



## Earth and Life

*Tibet: the Raymo-Ruddiman Hypothesis*

### Voice Over

Tibet, the most dramatic physical feature on the face of the Earth. An arid plateau as large as Western Europe that includes over three-quarters of the Earth's land surface, more than four kilometres high; its southern ramparts, the Himalayas, soar to altitudes well over eight kilometres above sea level. South of the Himalayas there's a marked climate change. Verdant slopes are irrigated each summer by the monsoon. The Earth has seen nothing like it before, certainly not for a billion years, perhaps over its entire history. No wonder it's thought to have a major influence on the world's weather patterns.

### Caption:

Did Tibet cool the Earth?

### Caption: John Kutzbach, University of Wisconsin

The Earth's climate has been warm for hundreds of millions of years, a greenhouse Earth, then that Earth began to change, it began to get cooler, first slowly; by about forty million years ago there was ice in Antarctica and in Greenland, it got colder still, and then almost in the twinkling of an eye huge ice sheets began to form, eventually reaching depths of well over a mile. Why did that happen?

### Voice Over

The consequences of a vast high-standing plateau on changing global climate was first realised by Bill Ruddiman.

### Caption: Bill Ruddiman, University of Virginia

I was thinking that we might make a major contribution to solving the problem at the beginning of glaciation, partly because uplifted terrain gets cooler and partly 'cos it turns the winds in such a way that for instance there's a more northerly flow into North America, into the area where the glaciers grew, so it was a reasonable assumption that it might help promote glaciation.

### John Kutzbach

When Bill came along with the idea that perhaps mountain uplift was changing the wind patterns in the planet in a way that would promote glaciation and high latitudes bring cold Arctic air further south, this was an exciting idea to me.

### Voice Over

John Kutzbach is a climate scientist who experiments with computer simulations of the world's atmosphere. Bill Ruddiman's uplift idea suggested a new experiment. What effect did the rising of Tibet have on the Earth's climate? Kutzbach calculated the effect of Tibet at three heights. First, Tibet at sea level.

### John Kutzbach

We've got this box outline where the Himalayan Mountains in the Tibetan Plateau are so you can have that for reference. Then the colouring on here shows the rainfall patterns in the summertime and you see that's there just a little bit of rainfall here in South East Asia and over in Africa. Now if we advance this to our experiment with half mountains you see that things are beginning to happen. And then if we go to the full mountain simulation there's even a more dramatic change, very heavy precipitation on the south and south east corner of the Tibetan Plateau, what was South Eastern Asia, and very large dry area extending from the Middle East into the Mediterranean in North Africa.

**Voice Over**

But what are the physical causes of these changes?

**John Kutzbach**

If we had a low lying continent of this form you might get a very weak convection cell with rising air spreading out in the upper atmosphere and then air coming in from the surrounding ocean, perhaps producing a little bit of rain along the edges of the continent, but it just wouldn't be a very exciting circulation because there's nothing on this continent to really focus the heating of the sunlight. If instead we place a high plateau on a continent such as this all of a sudden the sunlight during the summertime has a real focal point for heating this high plateau, so you'd have very more active currents of air rising over this plateau spreading out, sinking and air literally rushing in towards the continent. In addition to the air coming in towards the continent the spin of the Earth makes the air more or less spiral in, the air coming in off the Indian Ocean spiralling in over the continent, banging into the Tibetan Plateau, being forced to ascend, producing violent thunderstorms along the face of the plateau.

**Voice Over**

What Kutzbach had found was nothing less than the Indian monsoon system. This was the direct consequence of the uplift of the Tibetan Plateau.

**John Kutzbach**

We had gotten results out of the computer here in Madison and I hopped on a plane with a lot of computer output and went to his lab in Vermont and we spread all of these things out and looked at them.

**Bill Ruddiman**

I remember still with a sense of delight sitting in my office and we took the results from the model, the general circulation model, and I came to a just a very different realisation, and I think in a way he may have as well, as to how beautifully the uplift of Tibet changes the distribution of moisture. It doesn't explain everything on the face of the Earth but it has a major effect on the patterns of wet and dry climate and vegetation from the mid-latitudes, not just on the plateau but well around the plateau upstream and downstream. There is also a model ended up explaining a little bit of almost everything except what we were after. There was really a very small cooling of the Arctic area and the areas where ice sheets must grow.

**Voice Over**

Although successful in many respects, the Ruddiman-Kutzbach model was not able to predict large-scale global cooling. They'd not found a likely cause for the Ice Ages.