Continents grew early in Earth's history

As biographers of the planet, geoscientists find the first chapters the most difficult to write. Although they can date the origin of the globe to 4.5 billion years ago, they know precious little about what the world looked like during its early history. A new study of Australian rocks has removed some of the mystery: It shows that continents sprouted quite rapidly on the young planet.

"Our results suggest that the continents could have been around much earlier than people currently think," says Paul J. Sylvester, a geochemist at the Australian National University in Canberra. He and his colleagues describe their findings in the Jan. 24 SCIENCE.

According to standard theories of Earth's development, continental rock of the type seen today didn't exist when the surface of the infant planet cooled following its fiery birth. Initially, the world's outer skin was basaltic rock—the same material that makes up the floor of today's oceans and erupts from some volcanoes. Over time, remelting of the basalt created rocks richer in silica, giving rise to the first continental crust.

The oldest known continental rocks date back to almost 4.0 billion years ago, indicating that continents had begun to form by that time. Geoscientists have long believed that the amount of continental rock has grown slowly since that date, with little or no destruction.

Sylvester and his colleagues addressed the question of continental growth by studying 2.7-billion-year-old basaltic rocks collected from western Australia. Because basalt arises from molten mantle, these rocks provide a glimpse of the ancient mantle's chemistry.

To gauge how much crust had grown by 2.7 billion years ago, they measured the ratio of two elements, niobium (Nb) and uranium (U). Geologists believe that Earth's mantle began with a Nb-U ratio of 30, the value measured in meteorites that typify the material from which Earth formed. Over the course of geologic history, the creation of continental rocks removed uranium and many other elements from the mantle and concentrated them in the crust. As a result, the mantle now has a Nb-U ratio of 47, the continental crust a ratio of 10.

Sylvester's team found that the ancient Australian basalts had a Nb-U ratio near 47, indicating that the mantle had already lost much of its uranium to continental rocks by 2.7 billion years ago. If such uranium depletion is typical of the mantle at that time, it implies that the continents must have grown quite quickly. Earth apparently took less than half its history to form a volume of continental rock equivalent to today's.

Much of this early crust must have disappeared, says Sylvester, because most continental rocks are younger. Erosion may have worn down the ancient continents and carried this rock into the oceans. From there, the material would have been dragged down into the mantle. New crust is constantly forming from the mantle, but the total volume of continental rock has remained the same for at least 2.7 billion years.

Before rewriting Earth's early history, scientists will need to study basalts from other parts of the world and from older periods to see whether they have Nb-U ratios similar to those found in western Australia, says Sylvester.

Samuel A. Bowring, a geologist at the Massachusetts Institute of Technology, cautions that researchers must also use other methods to resolve the question of continental evolution. "It's not clear to me that Nb-U is the panacea for understanding crustal growth," he says.

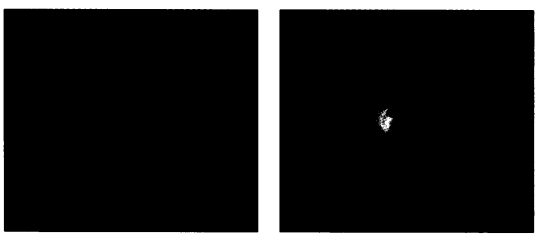
Despite such reservations, researchers remain excited by the prospect of filling in the details of Earth's early history. In the same issue of SCIENCE, A. W. Hofmann of the Max Planck Institute for Chemistry in Mainz, Germany, comments that "a crack has been made in one of the more intractable problems of understanding the history of the ground we live on."

—R. Monastersky

Sight for sore eyes: A glaucoma gene

A decade after they began studying a family plagued by an aggressive form of the eye disorder glaucoma, researchers have identified the mutant gene responsible. The scientists estimate that mutations in this gene may account for nearly 10 percent of all cases of glaucoma, including an estimated 100,000 in the United States.

"This is a treatable disease, and the hope is that this [discovery of the gene] will make it possible to find patients who need to be treated," says Val C. Sheffield of the University of Iowa College of Medicine in Iowa City.



Alward

A patient's left eye (left) has a healthy ring of optic nerve in the center; the right eye's nerve is damaged by glaucoma.

Sheffield and his colleagues had been looking for the gene since the mid-1980s, when a glaucoma patient named Alan Rogers walked into their offices and described how the disease had affected five generations of his family. By studying the DNA in blood samples from this family, the Iowa group narrowed its gene search to a small span of chromosome 1 (SN: 6/12/93, p. 376).

Glaucoma takes on many forms and is the second most common cause of blindness in the United States. Though it strikes most people in their 50s and 60s, some families, such as Alan Rogers', suffer from juvenile open-angle glaucoma, which can begin in the teens.

Like other glaucomas, this early-onset form results from elevated pressure inside the eye. The pressure damages the optic nerve, which carries visual information to the brain. Glaucoma patients suffer gradual loss of peripheral vision and can ultimately go blind.

"Glaucoma is a disease that's insidious. You often don't know you have it until it's really advanced," notes Janey L. Wiggs of the New England Eye Center in Boston. Caught early, however, glaucoma-induced vision loss can usually be prevented by surgery or drugs that lower pressure inside the eye.

In most cases of glaucoma, pressure builds up because the eye cannot properly drain away the clear fluid that circulates through the front of the organ, bathing the lens and cornea. This fluid normally flows out of the eye through a drainage system called the trabecular meshwork.

Several years ago, Jon R. Polansky and Thai D. Nguyen of the University of California, San Francisco isolated a gene that is active in the trabecular meshwork and the ciliary body, the ocular structure that makes the clear fluid.

Working with the UCSF pair, Sheffield and his colleagues have now found that this gene is located in the same chromosome 1 region they had already pinpointed and that it is mutated in several families with juvenile open-angle glaucoma, including Rogers'. In the Jan. 31 SCIENCE, they also report finding mutations in the gene, now called *GLCA1*, in a family beset with adult-onset glaucoma and in a few glaucoma patients with no obvious family history of the disease.

GLCA1 mutations may be too rare to make widespread gene testing practical. In glaucoma-prone families whose disease traces to chromosome 1, however, members would probably benefit from having the gene examined. "We can tell at birth who in that family is going to get glaucoma," says Wallace L.M. Alward of the University of Iowa.

Further research, he adds, should reveal *GLCA1*'s role in regulating eye pressure, suggest new ways to combat glaucoma, and point to genes causing other forms of the disease. *—J. Travis*