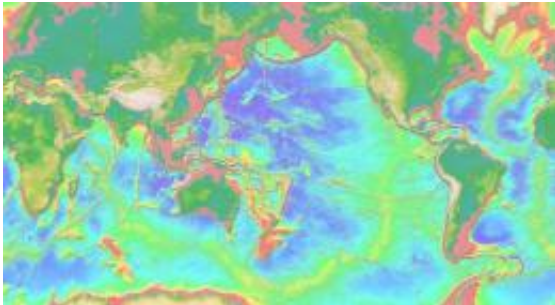


# Twenty-year study yields precise model of tectonic-plate movements

March 22 2010, by Jill Sakai

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A new model uses measurements from mid-ocean ridges (yellow and green) to precisely describe the movements of interlocking tectonic plates that make up about 97 percent of Earth's surface. Image credit: D. Sandwell/Scripps Institute of Oceanography and W. H. F. Smith/NOAA

(PhysOrg.com) -- A new model of the Earth, 20 years in the making, describes a dynamic three-dimensional puzzle of planetary proportions.

Created by University of Wisconsin-Madison geophysicist Chuck DeMets and longtime collaborators Richard Gordon of Rice University and Donald Argus of NASA's Jet Propulsion Laboratory, the model offers a precise description of the relative movements of 25 interlocking [tectonic plates](#) that account for 97 percent of the Earth's surface.

"This model can be used to predict the movement of one plate relative to any other plate on the Earth's surface," explains DeMets. "Plate tectonics

describes almost everything about how the Earth's surface moves and deforms, but it's remarkably simple in a mathematical way."

Tectonic plates are in constant motion, sliding past one another as they float atop the planet's molten interior. The collisions and shifts can create mountain ranges or cause earthquakes like the ones that struck Haiti and Chile this year.

"We live on a dynamic planet, and it's important to understand how the surface of the planet changes," Gordon says. "The frequency and magnitude of earthquakes depend upon how the tectonic plates move. Understanding how plates move can help us understand surface processes like mountain-building and subsurface processes like mantle convection."

The new model, dubbed MORVEL for "mid-ocean ridge velocities," is described in an extensive article available online and slated for the April issue of [Geophysical Journal International](#). The work builds on the collaborators' 1990 paper on tectonic plate velocities that has been cited more than 2,000 times by other scientists. During the past 20 years, the researchers have incorporated more and higher-quality data to improve the model's resolution and precision.

About three-quarters of MORVEL's data come from Earth's mid-ocean ridges, the undersea boundaries between tectonic plates. At these ridges, new crust forms constantly as magma wells up from beneath the planet's surface and forces the plates apart.

To judge how fast the plates are spreading, the team analyzed nearly 2,000 magnetic profiles of the crust formed at mid-ocean ridges in all the major ocean basins. The Earth's magnetic field changes polarity at irregular intervals — most recently about 780,000 years ago — and each time leaves a magnetic mark in the crust akin to a tree ring. Measuring

the distances between the marks tells them how quickly new crust is being formed. Most plate boundaries are currently moving at rates of 15 to 200 millimeters per year, DeMets says.

MORVEL also allows scientists to predict future plate movements and identify places where movements have changed over time, areas that are useful for studying the underlying forces that control plate movements.

"Along the boundaries where plates meet there are lots of active faults. It's useful to know how quickly the plates are slipping across those faults because it gives you some feeling about how often large earthquakes might occur," DeMets says. "The direction of movement across the faults gives some indication of whether plates are moving toward one another, which gives rise to one kind of faulting and seismic hazard, or slightly away from each other, which gives rise to another kind of faulting and a different type of seismic hazard."

The model is accessible online at [www.geology.wisc.edu/~chuck/MORVEL/](http://www.geology.wisc.edu/~chuck/MORVEL/) , a site that can be used to show present-day plate movements by choosing any location in the world.

Provided by University of Wisconsin-Madison

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