

## 'Gastroliths' deposited by mass flow

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Gastroliths are defined as 'Highly polished, rounded stones or pebbles from the stomach of some fossil vertebrates, esp. reptiles.'<sup>1</sup> They are thought to have been used for grinding food. Stones usually believed to be gastroliths are commonly found in the Morrison Formation, which is believed to outcrop over one million km<sup>2</sup> from southern Alberta and Saskatchewan, Canada, south to New Mexico, USA.<sup>2,3</sup> The Morrison Formation is famous for its dinosaur fossils, especially the large sauropod dinosaurs.

### Challenge to the Flood

While on a field trip in Wyoming, I found several of these stones in the Morrison Formation after looking for only an hour. If I can find several after a quick search, there must be billions of these so-called 'gastroliths' in the 'late Jurassic' Morrison Formation. Since few gastroliths are associated with dinosaur bones, the Flood would have had to pulverize tens of millions of dinosaurs just in the Morrison Formation to account for so many gastroliths, if that is what they are. How could such a feat be accomplished in a short period of time within the Flood?

Several years before this field trip, my exposed Flood sediment hypothesis for dinosaur tracks and eggs was challenged on the basis of the presence of gastroliths in the Morrison Formation.<sup>4,5</sup> Garner *et al.*<sup>6</sup> wrote:

'The problems are not limited to nest sites. Stokes (1987) has investigated gastroliths (stomach stones) from some Lower Cretaceous dinosaurs. He found that many of these gastroliths were composed of lithified, fossil-bearing sedimentary rock which appeared to be derived from

Palaeozoic and pre-Cretaceous Mesozoic sedimentary rocks. This is further evidence that these dinosaurs were living after the Flood, unless we want to suppose that—as well as fleeing from the rising Flood waters, making tracks, building nests, and feeding their young—they were swallowing pebbles of earlier Flood sediments for use as gastroliths!'

At the time, I did not have an answer to this 'gastroliths' problem.

### Problems with dinosaurian origin

This 'Lower Cretaceous' formation actually was part of the 'late Jurassic' Morrison Formation but was reassigned to the above formation.<sup>7</sup> Stokes did point out that there is much negative evidence against the dinosaurian origin of all these stones and that there were a number of skeptics. Two reasons for skepticism are the huge number of stones and the rare association of gastroliths with dinosaur skeletons. Moreover, stream and wind polished stones, which can be common in sedimentary deposits, look similar to gastroliths.<sup>8</sup> A study of gastroliths

in modern birds has shown that sandstone rocks quickly crumble in the birds' gizzards, and that limestone lumps dissolve after just a couple of days.<sup>9</sup> Rose quartz and granite stones disintegrated more slowly. None of the stones retrieved from ostrich gizzards were highly polished, such as the stones found in the Morrison Formation and others. So, the data on real gastroliths does not line up with the abundance of stones found in the Morrison Formation.

A recent article about gastroliths from the 'Lower Cretaceous' Cloverly Formation of Wyoming suggests that the stones likely are *not* gastroliths at all.<sup>10</sup> The polished and rounded stones are believed to have been transported long distance by mass flow from sources to the west, probably in Idaho. This belief is based on the lithologies of the 'gastroliths' and the fact that some of the stones contain fossils similar to those that outcrop in southeast Idaho. Mass flow is suggested as the cause because the stones are floating in a finer grained matrix. Since the source is 200 to 400 km distant over a surface with a low slope, the authors suggest the mass flow is a hyperconcentrated



**Figure 1.** Outcrop of quartzite gravel about 20 km east of Moran Junction. Note that the quartzites have pressure solution marks and percussion marks, and are polished and fractured.

flow, which is a flow between a turbidity current and a debris flow. Hyperconcentrated flows are defined generally as flows with a sediment volume percent in water of 20–47 % (40 to 70 weight percent).<sup>11</sup> Debris flows cannot transport sediments this far on such low slopes; they transport sediments less than 25 times their descent height.<sup>11</sup>

But the deduction of a hyperconcentrated flow is really a guess. Furthermore, it must be demonstrated that hyperconcentrated flows can travel such distances on low slopes. Unfortunately, hyperconcentrated flows are poorly understood:

‘The physical processes by which sediment is transported by, and deposited from, hyperconcentrated flows are unclear.’<sup>12</sup>

The authors suggest that their results for the Cloverly Formation also may have implications for other formations with presumed gastroliths, including the Morrison Formation just below the Cloverly Formation. If the billions of rounded rocks in the Morrison Formation, as well as the Cloverly Formation, are not gastroliths, the time problem for the Flood evaporates.

### Flood options

In the Flood, several options are available that would allow the transport of the rounded rocks for 200 to 400 km. It could have been any type of underwater bottom-hugging mass flow aided by strong currents flowing to the east. It is likely that the rounding and polishing occurred in watery transport and not mass flow, since water is a very efficient mechanism for rounding and polishing rocks. Rounded and polished quartzites are observed in many locations in northwest Wyoming, eastern Idaho, and southwest Montana. They have accumulated thousands of meters thick in paleovalleys in northwest Wyoming and adjacent Idaho<sup>13</sup> (figure 1). Quartzites make up 38% of the ‘gastroliths’ in the Cloverly

Formation. After rounding, the quartzites could have been entrained with much fine sediment as a matrix-supported mass flow by the time the quartzites and other lithologies were deposited much farther east.

I am disappointed, however, that the ‘gastroliths’ I collected likely are not real gizzard stones from dinosaurs.

### References

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