



# FLOOD BASALT ERUPTIONS

1  
00:00:03,128 --> 00:00:03,920  
A new NASA

2  
00:00:03,920 --> 00:00:07,716  
climate simulation suggests  
that extremely large volcanic eruptions

3  
00:00:07,716 --> 00:00:12,012  
called flood basalt eruptions  
can significantly warm Earth's climate

4  
00:00:12,012 --> 00:00:12,846  
and devastate

5  
00:00:12,846 --> 00:00:16,349  
the ozone layer that shields life  
from the sun's ultraviolet radiation.

6  
00:00:17,017 --> 00:00:22,272  
Unlike brief, explosive volcanic eruptions  
that occur over hours or days,

7  
00:00:22,480 --> 00:00:25,608  
flood basalts are regions  
with a series of eruptions, perhaps

8  
00:00:25,608 --> 00:00:29,070  
centuries each, and occurring  
over periods of hundreds

9  
00:00:29,070 --> 00:00:32,490  
to thousands of years,  
sometimes even longer.

10  
00:00:33,366 --> 00:00:37,537  
Some happen at about the same time  
as mass extinction events, and many

11  
00:00:37,537 --> 00:00:41,249

are associated with extremely warm periods in Earth's history.

12  
00:00:41,583 --> 00:00:45,712  
Researchers used the Goddard Earth Observing System Chemistry Climate Model

13  
00:00:46,171 --> 00:00:48,798  
to simulate one such flood basalt eruption.

14  
00:00:49,549 --> 00:00:52,802  
The four year long phase of the Columbia River basalt

15  
00:00:53,136 --> 00:00:57,932  
that occurred between 15 to 17 million years ago in the Pacific Northwest,

16  
00:00:58,933 --> 00:00:59,476  
the model

17  
00:00:59,476 --> 00:01:02,353  
calculated the effects of the eruption on the troposphere,

18  
00:01:02,729 --> 00:01:06,941  
the lowest layer of the atmosphere with most of the water vapor and weather

19  
00:01:07,067 --> 00:01:10,236  
and the stratosphere that is mostly dry and calm.

20  
00:01:11,071 --> 00:01:14,616  
Scientists expected to see intense cooling in simulations.

21  
00:01:14,741 --> 00:01:18,578  
However, they found that a brief cooling

period of about two years

22

00:01:18,912 --> 00:01:22,207

was overwhelmed  
by an intense warming effect.

23

00:01:22,874 --> 00:01:26,252

In the simulation,  
the Amazon and East Central Australia

24

00:01:26,294 --> 00:01:29,464

reached monthly mean temperatures  
of 49 degrees

25

00:01:29,464 --> 00:01:32,258

Celsius in the Arabian Peninsula.

26

00:01:32,675 --> 00:01:35,929

July mean temperatures were equal to  
or exceeded

27

00:01:35,929 --> 00:01:39,015

55 degrees Celsius

28

00:01:39,015 --> 00:01:40,934

in the central United States.

29

00:01:40,934 --> 00:01:44,604

There were extreme  
monthly mean temperatures equal to

30

00:01:44,646 --> 00:01:47,107

or exceeding 40 degrees Celsius

31

00:01:49,275 --> 00:01:51,611

the simulations  
predicted a reduction in the ozone

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00:01:51,611 --> 00:01:54,155

by about two thirds over  
global average values,

33

00:01:55,740 --> 00:01:58,201

which is roughly equivalent  
to the whole planet

34

00:01:58,451 --> 00:02:02,705

having an ozone thinning comparable  
to a severe Antarctic ozone hole.

35

00:02:03,790 --> 00:02:04,791

Eruptions emit

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00:02:04,791 --> 00:02:07,335

sulfur dioxide gas into the atmosphere

37

00:02:07,961 --> 00:02:10,421

which converts to solid sulfate aerosols.

38

00:02:11,923 --> 00:02:14,467

These aerosols reflect visible sunlight,

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00:02:15,218 --> 00:02:17,262

which causes the initial cooling effect

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00:02:17,971 --> 00:02:20,640

but also absorb infrared radiation,

41

00:02:21,057 --> 00:02:24,060

which warms the upper atmosphere.

42

00:02:24,060 --> 00:02:27,021

In the simulation,  
most portions of the atmosphere

43

00:02:27,355 --> 00:02:30,108

were almost completely opaque to the sun.

44

00:02:32,402 --> 00:02:35,029

Warming this region of the atmosphere  
allows water vapor

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00:02:35,405 --> 00:02:39,534

that's usually near the surface  
to get mixed into the dry stratosphere.

46

00:02:40,243 --> 00:02:45,039

Water vapor is a greenhouse gas that emits  
infrared radiation to warm the planet.

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00:02:45,665 --> 00:02:50,128

In the simulation,  
there was a 10000% increase

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00:02:50,128 --> 00:02:53,131

in stratospheric water vapor

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00:02:53,715 --> 00:02:57,427

These flood basalt eruptions  
also appear to have been common on other

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00:02:57,427 --> 00:03:01,598

terrestrial worlds in our solar system,  
such as Mars and Venus.

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00:03:02,765 --> 00:03:05,643

Although Mars and Venus  
may have had oceans of water

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00:03:05,643 --> 00:03:09,355

in the distant past,  
both are currently very dry.

53

00:03:10,648 --> 00:03:13,276

Scientists  
are investigating how these worlds lost

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00:03:13,276 --> 00:03:16,321

most of their water  
to become inhospitable for life.

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00:03:17,155 --> 00:03:20,783

And if the predictions of this simulation  
are correct, extensive flood