind of explosion do they form? Well in

general if you took all the world's nuclear arsenals and put them together that doesn't even begin to compare with explosion that formed at the time of Vredefort.

10 15 14 00: Commentary

The meteorite burrowed a crater more than 300 kilometers wide and 30 kilometers deep. It's one of the largest and oldest craters on the planet.

10 15 36 00

A lesion left by one of the most devastating disasters in Earth's history, the crater gives scientists unique access to the geological structure of the sub-soil.

10 15 52 00

Roger Hart

The rock that we see here, are sediments. quartzites to be exact. Quartzites like these are coming throughout the world. In a normal sense, sediments and Quartzites, generally formed in layers, horizontal layers. Normally these sediments rest on basement rocks such as granites. And the granites normally rest on mantle but not here in Vredefort. These quartzites that have been turned vertical. In fact what time of us believe, is in entire 36 km sequence of rocks have been turned on age exposing a vast section of the earth crust of view. Now, What is interesting for scientists, is that this section give us the opportunity to study the earth crust through geological time. What we believe is that, these quartzites over XXX granites in that very center of Vredefort we possibly have a mantle rocks exposed. So we are talking a sequence in time going back to almost 3.6 billions years the age of the rocks in the center. This is a very interesting concept for geologists because it allows us to study the chemistry, the tectonics and the evolution of this crustal section in time and in space.

10 17 18 00: Commentary

A veritable paradise for geologists, the Vredefort crater is a place unlike any other on Earth. Here, scientists have access to 3 billion years of evolution on a single outcrop. They can thus better comprehend the structure of the rocks that make up our planet.

Roger has dedicated his career to the study of this meteorite. Even though it's not strictly speaking a tectonic phenomenon, its impact had the same effect. It transformed the face of the entire region.

10 17 52 00

Roger Hart

Mountains can be formed in many ways, we know that mountains can be formed, for example like the Alps through tectonic processes, we know that volcanoes form mountains like Vesuvius but not here. These mountains are formed by a meteorite impact.

Meteorites are visitors from out of space that pieces of rock that are moving through our solar system and randomly impact anything that gets on their way. For example, you look at the moon, the moon is covered by meteorite impact craters. On earth we don't have that many, the reason you don't get that many craters on Earth, is the Earth, unlike the other planets which are dead, Earth is dynamic, Earth is living, Earth has plate tectonics, plate tectonics destroy craters, Earth has erosion, Earth has water. The important point here, Earth is a dynamic living planet.

Sequence 3 – The heart of Africa: a page of history

10 18 53 00: Commentary

Following this dramatic encounter with an object fallen from space, Africa experienced other upheavals.

10 19 05 00

The land masses of the southern hemisphere continued to converge, until nearly 800 million years ago, they at last formed a 'super-continent': Gondwana.

10 19 17 00

Even today, the landscape tells the story of Gondwana's birth, a major episode in Africa's history.

10 19 28 00

The Fish River canyon is located in Namibia.

10 19 40 00

At 160 kilometers long and 27 kilometers wide in certain parts, it is by far the largest canyon on the continent.

10 19 54 00

This sumptuous scenery is one of French scientist Olivier Dauteuil's work sites.

10 20 04 00

This researcher's goal is to retrace the geological history of the region in its smallest detail.

10 20 19 00

Olivier Dauteuil

We're here before a magnificent landscape that was sculpted by the Fish River, there on the valley floor. This river dug through a series of rocks making it possible to now study their history and also creating this magnificent scenery. This history begins about 1 billion years ago.

So, what are we looking at? At the bottom of Fish River, near the valley, we see layers that incline, like this. Those are rocks that have been deformed, metamorphosed, and heated. They formed during a collision which produced a mountain range.

So imagine above us was a huge mountain range with very high peaks… several thousand meters of altitude like for example, the Alps or the Himalayas. And it was those rocks that made up the continent we call Gondwana.

10 21 19 00: Commentary

When they collided, the rocks of the former African and American continents crumpled to the point of forming a gigantic mountain chain.

Water and wind then eroded the rock. Several tens of millions of years later, the mountain peaks disappeared and the sea pushed in to this area.

10 21 38 00

Thus began a long phase of deposits on the sea bed: sediments formed successive, even layers of strata.

But a little more than 500 million years ago, a new tectonic thrust progressively pushed up the ground in the region.

10 21 54 00

The sea then receded, revealing the multi-layered geological strata that the river would cut through bit by bit.

10 21 56 00

Olivier Dauteuil

What we see clearly are these horizontal layers, which means that for about 500 million years, nothing has happened in this region.

10 22 06 00: Commentary

From the canyon's ridge, Olivier Dauteuil can thus contemplate 1 billion years of West African history.

10 22 21 00

At the deepest levels are vestiges of the collision of the continental plates during Gondwana's formation.

10 22 33 00

Above, hundreds of strata are stacked up, revealing almost imperceptible variations.

10 22 43 00

Tirelessly, the scientist criss-crosses the area and gathers a multitude of specimens from the rocks.

10 22 53 00

Their analysis will one day make it possible to describe the infinitesimal movements that stirred the region until the present day.

10 23 00 00

Olivier Dauteuil

It's interesting to understand why, in a zone that is known to be stable, we find quantifiable vertical movement, even if it's minimal. It's moved about 1400 meters in 500 million years, enough to mold the entire landscape we see in Africa today.

10 23 17 00: Commentary

The Fish River region is one of Africa's best to tell the story of the on-going voyage of the continents. 700 million years ago, it was here that the future South American plate collided with Africa.

10 23 32 00

During the same period, another phenomenon was taking place further north.

A small fragment of land also collided with Gondwana…

<u>Sequence 4 : The making of Gondwana – Africa at the center of a supercontinent</u>

10 23 44 00: Commentary

Traces of this event can still be found today in the Sultanate of Oman on the Arabian Peninsula.

10 24 04 00

Sonia Rousse and Mélina Macouin are geologists at the Institute for Research Development in southwestern France.

10 24 12 00

Their mission: gather the proof of this ancestral collision that dates back 700 million years.

10 24 18 00

Their research zone is located on the coast of the Arabian Sea.

10 24 23 00

In the heart of these desert landscapes, they seek out veins of a specific type of igneous rock, called dykes

10 24 39 00

Melina Macouin

Oh look! You can see it there! Yes.

It crops out nicely.

10 25 02 00

Sonia Rousse

So we stopped here to look at this large dyke. Which is actually an igneous intrusion that comes from the earth's mantle. Magma from the depths, moved through the crust and changed composition as it crossed through the earth's crust. Forming a vertical intrusion that appears on the surface.

10 25 21 00: Commentary

In building this road, bulldozers exposed several dykes… But they also changed their structure. This forces the geologists to find another site to collect samples from.

10 25 34 00

These veins of igneous rock formed 700 million years ago, during the violent collisions of the tectonic plates.

10 25 45 00

Inside these rocks, miniscule crystals containing iron can be found. It's precisely this metal that is of interest to the scientists.

10 25 56 00

The Earth is in fact surrounded by a powerful magnetic field. Its inclination varies at every point on the globe.

10 26 03 00

When the dykes were formed, the iron they contained literally became magnetized. The crystals were thus oriented precisely to the earth's magnetic field at that time.

10 26 13 00

The rocks then moved around the planet's surface as the tectonic plates moved.

10 26 19 00

But the crystals in the dykes remained frozen in their original position.

10 26 25 00

In this way, they memorized, as it were, the localization of the rock – and thus the continent – at the moment of its formation. We call this, paleomagnetism.

10 26 39 00

To determine the ancestral position of this region, the scientists gather numerous samples along the coast.

10 26 55 00

Melina Macouin

So in the lab, we'll measure the paleo-magnetic direction which will give us an inclination and we'll convert that into latitude. So we'll know at what latitude these dykes were formed.

Melina Macouin

So… 340.

Melina Macouin

And 8 and a half.

Melina Macouin

Our hope is that the samples collected during this mission will give us a position for time T. So not the whole story but just the date of the intrusion of these dykes. Somewhere around 700 million years ago.

10 27 37 00: Commentary

Sonia and Melina carefully note the GPS position and most importantly the inclination of each specimen gathered.

10 28 04 00

In the laboratory, the rock fragments are placed in a room that is perfectly insulated from exterior magnetism. An instrument then measures the orientation of the crystals inside the rock.

10 28 16 00

Preliminary results seem irrefutable: 700 million years ago when the dykes were formed, Oman was located at a latitude of 30 degrees south. This region thus was undoubtedly part of Gondwana.

10 28 30 00

With the arrival of the future Arabia, all the pieces of the African puzzle began to come together.

Sequence 5 – Africa, the heart of a supercontinent

10 28 40 00: Commentary

But in the southern region of the continent, near Cape Town, there's another event in the works…

10 28 53 00

In the heart of the Cape Peninsula, the Table Mountain is the most famous vestige of a by-gone collision.

10 29 06 00

The plate that will later become Latin America enters into contact with West Africa. But in pivoting on its axe, it also butts up against South Africa.

10 29 38 00

For John Compton, researcher at the University of Cape Town, this area is like home. He's roamed the cliffs of this massif (pronounced in English as in French) for many years in search of new clues to the history of its formation.

10 30 10 00

John Compton

Table Mountain is one of a much larger mountain chain, and this larger mountain chain formed at the time when Gondwana was forming. So from the west we had South America, the continent colliding with Africa. This produced large compressional forces of the collision of the two continents. So in that situation when two continents collide, you have tremendous physical force of the two continents and those tend to crumple and thicken in the crust.

10 30 47 00: Commentary

When the 2 continents moved closer together, the oceanic plate that separated them dove into the depths.

Then the ocean disappeared and the land masses were left face to face.

10 30 59 00

They collided, and then continued to press against one another to the point of deformation… Between the 2 plates gigantic reliefs then appeared.

10 31 09 00

In the depths granitic magma formed.

10 31 20 00

John Compton

So the Cape Fold Belt Mountains, of which kept Table Mountain is a part, formed from those collisions. So the northern branch, to the north of us, formed from when South America collided with Africa, the branch that goes to the east to Port Elisabeth formed with Antarctica collided from the south. So these two large continents joined Africa and in that formation all these rocks were crumpled up and formed into this Fold Mountain Belt.

10 31 55 00: Commentary

The Cape Fold Mountains run the entire length of the South African peninsula. They thus demarcate the zone where the continental plates collided.

10 32 07 00

In the foothills, the violent collisions left other traces.

10 32 15 00

Under pressure, the Earth's crust tore apart in several areas, allowing magma to rise to the surface.

10 32 30 00

As it cooled, this magma turned into granite…A rock that is found all over the coast nowadays.

10 32 50 00

John Compton

Behind me, we can see Lions head, a famous monument in Cape Town. We can see the slopes of granite, that same granite rock is exposed here along the coast. And this granite extends from here all the way south here on cape point. The very large body, a large (pluton) of granit has been in place here. You can tell that because it's very light in color and that is very nice large crystals of (those parts) in it that make in lightening color and it has intruded into this darker rock that I'm walking over now. And this darker rock is known as the Malmesbury Group and was here before the granite intruded into it.

So we can see this mixture or the contact zone between the granite rock to the south and this Malmesbury rock to the North. So I'm standing on that part of the contact zone here which includes this light colored large (felt parts) crystal granite and these ribbons of dark shell from the Malmesbury.

So this sea point contact is famous as both example of deep earth processes; this is probably what's happening about 5km below the surface in the time, it is since been exposed here through the long processes of waving of erosion and we now see the surface.

So What happened here was approximately 540 million years ago this granite was intruded into and placed into the Molnes peri group and the reason why that's happened was because at that time there was no Atlantic ocean here but there was an ocean like the Altlantic called the

Adamastor ocean and instead of spreading apart as the Atlantic is today the Adamastor ocean was closing. So what was happening was the oceanic crust was getting subducted beneath the African continent and what we're seeing here is a sort of freeze-frame image of that intrusion of that molten rock into the solid existing Malmesbury rock. And that meant that we had the closing of Adamastor ocean and the continents were then joined together to make for a larger supercontinent, Gondwana.

10 36 06 00: Commentary

500 million years ago, the formation of Gondwana was complete.

10 36 13 00

All the continental plates of the southern hemisphere were pressed up against one another. As for the future African continent, it could be found at the center of this supercontinent.

10 36 29 00

John Compton

So if you look to the west we have the Atlantic ocean basin, very large ocean basin that is formed over the past 130 million years. At that time, the South America, Argentina, Buenos Aires was right next door to us here in Cape town. Until the South we have Antarctica and then further to the East we have Australia, Madagascar and India. And all those continents once used to all be together as well as part of Gondwana

10 37 16 00: Commentary

Even after the birth of the supercontinent, tectonic movement didn't stop.

Slowly, Gondwana drifted across the surface of the globe…

10 37 26 00

Thus the tip of the African plate found itself… at the South Pole. The Earth entered into a phase of climatic cooling, and a large portion of Gondwana was covered in a thick layer of ice.

<u>Sequence 6 – Africa at the South Pole under the ice</u>

10 37 52 00: Commentary

In the Damaraland region of Namibia, this period of glaciation left traces even in the heart of the savannah.

10 38 06 00

Several years ago, Nicole Ulrich discovered astonishing fossils here…

10 38 12 00

Hundreds of petrified trees, perfectly preserved, for millions of years.

10 38 31 00

Nicole Ulrich

Oh this is fascinating! Look here. It looks like a piece of wood. But it is actually a big piece of rock. It is a rock because of the process of petrification. These trees once grew in a cold environment nearly 3 hundred million years ago, they were uprooted maybe by water, by a big float and they were very quickly covered by a lot of sediments and by this process they were cut off from oxygen and they could not rooted! And over geological time, in a very slow process the wood material was replaced by woods that crystallize in the sediment. This area, here, is regarded, as the largest assembly of fossilized wood in Southern Africa. If you look at this example, it is a perfect example. The structure, here, looks like a back from a present dead tree. All the fine line are very well preserved. This is absolutely amazing.

10 39 36 00: Commentary

In analyzing these petrified trees, specialists noticed they were species typically found in Nordic countries.

When they grew here, this area resembled parts of Canada…

10 39 50 00

The climate was cold and humid, a far cry from Africa today.

These fossils are thus irrefutable proof that 300 million years ago, Gondwana was located at the level of the South Pole.

10 40 03 00

But some time later, the supercontinent once again moved north.

10 40 08 00

It's the end of the Ice Age. Temperatures rise, the ice melts and enormous quantities of water sweep through the entire region.

10 40 18 00

Nicole Ulrich

Here we have 3 examples of big fossilized trees. These trees are all situated more or less parallel to each other that means that they have been transported by river, in an old river channel. Also the sediment around here that we can find, indicate a river sediment.

10 40 40 00

Nicole Ulrich

These trees give even evidence of plate tectonic movements. Two hundred and seventy million years ago in Namibia, they were growing in cold climate, which indicate that the whole continent was situated further to the South Pole. Then due to plate tectonics, the continent have moved away from the South Pole and from the Arctic climatic condition and today we have hot desert conditions in Namibia.

10 41 03 09: Commentary

Today, these trees frozen for eternity, tell us of Gondwana's voyage across the surface of the globe, and most importantly, of the intense climate changes the region encountered in the past.

Sequence 7 – Africa splits apart

10 41 26 00: Commentary

But the era when Africa is the center of the world comes to an end. Tectonic forces tirelessly continue to mold the face of our planet.

10 41 42 00

After millions of years of living as a unit, the continents go their separate ways. Each one evolves in an entirely different fashion from the others.

10 41 55 00

India will collide with Asia, and thus create the Himalayas, the highest mountain range in the world.

10 42 08 00

Australia will become its own unique ecosystem, an island-continent isolated from the rest of the globe.

10 42 20 00

Antarctica wanders to the South Pole and transforms into a frozen territory.

10 42 30 00

South America veers west. Becoming home to the longest mountain range, the densest forest, and the mightiest river on the entire planet.

10 42 45 00

Less spectacularly, Madagascar moves barely 400 kilometers off the African Coast. But over the course of centuries, the "Great Red Island" evolves into a distinct and unique world all its own.

Sequence 8 – Madagascar's isolation

10 42 57 00: Commentary

In the northwest of the country, in Mahajanga, a young researcher is studying the exact phase when Madagascar separated from Africa.

10 43 17 00

Karen Samonds is a biologist at Northern Illinois University in the United States.

10 43 24 00

For more than 10 years, she's travelled here each summer to study fauna in this region. Her goal: learn how and during which period animal species arrived on the island.

10 43 45 00

In the field, her team methodically excavates the soil in search of fossils. And tiny clues buried in the ground, which recount in detail Madagascar's history.

10 44 06 00

Karen Samonds

So Madagascar was part of Gondwana, so 200 million years ago it was connected to the rest of the landmasses. And it was actually between Africa on one side and India so it was wedged between the two. And about 165 million years ago it was actually separated from Africa. So even now we think of Madagascar has being closed to Africa, (It several testary was that landmass long long time ago) So remain connected to India and 120 million years ago it moved approximately to where it is today. It was only 88 million years ago that it became completely isolated and broke away from india. And then India went North through the Himalayas to form the Himalayas So Madagascar has been an island for really only about 90 million years. And this is a long period of time that is much older than a lot of the groups that lived there have thought to have evolved.

10 45 06 00: Commentary

The animals living on the island reflect this very distinctive geological history.

10 45 13 00

Separated from Africa and Asia for millions of years, Madagascar has become a singular ecosystem, home to dozens of species that exist nowhere else on Earth.

10 45 27 00

Karen Samonds

Madagascar has some of the most unique and bizarre animals on the planet. And one of the most unique things about Madagascar is the fact that almost all the animals that are found in

Madagascar are only found there so no place else on earth. So, one of the most famous groups that people associate with Madagascar is lemurs. Lemurs are a very interesting group of primates. There is more than an hundred species now recognized in Madagascar and they're only found on the island so they're completely endemic. That was interesting about lemurs is that people have hypotheses how can there be primates in Madagascar when the group primates which is found in another parts of the world is actually younger than the separation. So People are very struggled with this question if they were stranded when the island were separated and if they didn't come across from Africa in some way and how did they get here.

10 46 19 00: Commentary

Madagascar's climate and soil type aren't conducive to the preservation of fossils. Karen and her team thus instigate a multitude of dig sites in the search for new clues.

10 46 38 00

For the moment, given insufficient data, the origin of lemuroids on the island of Madagascar as yet remains unknown.

10 46 47 00

Today, 3 hypotheses vie to explain the arrival of the first individuals.

10 46 54 00

The first is that these animals appeared a very long time ago… well before the separation of India and Africa.

10 47 04 00

The second hypothesis is that with changes in sea level, an ephemeral land bridge formed between Africa and Madagascar, allowing the primates to cross dry land.

10 47 28 00

The final theory is the most astonishing: Lemurs arrived from Africa on makeshift rafts, carried by the sea and pushed by storms.

10 47 55 00

Karen Samonds

Well we know that last, even the last ten years we've seen some storms bounds between Africa and Madagascar even just a couple of days back and forth. And some of actually reconstructed that you could make a journey and last on 30 days if you were stranded on a raft. So when we talk about raft it could be something like this or even something much bigger. In fact we see another parts of the world people of witnessed giant masses of vegetation even 1 or 2 km long. But they were carryng trees and animals and even a little pocket of a fresh water. So in fact

there’s actually many different types of ways that these animals could have come to Madagascar.

10 48 38 00: Commentary

The raft theory seems implausible… And yet today is it considered the most probable hypothesis within the scientific community.

10 48 51 00

Karen Samonds

Some of said that’s crazy the chances of success are very small but on the other side, is said well that’s true it’s very small but if you have say 100 million years or 200 million years, that even something that has a very small chance is sure to be successful. There has been a big debat about whether it's actually a reasonable explanation but we've really had to reconsider the fact that most of the group we see appeared or evolved after Madagascar was already an Island. So right now that's actually the most supported hypothesis to explain their presence.

So the best evidence are (??weese) to be direct evidence and the best direct evidence is to find fossils of the right age.

10 49 43 00: Commentary

Perhaps one day we will discover how these primates, found nowhere else on the planet, took up residence on this sister island of the African continent.

But already their mere presence demonstrates how greatly plate tectonics can influence the destiny of a region and the species that live there.

10 49 59 00

Separated from the other continents some 90 million years ago, Madagascar has become a distinctive ecosystem, very different from that of Africa.

<u>Sequence 9 – Conclusion</u>

10 50 12 00: Commentary

But even today, emerged lands continue their perpetual voyage across the Earth’s surface.

10 50 19 00

Africa as we know it represents just an ephemeral phase in the history of our planet.

10 50 27 00

A giant scar cuts across the eastern face of the continent. The Great Rift.

10 50 36 00

From Mozambique to Turkey, little by little it tears Africa in two.

10 50 44 00

In a few million years, a new sub-continent will be born: Arabia.

10 50 54 00

In parallel, Africa as a whole continues to move north.

10 51 00 00

Its collision with Europe and Asia will thus take place tomorrow… on a geological time scale.

10 51 08 00:

End credits