Abstractions

SENIOR AUTHOR

According to conventional wisdom, proteins are either completely folded or completely unfolded — the in-between steps all occur synchronously, making it impossible to examine them one by one. But Victor Muñoz and his colleagues at the University of Maryland, College Park, tested this idea with atom-by-atom analysis of protein folding. This was a great challenge, as the process involves protein purification, data capture using either nuclear magnetic resonance (NMR) or X-ray crystallography, and then a massive data crunch. Doing this for every step of the protein's folding process is costly and time-consuming. But, in doing so, this team found that sometimes the many atoms of a protein fold almost independently of one another, instead of all together (see page 317). *Nature* caught up with Muñoz to talk about how he set up the experiment.

Just how difficult was this work?

It was very time-consuming. The data initially looked a real mess. Instead of capturing one folding condition, we created many different conditions at different temperatures, and had to track hundreds of atomic signals that kept changing.

How did you know your approach was working?

When we looked at the atomic folding patterns and saw their complexity, it was what we had anticipated. But we still had our doubts. Was this complexity real, or were we looking at the wrong thing? Then we performed a beautiful control in which we obtained the conventional folding behaviour by simply averaging the hundreds of atomic signals in the protein. And when we saw the same thing in both low and high resolution, we were pretty sure we had it. It was very fulfilling and exciting.

What was different from what the conventional idea would have shown?

If proteins have to cross an energy barrier when they fold, the making of all the bonds that hold the atoms in their folded position would occur simultaneously, and therefore all atomic unfolding behaviours would be identical. What we saw is that pairs of atoms make bonds almost independently of the rest of the protein. It is the consolidation of the whole network of bonds that acts as a web, holding the folded structure together.

What's next?

We are developing theoretical predictions to determine which proteins show these properties. Small and helical proteins are more likely to conform to this type of behaviour, but we may find it is more ubiquitous than previously thought. ■

MAKING THE PAPER

Tim Wright

A huge rupture, detected in satellite data, leads to a gruelling camel trek.

The radar carried by the European Space Agency's Envisat satellite, which was launched in 2002, was designed to measure and map Europe's atmosphere, ocean and land — not to monitor earthquakes. But earthquake scientists, lacking other options, have appropriated such satellites for their own purposes. Last autumn, one research group was rewarded for its improvisation with startling data on a rarely seen tectonic phenomenon. The researchers' careful observation, combined with good fortune, earned them a trip to one of the hottest places on the planet.

On page 291 of this issue, Tim Wright, an Earth scientist at the University of Leeds, UK, and his colleagues detail the phenomenon. Over the course of about a week, a 60-kilometre-long section of a rift, located in Afar, Ethiopia, opened up by as much 8 metres. Molten rock percolated to the surface, pushing apart two tectonic plates. It's the largest magma-induced rupture ever examined with modern satellite technology. Such a splitting happens more often under water, where radar satellites cannot see, and where measurements are difficult and expensive to obtain.

When Atalay Ayele, a seismologist at Addis Ababa University, noticed 163 small earthquakes near Afar's Dabbahu dyke over the course of about 3 weeks, he contacted Cindy Ebinger, a geologist at the University of London's Royal Holloway, who, in turn, asked Wright to take a look at what Envisat might have detected. Wright was not expecting anything unusual. "We got the biggest deformation signal we've ever measured," Wright says. "It was absolutely extraordinary."

In January 2006, Wright and his colleagues set out on a gruelling 3-week expedition to the scorching desert of Afar. Their mission: to install 10 continuously recording global positioning instruments around the rift to measure the rapid ground motion resulting from the initial earthquakes.

The trip was not easy. After driving to within 20 kilometres of the rift by car, the researchers continued on foot and by camel. The Afari government, local tribal chiefs, and two sets of translators helped them reach the rift and negotiate an agreement to have local inhabitants guard their scientific instruments.

According to Wright, the data suggest that, in general, magma controls the rifting in the late stages of continental splitting. This rupture sets up stresses that Wright and his colleagues continue to monitor. "We now have a unique and timely opportunity to learn about Earth's physical properties, how magma moves through the crust and mantle, and how the crust grows at divergent plate boundaries," Wright says.

Wright would like to see NASA or the European Space Agency launch a new satellite that is specially designed to study earthquakes and volcanoes. That would lessen the dependence on ground-based instruments — as well as the camel treks sometimes necessary to install them. Longer-wavelength radar would do a better job of peering through vegetation. And better estimates of satellite orbits would allow geologists to measure motion in millimetres rather than centimetres. "We'd be able to see how the plates are moving and how the strain is building up before earthquakes and eruptions," says Wright. ■

QUANTIFIED **CROSSREF**

A numerical perspective on CrossRef.

In 2000, the world's leading scholarly publications formed an association to provide citation linking between peer-reviewed publications. It holds no full-text content, but rather offers online linking through digital object identifiers (DOIs). Using these numerical tags allows users to click from one citation to another. CrossRef gets around the open-access debate by linking only to citations. If users have access to those publications they can then access the article's full text. Nature Publishing Group (NPG) helped found CrossRef, and deposited CrossRef links to *Nature* in 2000. In 2001, NPG added 13 research and reviews journals, 28 specialist journals and several reference resources. Last month CrossRef released data showing how the network has grown and has been used.

1,657 is the number of publishers and societies participating in CrossRef.

65% is the proportion of non-profit publishers who have joined CrossRef.

1,066 is the number of libraries participating in CrossRef.

21,744,529 DOIs have been registered so far.

14,855 is the number of journals included in CrossRef.