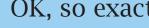
## 18. Flash Floods Unleash Nature's Raw Power

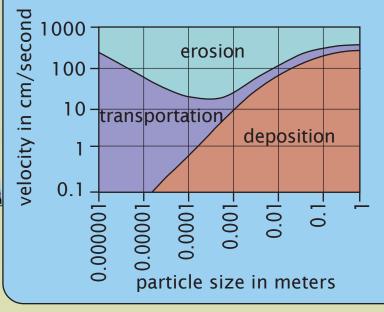
Flash floods are very common in the desert where thunderstorms rain down a lot of water faster than it can sink into the ground. Flash flood waters race down canyons, carrying mud, rocks, and torn up plants. If there is a lot of mud, the floods turn into mud flows. A flash flood can happen in just one valley or in many, depending on the size of the storm. Flash floods don't usually last long, just an hour or two from start to finish, but they cause more erosion than years of quiet weathering.

How did this big, rock get here? As you walk up trail 03 along the stream channel, you will see many similar boulders. These are Precambrian metamorphic rocks, similar voulders, mess are rrowanny raining anny prive rooms, much older, harder rocks than the sedimentary ones we have looked at so far. The nearest outcrop of Precambrian rocks is up the canyon 4,800 feet (146 km) away.

It probably took several flash floods to move this boulder so far, rolling and bouncing it down the canyon. When the most recent flood of its power, and heaped some of its load here



Unfortunately, it's not a simple problem. There are a lot of variables to consider, things that can influence the result, including distance, steepness, roughness of the channel and the rock, the amount of turbulence in the water, and the nature of its sediment load.



3 feet

In this aerial view looking up Devils Canyon, it is easy to see what a big area the canyon drains, and to get an idea of how far the big boulder was carried. Snooks Bottom You can tell if a rock was moved by water if you look at how well rounded it is: - All angular, sharp corners? Just fell from a cliff (above, at left). - Corners rounded but some rough sides? Rolled and tumbled a little way, - Well rounded and smooth all over? Carried a long way, like the Colorado River gravel on the east side of Opal Hill (right). Devils Canyon Trailhead You are here Be alert for flash floods any time there are

## OK, so exactly how much water, flowing how fast, would it take to move this boulder?

One geologist set up experiments and developed a diagram that can be used to estimate the flow needed to move sediment, a Hjülstrom Diagram.(at left). Unfortunately again, the diagram does not extend to boulders this large. Notice that on the scales of the diagram, each mark is 10 times larger than the one before it.

We can also figure out about how much the boulder weighs and compare it to actual incidents where boulders were moved by flash floods.

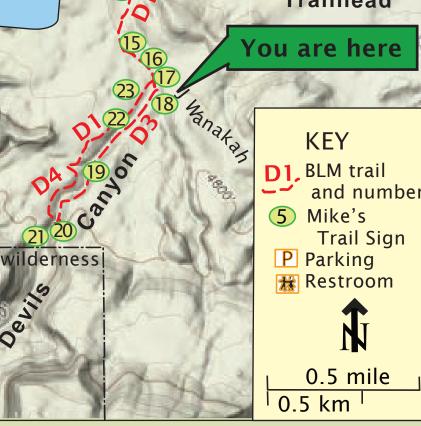
This boulder measures about 10 feet long x 7 feet high x 6 feet wide = 420 cubic feet. Since this kind of metamorphic rock weighs about 1 ton for 12 cubic feet, this rock weighs about 35 tons. In metric, that equals 31.8 tonnes. It's heavy.

Documented flash floods along Colorado's Front Range travel at about 15 feet per second. They move boulders as big as 7 feet across, in a slurry of muddy water. They come and go in less than an hour. A really big flash flood in 1976 in Big Thompson Canyon moved rocks up to seven times as large as this boulder after a stationary thunderstorm dumped 7.5 inches (19 cm) of rain in less than an hour. A 20-foot (6 m) wall of muddy, debris-laden floodwater swept down the canyon, moving as fast as 25 feet (7.6 m) per second at its peak.

thunderclouds around. A cloudburst up the canyon can cause a flood downstream where it hasn't even rained! Flash floods move fast. You can't outrun one. If you hear a flash flood coming, climb to higher ground right away!







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