Research sheds new light on oceanic channel-levee systems

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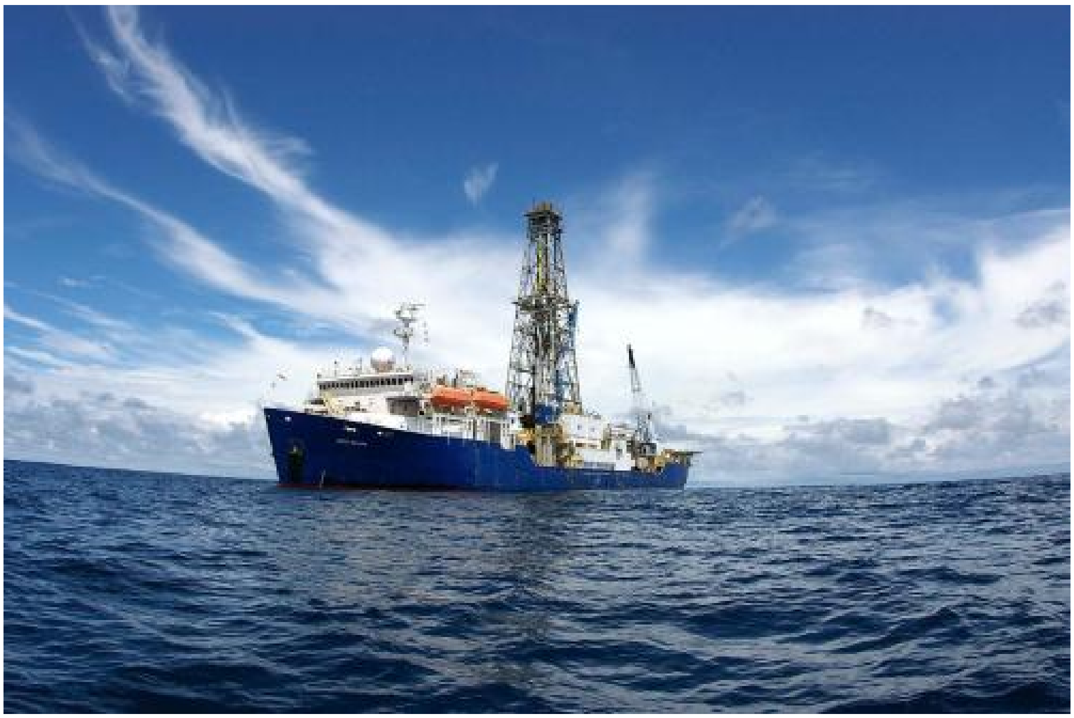

For most Americans, levees are man-made engineering projects, rarely mentioned outside of the flooding that follows disasters like Hurricane Katrina.

However, recent research conducted by Earth and Environmental Sciences (EES) Assistant Professor Derek Sawyer and published in the journal *Geology* sheds new light on levees most of us never see—those built naturally by underwater rivers deep below the ocean's surface.

"On the ocean floor there are rivers gouging their way to deeper parts of the ocean," Sawyer said. "As a river moves along the bottom it makes its own channel, and it can run for hundreds of miles."

These underwater rivers typically form outboard of major rivers like the Mississippi, carrying sediment, sands in particular, from mountains out into the ocean. Sawyer's research, conducted in the Gulf of Mexico, sheds new light on how the channels that direct these rivers are formed.

"For decades oil companies thought sand would just settle at the bottom of the ocean a few miles offshore," Sawyer said. "But through these channels and currents, sands can get out to the deep parts of the ocean."

Levees are created as a result of the difference in density between the ocean water and the particle-laden currents cutting through it: they are composed of the smallest and lightest particles, clays and silts, while larger sand grains gouge the channel deeper. But over thousands of years as the rivers spill onto the ocean floor, the levees get higher and steeper, eventually becoming unstable.

Sawyer noted that these deep-seated failures can cause previously trapped materials to break through the bottom of the channel, freeing them up to be carried down-slope by other currents.

"We had not recognized this type of levee recycling process before as a geoscience community, so it was a new observation," he said. "It leads us to rethink models of how deep sea environments and their channels evolve."

Since channel-levee systems can form great oil and gas reservoirs, Sawyer's research has far-reaching implications for attempts to locate and safely recover these resources.

As Sawyer explains, the plugging of these channels by failed levees makes it necessary to rethink models of how sands are distributed.

"If an oil company is exploring an ancient deep water system, they need to incorporate this information into their systems when trying to work out how sands might be distributed," he said.

Moreover, rapid levee deposition creates elevated pore pressures within the levees and underlying sediments, trapping water in barriers of fine-grain mud. The data Sawyer collected shows that deep-seated levee failures are invoked by elevated pore pressures. Evidence of these failures suggests that systems could still have high pressure today, which leads to potential engineering hazards that should be considered in pre-drill hazard assessments.

"Think about wrapping a sponge in cellophane and stepping on it," Sawyer said. "The water can't escape, and it's going to have a very high pressure inside the sponge. If you stick a straw in that sponge the water is going to flow up the straw. It's the same with drilling a well."

Fluid pressures can be very high in places, so it is a constant and challenging job to keep them balanced. Sawyer's research shows these types of levee failures require high fluid pressure. Therefore, observation of these failures can be a valuable indicator of pressures that may still exist.

While Sawyer's work illustrates the effects of elevated pore pressure and offers models for safer well placement practices, he also hopes to show the value of this research to a wider audience and demonstrate the exciting work taking place in the College of Arts and Sciences.

"I think scientists fall short a lot of times in communication to a broad audience, even among other scientists," he said. "We get in-depth in science but do not always step back to say what it means in general terms. Getting published in *Geology* means it is good science and applicable to a broad audience. Hopefully we can highlight the benefits of this work and show students why this research matters."

Provided by University of Kentucky

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