Abstractions

FIRST AUTHOR

Clues about the evolution of certain objects in the Solar System are concealed in their rocky crusts. On Earth, for example, the continents and mountain ranges so familiar to us today are the result of billions of years of plate movements and collisions. Meanwhile, the Moon's crust is thought to have originated from low-density minerals floating to the top of a molten 'magma ocean' early in the satellite's history. By analysing the compositions of a pair of meteorites discovered in Antarctica, James Day, a postdoc at the University of Maryland in College Park, and his colleagues have identified a new mechanism of crust formation (see page 179). Day tells *Nature* why these rocks are in a class of their own.

What intrigued you about the meteorites?
They were found in 2006, and we began studying them at the end of 2007. We realized immediately that their compositions were unusual — for one thing, they contain a lot of feldspar, a type of mineral that crystallizes from magma. Feldspar is common in Earth's crust and that of the Moon, but it is rare to find such quantities in meteorites from other worlds.

Is the origin of these meteorites known?
At one stage geologists thought they might have originated on Venus or the Moon, but research has put that debate to rest. From their composition it's clear that these meteorites are very old; they formed at least 4.5 billion years ago, before Venus' crust. And their oxygen-isotope compositions are not like those of Earth or the Moon, which argues against that link. All the data we have so far are consistent with the meteorites originating from the asteroid belt.

What else is unusual about them?
When we looked at the platinum-group elements in the meteorites, we found them to be enriched in these precious metals, which are rare in the crusts of Earth and the Moon. This told us that the planetary body from which these meteorites came did not melt extensively. It has been shown experimentally that you can generate rocks just like these meteorites through partial melting of planetary-body constituents.

How common do you think this mechanism of crust formation might be?
That is a question we want to answer. Asteroids that have a lot of feldspar in their crusts are expected to reflect light from the Sun very brightly. We plan to compare spectral reflectance data for different asteroids with our data for these meteorites to see whether this type of crust formation was extensive in the early Solar System. ■

MAKING THE PAPER

Dorian McGavern & Jiyun Kim

A window onto the brain reveals the true villains in viral meningitis.

Our robust immune systems are equipped to conquer a host of infections, but sometimes the very cells sent to help cause catastrophic injury. This is a risk in viral meningitis, a relatively common infection of the cells lining the brain and spinal cord. In the process of tackling disease, immune cells sometimes damage blood vessels and cause them to leak, leading to convulsions and, ultimately, death. Until now, scientists believed that cytotoxic lymphocytes (CTLs), the killer cells that destroy infected cells, were causing this damage. But by obtaining a window onto the brain, Dorian McGavern at the Scripps Research Institute in La Jolla, California, Jiyun Kim of New York University School of Medicine and their colleagues show that CTLs merely recruit other immune cells that are responsible for wreaking the havoc.

To study the role of CTLs in viral meningitis, McGavern and his collaborators needed to find a way to see the CTLs in action in the living brain. Kim suggested performing a skull-thinning surgical technique in which a mouse's skull is painstakingly scraped until it is translucent enough for the brain to be visible through it, but still sturdy enough to provide protection for the underlying brain tissue. "It was ideal for viewing living brain tissue," says Kim. "Usually researchers do a craniotomy, a hole in the skull." But, she explains, that approach means exposing the brain to possible damage and inflammation.

The researchers then injected the mice with lymphocytic choriomeningitis virus, an infection that serves as a model of acute viral meningitis, and used two-photon microscopy to view CTLs in the animals' brains. The mice had been engineered so that these cells expressed a fluorescent tag. The authors were not expecting what they saw. "The vessels were breaking down," says McGavern. "There was heavy damage and they were leaking. But when we looked at what the CTLs were doing, they weren't associated with that vascular damage at all."

To determine what was causing the damage, the team first tested mutant mice deficient in various proteins typically produced by CTLs to kill their target cells. This essentially disarmed the CTLs, but to no avail. "Every time we knocked something out, we got the same result," says McGavern. "The mice still died."

The researchers discovered that, rather than causing vascular damage themselves, the CTLs were releasing chemoattractants that draw in myelomonocytic cells — a class of white blood cells that includes monocytes and neutrophils. Kim's live imaging showed that monocytes were tethered to the outside walls of brain blood vessels, apparently causing transient leakage throughout the brain. Neutrophils, conversely, lined up along the interior of the brain's blood vessels and burst through en masse, causing immediate injury (see page 191).

The finding that CTL-recruited myelomonocytes can produce the symptoms of meningitis has important implications. "The idea was, CTLs cause the damage and if you get rid of them, the damage goes away. The big surprise was that they weren't doing the physical damage; it was the cells they recruited. That was the twist," McGavern says. These recruited cells may thus be a better target in the treatment of infections from West Nile virus to herpes simplex, both of which can cause meningitis, as well as multiple sclerosis and other autoimmune disorders — all conditions that involve damage to brain blood vessels by immune cells. ■

FROM THE BLOGOSPHERE

A vast room of poster presentations greeted thousands of scientists at the American Geophysical Union's annual autumn meeting, which started on 15 December 2008 in San Francisco, California. One of the posters stood out, writes *Nature* reporter Rex Dalton at In The Field (http://tinyurl.com/a4oe48), because it described an 'experimental hydrology wiki', or collaborative website for researchers in the field.

The website, www.experimental-hydrology.net, was created by Theresa Blume of the University of Potsdam in Germany and Llja Tromp-van Meerveld of Simon Fraser University in Burnaby, British Columbia, with the aim of sharing knowledge about established and new methods of experimental hydrology. As well as helping people to avoid reinventing the wheel when planning measurements, and enabling users to learn from others' mistakes, the wiki should assist researchers in choosing appropriate methodology and equipment.

All experimental hydrologists are invited to contribute to the website, either by writing or contributing to an article, or by answering questions at the site's help desk. ■

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