The Late Ordovician striated pavement in North Africa—not directly caused by glaciation

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One of the major challenges to Flood models from the uniformitarian preconceptions of the earth sciences has been pre-Pleistocene or ancient 'ice ages.'[1] Davis Young, an old-earth creationist geologist from Calvin College, considers these supposed ice ages as one of the strongest evidences for long ages and against a recent worldwide Flood.[2]

There are four main pre-Pleistocene 'ice ages', starting from the oldest within the uniformitarian geological column: (1) the early Proterozoic, (2) the late Proterozoic, (3) the late Ordovician and (4) the Permo-Carboniferous. Creationists are challenged to provide an alternate mechanism to account for the purported glacial evidences in these rocks, since one would not expect an ice age during a one-year Flood. One also would not expect evidence of a pre-Flood ice age, if it occurred, to have survived the onslaught of the globally catastrophic Flood.

The uniformitarian scientists do present what seems like powerful evidence for their claimed ancient ice ages. Three main diagnostic criteria are normally considered, one of which is a striated or grooved bedrock surface below what is called a tillite[3]. Such striated surfaces are often associated with the Pleistocene or post-Flood Ice Age.

However, such surfaces can also form below mass movement as the debris scrapes against the bedrock.[4] For example, a striated pavement caused by a debris flow occurs on top of the Gravelly Mountains of south-west Montana, USA. This pavement even has striations in two directions, with some striations that contain chattermarks, regarded as a product of glaciation.

Recently, a new analysis[5] has been carried out on the famous striated and grooved pavement from the late Ordovician 'ice age', which is based on outcrops scattered across most of the Sahara Desert and north-west Africa.[6]

The impressive striated and grooved pavements of north-west Africa were considered diagnostic of the late Ordovician glaciation.[7] However, they possess one significant contrary feature: the grooves and striations are strikingly parallel towards the north over most of the area.[8,9] (In the recent publication on the subject, the flow directions are shown to deviate more than previously identified, but are still similar over a large area.)[10] The problem with such unidirectional flow indicators is that modern and past Pleistocene ice sheets show different directions, even up to 180°, within short distances. Uniform flow directions are more indicative of mass movement and prompted Schermerhorn, a uniformitarian critic of many pre-Pleistocene 'ice ages', to suggest a mass flow mechanism as the origin of the striations and grooves. He wrote that the Saharan grooves '… might be dragmarks gouged in soft sediment by the movement of pebbly mass flows.'[11] I believe Schermerhorn is correct.

Many pre-Pleistocene striated and grooved pavements are now believed to have been etched on originally soft substrate. This has resulted in three hypotheses for their formation, two of which have been previously considered significant for the examples from North Africa: 1) a grounded glacier overriding unlithified sands, or 2) the result of scouring action of drifting icebergs.[12] It is remarkable that this second mechanism was even considered, given that iceberg scourmarks are commonly gouged in variable directions over short distances. The third hypothesis, subglacial erosion of a debris-rich glacier sliding over a frozen or compacted substrate, is not considered significant for North Africa because the sediments are believed to have been soft and deformable.

The recent analysis of the striations and grooves in north-west Africa suggests that none of the three proposed mechanisms for soft sediment grooves and striations is correct,[12] because similar marks are found *vertically stacked in waterlain sandstones* below the main surface:

> 'However, at the outcrop scale, the striated surfaces are generally not found precisely at the interface between these two contrasting lithologies. In many examples,

Photo by Andrew Snelling

Example of a striated pavement interpreted as an ancient ice age on a Late Precambrian surface near Adelaide, South Australia.

they are observed in the upper part of the *fluvial* sandstones over flat horizontal to slightly undulating surfaces.

'… Additional striated surfaces, with similar characteristics and orientations, can be found at *different superimposed horizons* within apparently undeformed *fluvial* sandstones, up to several metres below the uppermost striated surface [emphasis added].'[10]

Thus, the classical terrestrial-based, glacial, sliding-mechanism first suggested for the striations, and the iceberg scouring mechanism, must be rejected.[13]

One would think the investigators would completely reconsider the glacial mechanism for the North African striations, especially since the striations and grooves are so uniform and there are other processes that form striated bedrock, including mass movement,[4] fast flowing water[14] and ground-hugging volcanic eruptions.[15]

Unfortunately, the pre-Pleistocene glacial paradigm remains intact leaving uniformitarians with no other options. They continue to view the deposits in North Africa as glaciogenic, based mainly on the striated and grooved surfaces, which now should be questionable:

'In the pre-Quaternary geological record, such striated pavements, overlain by diamictite (tillite) horizons, provide convincing evidence of former glaciations.'[12]

Chained to the glaciogenic mechanism, the authors propose a new hypothesis that the stacked striated surfaces are shear zones, in unlithified water-laid sediments, caused by a moving ice sheet. So, the striations are not produced directly by glaciation, but indirectly, according to this new concept. Such striated shear zones are probably rare in Pleistocene sediments (I have not come across any references before), but the authors are able to conjure up several references that striated shear surfaces can occur in outwash deposits that are overridden by ice. Unfortunately for their hypothesis, the striated shear surfaces in the water-laid sand occur *at the continental scale* and it is admitted that such extensive shearing striations have not been demonstrated from past Pleistocene ice sheets.[12]

Such shear features could just as easily, if not *more* easily, have formed by mass movement in water over soft sand as by an overriding ice sheet. If the authors jettison the glacial hypothesis, they would probably be forced to admit that mass movement occurred at the continental scale over North Africa. But such implications are likely to be unpalatable to uniformitarian thinking.

The authors also state that the late Ordovician examples are not the only instances of such shear striations in the pre-Pleistocene 'glacial' record. They suggest that the shearing mechanism can be applied to similar pre-Pleistocene striated pavements from the Permo-Carboniferous and late Proterozoic 'ice ages', which are apparently difficult to explain by overriding ice. (The early Proterozoic 'ice age' does not have any, or at least very few, striated surfaces.) This indicates that striated pavements in other pre-Pleistocene 'ice ages' are not clearcut indicators of glaciation, and that mass flow may be responsible for many, if not all, pre-Pleistocene 'ice ages.'[1]

Whatever the merit in the new hypothesis, glaciologists are forced by the evidence to back away from classical and straightforward deductions of ancient glaciation based on striated and grooved bedrock. It seems that the more we know about an area, or the data, that challenges the Flood, the more the challenge evaporates.

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