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RESEARCH SPOTLIGHT

Highlighting exciting new research from AGU journals

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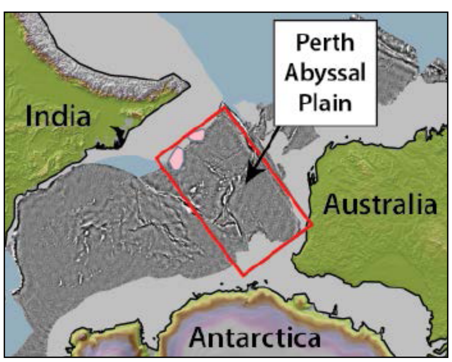
Revealing the early seafloor spreading history between India and Australia

The Perth Abyssal Plain, a section of ocean floor that lies off the western coast of Australia, formed as India and Australia broke away from what had been the supercontinent Gondwana, beginning around 130 million years ago. Oceanic crust within the Perth Abyssal Plain is the only region of preserved seafloor that directly records the early history of relative motion between India and Australia, but the lack of magnetic data collected in that region had made it difficult for scientists to validate tectonic models of the motion of those continents.

Now *Williams et al.* present new magnetic data, collected across the Perth Abyssal Plain in October and November 2011 from the R/V *Southern Surveyor*, that place significant new constraints on the early seafloor spreading history of India and Australia.

The new data reveal previously unrecognized magnetic anomalies in the western Perth Abyssal Plain. The crust in the western part of the basin formed as part of the Indian Plate during the early stages of seafloor spreading between Australia and India. The crust that initially formed the Indian Plate was later transferred to the Australian Plate by a westward jump of the spreading ridge, which also led to fragments of the Indian continent being broken off and becoming stranded in the Indian Ocean. The study should be useful in tectonic models of the breakup of eastern Gondwana. (*Journal of Geophysical Research-Solid Earth*, doi:10.1002/jgrb.50239) —EB



Reconstruction of East Gondwana at about 102 million years ago. Geophysical and geological data collected in the Perth Abyssal Plain in 2011 provide new insights into the history of East Gondwana's breakup.

A new metric to help understand Amazon rainforest precipitation

In the Amazon rainforest, the chain of events that turns a small-scale process like a localized increase in evaporation into a towering storm cloud is long and twisted. To understand the complex dynamics that lead to precipitation and to identify the relative importance of various processes, researchers need uninterrupted observations at high-resolution time scales over many years. Such observations have traditionally been scarce for tropical continental environments, such as the Amazon, where logistics are difficult.

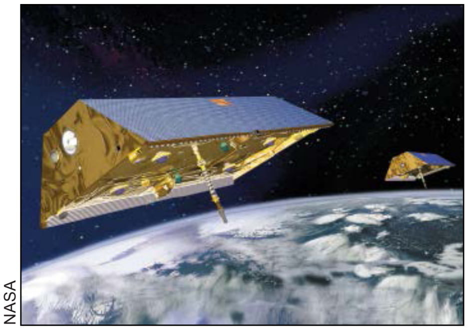
In recent years, however, Global Navigational Satellite System (GNSS) stations have provided a way to gather these measurements of atmospheric water vapor. In their study, *Adams et al.* use 3.5 years of observations from a GNSS meteorological station in Manaus, Brazil, to analyze the processes that turn localized dynamics into deep convective rainfall.

To identify which physical processes are most important in contributing to cloud formation, growth, and precipitation, the authors developed a new metric called the "water vapor convergence time scale." Moist air is more buoyant than dry, so understanding water vapor convergence is important to understanding the development of deep convective cloud formation. Using their metric derived from GNSS water vapor observations, the authors identified two main time scales relevant to Amazon convective storm formation.

Starting about 12 hours before precipitation onset, the authors found that localized evaporation is the most likely dominant factor in moistening the atmosphere. Then, about 4 hours before the onset of deep convective precipitation, water vapor convergence becomes dominant. This 4-hour period of strong water vapor convergence before heavy rainfall encompasses the transition from shallow to deep convection. This transition is a process during which small, scattered cumulus clouds grow into deep convective towers. The authors found that this 4-hour shallow-to-deep convection transition time scale is not dependent on the season, the intensity of the convective precipitation, or the time of day. (*Geophysical Research Letters*, doi:10.1002/grl.50573, 2013) —CS

Decadal shifts in ocean basin mass detected in satellite observations

Global warming is changing the sea level on a global scale by melting ice and snow, but sea level variations on smaller scales are linked to change in ocean circulation. From 2003 to 2012, observations show that some of the world's ocean basins have lost mass while others have grown. For instance, changing circulation patterns have caused the North Pacific to rise by an extra 1.9 centimeters per decade, irrespective of sea level rise caused by water additions from melting ice or groundwater depletion. Parts of the South Atlantic, the Arctic, and the southern Indian Ocean are also rising, while regions of the North Atlantic, South Pacific, and northern Indian Ocean are falling, according to an analysis by *Johnson and Chambers* of the most recent observations made by NASA's Gravity Recovery and Climate Experiment (GRACE) satellites.



Twin GRACE satellites measure tiny variations in Earth's gravity from accelerations and decelerations along their orbits.

GRACE looks at changes in local gravity to calculate the mass of the water in the ocean, giving an insight into regional sea level rise and changes in ocean circulation patterns. The orbiting probes, the authors say, are able to detect the long-term, small-scale shifts in mass that would be impossible to determine using existing in situ techniques.

On top of the small long-term changes, the authors also detected much more sizeable seasonal shifts in ocean basin mass. While decadal changes amount to a few milliSverdrup (a measure of volume transport), seasonal exchanges are 2 orders of magnitude larger. In general, the subpolar ocean mass minima and subtropical maxima occur in the winter. (*Journal of Geophysical Research-Oceans*, doi:10.1002/jgrc.20307, 2013) —CS

—Ernie Balcerak, Staff Writer, and Colin Schultz, Writer