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Flood geology explains Grand Canyon folds

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ABSTRACT

The Grand Canyon of Arizona, in the southwestern United States, has been eroded through a high, uplifted plateau. At the time of uplift, steep faults in the region's basement rocks were reactivated, causing the overlying sedimentary strata to drape over the tops of the faults in a series of step-like folds. The conventional geological model suggests that about 450 million years elapsed between the oldest of the sedimentary strata being deposited and the time they were folded, in which case the rocks had ample time to be compacted and hardened into solid rock. By contrast, in the creationist model only a short time, perhaps a few months, may have elapsed between the time of deposition and the time of folding. Recent observations based on careful examination of thin sections taken from the folds and the surrounding rocks indicate that the rocks were soft and uncemented at the time of folding, favouring the creationist model.

INTRODUCTION

The Grand Canyon is a dramatic erosion feature in northern Arizona, more than 1½ kilometres deep and exposing a thick section of flat-lying sedimentary rock strata belonging to the Cambrian to Permian systems (Beus and Morales 2003). These horizontal sedimentary strata sit on top of an even older eroded basement of crystalline igneous rocks and tilted sedimentary rocks belonging to the Precambrian.

Earth movements uplifted the region to form a series of high-standing plateaus, and the Grand Canyon was carved through the uplifted terrain. At the time of uplift, steep faults (or fractures) in the Precambrian basement rocks were reactivated, causing the overlying sedimentary strata to drape over the tops of the faults in a series of step-like folds (Figure 1; Huntoon 2003).

One of these spectacular folds can be seen in Carbon Canyon, a side canyon along the Colorado River in Grand Canyon, shown in Figure 2. At this location, the oldest of the flat-lying sedimentary strata – a rock unit known as the Tapeats Sandstone – has been folded at a 90° angle by the earth movements. As a consequence, the sandstone layers on the western side of the canyon are oriented almost vertically.

THE TIMING OF THE FOLDING

When did these rock folds form? The conventional geological model gives a very different answer to the creationist model.

According to the conventional model, the Tapeats Sandstone was deposited about 507–508 million years ago. Subsequently, hundreds of millions of years elapsed, during which other sedimentary strata built up on top of the Tapeats Sandstone, burying it deeply. Eventually, about 60 million years ago, the Colorado Plateau began to be uplifted, fracturing the Precambrian basement rocks and folding the overlying sedimentary strata, including the Tapeats Sandstone (Huntoon 2003, p.240).[1]

So in this model about 450 million years elapsed between the time the Tapeats Sandstone was deposited and the time it was folded – more than enough for the deeply buried sandstone to be compacted and hardened into solid rock. In this scenario, the sandstone was only able to be folded in a 'plastic' fashion because of the elevated temperatures and pressures associated with its deep burial.

By contrast, the creationist model suggests that the rocks of the Grand Canyon region were formed only thousands of years ago as a result of events in biblical Earth history. Most probably, the Precambrian basement rocks date from Creation Week and the time before Noah's Flood, while the overlying sedimentary strata, including the Tapeats Sandstone, were deposited during the worldwide Flood itself (Austin 1994).

Around the end of the Flood the Colorado Plateau was elevated by earth movements, causing the folding of the freshly deposited sedimentary strata. In this model, the time that elapsed between the deposition of the Tapeats Sandstone and its subsequent folding was short – perhaps only a few months – and so the sandstone and the other sedimentary strata above it were likely still soft when they were uplifted to form the plateau (Snelling 2009).

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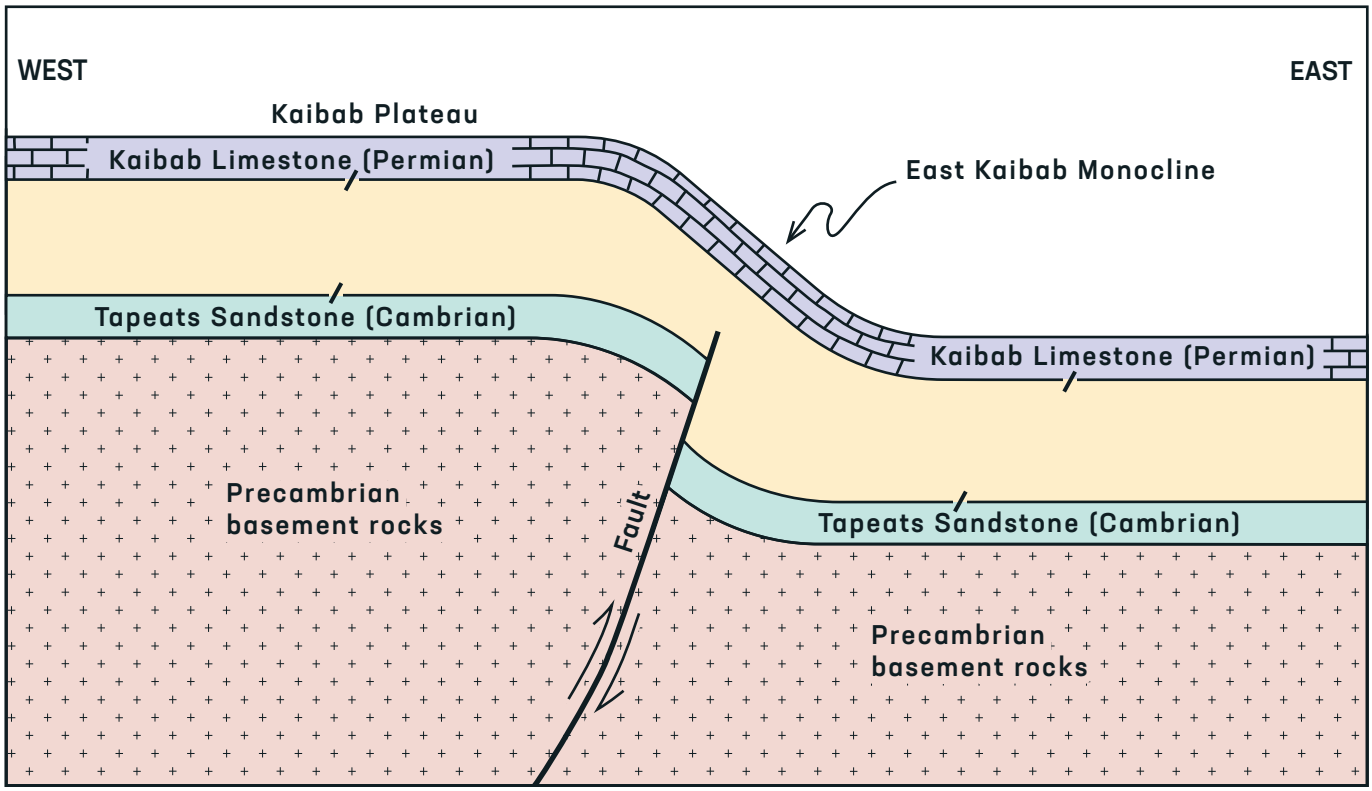

Figure 1. Cross section of Grand Canyon rock strata showing the East Kaibab Monocline with the uplifted Kaibab plateau to the west. Compression of the crust has reactivated faults in the Precambrian basement rocks, causing the folding in the overlying sedimentary rocks. The folding must have occurred after the topmost sedimentary layer of the Grand Canyon was deposited, because it was caught up in the folding. Modified from Huntoon (2003, p.237; Figure 14.10.a).

CAREFULLY EXAMINING THE ROCKS

But which of these models is right? Is it possible to determine whether the sedimentary strata were folded while in a hard, brittle state (as the conventional model suggests) or while soft and uncemented (as the creationist model suggests)? One way is to carefully examine the rocks under the geological microscope. In rocks that were folded in a hard, brittle state, we ought to see shattered mineral grains and evidence that the mineral cements binding the grains together had been broken and recrystallised. But if the sandstone was soft when it was folded, we would not expect to find these features.

Until recently, no studies of this kind had been conducted. However, in 2017 Dr Andrew Snelling, Director of Research at Answers in Genesis (USA), obtained permission to collect 53 rock samples from locations within the Grand Canyon National Park in order to test the two models (see 'The legal battle for the rock samples'). Forty-four of the samples were collected from the folds and nine from the same rock layers some distance from the folds. Most of the samples came from the Tapeats Sandstone, but some other rock units were sampled too.

the evidence indicated that the Tapeats Sandstone was still soft and uncemented when it was uplifted.

Back in the laboratory, Dr Snelling spent about 2500–3000 hours carefully examining thin slices of these rock samples under the geological microscope, looking for features that might suggest that the sediment had been brittle and hard at the time it was folded (Snelling 2022a). However, he was unable to find any evidence of shattered or broken mineral grains or the breaking and recrystallisation of the mineral cements (Snelling 2021a). Instead, the evidence indicated that the Tapeats Sandstone was still soft and uncemented when it was uplifted and folded. Other rock strata caught up in the folding likewise showed evidence of being soft when the folding took place (Snelling 2021b, 2022b).

THE DATA FAVOUR THE CREATIONIST MODEL

If the conventional model is correct, these observations are very unexpected! Geological evidence indicates that more than 3000 metres of sediment once covered the Grand Canyon region, and, given the known rates at which temperature and pressure increase with depth,[2] this overburden ought to have caused the Tapeats Sandstone to become solid rock after 450 million years. How could the sandstone have remained soft if such an immense span of time had elapsed between the time of deposition and the time of folding?

However, these data are consistent with the creationist model, in which the Tapeats Sandstone and

Figure 2. A spectacular fold in the Tapeats Sandstone in Carbon Canyon in the eastern Grand Canyon. The uplift associated with the East Kaibab Monocline has caused the strata to be folded into a near-vertical orientation. The view is toward the south with the uplift on the right (west) side. Note the people for scale. Photograph by Paul Garner.

the other flat-lying sedimentary strata of the Grand Canyon region were deposited rapidly during the worldwide Flood. Earth movements associated with the uplift of the western United States at the end of the Flood reactivated dormant faults in the Precambrian basement rocks, resulting in the folding of the sedimentary strata overlying them. However, these strata could be folded in a 'plastic' fashion because they were recently deposited and still soft and uncemented.

So it seems that the folds in the rocks of the Grand Canyon provide yet more evidence that the earth's sedimentary strata were deposited rapidly and recently, just as the Bible's record of a worldwide Flood implies.

ENDNOTES

1. The folding is thought to have occurred during an episode of uplift called the Laramide orogeny, conventionally dated to the Upper Cretaceous to Eocene, between 60 million and 35 million years ago.
2. Temperature increases at about 0.033°C per metre and pressure at about 23 kilopascals per metre. At the depth of burial of the Tapeats Sandstone (about 3,000 metres), this would have generated temperatures of about 100°C and pressures of about 70,000 kilopascals.

THE LEGAL BATTLE FOR THE ROCK SAMPLES

Dr Snelling's research on the Grand Canyon folds hit international news headlines when his original application for a research and sampling permit, submitted in 2013, was declined by the Grand Canyon National Park authorities. A 'Freedom of Information' request lodged by lawyers with the Alliance Defending Freedom revealed that his application had been refused on religious worldview, rather than scientific, grounds – a clear contravention of the rights granted to United States (US) citizens. Eventually, US government lawyers overturned the original decision, the permit was granted and in 2017 Dr Snelling was able to make a river trip into the Grand Canyon to collect the samples needed for his research (Snelling 2022a).

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Paul Garner is a full-time Researcher and Lecturer for Biblical Creation Trust. He has an MSc in Geoscience from University College London, where he specialised in palaeobiology. He is a Fellow of the Geological Society of London and a member of several other scientific societies. Between 2007 and 2011 he was part of a team undertaking a major field and laboratory investigation of the Coconino Sandstone of northern and central Arizona, funded by the Institute for Creation Research. He wrote and featured in the documentary, *Set in Stone: Evidence for Earth's Catastrophic Past* (Truth in Science, 2012). He is the author of two books, *The New Creationism: Building Scientific Theories on a Biblical Foundation* (Evangelical Press, 2009) and *Fossils and the Flood: Exploring Lost Worlds with Science and Scripture* (New Creation, 2021). He is co-host of the fortnightly podcast, *Let's Talk Creation*, with Dr Todd Wood.