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Suggested Strategies for Fitting Precambrian Rocks into Biblical Earth History

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Abstract

A comprehensive Flood model requires an appraisal of the rock record. At the global scale, knowing the global volume and distribution of such rock is an important first step. This requires significant mapping and quantifying of rock volume, which in turn requires determining basal and upper diluvial boundaries for each location. An important question in determining basal boundaries is how to address Precambrian sedimentary and volcanic rocks. We present strategies for evaluating such rocks vis a vis the Genesis Flood, concluding that many such rocks should be considered diluvial.

Key Words: Archean impact spherules, discontinuity criteria, lower diluvial boundary, Precambrian, Sudbury impact, upper diluvial boundary, Vredefort impact

Introduction

A Flood model must be constrained by data. Hydrodynamic and/or sedimentological facets of such models require reliable estimates of the volume and distribution of all sediment deposited by the Biblical Flood. As little as two decades ago, such estimates were rough, but the online availability of modern datasets and developments in mapping software allow more accurate mapping and quantitative analysis.

Determining total global diluvial sediment volume and distribution can be seen as a two-step process: (1) assessing marine sediment volume and distribution and (2) assessing continental sediment volumes and distributions. Marine sediment volume is currently thought to be 3.37 x 10^8 km^3 (Reed et al., 2022), and Straume et al. (2019) have developed grids and maps showing distribution. A conservative estimate of the diluvial percentage of that volume is 2.80 x 10^8 km^3 (Oard et al., 2023). Most of this volume represents sediment eroded from the continents in the Recessive Stage, though it includes some chemical and biochemical rock and even rare coalbeds (Clarey, 2020a). If we assume most is clastic, it equates to an average thickness of 1900 m removed from today's continents at that time (Oard et al., 2023).

The second step is to determine current continental volumes and distributions. This is best done by mapping basal and upper diluvial boundaries and quantifying volume by subtracting the upper from the basal. Uncertainties arise from differing accuracy of the data sets, the volumes of exposed crystalline basement and large volcanic areas, and the volume of sediment reworked after the Flood. Once a terrestrial volume is estimated, the marine volume derived

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Table I. Pre-Flood/Flood boundary criteria and proposed boundary location after Austin and Wise (1994) and Wise and Snelling (2006).

Boundary Criterion	Boundary Location
Paleontological Discontinuity	Between rocks with no multi-cellular fossils and rocks with multi-cellular fossils
Erosional Discontinuity	The lowest unconformity with sedimentary rocks or a nonconformity at the contact with crystalline basement
Time Discontinuity	Lowest and most significant time gap
Sedimentary Discontinuity	At the base of the lowest fining upward sequence
Tectonic Discontinuity	At the lowest tectonic event

from diluvial erosion can be added to it to provide an estimate of the volume of rocks deposited and emplaced on the continents at the peak of the Genesis Flood, about Day 150 (Boyd and Snelling, 2014; Johnson and Clarey, 2021). Where did this total continental volume originate? How was it eroded and transported onto the continents? These are questions we cannot answer now, but hope to in the future.

Reed et al. (2023) presented a method for deriving continental sedimentary volumes using global information system (GIS) analysis of mapped surfaces. Total diluvial volume was derived for Colorado and its sedimentary basins. This study illustrated one of the significant unknowns for such a project—the diluvial status of Precambrian sedimentary, volcanic, and metasedimentary rock. In Colorado, these were minor relative to the total volume. In other regions, these Precambrian rocks comprise a significant portion of the total rock record. Examples include the Midcontinent Rift System, the Belt Basin, and the various Baraboo quartzite basins. Which, if any, of these can be attributed to the Noahic Flood? Although we believe that these should be assessed on a case-by-case basis, we provide some basic parameters for doing so in this paper, as well as for the overall scope of such a project.

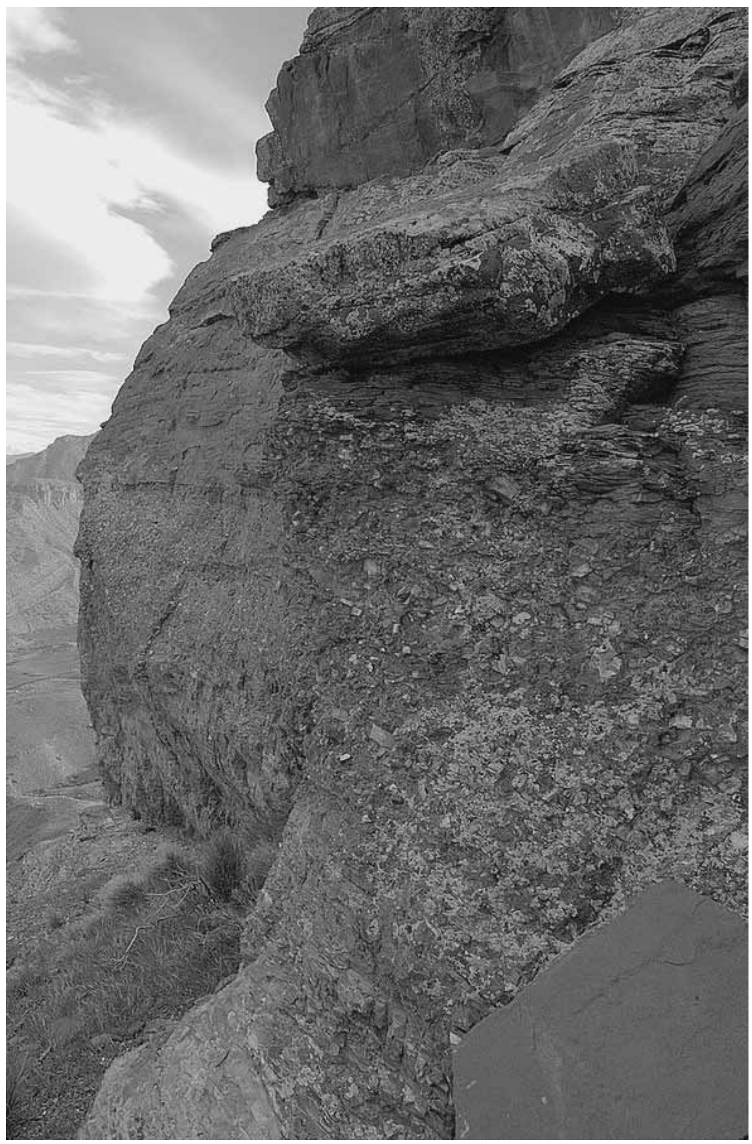


Figure 1. Upper Precambrian Sixtymile Formation in Grand Canyon (National Park Service, public domain).

Figure 2. A layer of dolomitic stromatolites in Glacier National Park, Montana.

Questions about the Lower Diluvial Boundary

Some creation scientists think oddities in the rock record should define the boundaries. Coulson (2021) placed the lower diluvial boundary at the Carboniferous/Permian boundary because of Cambrian "stromatolites" in southwest Utah, arguing insufficient time for them to form in the Flood. However, stromatolites are also found elsewhere in the Phanerozoic (Gebelein, 1969; Monty, 1981; Bertrand-Sarfati and Monty, 1994; Riding, 2000; Flügel, 2004), including the Triassic (Schubert and Bottjer, 1992; Perri and Tucker, 2007; Woods, 2009; Luo et al, 2014) and in the Jurassic Navajo Sandstone (Eisenberg, 2003). Determining diluvial boundaries requires a full analysis, with greater certainty. Puzzles such as stromatolites are insufficient. Some think they are abiotic (see below).

Aside from advocates of the recolonization model (Tyler, 2005), most creation scientists believe that the Mesozoic and Paleozoic are diluvial strata, and many place the lower boundary at, or slightly below, the Cambrian/Precambrian boundary (Austin, 1994; Austin and Wise, 1994; Wise and Snelling, 2006). Dickens (2018) and Dickens and Hutchison (2021) believe the boundary is at the Mesoproterozoic/Neoproterozoic boundary. Hunter (2022) thinks all Precambrian rocks are early Flood. So how are we to determine the answer?

The Discontinuity Criteria

A start would be the multiple "discontinuity" criteria (Table I) proposed by Austin and Wise (1994) and Wise and Snelling (2006). We agree with examining multiple criteria over a wide range of rocks because the efficacy of any one criterion will vary from place to place. In

Table II. The discontinuity criteria and reasons why criteria are equivocal.

Type of Discontinuity	Why Equivocal
Paleontological	Upper Precambrian multi-celled organisms (Precambrian catastrophism would destroy multi-celled organisms), abundant Precambrian microfossils, Upper Archean eukaryotes
Erosional	Other major unconformities exist below the Great Unconformity in the Grand Canyon. Erosion governed by location, elevation, slope, available water, and its energy
Time	Time interpreted, not observed; more likely time discontinuity would be between Precambrian sedimentary rocks and crystalline rocks below
Sedimentary	Fining-upward sequences should be common in Flood and pre-Flood; they should occur also in deep Precambrian sedimentary basins
Tectonic	Tectonic activity likely variable, sufficient erosion can erase evidence

Figure 3 ***(left)*****. View on top of layer of dolomitic stromatolites in Glacier National Park, Montana.**

Figure 4 ***(below)*****. Stromatolites in carbonate in Glacier National Park, Montana.**

Figure 5. Stromatolites in Figure 5 transition into layered carbonate rocks.

the eastern Grand Canyon, where tilted, thick Precambrian sedimentary rocks exist beneath the Great Unconformity, they defined the lower diluvial boundary just below the Precambrian Sixtymile Formation (Figure 1). In the eastern Mojave Desert near Death Valley, they placed it in the lower Kingston Peak Formation (Austin and Wise, 1994; Wise, 2003), about four km below the top of the Precambrian and two km above crystalline basement. The upper and middle Kingston Peak Formation consists mostly of diamictite, an unsorted or poorly-sorted sedimentary rock with a wide range of particle size. Uniformitarian scientists attribute it to a Late Precambrian ice age, while Austin and Wise (1994) and Wise and Snelling (2006) interpreted it from the perspective of rifting and landslides at the beginning of the Deluge. It is interesting that some secular scientists also think the Kingston Peak Formation is due to landslides transitioning into rifts (albeit over long periods of time) and not glaciation (Kennedy and Eyles, 2021; Oard, 2021). However, none of the discontinuity criteria are absolute (Table II).

The Paleontological Discontinuity

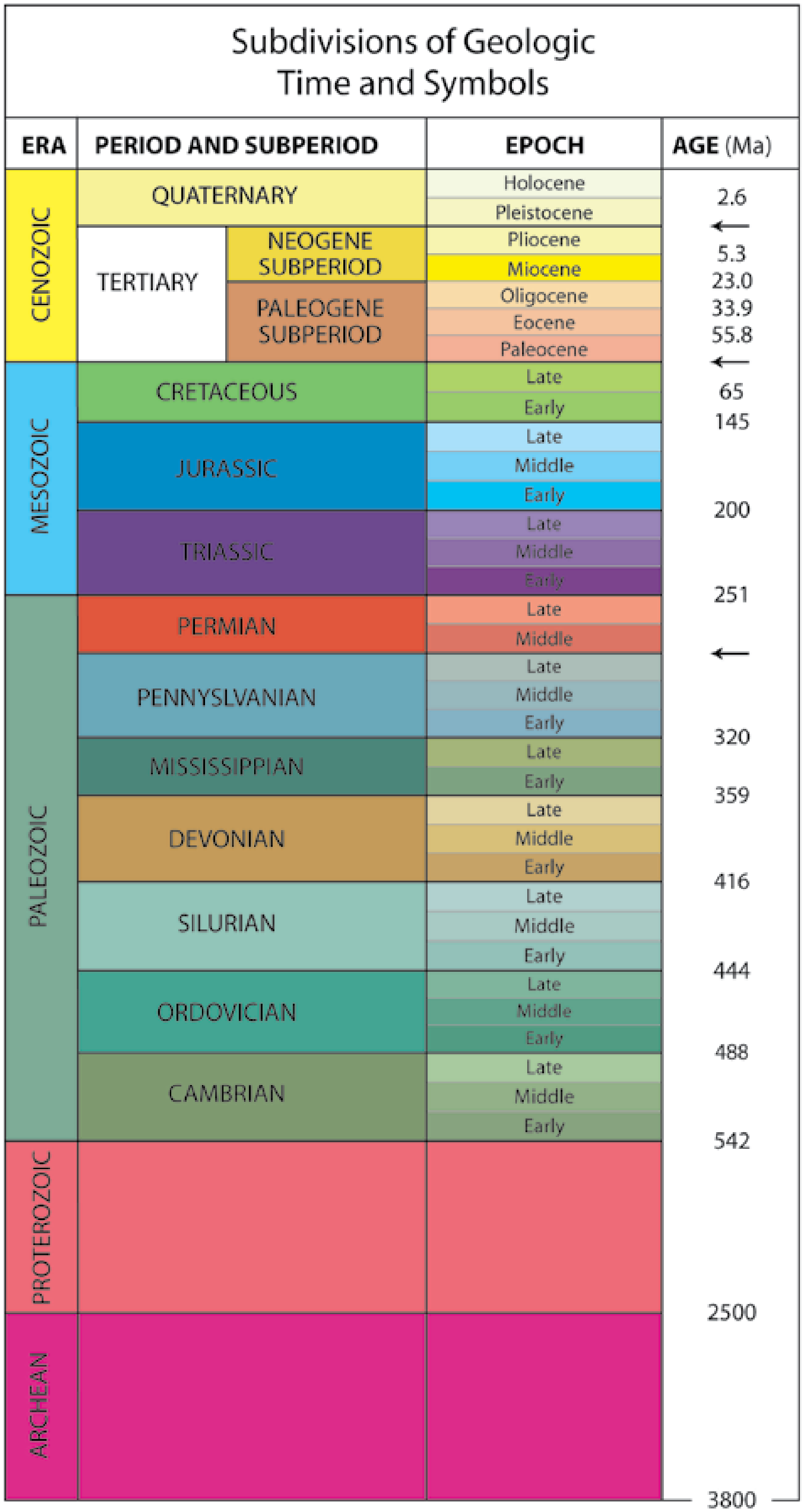
Since any one of these criteria might not apply at any given place, they proposed multiple confirmatory criteria—a good procedure, though Froede and Oard (2007) and Oard and Froede (2008) reasoned they were not absolute (Table II). The paleontological discontinuity seems primary for many creation scientists, who think a sudden upward abundance of metazoans reveals the basal boundary. While significant, it is not absolute; the paucity of Precambrian metazoans could be due to elevated temperatures, as suggested by abundant dolomite (Oard, 2022a, 2022b). Primary dolomite requires temperatures over 100°C, probably well over that. Moreover, the high energy and resulting turbulence characterizing the early parts of the Flood judgment might have pulverized potential fossils, leaving primarily microorganisms. If impacts occurred at that time, poor conditions of preservation would have been present in affected areas.

As mentioned above, some see abundant Precambrian stromatolites as evidence of antediluvian rocks, since they were once thought to be rare or non-existent in the Phanerozoic. Glacier National Park, Montana, is well-known for stromatolites. Figures 2 and 3 show a layer of dolomitic stromatolites. Figure 4 shows stromatolites in carbonate that transition laterally into thin-bedded carbonate layers (Figure 5). Stromatolites occur today, such as those in the classic area of Shark Bay, Western Australia (Figures 6 and 7), and these take years to grow. Some creation researchers believe

Figure 6. Stromatolites in Shark Bay, Western Australia (Happy Little Nomad, Wikipedia Commons CC-BY-SA-2.0). Notice that the stromatolites are mostly isolated, mushroom-shaped buildups.

Figure 7. Close up of a Shark Bay stromatolite as displayed in the Museum of the Rockies, Bozeman, Montana.

Figure 8 *(right)*. The geological column, showing three locations where creation scientists have placed the upper diluvial boundary (horizontal arrows on right side). Only a few have assumed the Upper Paleozoic boundary where Coulson now places the basal diluvial boundary.



stromatolites in the sedimentary rocks are biological (Purdom and Snelling, 2013; Snelling and Purdom, 2013). Snelling (2009, p. 634) states:

> The fact that stromatolites and these bacteria [that built the structure] are among the major fossils of the Precambrian rock record, and then are virtually absent in Phanerozoic rocks and are rare today, suggests that these stromatolites were a significant part of an important late Creation Week/pre-Flood hydrothermal biome.

However, stromatolites are well known to exist in the Phanerozoic and are not so rare. Coulson (2021) has found Upper Cambrian stromatolites in southwest Utah that also occur over many other locations of the world. Despite Coulson (2021), many fossil stromatolites appear to be much different from those forming today, which may indicate an inorganic origin (Oard and Froede, 2008). For instance, practically all stromatolites are found in carbonates. Schopf (2006) states: "Almost all known ancient stromatolites are or were originally of calcareous composition." However, modern stromatolites bind all kinds of sediments (Schieber, 1998). Perhaps creation scientists should be looking for other mechanisms. Some uniformitarian scientists believe that some stromatolites could be non-biological (Lowe, 1994; Grotzinger and Rothman, 1996; Walter, 1996; Schieber, 1998; Brasier et al., 2006; Stokstad, 2006).

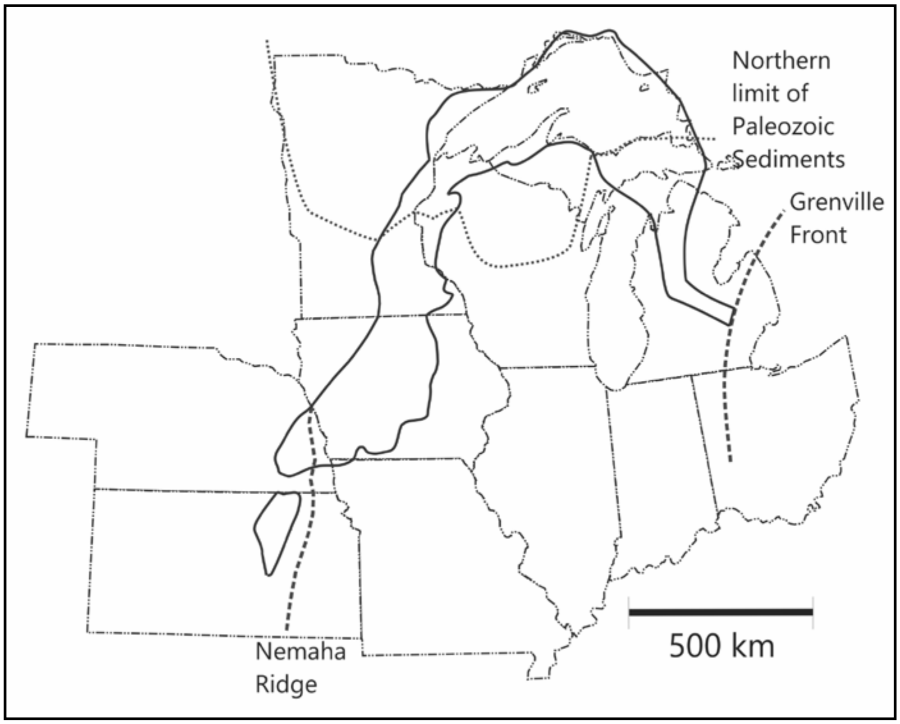


Figure 9. Map of the North American Midcontinental Rift within the solid lines.

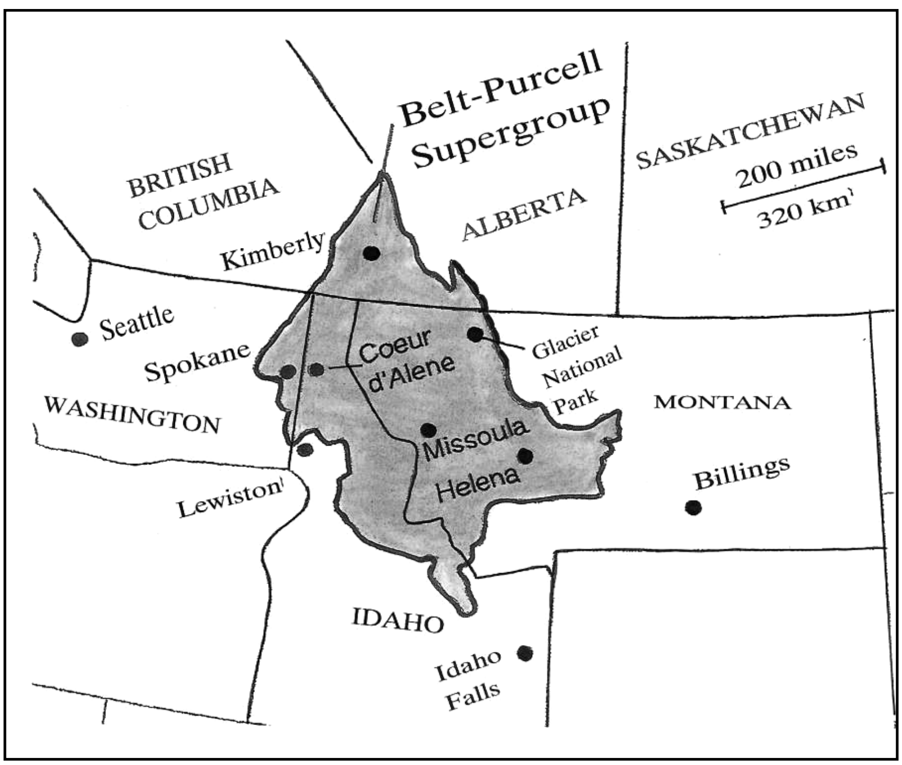


Figure 10. Map of the Belt Basin. Scale is in the upper right.

Current Views on the Place of the Precambrian in Biblical Earth History

It is clear that Precambrian sedimentary and volcanic rocks need to be assessed using all the evidence. At present, creation scientists differ on whether the Precambrian is a record of the Creation Week, the antediluvian period, or the global Flood.

Creation Week

Dickens and Snelling (2008) and Dickens (2018) think the relative order of Precambrian radiometric dates is valid. They also see a sequence of Precambrian events correlative to Creation Week, the antediluvian period, and the Deluge. In this view, the Archean Era (Figure 8) correlates to Day 1 of the Flood Year with abiotic stromatolite-like features that gave way to biotic stromatolites and banded iron formations (BIFs) in the Upper Archean and Lower Paleoproterozoic of Day 2. Note that they admit that some stromatolites are abiological. The Mesoproterozoic was interpreted as a time of rifting on Day 3, such as the Midcontinental Rift in North America (Figure 9). The Neoproterozoic is considered early Flood by Dickens (2008), Dickens and Hutchison (2021), and Dickens and Snelling (2008) but primarily antediluvian by Snelling (2009, p. 662).

Antediluvian

Humphreys (2014) places most of the Precambrian between Creation and the Flood, based on the decay of the Moon's magnetic field, remnant magnetism in Moon rocks, and accelerated radiometric decay. Spencer (2015) questions this scenario because the scale of Precambrian impacts and processes would be too catastrophic. Most creation scientists believe that geological effects of the Fall were benign (Snelling, 2009), but we cannot know.

Figure 11. Quartzite layers in the Belt Supergroup.

Figure 12. Abrupt changes in the color of argillite from red (oxidized, right) to green (reduced, left).

Early Flood

We suspect that much of the Precambrian sedimentary record, along with associated igneous and metamorphic rocks, formed at the onset of the Flood (Oard, 2014; Oard and Reed, 2017). Our reasons include: (1) evidence for large-scale catastrophism congruent with the Flood, (2) Precambrian impacts that would have devastated antediluvian life; (3) the continuity of certain unique rocks across the Precambrian/Phanerozoic boundary, such as black shale, carbonates, quartz arenite sandstone, and phosphorites (Oard, 2013); and (4) the apparent conformity moving up through the Mesoproterozoic Belt Supergroup into the Cambrian Flathead Sandstone.

The Belt Supergroup

Mesoproterozoic metasedimentary rocks crop out in western Montana, northern and central Idaho, northeast Washington, and adjacent Canada over an area of 197,000 km^2 (Link et al., 2021). Called the Belt Supergroup in the U.S.A., they are named the Purcell Supergroup in Canada. Researchers often simply call them the Belt-Purcell Supergroup. They were deposited in the Belt Basin (Figure 10). The maximum known thickness of Belt rocks is 20 km, west of Missoula, Montana (Harrison et al., 1974). The Belt rocks may be considerably thicker in northwest Montana (MacLean and Sears, 2016). The sediments were deposited with little deformation, but later mildly metamorphosed to quartzite (Figure 11) and argillite, then uplifted, faulted, and folded. Finally, the upper section was removed by erosion. The argillite often changes to red (oxidized) to green (reduced) abruptly (Figure 12). The Belt Supergroup is dated as Early Mesoproterozoic at 1,470–1,400 Ma, based on U-Pb dating.

The Cambrian Flathead Sandstone in Montana, correlative with the Tapeats Sandstone in Grand Canyon, overlies Belt rocks at many locations, and the contact represents about one billion years

Figure 13. The Belt/Cambrian contact in Bridger Mountains (Peter Klevberg is pointing at the contact).

of missing time (i.e., presumed evolutionary time) at the contact. It is 30 to 100 m thick, coarse-grained with quartz pebbles, few shale interbeds, and was deposited mostly over crystalline basement over nearly half of North America (if correlative formations are included). The Flathead Sandstone is claimed to be disconformable with the Belt rocks, with a slight angular unconformity in spots (Harrison et al., 1974; Harrison and Cressman, 1993). Deiss (1935) acknowledged that many geologists cannot see that unconformity because the relationship is rarely angular, but he found eight locations with a slight angular unconformity. Campbell (1960, p. 573) reinforced this lack of an angular unconformity: "The angular discordance between the Precambrian and the Cambrian beds at these locations is so slight that it was not detected." Oard and Klevberg have seen one of these contacts at the top of the Bridger Mountains, and it appears conformable (Figure 13). The big picture indicates continuous sedimentation from the Belt Supergroup upward into the Paleozoic. This is one of the main reasons we think the Mesoproterozoic Belt Supergroup was very early Flood.

The Vredefort and Sudbury Impacts

The Vredefort (Figures 14 and 15) and Sudbury (Figure 16) impacts are well-documented and dated at about 2 Ga. The present Vredefort and Sudbury craters are 250 km and 200 km in diameter, respectively (Huber et al., 2020; Allen et al., 2022), despite 8–11 km of erosion in the Vredefort area and 5 km of erosion in the Sudbury area (Senft and Stewart, 2009). That could be the equivalent of erosion from the Kaapvaal and Canadian Shields, respectively, if the locations of these impacts are representative of the whole shield. This would mean that

much sediment was deposited at least on these two shields that was subsequently eroded off.

The surface of the Canadian Shield is likely part of the Great Unconformity (Sturrock et al., 2021). The region was once covered by Paleozoic and Mesozoic sediments, as shown by erosional remnants (Ambrose, 1964; Clarey, 2020b). Feinstein et al. (2009, p. 190) state:

> …all or much of the Canadian Shield was once overlain by significant Phanerozoic successions that are now completely or nearly completely eroded across broad regions, apparently as the result of epeirogenesis.

Thus, the Canadian Shield likely is an exhumed erosion surface. However, Clarey (2020) found that all of the Phanerozoic rocks thin towards the Canadian Shield.

Figure 14 *(above)*. Map of South Africa showing the location of the Vredefort dome and the probable location of its original rim (Oggmus, Wikipedia Commons CC-BY-SA-3.0).

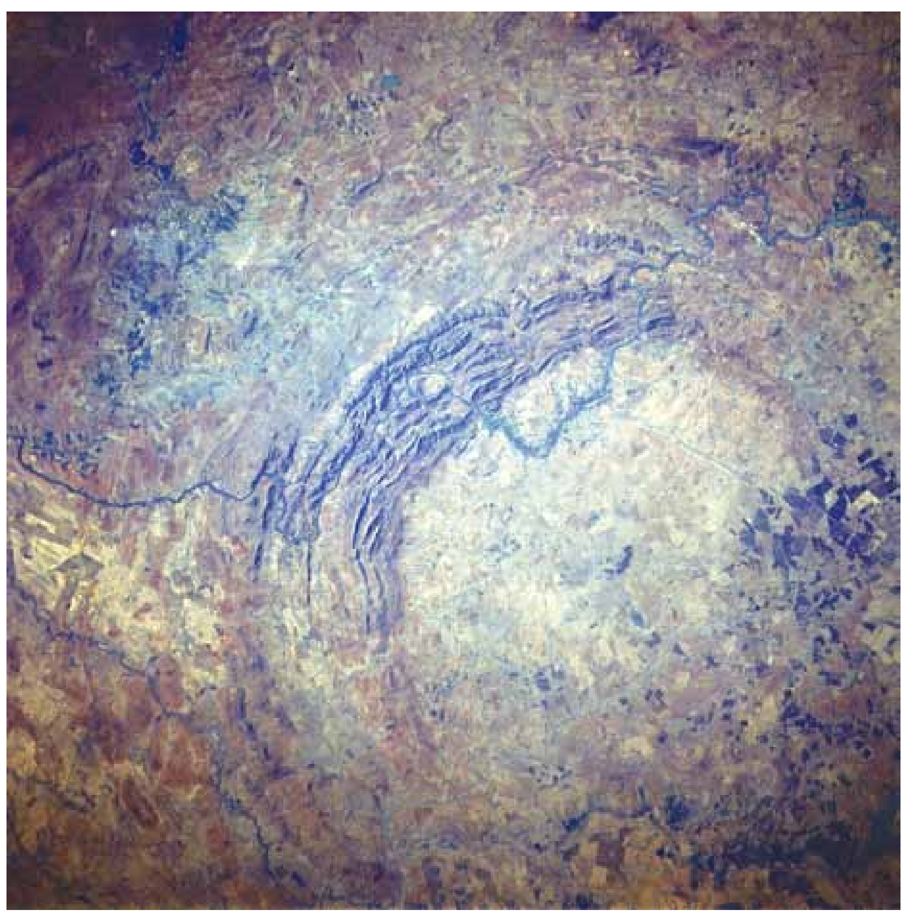


Figure 15 *(right)*. The upturned central portion of the Vredefort impact structure, South Africa (Júlio Reis, Wikipedia Commons, PD NASA).

How Destructive Would Vredefort and Sudbury Have Been?

Destruction by impacts depends on many variables, but can be correlated to crater size, as a surrogate for impact energy. The Earth Impact Effects Program indicates that these two impacts would have devastated an area equal to today's land mass. However, it does not account for the curvature of the Earth (Collins et al., 2005). Taking this variable into consideration, strong winds and the fireball from these two impacts would have destroyed only 15% of today's continental area (Toon et al., 1997).

But air blast and fireball are only two effects of an impact. An impact of that scale would send debris and vapor on ballistic trajectories over much of the Earth (Toon et al., 1997; Toon et

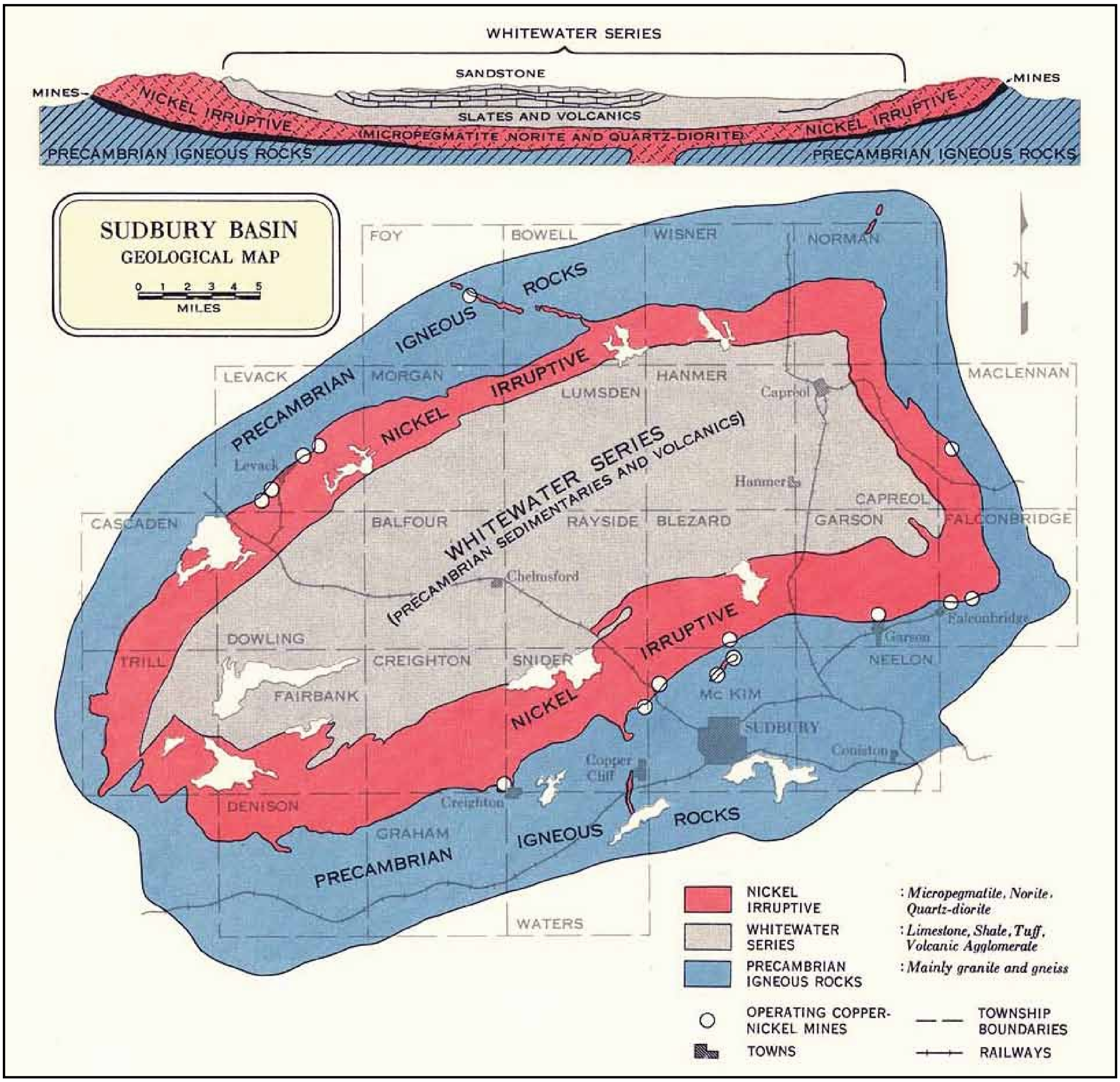


Figure 16. Geological map of Sudbury Basin (Natural Resources Canada, Wikipedia Commons public domain).

al., 2016; Bardeen et al., 2017). The vapor would condense into spherules. Debris and spherules that would not overcome Earth's gravity would accelerate back, striking the top of the atmosphere at velocities little less than escape velocity. Strong frictional heating to around 1600°K would radiate upward and downward. Downward infrared radiation would cause global wildfires by igniting lichen, grass, pine needles, etc. (Goldin and Melosh, 2009; Robertson et al., 2013; Toon et al., 2016). The optical depth of debris and wildfire soot would shroud Earth in total darkness, stopping photosynthesis. The submicron particles would cause impact winter that would last years. Acid rain and air pollution would be intense. The ozone shield would largely disappear.

That is just from two confirmed large Precambrian impacts. There are 28 smaller confirmed impacts in the Proterozoic (Schmieder and Kring, 2020) that had the potential to devastate local and regional areas. Of course, if these impacts occurred early in the Deluge, the heavy continuous rain would mitigate some of these effects. But if they are antediluvian, they would have had the potential to destroy the surface of the Earth and its inhabitants *before* the Flood.

Huge Archean Impacts

There likely were other impacts not yet recorded in the Earth Impact Database. Evidence for these comes from Archean spherule layers (older than 2.5 Ga) occurring in sedimentary, volcanic, and volcaniclastic rocks in Western Australia and eastern South Africa (Simonson et al., 2000). The spherules are about 0.1–4 mm in diameter and form layers ranging from 0.4 to 70 cm thick. But these layers cover hundreds of km distance (Glass and Simonson, 2012) and are dated 3.47 to 2.49 billion years (Smith et al., 2016). Shocked quartz and high-pressure rutile (TiO_2—II) have also been found (Rasmussen and Koeberl, 2004; Smith et al., 2016). The number of Archean impacts and their sizes are debated, but it seems that the spherule layers could represent at least 11 impacts from bodies 10–100 km in diameter (Johnson et al., 2016; Schmieder and Kring, 2020). The low end of these estimates are the size of the Vredefort and Sudbury impactors. If these spherules represent huge impacts, these likely are also from the early Flood.

Precambrian Sedimentary Rocks Need to Be Included in Volume Estimates

Precambrian impacts are significant in any Flood model. Their stratigraphic position suggests that most Precambrian sedimentary rocks are early Flood (Oard, 2014; Spencer, 2015). Some igneous and metamorphic rocks may also be part of the diluvial rock record, especially if associated with sedimentary rocks, such as interbedded within the Precambrian sedimentary rocks. Such a determination would be critical for mapping a basal diluvial boundary. However, we suggest that large basins, like the Belt, be assessed by their own evidence. In general, we propose to map at the base of many such rocks. In many cases, we will also map the top of the Precambrian and compare the results in doing volumetric analyses of the diluvial rock record.

Summary

Calculating Flood sediment volume requires mapping both basal and upper diluvial boundaries. Discerning these surfaces can be difficult. Particularly important is the status of Precambrian sedimentary and volcanic rocks. Features like the Belt Basin and Midcontinent Rift are extensive with thick sedimentary and thick volcanic rocks in the latter. Examining each feature using multiple criteria and comparing maps both above and beneath them seems the best approach. In general, we provisionally place Precambrian sedimentary rocks, large impacts, quartzite outcrops, and sedimentary basins in the diluvial record.

To accommodate this uncertainty, we have developed a method of "plug-and-play" for mapped surfaces that can present volumetric analyses for different horizons (Reed et al., 2023). We are also working to develop other physical criteria that may be more widely applied. At present, such a determination is often based on the local conditions and regional context, such as the conformable contact between the Belt series and the Flathead Sandstone. The ultimate goal is a well-constrained, well-supported determination of sediment volume and distribution to aid in our understanding of the Genesis Flood and then to determine where that sediment originated.

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