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SATELLITES SEE SHADOWS OF ANCIENT GLACIERS

EVANSTON, Ill. --- People in the central and eastern United States and Canada are used to the idea that the land they live on -- its variety of hills, lakes and rivers -- are left over from the great mile-thick ice sheets that covered the area 18,000 years ago.

They may, however, be surprised to learn that today, long after the glaciers melted, an international research team led by Northwestern University geologists using the Global Positioning System (GPS) satellites can "see" the land moving -- up to half an inch per year in some places -- as the earth rebounds in response to the ice that once pushed the land down.

Looking at data from more than 200 sites across the continent, the researchers discovered a spectacular pattern. While sites in Canada are rising, with those near Hudson Bay -- which is where the ice load was heaviest -- rising the fastest, U.S. sites south of the Great Lakes are sinking instead of rebounding.

Giovanni Sella, postdoctoral fellow in the department of geological sciences at Northwestern, will present the research team's results at 2 p.m. Wednesday, May 19, at the Spring Joint Assembly of the American Geophysical Union and Canadian Geophysical Union in Montreal, Canada.

"If you take the load off of road tar it won't pop back immediately," said Seth Stein, professor of geological sciences at Northwestern. "The earth is similar -- the ground continues to rebound as the viscous mantle flows back in. It is amazing that we can actually see this going on now. The glaciers continue to make their presence felt."

These small motions resulting from "post-glacial rebound" (GPS can detect motions as small as 1/25 of an inch per year) stem from the fact that the mantle below the earth's crust flows like a super-viscous fluid -- much, much stickier than road tar or maple syrup. The mantle is still flowing to fill areas underneath the places where the heavy ice sheets pushed out the mantle 18,000 years ago.

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Post-glacial rebound also affects the water levels of the Great Lakes. As the northern shores rise, water levels are steadily decreasing. Conversely, as the southern shores sink, water levels are rising. This impacts not only industries and homeowners along the shores of the Great Lakes but also the international management of water levels, dams and shipping.

These small motions may well be one of the causes of the mysterious earthquakes that occur in the center of the North American continent, including the St. Lawrence Valley, northern New England, and perhaps even the New Madrid earthquake zone in the central U.S., and along the Atlantic coast including Newfoundland.

"This idea has been around for a while, but until now, no one knew how large the ground movements were across the area," said Stein. "We believe they may have significant effects."

Another good reason to study post-glacial rebound is that it tells about the properties of the deeper earth. The initial GPS results indicate that the lower mantle (below a depth of 400 miles) is probably not much stiffer than the upper mantle, contrary to what has been often thought.

In addition to Sella and Stein, other members of the project include Timothy Dixon and Shimon Wdowinski from University of Miami; Michael Craymer from the Geodetic Survey Division of Natural Resources Canada; Thomas James and Stephane Mazzotti from the Geological Survey of Canada of Natural Resources Canada; and Roy Dokka from Louisiana State University.

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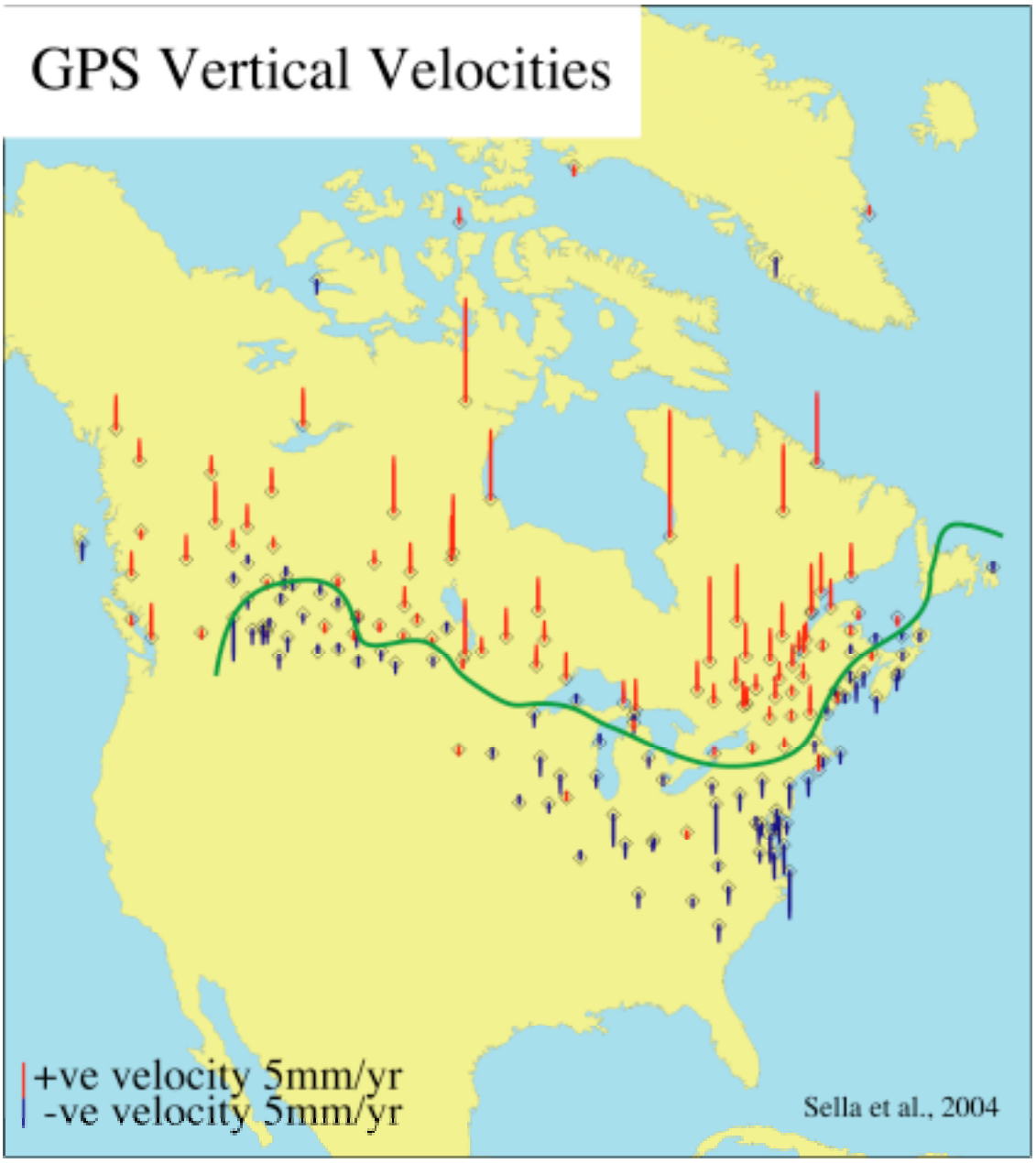
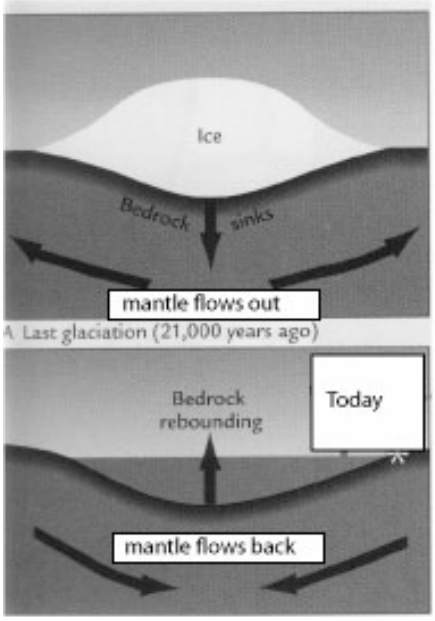


Today's post-glacial rebound, shown by GPS site velocities. Sites in red are going up; sites in blue are going down. Green line separates up and down motions.

BACKGROUND MATERIAL

Schematic of post-glacial rebound (after Ruddiman, 2001)



North American ice sheet (purple) at its maximum, 18000 years ago (University of Colorado)

For a WWW-movie of the ice sheet history over the past 18 thousand years (ka), see
http://jesse.usra.edu/archive/jesse01-300-01/ and run
http://jesse.usra.edu/archive/jesse01-300-01/iceage/time/namerica.mov

A good general reference on post-glacial rebound is
http://www.homepage.montana.edu/~geol445/hyperglac/isostasy1/

For work by the Geodetic Survey Division of Natural Resources Canada see
http://www.geod.nrcan.gc.ca/