# More evidence against so-called paleokarst

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**A long-accepted mid-Carboniferous 'paleokarst' in the western United States fails several tests for subaerial exposure at the time of 'karstification'. The evidence for a onetime erosional surface is ambiguous. Other geologic evidences, notably indicators of sediment cave-in, demonstrate that the overlying sedimentary rock was already present when solution features such as vugs, sinkholes, and intra-formational breccias formed. And, far from requiring long periods of time to form, the alleged karstic features formed rapidly, within the entire 'stack' of sedimentary rocks, as a result of deep-seated hydrothermal action during and after the Flood. Thus, this alleged indicator of long periods of geologic time turns into evidence for extensive geologic catastrophism during the Flood.**

Paleokarst refers to features within a rock that supposedly indicate a protracted period of surface and near-surface erosion that occurred before the next layer of sediment was deposited. It is obviously incompatible with a global Flood. Silvestru[1] has comprehensively critiqued paleokarst using European examples. He showed that true karstic features, such as deeply-emplaced caves, are invariably absent from so-called paleokarst. Moreover, as used by certain uniformitarian geologists, paleokarst is an amorphous term associated with a particular mineral paragenesis. However, to geographers the word paleokarst connotes a landform. Furthermore, uniformitarians often infer an ancient surface of prolonged exposure solely from petrographic and isotopic data, without any collateral geologic evidence of subaerial exposure![2]

One outstanding example from the Rocky Mountains of west-central USA has been long claimed to strongly demonstrate a paleokarstic surface. However, certain uniformitarian geologists are now challenging this claim. This so-called paleokarst occurs near the mid-Carboniferous[3] (the Visean/Namurian boundary) of several US States. It should also be noted that, according to sequence stratigraphy, the mid-Carboniferous is the boundary[4] between the Kaskaskia and the Absokora cycles. Therefore, a challenge to subaerial exposure here also challenges the entire sequence-stratigraphic concept.

## Description of alleged paleokarst

Referring to my Figure 1, taken from Fig. 1 of Sando,[5] the following statements summarize the orthodox uniformitarian interpretation:

> 'A karst topography developed on top of Madison Group sediments near the close of Mississippian [Lower Carboniferous] time, and solution phenomena such as sinkholes and "bedding plane solution cavities", here referred to as *bedding cavities*, were abundant. Subsequently these cavities were filled with sandstone and shale of the Amsden Formation (Pennsylvanian) [Upper Carboniferous]. Bedded sandstones fill the numerous bedding cavities, giving the illusion that the basal sandstone of the Amsden has a sequence of Mississippian carbonate beds within it, beds which in reality are the uppermost strata of the Madison Group ... . The filled bedding cavities may extend from several feet to hundreds of feet ... . This situation has led some workers to assign erroneously a Mississippian age to the basal part of the Amsden Formation.'[6]

Note from Figure 1 that there are two layers of breccias in the Madison Limestone: the lower solution zone and the upper solution zone. However, only the uppermost part of the Madison Limestone is supposed to be the paleokarst surface (more on this later). The overlying Amsden Formation is supposed to include the sedimentary deposits of the marine transgression that finally covered the long-exposed paleokarst surface.

Note also that, within the Madison Limestone, the Darwin sandstone member of the Amsden Formation not only fills sinkholes, but also vugs (solution cavities). However, one should not suppose from Figure 1 that the Madison Limestone is perforated in three dimensions like Swiss cheese. Rather, the vugs within the limestone are not generally interconnected.

If the paleokarstic interpretation is to be credible scientifically, the claim must pass unambiguous tests. First, it must be shown that the overlying sedimentary lithologies (in this case, the Amsden Formation) were **necessarily** deposited **after** the solution zones, sinkholes and vug-filled texture formed within the underlying carbonate (the Madison Limestone). Second, and as a corollary, the solution cavities of the alleged karstic carbonate horizon must clearly point to post-solutional infilling through **sedimentary** processes (i.e. the marine transgression), rather than post-solutional infilling through secondary processes such as cave-ins of existing overburden (sediment or sedimentary rock). Finally, the alleged karstic horizon must be uniquely explicable by **protracted**, **near-surface** processes involving water of strictly **meteorological** origin. As discussed below, the alleged 'paleokarst' fails all three tests.

## Stratigraphic evidences against a paleokarst interpretation

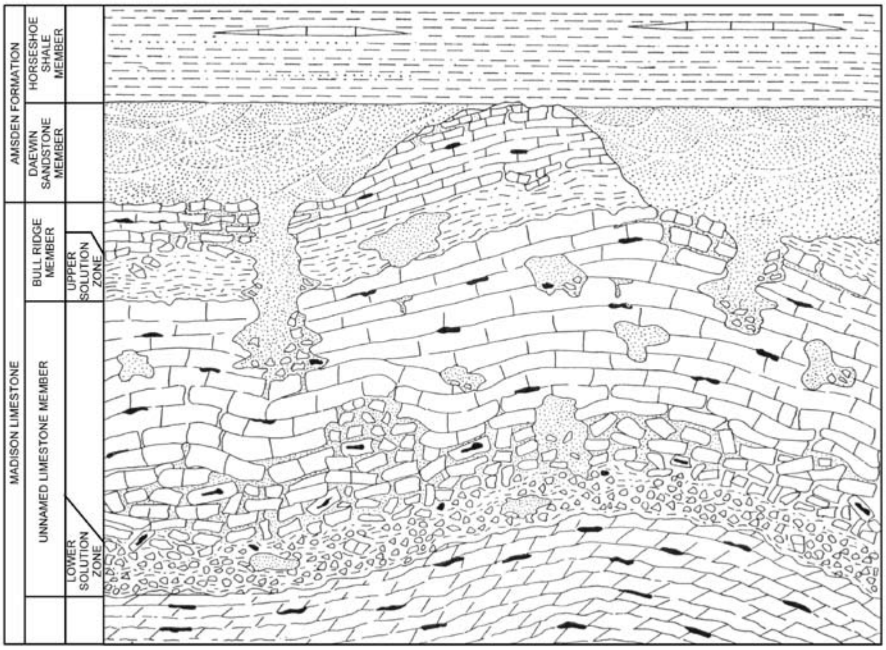


***Figure 1**. Generalised sketch of the geology of the Madison Limestone and Amsden Formation in north-central Wyoming, USA (from Sando).*[5]

Silvestru pointed out that, in large areas of the Swiss Alps, carbonates of mid-upper Cretaceous age are overlain by mid-Tertiary beds, implying a hiatus of tens of millions of years according to standard uniformitarian thinking.[7] Yet the Cretaceous carbonates show no hint of paleo-relief, let alone a karstic surface. Ironically, the opposite situation exists in the US Rockies. The alleged paleokarst exists on a surface where the inferred period of 'missing' time is only 2–3 million years. Surprisingly, Bridges[8] suggests this time is too **short** to form a paleokarst! Again, the plasticity of uniformitarian thinking is impressive.

For the Madison/Amsden contact (Figure 1) to have a chance of being paleokarstic, the contact must first be an unconformity. The equivalent contact in Wyoming contains arches and other irregularities,[9] which argue against an unconformable contact, and prove that the overburden was **already there**. This demonstrates that the contact was corroded, not by near-surface karstic solution, but by deep-***sub***surface solution of Madison-equivalent limestones.

Rounded limestone clasts within the solution deposits[10] at the top of the Madison formation (Figure 1) are often cited as evidence for a onetime erosional surface. However, **sub**-surface solutions can generate rounded limestone clasts, as demonstrated elsewhere by *in-situ* limestone wall-rock fragments that are rounded.[11] Hence, rounded limestone clasts are not, on their own, evidence for a penecontemporaneous subaerial erosional surface. Also there are numerous chert pebbles in the regionally-equivalent 'erosional' surface, but these are angular, not rounded as we would expect if the unconformity had existed for a long time. Moreover, they are not bedded, and some chert pebbles are incrusted, suggesting growth in place.[8] All this argues that the chert is a secondary product of subsurface solution, not the result of sedimentary water transport along a mythical erosional surface, let alone a paleokarstic one.

It is also claimed that the upper breccia (Figure 1) was formed by karstic processes, thus supporting the paleokarst interpretation. However, the thickness of the breccia layer is too regular for it to have been formed concurrently by karstic process.[12] We would expect a breccia of karstic origin, especially one that covers an area as large as 250 km$^2$, to display more thickening and thinning.

### Sedimentary evidences against a paleokarst interpretation

Whenever we think of caves we think of stalagmites and stalactites. Yet, not only do the 'caves' (actually, vugs) within the Madison Limestone lack these features, but they also lack flowstone and dripstone deposits.[13] This itself does not disprove a paleokarst interpretation, as some modern caves also lack these deposits.[14] But it is significant that this major evidence for paleokarst is missing.

The scale of the alleged paleokarstic features also bears comment. Like the alleged European 'paleokarst' discussed by Silvestru,[7] the North American mid-Carboniferous features discussed here are essentially surficial. Thus, they bear little resemblance to the deep channels and huge caverns encountered in the genuine paleokarstic systems found today.

An examination of the overlying sedimentary structures can help us determine if a surface was exposed to weathering for a long time before the overlying sediment was deposited. For a weathering surface, or paleokarst, the overlying sedimentary cover must have been absent while the karst features were forming. It's like detective work, like finding snow covering a deep depression in the ground and trying to determine whether the depression slumped before or after the snowfall. Clearly, if the depression existed before the snowfall (like a paleokarst), the snow should have a gently-rolling contact at the edges of the depression. In addition, the snow surface should gently sag inward as it blankets the hollow and the surrounding area. Conversely, if the snowfall occurred first, the ground must have caved-in later. This would have disturbed the pre-existing snow layer, and may even have caused the snow surface to cave-in. Instead of a gently-rolling surface, the snow surface would show abrupt changes in its 'stratigraphy', indicative of collapsing into the hollow. The latter would also include features such as sharp bends at the edges of the hole, cracking and 'downfaulting' of the snow (especially if it was partly frozen), and possibly a chaotic mixture of snow within the hole itself.

There are many solution cavities in the Madison Limestone (and regional equivalents) where the fill-in material clearly has caved-in or collapsed. Such evidence does not support the concept of a paleokarst, that the cavities were already present before the overlying sediment and fill were deposited from a transgressing sea. In some places, notably Wyoming, the overlying Upper Carboniferous sedimentary rock has downfaulted and collapsed into a solution cavity in the underlying Lower Carboniferous carbonate.[15] In another example, sedimentary material above the Madison-Limestone-regional-equivalent is downfaulted into a sinkhole.[16] The final blow against the idea of karstification is the presence of sandstone boulders from the overlying Amsden Formation **within** the Madison-Limestone solution breccia.[23] Clearly, the Amsden Formation was already in place before the breccia formed in the underlying limestone.

Another alleged 'paleokarst', within the Silurian dolomites of northeastern Illinois, USA, is similarly discredited because its sedimentary fill shows evidence of downbending, not deposition. Abrupt changes, over short distances, in the dips and strikes of infilling Carboniferous shales within cavities in Silurian dolomites,[16] demonstrate that the overlying Carboniferous sediments were **already present** when the cavities formed. Far from showing a depositional contact, the sandstone slabs downbend and stretch to fit over and into the cavities in the Silurian.[17] Furthermore, the Carboniferous coals are contorted in ways that are irreconcilable with the premise that they were deposited by sedimentary processes over pre-existing karstic cavities in the Silurian dolomite.[18]

Another way of confirming significant post-depositional sediment movement is by the presence of slickensides and slickolites.[19] Slickensides indicate tectonic movement, or extensive vertical compaction of sediment.[20] Slickolites, which are closely related to slickensides, are indicators of vertical sedimentary movement. Slickolites are especially prominent in the Carboniferous material that fills the Silurian 'paleokarst' solution cavities[21] of northeastern Illinois, USA, showing that the material caved-in. In like manner, slickolites frequently occur within the material that fills the mid-Carboniferous Madison Limestone cavities, proving that the fill material caved-in and was not water deposited.[22] Indeed, the evidence indicates that there was **considerable** downward sliding (caving-in) of the overburden into the solution cavities and sinkholes.[16] For the Amsden Formation (Figure 1) and regional equivalents to move downward *en masse*, they must have obviously **already existed** as overburden, when the cavities and sinkholes were forming underneath. This alone rules out a surface-weathering, karstic explanation for the solution features in the Madison Limestone (and regional equivalents).

To preserve the paleokarst interpretation, a uniformitarian might claim that a karstic surface formed in the mid-Carboniferous but that the solution cavities were filled with pressurized water from below. He may argue that the pressure of the water prevented the cavities from collapsing until a large thickness of Upper Carboniferous sediment accumulated on top. Such an invention would be totally *ad hoc*, lacking any independent evidence of a local karstic aquifer, much less the 'plumbing system' needed to supply and maintain the pressurized water. More importantly, the claim does not deal with the central problem. If the cavities really existed as an erosional surface when the overlying sediment was being deposited, they would have filled with clouds of fine sediment from the transgressing Upper Carboniferous sea. Thus, the cavities (as discussed earlier) would be largely, if not completely, filled with sediment exhibiting a gentle, depositional contact. And the sediment filling the cavities would have prevented the overburden from collapsing and caving-in.

But what if the cavities were covered by a 'roof' of carbonate rock at the time of the Upper-Carboniferous transgression. It could be claimed that a rock 'roof' would initially prevent the sediment from filling the cavities. However, this idea only creates more problems. The pressure of the subterranean waters would need to follow a very delicate balance. The pressure would have to be high enough to prevent the postulated roof collapsing under the weight of the ever-encroaching Upper Carboniferous sea, yet not so high that it pops the roof off the karstic cavities. Moreover, this delicate balance of pressure would have to be maintained over the millions of years needed for an appreciable amount of Upper Carboniferous sediment to accumulate and lithify, all the while keeping pace with the increasing weight of overburden. Only when all these processes were complete could the 'roof' and overlying sedimentary rock collapse.

As if all this was not enough, as noted earlier, the presence of Amsden rock within Madison-Limestone breccias proves that overlying Amsden Formation was already in place when the breccia formed. Even if a paleokarstic explanation could be rescued by a series of complex, secondary hypotheses, the *prima facie* evidence nevertheless continues to favour a nonkarstic explanation. At very least, the evidence most definitely does not require a paleokarstic explanation.

It is interesting to note that other evidences from the Mid-Carboniferous that could potentially support a paleokarst interpretation have been recently discredited. For example, from the southwestern USA:

> 'The Pennsylvanian [Upper Carboniferous] Molas Formation has long been considered as a *terra rossa* (residual) paleosol that developed above a paleokarst surface above the Mississippian [Lower Carboniferous] Leadville Limestone. A detailed field, SEM/EDS, XRD, and petrography study shows that this classic interpretation is untenable.'[23]

The erstwhile paleosol, an obvious long-time indicator, is now considered a massive aeolian siltstone (loessite). In like fashion, the characteristic reddening of the

Molas Formation, often attributed in the past to long-term near-surface weathering, is now regarded as a diagenetic feature.[24]

### Geologic alternatives to paleokarst

Silvestru[25] explains that aqueous solutions can exist at considerable depths because of hydrothermal activity. Consequently, karst-like features can form at great depth. They do not require a subaerial erosional surface to be exposed for long periods to allow meteoric water to percolate through and enlarge the joints within the carbonate rocks. And hydrothermal activity hardly exhausts non-karstic explanations for supposedly paleokarstic features. For instance, cavities and breccias can be formed at depth in sediments by bubbles of gas rising from below.[26]

Here, however, I focus exclusively on hydrothermal explanations. It is believed that such processes require a temperature of only 150°C (quite cool by geologic standards) to not only dissolve limestone, but also large volumes of sandstone.[27] In some locations, notably Colorado, USA, the dissolution observed in mid-Carboniferous lithologies is closely correlated to the presence of ore deposits.[28] This has prompted the suggestion that mineral-bearing hydrothermal solutions utilised the existing permeability generated by previous karstic activity, enlarging the openings while depositing the ore material. But this explanation assumes that the previous karstic activity really existed. In fact, the hydrothermal explanation is perfectly adequate to explain the morphology of the limestone horizons without adding alleged 'paleokarst' processes.

Perhaps ironically, a double standard has long been followed relative to the two solution breccias (Figure 1) within the Madison Limestone. For decades, while the paleokarst explanation for the upper breccia reigned unchallenged, some uniformitarian investigators concluded that the lower breccia formed in hydrothermal processes related to the Tertiary Laramide orogeny (see below). Thus, the lower breccia considerably postdated the deposition of both the Madison and the Amsden. However, the only recognisable differences between the breccias involve the clay mineralogy,[29] and these do not compel a paleokarstic origin for the upper breccia. Rather, the origin of both breccias can be explained by the same hydrothermal activity, which affected **both** the upper and the lower breccias of the Madison Limestone. The differences in clay mineralogy are readily explained by each layer being affected for a different duration and intensity.

The hydrothermal action that formed the karst-like features, uniformitarians attribute to the Tertiary Laramide orogeny.[30] This is solely because that orogeny is the only major geological event that locally postdates both the 'karst' and the overlying sediments. However, freed from uniformitarian thinking, Flood geologists realize that the hydrothermal action could have occurred **anytime** after the Madison-Amsden (and equivalents) were deposited. In a young-Earth, global-Flood context, the hydrothermal action probably occurred soon after the sediments were deposited by the Flood and for some years afterwards.

The deep-seated hydrothermal explanation is more understandable from a Diluvial context than a uniformitarian one. According to the latter, mountains are built and magmas are generated and cooled over millions of years. Thus, hydrothermal activity would be less likely because any heat generated would tend to dissipate instead of accumulating over a large geographic area. By contrast, in a Diluvialist context, processes ranging from the rapid melting of continental crust[31] to the rapid cooling of intruded magmas[32] would produce great quantities of heat all at once. Vigorous hydrothermal activity would occur as a result of the enormous volumes of hot subterranean water produced. Consequently, 'paleokarst' would have been produced well below the land surface on a subcontinental scale within pre-existing layers of thick sedimentary rocks.

### Conclusions

Even within uniformitarian thinking, the rejection of paleokarst explanations in favour of giant, deep-seated hydrothermal systems is nothing short of revolutionary:

> 'I am convinced that **we have not been thinking big enough**, and conclude that this breccia lense [sic] is part of a Tertiary heated-water subsurface-plumbing system ... (emphasis added).'[12]
>
> 'The primary conclusion is that Laramide-Tertiary subsurface solution from heated subsurface waters is **an important geologic phenomenon whose scope vastly exceeds present geologic thinking**. Many low-grade metamorphic phenomena in sedimentary rocks have gone unnoticed or been misinterpreted. It is suggested that much of the chert in Paleozoic rocks, which we have taken for granted to be Paleozoic chert, may be Tertiary chert. In my opinion, the late Mississippian [Mid Carboniferous] karst story in the Rocky Mountains is completely fallacious (emphasis added).'[33]

Once again, a 'self-evident' indicator of long periods of geologic time turns out to be more suited to an alternative interpretation, one that is compatible with a young-Earth global-Flood model. Instead of being paleokarstic in origin, the structures within carbonates formed **after** the overlying sediment was deposited, and they furthermore bear witness to geographically extensive deep-crustal upwellings of hot-water solutions. Consequently, not only does the claim for long-duration earth-surface processes dissolve (pardon the pun), but, ironically, in a jujitsu turnaround, the claim self-converts into evidence for extensive geologic catastrophism during the Flood.

### References

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3. In this work, I use international stratigraphic terms (e.g. Carboniferous, Namurian), not North American ones (e.g. Mississippian, Pennsylvanian, Chesterian) used by the authors of the geologic papers I cite.

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7. Silvestru, Ref. 1, p. 104.

8. Bridges, L.W.D., Rocky Mountain Laramide-Tertiary subsurface solution vs. Paleozoic karst in Mississippian carbonates; in: Reid, S.G. and Foote, D.J. (Eds), *Thirty-Third Annual Field Conference—1982 Wyoming Geological Association Guidebook*, p. 257, 1982.

9. Bridges, L.W.D., Ames Depression, Oklahoma: domal collapse and later subsurface solution, *Oklahoma Geological Survey Circular* **100**:164–165, 1997.

10. Bridges, Ref. 8, p. 251.

11. Bretz, J.H., Solution cavities in the Joliet Limestone of northeastern Illinois, *J. Geology* **48**(4):362, 1940.

12. Bridges, Ref. 8, p. 260.

13. Sando, Ref. 5, p. 135.

14. In order for flowstone and dripstone to form in caves, the cave must be above the water table. When that happens, carbonate-rich waters can enter the cave, through tiny to large openings, and deposit their load in the free-air environment of the cave.

15. Bridges, Ref. 9, p. 165.

16. Bretz, Ref. 11, pp. 368, 371. The dips are recognizably much too steep to have originated from deposition of the Carboniferous sediments into already-existing Silurian surficial karstic features.

17. Bretz, Ref. 11, p. 377.

18. Bretz, Ref. 11, p. 373. Not surprisingly, Bretz (Ref. 11, p. 384) rejects the paleokarst explanation for the Silurian dolomites of northeastern Illinois, USA.

19. Slickolites are striations found on rock surfaces, consisting of closely crowded grooves and ridges along vertical or nearly vertical planes, which roughly parallel the cavity walls. They are unequivocally indicative of considerable subsidence adjustments.

20. Woodmorappe, J., *Studies in Flood Geology*, Institute for Creation Research, El Cajon, p. 216, 1999. For example, the so-called underclays in coal-bearing cyclothems often show slickensides as a result of extensive compaction which followed deposition.

21. Bretz, Ref. 11, pp. 352–354, 379.

22. Bridges, Ref. 8, pp. 254–255.

23. Evans, J.E. and Reed, J.M., Reinterpretation of the Pennsylvanian Molas Formation (San Juan Basin) as a loessite, not as a terra rossa paleosol, *Geological Society of America Abstracts with Programs* **31**(7):A–160, 1999.

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25. Silvestru, Ref. 1, p. 103.

26. Silvestru, E., Bubbles of surprise, *TJ* **15**(2):89–93, 2001.

27. Bridges, L.W.D., Tertiary subsurface solution versus Paleozoic karst solution, Guernsey, Wyoming, *Geological Society of America Centennial Field Guide—Rocky Mountain Section*, p. 205, 1987.

28. Lovering *et al*., Ore deposits of the Gilman District, Eagle County, Colorado, *United States Geological Survey Professional Paper 1017*, p. 32, 1978.

29. Bridges, Ref. 8, p. 253. The upper solution breccia, attributed to paleokarst, contains kaolinite as the chief clay mineral. The lower solution breccia, not attributed to paleokarst, has illite as the chief clay mineral. However, kaolinite is a hydrothermal-alteration product of illite. Therefore, the longer and more intense the hydrothermal processes are, the more kaolinite there will be at the expense of illite.

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31. Woodmorappe, J., The rapid formation of granitic rocks: more evidence, *TJ* **15**(2):122–125, 2001.

32. Snelling, A.A. and Woodmorappe, J., The cooling of thick igneous bodies on a young Earth; in: Walsh, R.E., (Ed.), *Proceedings of the Fourth International Conference on Creationism, Technical Volume*, Creation Science Fellowship, Pittsburgh, pp. 527–545, 1998. For a popular-level summary of this research, see Woodmorappe, J., Granites ... they didn't need millions of years of cooling, *Creation* **21**(1):42–44, 1999.

33. Bridges, Ref. 8, p. 264.

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## Editors' note

Original manuscript was received on 17 August 2001. It is worth noting that the papers dealing with alleged paleokarsts by Woodmorappe and Silvestru in this issue of *TJ* were prepared independently of each other. Any similarities between the concepts expressed are due to creationist thinking converging upon a solution to an alleged problem.