Several types of sandstones challenge uniformitarianism

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Classically, there are four main types of sandstone: (1) quartzarenite, (2) lithic arenite, (3) arkose, and (4) greywacke. This paper will examine the last three. The sand that makes up lithic arenites forms today on a local scale. However, the huge scale of lithic arenites in the rock record undermines the application of the uniformitarian principle to their formation. Arkose also forms locally, but its high feldspar content weathers rapidly to clay. The huge scale of arkose and the fact that it must be eroded and deposited rapidly also makes uniformitarian explanations implausible. Greywacke has no plausible uniformitarian explanation on either a local or large scale. It is not forming today. These sandstones can be best explained by Noah's Flood. Arkose and greywacke were likely eroded from a granite or gneiss terrane and rapidly deposited. The arkose beds underwent enough water current action to winnow out the fine-grained matrix, while greywacke did not. Greywacke has characteristics of mass flow. The sands that make up these types of sandstone could end up in deep basins or rifts. Lithic arenite, on the other hand, was mainly eroded from Flood-derived volcanic and metamorphic rocks, which is why they mostly outcrop toward the end of the Flood in the Cretaceous and Tertiary.

Classically, there are four main types of sandstone: (1) quartzarenite, (2) lithic arenite, (3) arkose, and (4) greywacke. Quartzarenite, a very pure type of sandstone, very likely is not forming today.[1] In the rock record, quartzarenites are sometimes geographically widespread and/or thick, especially in the Precambrian. Thus, quartzarenites have no plausible explanation according to uniformitarianism, defined roughly as 'the present is the key to the past'.

The other three types of sandstones in the classical classification,[2] lithic arenites, arkose, and greywacke, also challenge uniformitarianism in various ways. The sands that make up lithic arenite and arkose are forming on a local scale today, but the sand that makes up greywacke apparently is not. However, the enormous scale of their deposits conflicts strongly with uniformitarianism.

Lithic arenites

If a sand has a large proportion of rock fragments, usually greater than 50%, with a lesser percentage of feldspar and quartz with little matrix, it is termed a 'lithic arenite'. Lithic arenites compose generally around 20–26% of all sandstones.[3] Lithic arenites are an extremely diverse group of sandstones, depending upon the rock that is eroded, and are composed of a substantial quantity of unstable rock fragments.[4] This implies a wide array of environmental conditions for the formation of the original sand for lithic arenites. For instance, the more unstable plagioclase feldspars usually dominate over the more stable K-feldspars.[5] The rock grains are commonly volcanic or metamorphic rocks.[6] The framework grains are usually poorly sorted and poorly rounded.

Although they outcrop throughout the rock record, lithic arenites are found especially in the Cretaceous and Tertiary.[7] They make up most Paleozoic sandstones in the central Appalachians.[8] Most of the Jurassic and Cretaceous sandstones in the Rocky Mountains are lithic arenites.[9] Much of the Tertiary Gulf Coast sandstones are lithic arenites. Pettijohn summarizes:

> "Lithic arenites are immature sands in that most of their rock particles are either mechanically weak or are chemically unstable. Just how large volumes of sand are generated from fine-grained rocks is not clearly understood."[7]

Most present-day sand deposits, especially in most present-day large rivers, would, if lithified, probably be lithic arenites.[10]

However, those in the sedimentary rocks are spread across a much more extensive area and can be very thick.[11] Moreover, if the lithic arenites in the rock record were deposited slowly over many millions of years, as assumed, the unstable grains would disintegrate. There would be abundant matrix, but arenites have little matrix.[12] Therefore, it appears that present conditions do not explain lithic arenites over naturalistic timescales.

The arkose problem

Arkose, a feldspathic sandstone with about 25% or more feldspar, forms no more than 15% of sandstones.[13] The grains are mostly quartz and feldspar and are generally

Figure 1. Panorama of Uluru (Ayers Rock), central Australia, at sunset

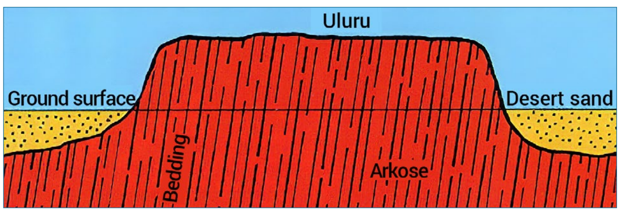

Figure 2. Interpreted cross-section through Uluru (Ayers Rock) showing the tilted layers of arkose continuing under the surrounding desert sand[19]

poorly rounded and usually cemented by calcite.[14] Arkose occurs from the Precambrian to the Recent and has little matrix, different from greywacke. Boggs echoes numerous sedimentologists in considering arkose an ill-defined category with variable meanings.[15] Sand deposits today can have a fair amount of feldspar, about 11% on the average,[10] probably because there has not been enough time or transport for the feldspar to disintegrate after erosion from the parent rock.

Some modern-day feldspathic sands likely meet the criterion of 25% feldspar, especially if weathering above granite or gneiss, which has a high proportion of feldspar. These sands would therefore be considered arkose. So, arkose can be explained by uniformitarian principles, but only on a small scale: "the idea of arkoses being either local deposits related to block faulting or residual deposits above granitic basement is confirmed".[16] The arkose sand would be preserved by block faulting and rapid deposition and burial.

However, the sedimentary rock layers tell a different story. The rock record displays thick, widespread arkosic sandstones. For instance, the Old Red Sandstone is an arkose containing up to 60% feldspar. It extends over much of the United Kingdom and Norway;[17] it is not a local deposit. The early Cenozoic Swauk Formation of Washington State, USA—also an arkose—is over 1,525 m thick.[1717]

Uluru (Ayers Rock) is a 340-m high erosional remnant in central Australia (figure 1), but it represents the eroded top of a large accumulation of arkose, 6,000 m thick (figure 2)![18,19] This arkose is believed, by mainstream geologists, to have accumulated slowly over 350 million years. If this were the case, the majority of feldspar should have transformed into clay by now.

Just as amazing is that the arkose beds are nearly vertical (figure 1). After 6,000 m of sand with high feldspar content accumulated over a vast area, it lithified into arkose and the beds folded severely enough for some layers to end up vertical. The folding was followed by enough erosion that the tops of the folds were sheared off, which formed a planation surface with Uluru standing as an erosional remnant. Uluru stands as a testament against a uniformitarian origin.[20]

The paradox of how such a large-scale deposit of arkose sand could accumulate so slowly, which should be typical under uniformitarian conditions, is called the 'arkose problem' by secular science.[21] Because feldspar weathers rapidly into clay, the erosion of a terrain high in feldspar and the deposition of the erosional products and their burial must have been rapid. Another problem is that the provenance (or source) of the sand that makes up arkose is usually unknown for huge amounts of arkose, although erosion is likely from a granitic or gneissic terrain.[6] Pettijohn *et al.* express the arkose problem this way:

> "But beyond provenance the question is: under what conditions is feldspar released to the sediments rather than decomposed to clay in the source region? Normally, or certainly ultimately, the feldspar is so decomposed and the clay formed is separated from the quartz so that the resulting sand is quartz-rich and feldspar-free."[22]

Like lithic arenites, the vast volume of these deposits contradicts the uniformitarian principle. Arkose further violates the uniformitarian principle in that arkose is mostly a large deposit that must accumulate rapidly.

The greywacke problem

Greywacke (or graywacke) is another class of sandstone that is ill-defined with much confusion, but it continues to be used by geologists.[15] It is a well-lithified sandstone that is dark grey, greenish-grey, or black with a matrix greater than 15%. The matrix mostly consists of clay- and silt-sized particles. It is essentially a 'muddy' sandstone, with generally angular, poorly sorted quartz grains. Greywacke is considered mostly marine, being often interbedded with shale containing marine fossils. It is commonly quartz rich but can have a high percentage of feldspar and rock particles. The feldspar is largely the more unstable plagioclase. About 22% of all sandstones are greywacke and are predominantly dated as Precambrian (22%) and Paleozoic (49%) by secular geologists.[23,24] Most Archean sedimentary rocks are greywacke.[25]

The greywacke problem is how to account for the matrix. In other words, the mixture of silt- and clay-sized particles within the sand-sized grains:

> "The problem became one of explaining the simultaneous deposition of mud and sand. Normally, as a result of current action, the two part company and are separately accumulated."[26]

No significant near-shore environments are accumulating such sands today that when lithified would be called greywacke: "Few, if any, modern near-shore, shallow-marine sands have the requisite character, that is, interstitial mud, to become greywackes on lithification."[27] Garzanti is another who notes the problem of finding modern examples of greywacke:

> "Such a dualistic representation [of two endmembers of a 'dirty' sandstone and a pure sandstone], however, is contradicted by *the virtual absence* of a suitable modern incarnation of graywacke [emphasis added]."[27]

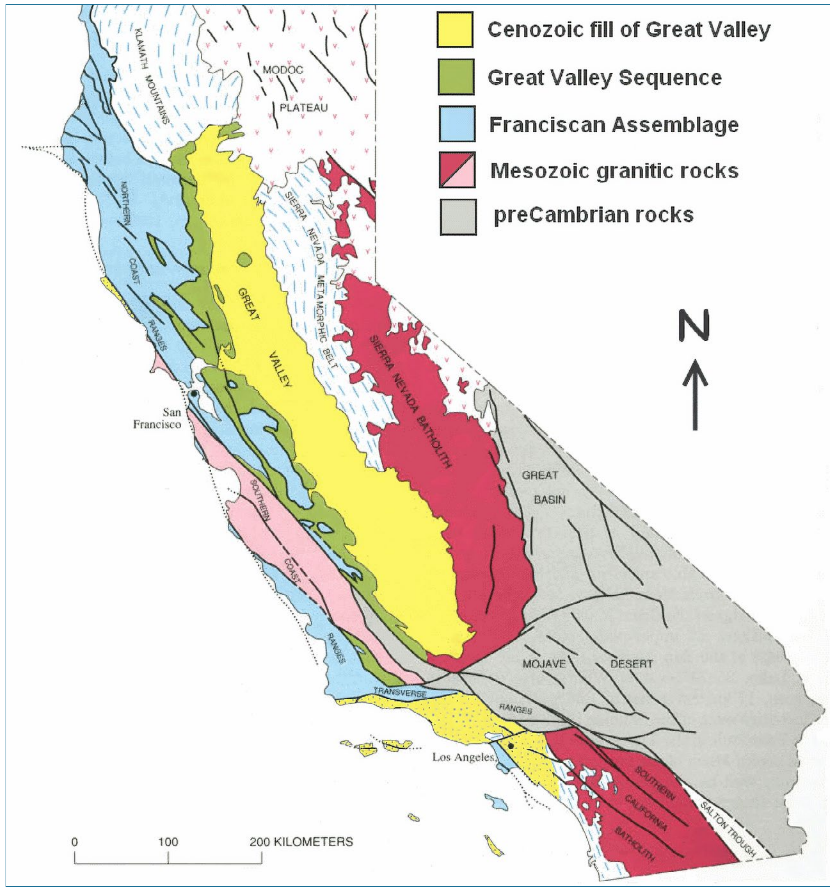

Figure 3. The Franciscan complex, coastal California, USA (in blue) that contains thick greywacke

Greywacke in the rock record consists of a massive volume, similar in quantity to quartzarenite and arkose. It outcrops in the thick, widespread Franciscan Formation in the Coast Range of California (figure 3). The Torlesse Greywacke, in New Zealand (figure 4), is said to be 15 to 20 km thick![28] It crops out in the southern Alps, east of the Alpine fault.

It has been suggested that greywacke represents sandstone formed in deep-sea turbidites. However, turbidite currents descending the continental slope to the deep-sea should easily winnow the sand from the silt and clay (mud), resulting in an upward graded profile with matrix-poor sand. And this is what is observed in the deep sea: "In addition, graywacke, that is, matrix-rich sands, do not appear to be common among present deep-sea sands of presumed turbidite origin."[29] They likely were deposited in sediment gravity or mass flows.[25]

Although not observed forming today, Pettijohn *et al.* suggest that, in the past, greywacke was deposited by rapid erosion and deposition into deep basins, similar to arkose:

> "On the other hand, the detritus of which graywackes are composed must, like that of arkose, require an environment in which erosion, transportation, and deposition are so rapid that complete chemical weathering of the materials does not take place."[30]

We do not see such environments of rapid deposition today, so this is another aspect of sedimentary rocks against the uniformitarian principle.

Since greywacke in the rock record defies uniformitarianism, secular scientists have simply hypothesized that greywacke is a result of diagenesis or post-depositional changes.[6,31] This is Garzanti's hypothesis. Some even think that diagenesis solves the greywacke problem.[25] However, a major problem with the diagenetic interpretation is that many greywackes could not have had this origin because they are too quartz-rich and that much of the clay and silt is of detrital origin.[25] So, what is the basis of this speculation? It is simply that uniformitarianism must be true—and greywacke exists:

> "Modern sediments of comparable origin, whether found in nature or deposited experimentally, are not greywackes. Thus if the principle of uniformitarianism is applied, *the peculiar texture of greywackes cannot be an original detrital [deposited] feature, but must be the*

Figure 4. Mount Cook, New Zealand, with Hooker moraine lake in the foreground. Torlesse greywacke in the strata to the right.

result of post-depositional alteration of 'normal sand' [emphasis in original]."[32]

We have come across special pleading by secular scientists numerous times to explain the many contradictions to uniformitarianism, deep time, and evolution. The rescuing hypothesis for greywacke is like evolutionists saying, in the face of contradictions, that we are here; therefore we must have evolved; so any contradiction must be apparent, not real.

Noah's Flood can account for the types of sandstone

Although uniformitarian scientists have severe problems explaining most aspects of sandstones by uniformitarianism, creation scientists can potentially explain them. The large size of these sandstones can readily be explained by the global Flood that would have spread sediments over large areas, with one formation deposited within layers, one upon another with little or no erosion between.[33] The Flood would have quickly accumulated great thicknesses of sediments in deep basins or rifts. And the types of sandstones provide insights into some of the processes that occurred during the Flood.

Sediment eroded from a granite or gneiss terrain, high in quartz, that subsequently experienced great turbulence with mechanical and chemical weathering before deposition, would be deposited as a quartzarenite. Large impacts did occur in the Proterozoic and Archean.[34] The powerful currents and turbulence from such impacts would be capable of quickly forming a prodigious amount of pure quartz sand that is rounded to well-rounded. This is one of many reasons that I believe most, if not all, Precambrian sedimentary rocks are from the Flood, since they contain many quartzarenites. Sands highly winnowed by flood waves could have eventually been deposited in rifts or basins, even during the Precambrian. During the Great Deposition,[35] as the currents and turbulence lessened with minimal deformation, much quartzarenite sand could have been deposited over wide areas in the early Paleozoic, especially above the Great Unconformity. The St Peter Sandstone and other early Paleozoic quartzarenites would fall into this category. The amount of quartzarenite would have diminished quickly above the early Paleozoic.

Other Precambrian sandstones must have been eroded and deposited rapidly in rifts and basins that likely formed early in the Flood, such as the Midcontinent Rift and the Belt Basin. The Midcontinent Rift starts in northeast Kansas and continues north-northeast into Lake Superior, where it turns sharply south and ends in Michigan. This rift contains 10–25 km of basalt lava with interbedded sedimentary rocks. The Belt Basin in extreme western Montana, northern and central Idaho, northeast Washington and adjacent Canada is filled with fine-grained sand and coarse silt over 20 km deep. It was likely deeper since the lithified sediments uplifted with a great amount of erosion of the top.[36] The type of sand deposited in the rifts and basins would depend on several variables. If the high feldspar sand undergoes some turbulence and current activity and little chemical weathering, the clay and silt could winnow out and end up as arkose, which has little fine-grained matrix. Greywacke, on the other hand, did not winnow out the silt and clay but was deposited, probably very rapidly and more as mass flows, so that the sand and fine-grained particles did not separate.

Lithic arenites would likely be rare early in the Flood, since it seems probable that the main rock eroded was granite and gneiss of the upper crust. But as more volcanic and metamorphic rocks are formed later in the Flood, and especially during uplift of mountains during the draining of the floodwaters, lithic arenites would more likely form. The fact that lithic arenites have many unstable grains and little matrix indicates that the sediment was rapidly eroded and deposited. This is why the more unstable grains did not have time to break down. This could be the reason lithic arenites are more common in the Cretaceous and Tertiary, when the mountains rose and the ocean basins sank (Psalm 104:6–9), with more volcanic and metamorphic terranes exposed. A little arkose and greywacke could also have formed late in the Flood, if erosion products were predominantly from a granitic or gneiss terrane.

Conclusions

The principle of uniformitarianism has great trouble explaining most sandstones, which means that it cannot account for 20–26% of the sedimentary rocks. Greywacke and quartzarenite do not seem to be forming, even on a local scale, today. Although arkose and lithic arenites are forming on a local scale, their large scale in the rock record defies uniformitarianism. If these sandstones took many millions of years to accumulate, the unstable grains, including feldspar, would have decayed, with much matrix within the sandstone. This is evidence of quick deposition of a huge amount of sand with many lithic grains for lithic arenites, and feldspar for arkose.

Arkose and greywacke underwent a different history than quartzarenite. Quartzarenites likely underwent powerful currents and turbulence with chemical weathering before deposition in a rift or deep basin in the Precambrian and spread over large areas in the early Paleozoic. Arkose and greywacke, on the other hand, were eroded and deposited quickly in rifts or deep basins. Arkose underwent a little winnowing of the fine-grained matrix, while greywacke did not. Greywackes likely were commonly deposited by mass flows. Lithic arenite was commonly eroded from volcanic and metamorphic terrains, mostly later in the Flood when the mountains rose and ocean basins sank (Psalm 105:6–9). The properties of each type of sandstone provide more information for deciphering the catastrophic action during the Flood.

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