Geomorphology

Catastrophic canyon formation (*September 2010*)

Huge canyons, such as the Grand Canyon and the Gorge of the Blue Nile, have generally been supposed to have resulted from steady-state erosion through resistant rocks, which accelerated during annual floods. There are exceptions that produced spectacular gorges during emptying of proglacial lakes in North America and on a lesser scale in northern Britain. Just how efficient at erosion individual floods may be was demonstrated by release of reservoir water through a spillway in Texas for about 3 days in 2002 (Lamb M.P. & Fonstad, M.A. 2010. Rapid formation of a modern bedrock canyon by a single flood event. *Nature Geoscience*, v. **3**, p. 477-481; DOI: 10.1038/ngeo894). The peak discharge was ~1500 $m^3 s^{-1}$, which is not especially huge, yet up to 12 m of erosion through bedrock occurred, to produce a sizeable canyon in what was previously a typical small-stream valley. Although some erosion was by plucking of joint blocks, a considerable amount occurred by boulders swirling in the rapid currents to scour potholes. Small islands, resembling those preserved in glacial lake outburst floods, were sculpted mainly by suspended sediment rather than by boulder impacts. Another feature that forces a rethink of erosional processes is that waterfalls in the stream course show no sign of headward retreat by undercutting, but seem to have formed as slabs were plucked by the hydraulic force and slid down stream to form tabular, imbricated boulders. The implication is that canyons may form episodically during flood events, when the shear stress of the flow on its bed is sufficient to lift and slide joint-bounded slabs.

Threat to landscape from alien crayfish? (*November 2010*)

The stealthy invasion of rivers in Europe by the tasty American signal crayfish *Pacifastacus leniusculus* poses a threat not only to the indigenous European species *Astacus astacus* (*P. leniusculus* carries a fungal infection as well as being formidably armed), but conceivably to the very landscape itself (Johnson, M.F. *et al*. 2010. Topographic disturbance of subaqueous gravel substrates by signal crayfish (Pacifastacus leniusculus). *Geomorphology*, v. **123**, p. 269-278; DOI: 10.1016/j.geomorph.2010.07.018).

The American signal crayfish *Pacifastacus leniusculus* (Credit: Wikipedia)

Johnson and colleagues from the University of Loughborough, UK used captive alien crayfish to model the effects of their bioturbation under controlled laboratory conditions, assessing their activity by the use of millimetre-resolution gravel-surface elevation data generated by a laser altimeter. The sturdy little beasts behave like frenzied bulldozers creating mounds and pits in the gravel substrate, displacing on average about 1.7 kg of gravel every day over an area of 1 m^2 thereby completely disrupting the perfectly flat experimental substrate onto which they were introduced in about 3 days. By this activity they render the surface more prone to erosion by flowing water so that greater grain transport ensues; they could effect both erosion and deposition by increasing grain transportation. To my knowledge, this is the first experimental study of bioturbation in the context of hydrology. We can expect more now that the technology is available: the burrowers as well as the diggers of the animal world. While the Phanerozoic is best known for having begun with the Cambrian Explosion of multicellular life, a sometimes overlooked attribute is that it coincided with the start of bioturbation. That may well have had a profound effect on sediment transport as the American invader suggests.

See also: Newton, A. 2010. Crayfish at work. *Nature Geoscience*, v. **3**, p. 592; DOI: 10.1038/ngeo953.