

viruses that their immune systems had once had under control. So Giorgi, Effros, and their colleagues decided to look at the telomeres of CD28⁺ CD8⁺ T cells from HIV-infected people to see whether they show similar signs of being worn down.

The answer proved to be yes. The researchers found that CD28⁺ CD8⁺ cells from seven HIV-infected adults had telomeres that ranged in length from 5.2 to 7.0 kilobases, while in the CD28⁺ CD8⁺ cells from five age-matched control subjects they ranged from 7.1 to 8.3 kilobases—a statistically significant difference. Indeed, the telomeres of the HIV-infected patients were as short as those in white blood cells of people who were 100 years of age or older. These data argue, Giorgi says, that in both HIV-infected people and centenarians, “the immune system has become worn out in the process of making the immune response, and it’s had to continue to call on the reserves until there’s nothing left.”

Hodes says that he has preliminary data confirming the telomere finding, as has Frank Miedema, an AIDS immunologist at the University of Amsterdam in the Netherlands, who plans to report his findings this week at the international AIDS conference in Vancouver, Canada. Hodes cautions, however, that much work has to be done before researchers understand the biological relevance of the telomere alterations. “It’ll be more challenging to directly demonstrate that telomere shortening has functional consequences in human disease,” he remarks.

But Miedema and others are even more interested in the relationship between telomere length and CD4⁺ T cells, HIV’s main target. “The \$100 question is what is happening to the CD4s,” says Miedema. The popular view is that HIV kills CD4s directly, which should compel the surviving CD4s to divide more frequently as part of the replenishment process. But Miedema’s preliminary data do not show shortened telomeres in CD4s from HIV-infected people. He argues that CD4s are not being rapidly destroyed, but rather they may be hiding out somewhere in the body and some unknown mechanism is “blocking” their release.

Virologist David Ho, head of the Aaron Diamond AIDS Research Center in New York and a main proponent of the direct-killing theory, isn’t convinced. Ho is also looking at telomere lengths in CD4 cells and says, “We’re certainly not ready to draw any conclusions at this point.” What’s more, he says, evidence from other sources says CD4s are being removed and replaced at a high rate.

Miedema doesn’t buy it, but allows that “there are a lot of things to sort out.” Whatever the outcome, telomeres are lengthening the reach of AIDS researchers—and promise to extend it even further in the near future.

—Jon Cohen

GEOLOGY

Long Ago, a River Ran Through It

Geologist Nancy Riggs collected rock samples for her most recent work in a shallow canyon tucked among dry, chaparral-covered hills outside Amarillo, Texas, where streams are apt to disappear in the dry season. But by precisely dating 17 microscopic zircon crystals from this area, the geologist from Northern Arizona University in Flagstaff and her colleagues have found that this semiarid region once held the thunderous headwaters of a giant river system. As the researchers report on page 97, these zircon crystals link the source of the river to its mouth, showing that 225 million years ago in the late Triassic, the river rushed 1500 kilometers across the supercontinent of Pangaea with all the muddy glory of the Mississippi.

The new work is the first to provide such a detailed map of an ancient river system and is helping to crystallize geologists’ view of Pangaea during the first creaks and groans of its breakup. The existence of the river, named the Chinle, is no surprise. But by linking its mouth to its source, the study confirms that much of western Pangaea was drained by this single river system. “This opens up a whole new understanding of that depositional basin and how it evolved,” says paleontologist Spencer Lucas of the New Mexico Museum of Natural History and Science in Albuquerque. And the work also demonstrates the utility of a new method, using zircon crystals, to decipher the geography of the past, notes Lucas.

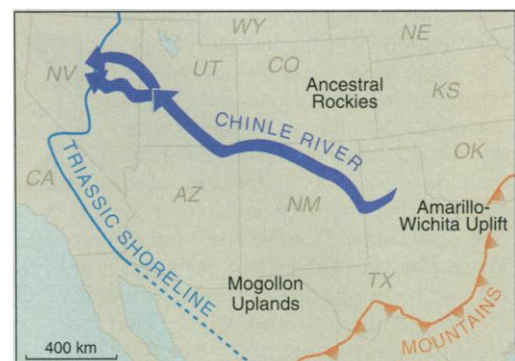
The study was spurred by what Riggs calls a “bizarre finding” made last year by her colleagues George Gehrels and William Dickinson, both of the University of Arizona. They identified Cambrian-aged zircon crystals, 515 million to 525 million years old, that had been incorporated into much younger sandstone in Nevada. The source of those zircons must have been a body of igneous rock of that same age—but there is no such rock anywhere on the western United States. So Riggs, Gehrels, Dickinson, and Tom Lehman from Texas Technical University in Lubbock began to hunt farther east for the zircon’s source.

Riggs and other geologists already knew that during the late Triassic the region was drained by some sort of river system, which could have eroded the zircon and carried it westward. The Nevada sandstone bearing the zircon closely matched other outcrops across Utah, Arizona, and New Mexico—all Late Triassic river deposits. But these far-flung beds were difficult to link, and so geologists debated whether one or more river systems connected them, and where the rivers originated.

Riggs realized that zircon crystals offered a

new approach to the problem. Unlike most minerals found in stream beds, sturdy zircon resists breakdown, and the uranium trapped within the crystals provides a way to date them, a maker’s mark by which the crystals could be traced to a distant source. Using the ratios of radioactive uranium and its daughter product, lead, Riggs and her colleagues matched the Nevada zircon, from near the mouth of the ancient Chinle river, to a distinctive Cambrian rock near Amarillo, Texas, one of the few places in North America with zircon of the right age. That rock had to lie near the river’s headwaters. And by including earlier data on sediment deposition and water flow from other outcrops, Riggs and her colleagues approximated the entire course of the Chinle, showing that it drained a vast area of the supercontinent.

Finding the river’s source also gives researchers a glimpse of Pangaea’s topography.



Triassic topography. The ancient Chinle River once roared from what is now Texas to Nevada.

By the Late Triassic the once mighty mountains of the Amarillo-Wichita Uplift, which had risen 300 million years earlier, were thought to have been eroded down to a plain. But the course of the Chinle implies that the Cambrian rocks in this area were indeed uplifted during the Triassic. “To get zircons flowing out of there, you had to have uplift of the source range,” says Lehman. He proposes that the initial opening of the Gulf of Mexico reactivated the faults there, raising the mountains once again and providing a pulse of sediment—including the zircons—that was swept down the Chinle River.

Riggs and others plan more studies of the river and its basin, but one thing is already clear: Geologists may not find much more gold in the hills of the southwest—but they can find zircon. And to a paleogeographer, that may be even better.

—Bernice Wuethrich

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