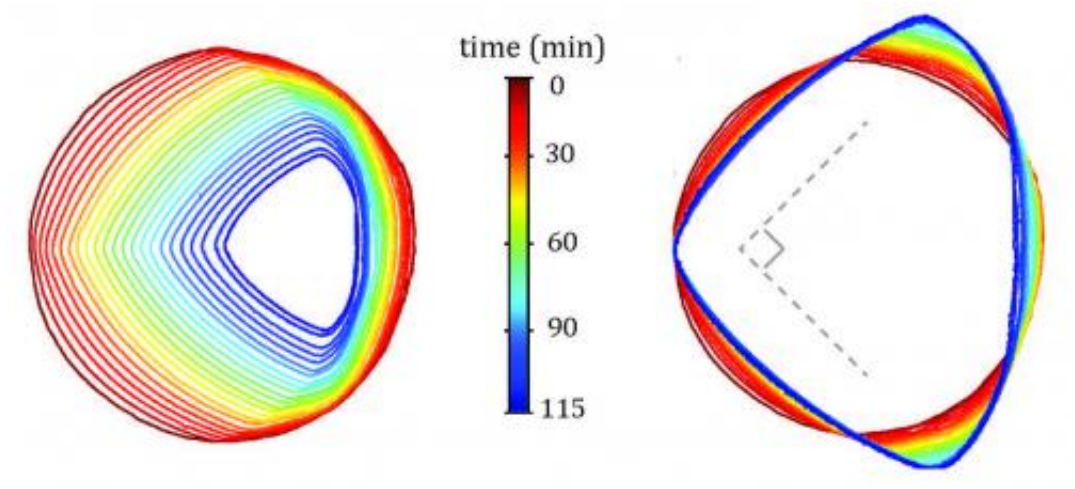
Erosion has a point—and an edge, researchers find

November 12 2012



Erosion caused by flowing water does not only smooth out objects, but can also form distinct shapes with sharp points and edges, a team of NYU researchers has found. Their experiments showed water flow acts as a shearing force against objects, working them into specific shapes. The above illustrates how a cylinder, over time, was sculpted into a triangular shape. Credit: New York University

Erosion caused by flowing water does not only smooth out objects, but can also form distinct shapes with sharp points and edges, a team of New York University researchers has found. Their findings, which appear in the latest edition of the journal the *Proceedings of the National Academy of Sciences* (*PNAS*), reveal the unexpected ways that erosion can affect landscapes and artificial materials.

The impact of erosion is widely recognized by environmentalists and geologists, but less clear is how nature's elements, notably water and air, work to shape land, rocks, and artificial structures, often resulting in unusual formations.

"The main focus of this study was to understand how and why erosion makes these funny shapes," explained Leif Ristroph, a post-doctoral researcher at NYU's Courant Institute of Mathematical Sciences and one of the study's co-authors.

To explore these questions, the researchers designed an experiment, conducted in the Courant Institute's Applied Mathematics Laboratory, to replicate natural erosion. In it, the researchers submerged clay—shaped as balls or cylinders—into a 15-ft. long water tunnel. The apparatus was designed to continuously generate a uniform flow of water, which would allow the researchers to observe how erosion shapes an entire object.

What they found was water flow acts as a shearing force—not unlike a nail file—against objects, working them into specific shapes. Starting from a clay ball, the flowing water sheared the sides away, producing a cone with a pointed face. Likewise, the clay cylinder was sculpted into a triangular shape. The researchers then sought to confirm these findings by replicating the experiment using a computer model. These results were consistent with the experimental findings, revealing in a computer simulation how the shape was maintained as the body eroded away.

"Water acts tangentially to the surface of objects and skims off material to create these unique shapes," explained Ristroph. "In a sense, it works as a sculptor to naturally mold materials into new forms."

More information: "Sculpting of an erodible body by flowing water," by Leif Ristroph, Matthew N. J. Moore, Stephen Childress, Michael J. Shelley, and Jun Zhang, *PNAS*, 2012. (PDF)

Provided by New York University