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River Potholes: Modern and Ancient

Robert F. Diffendal Jr.
University of Nebraska-Lincoln, rdiffendal1@unl.edu

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Pothole about one foot wide in the basalt floor of a stream in Boiling Pots Park, Hilo, Hawaii. Note the two basalt cobbles in the bottom of the pothole. Their erosive power during high water may have formed and enlarged the pothole.

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Potholes at Boiling Pots, Hilo, Hawaii.

In many areas of the world streams and rivers flow in channels cut into sediments previously deposited by the streams and rivers or their precursors.

Those of us who have swum, waded, or fished in such bodies of water know that the floors of their channels are not smoothly sloping or of uniform depth, that there are shallows and deeper pools along the length of each channel. We also know that from time to time these shallower and deeper pools change shape and shift positions. The shape of the channel itself is ever changing.

The same holds true where rivers have eroded channels into bedrock, but here the channel floors frequently are grooved, pitted, and very irregular due to erosion by the water and its sediments. When water levels are low and channel floors are exposed, an interesting feature one can observe is the pothole.

Formed by water action

A river pothole is a cylindrical, bowl-shaped, or irregular hollow that is usually deeper than wide. It is formed in the rocky bed of a stream by either the grinding action of sediment whirled around by stream eddies or the force of fast flowing water. Potholes usually have spirally grooved surfaces. Their widths and depths range from a few inches to many feet. Potholes on the floor of the Susquehanna River near Columbia, Pennsylvania, for example, are large enough to hold objects the size of a small car.

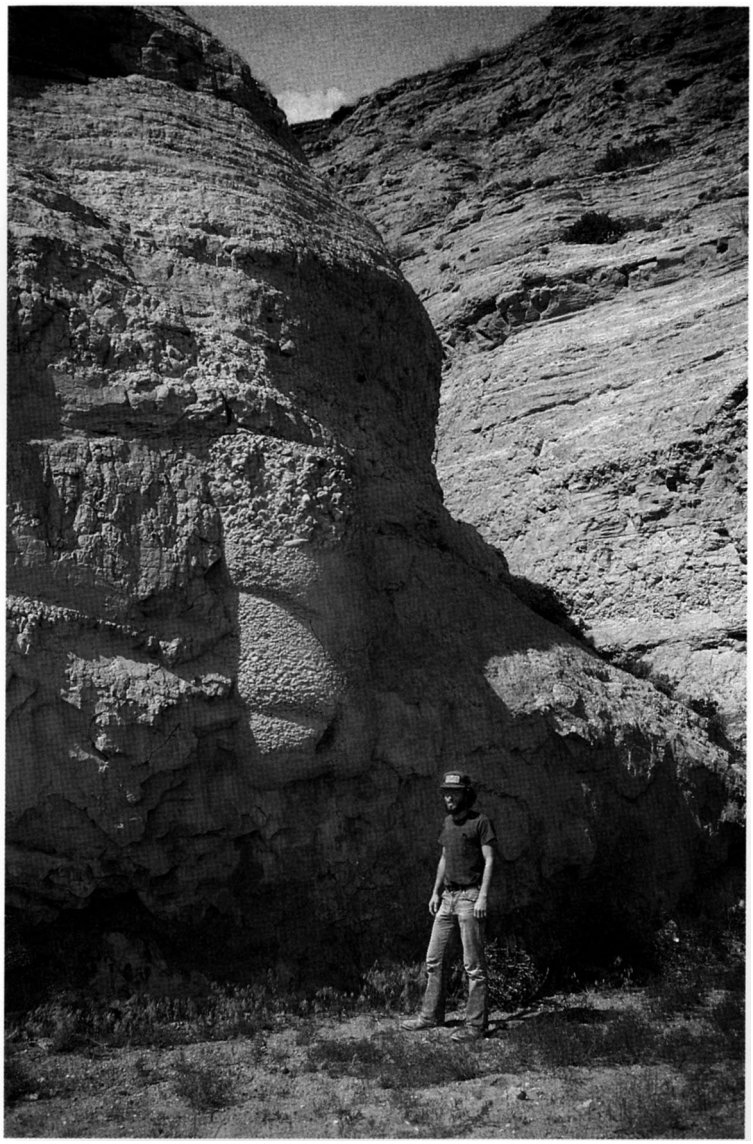
Potholes generally are formed in fairly homogeneous rock by streams that at least periodically have high discharges. Long grooves running parallel or nearly parallel to the stream flow are often carved into the bedrock floor of the channel and may lead from one pothole to another. A wonderful example of these related features occurs on the channel floor of the Niobrara River at Norden Bridge in north-central Nebraska. As the river continues to erode its channel the shapes and sizes of the grooves and potholes change.

Another fantastic example of pothole development occurs at Boiling Pots Park on the southwest outskirts of Hilo, Hawaii. Here a stream has carved a valley through several sheets of hardened lava rock or basalt. The stream plunges over successively exposed layers of this basalt, each of which are up to 20 feet thick. A pothole or series of potholes in each layer of rock crossed by the stream produces a series of circular pools that at times of low water are arranged like a string of beads.

Potholes found in river channels

Most potholes studied by geologists and other naturalists are found in present day river channels, but they also can be found in ancient channels of streams many millions of years old which have been preserved by a cover of sediment or harder sedimentary rock.

An elegant example of such an ancient pothole is today exposed along the side of Rocky Hollow, an intermittent



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Gravel filling of a pothole eroded into the Brule Formation, Rocky Hollow, Banner County, Nebraska. The spirally grooved impression of half of the pothole is visible on the surface of the filling. Gravel from the bottom to the top of the filling increases in size several times, indicating that the hole probably filled up sporadically.

stream valley, in Banner County, western Nebraska. Present-day erosion of the bedrock-valley-side of Rocky Hollow has exposed both the lower part of a gray colored rock formation called the Gering Formation and also the underlying upper part of a brown-colored rock unit called the Brule Formation. These rock formations are nearly 30 million years old. The Gering is composed mostly of sand; the Brule is made of silt particles with diameters smaller than sand.

The Brule, which was deposited generally by winds rather than by water, is harder and has more uniform characteristics than does the Gering. The surface between the Brule and the Gering was eroded by a stream and has grooves and potholes filled with stream-deposited gravel and sand of the oldest Gering Formation. At one place a solid gravel plug is exposed that fills a pothole carved into the Brule that is about eight feet deep and three to four feet wide. The surface of the plug is a replica of the surface of the pothole and even has the spirally grooved pattern typical of such features.

Similar but less spectacular features occur at the top of the Brule at several sites in western Nebraska. They mark the locations of the floors of ancient stream channels ranging from as old as 30 million to as recent as 5 million years old. Any naturalist who explores a stream or riverbed may expect to find similar features preserved in rocks of any age that were deposited by streams. □

ROBERT DIFFENDAL, PHD, has been a Research Associate of the University of Nebraska State Museum for fifteen years and has found many fossil sites for the museum. He began his geological career at the age of 10 when he and some friends discovered a pile of discarded mineral specimens. Bob collected as many different kinds of minerals from the pile as he could find, took them home, learned how to identify them, and became the local geologist. This interest led to his position with the State Museum and his professional work as a Research Geologist and Professor at the Nebraska Geological Survey, also a part of the University of Nebraska-Lincoln.