SCIENCE NEWS of the week

Tibet Reveals Its Squishy Underbelly

Known as the Roof of the World, the vast Tibetan plateau soars so high above the steppes of Asia that for much of history it repelled many would-be invaders. Yet this lofty fortress rests on something quite insubstantial, according to new research.

An international team of investigators has discovered a layer of partially molten rock hiding beneath Tibet—an arrangement that makes the plateau the geologic equivalent of a jelly sandwich.

Geoscientists are seeking to understand Tibet and its flanking mountain ranges because these features represent the best available lesson on what happens when one continental plate rams into another, an event that has recurred countless times in Earth's past (SN: 7/14/90, p. 24).

"Continental collisions play a very big part in shaping the continental crust, and the collision between India and Asia is *the* example of this process going on today," says K. Douglas Nelson, a geologist at Syracuse (N.Y.) University and a participant in a large-scale collaboration between U.S., Chinese, German, and Canadian researchers.

Members of the project, called INDEPTH, report their findings in five separate reports in the Dec. 6 SCIENCE.

The multinational team spent three summers probing deep beneath the surface of south-central Tibet using a variety of geophysical techniques. Small explosions set off in boreholes sent out volleys of seismic waves that reflected off buried structures in the crust and underlying mantle. Measurements of magnetic and electric fields at the surface provided insights into the electric properties of buried rocks. By timing the speed of vibrations arriving from distant earthquakes, scientists gauged the stiffness of rock beneath the plateau.

All of the geophysical data point to the existence in the crust of a liquid-rich zone that extends from about 15 kilometers below the surface to an unknown depth, says Nelson. The INDEPTH scientists surmise that the liquid is partially molten rock in a layer underlying much of the Tibetan plateau.

If these conclusions are correct, they would help resolve a major debate about what is happening to the crust of India as it slams into Asia. Some scientists hold that the Indian plate, including its crust and mantle, is sliding beneath the Asian plate. Others have proposed that the two plates are meeting like cars in a head-on crash, with both getting squashed in the process. The new results suggest, however, that the collision is creating a melting pot where the lines between India and Asia blur.

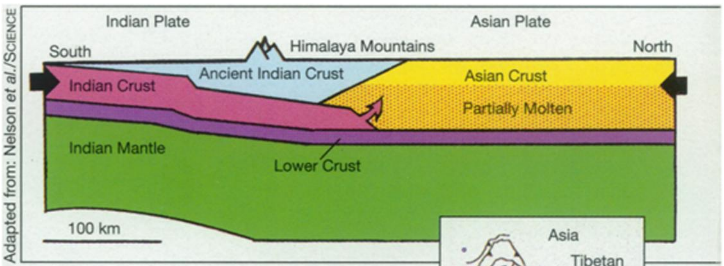
"You don't have an identifiable Indian crust or Asian crust beneath Tibet. It's all been mixed together. This is a new paradigm for a continent-continent collision," says INDEPTH participant Alan G. Jones of the Geological Survey of Canada in Ottawa.

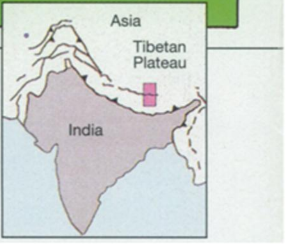
The partially molten layer formed, the scientists believe, during the last 40 million years as the viselike continental collision squeezed the Indian and Asian plates from the north and south. The mangled crust at the meeting point spread vertically into a plateau and went downward, where it grew warm enough to melt. This molten rock then migrated up to form a layer of liquid-rich rock in the upper crust.

The INDEPTH study represents an important achievement because "it's the first systematic view of what the Tibetan crust looks like," says B. Clark Burchfiel of the Massachusetts Institute of Technology. Yet the conclusions drawn from the study remain controversial because INDEPTH scientists investigated only a small part of the southern plateau and cannot tell how far the partially molten layer extends.

Nelson, Jones, and their colleagues plan to return to Tibet next summer to examine the crust farther north. If the mushy zone does underlie much of the Tibetan plateau, it would help solve a number of puzzles about the region. In particular, geologists have wondered why a plateau ringed by mountains is so flat. A soft underlying layer could not support any large mountains, thus explaining the lack of relief, says Nelson.

Lessons learned from Tibet can provide insights into much earlier continental collisions, such as the one 300 million years ago between North America and Africa, which constructed the Appalachian Mountains. — *R. Monastersky*





Adapted from: Nelson et al./SCIENCE

Colliding worlds: As India crashes into Asia, part of the Indian crust gets pushed down until it melts and mixes with the Asian crust in a partially molten zone under Tibet. Tibet's crust is twice as thick as normal crust. Inset shows area of study in pink box.

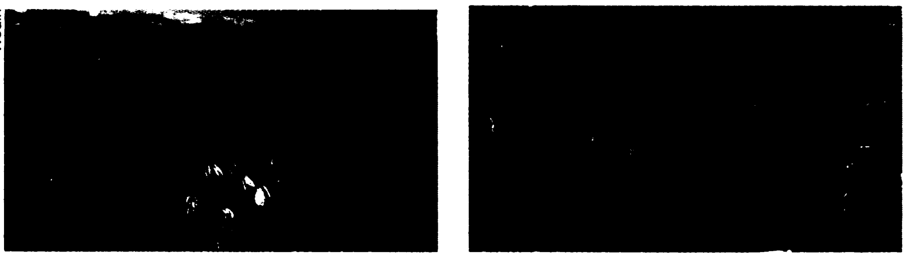
Pollution helps weeds take over prairies

Acid rain and agricultural pollution both spew nitrogen into the air. Though plants need nitrogen to grow, a new study finds that even small additions of this fertilizing pollutant can perturb the landscape.

In plots of Minnesota prairie to which ecologists applied nitrogen for 12 years, native grasses showed a dramatically impaired ability to compete against weeds that had immigrated from Europe centuries ago.

The nitrogen treatment triggered the terrestrial equivalent of eutrophication—algal blooms that result when aquatic systems are overfed, argues David A. Wedin of the University of Toronto. Just as unchecked algal growth can choke out native aquatic species, so overfertilized weeds began choking out native tallgrass prairie plants.

Like trees and shrubs, the interloping weeds belong to a class of plants, known as C3, that employs a slightly different scheme for using carbon dioxide than the native C4 prairie grasses. Overall, C3



Wedin

Adding nitrogen to prairie remnants (like those in the foreground, left) fostered the invasion of quack grass, a European weed, and its rise to dominance (right).

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