Is the pre-Flood/Flood Boundary in the Earth's Mantle?

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ABSTRACT

Probable constraints on pre-Flood water volume, purity and temperature are considered to preclude deposition of the Precambrian Archaean, dominantly volcanic, and Proterozoic, dominantly sedimentary, strata during Creation Week. A Flood origin for these strata at the base of the stratigraphic record is thus proposed. A pre-Flood land:sea area ratio of 50:50 and a postulated pre-Flood water volume of $138x10^6$ km^3, about 10 per cent of today's free water volume, would have been sufficient to provide required depth environments for all pre-Flood fish and sea creatures.

The extrusion of about $60x10^6$ km^3 of Archaean submarine volcanic strata, at 1200°C, at the base of the stratigraphic record, into the volume of pre-Flood water would probably, without miraculous intervention, have caused such a large temperature rise as to preclude survival offish and sea creatures created on Day 5 of Creation Week. Erosion from the emergent 'dry' landmass, transport, and sedimentation of the Proterozoic sedimentary strata in a 24-hour period on Day 3 would have had to have been accomplished with a water: sediment mass ratio of approximately 1:6, and again, without miraculous intervention, would have caused land and water environments unsuitable for growth of land plants and survival offish and sea creatures created on Day 5, and land creatures and mankind on Day 6.

Environmental factors during deposition of the Archaean and Proterozoic strata would have prevented the preservation of fossils. The water of the fountains of the great deep 'was probably exsolved from magma, which rose from depth in the Earth's mantle to be extruded as the Archaean volcanic strata and intruded as the Precambrian 'basement granites'. The 'basement granites', the immediately overlying Archaean volcanic strata, and possibly the Proterozoic sediments might be considered to be the products of magma differentiation processes initiated in the mantle, hence the pre-Flood/Flood boundary might be considered to exist in the mantle where these differentiation processes were initiated.

INTRODUCTION

In view of prevailing creationist views concerning postulated pre-Flood geological activity and the location of the pre-Flood/Flood boundary in the stratigraphic record, a critical analysis of certain potentially limiting physical parameters seems warranted.

This paper attempts to quantify the volumes, temperatures and interactions of pre-Flood water, Archaean 'basement granites' and volcanics, and Proterozoic sediments, which are considered to place potential constraints on pre-Flood geological activity.

PRE-FLOOD WATER VOLUME AND DISTRIBUTION

Genesis 1:1 (KJV) *'In the beginning God created the heaven and the earth!*

Genesis 1:2 *'And the earth was without form, and void; and darkness was upon the face of the deep.*

And the spirit of God moved upon the face of the waters.'

Genesis 1:6 *And God said, Let there be a firmament in the midst of the waters, and let it divide the waters from the waters.'*

Genesis 1:7 *And God made the firmament, and divided the waters which* (were) *under the firmament from the waters which* (were) *above the firmament: and it was so.'*

Genesis 1:9 *And God said, Let the waters under the heaven be gathered together unto one place, and let the dry* (land) *appear: and it was so!*

Genesis 1:10 *And God called the dry* (land) *Earth: and the gathering together of the waters called he Seas: and God saw that* (it was) *good.'*

Geological activity, including submarine volcanism, erosion, transport and sedimentation, requires the availability of sufficient water to accomplish these processes. For this reason, speculation regarding pre-Flood geological activity should be made with some concept of the amount of water available for geological processes, which, unless water has escaped to space, or descended back into the mantle, in significant quantities, must have been less than the current volume of free water.

If, as suggested by several creationist authors,[1-10] a uniformly warm, temperate climate was maintained during the pre-Flood period of about 1656 years,[11] from the end of Creation Day 7 to the Flood, possibly with the assistance of a water vapour 'canopy' which may have surrounded the globe, then there may not have been any need for a complex ocean-land-atmosphere meteorologic system, such as the one which exists today to provide the climatologic needs of our post-Flood world. Thus, the pre-Flood sea, which was formed by the gathering together of the waters on Day 3, may have been considerably smaller and, in part, shallower than the oceans of today.

Table 1 shows that 11 per cent ($152 \times 10^{6} km^{3}$) of the currently existing 'free' water volume at the Earth's surface ($1,384 \times 10^{6} km^{3}$)[12] is sufficient to submerge the entire globe surface to an average depth of 270 m above current sea level (or half the globe to a depth of 540 m), and to provide, in a water vapour 'canopy', sufficient water ($14 \times 10^{6} km^{3}$) to supply rainfall at an average rate of one inch per hour for 40 days and nights during Stage 1 of the Flood.

If we, reasonably, assume a pre-Flood land: sea area ratio of 50:50 and that the pre-Flood sea volume was about 10 per cent of today's 'free' water volume, we can see from Table 2 that this amount of water can adequately provide water depth environments required for all fish and sea creatures created on Day 5 and presumably any other functions that were carried out by the sea(s).

The additional water ($1,232 \times 10^{6} km^{3}$) required to make up to today's 'free' water volume might be assumed to have been supplied by the *fountains of the great deep'* during the 40 day and night period of Stage 1 of the Flood (at a rate of approximately $1.28 \times 10^{6} km^{3}$ per hour).

Bergman[13] claims that Frank[14] has discovered evidence that cometesimals (mini-comets consisting of frozen water) add an estimated 100 million tonnes of water to the Earth's atmosphere annually, and suggests that if, as suggested by Frank, they have been impacting the Earth for eons, they would be the major source of water for the Earth's oceans, lakes and rivers.

It is noted that 100 million tonnes of water (annually) is only about 0.10 km^{3}. If we assume a young Earth and multiply this annual addition rate by 6,000 years, the approximate time since creation, we get about 600 km^{3}, only about 0.43×10^{4} per cent of the present free water volume.

		Total Free Water	11% Free Water	10% Free Water	1% Free Water
	Mean Earth Radius, R_E (km)	6,371.00	6,371.00	6,371.00	6,371.00
1.	Earth Volume, V_E (km^3)	1,083,209,449,854.72	1,083,209,449,854.72	1,083,209,449,854.72	1,083,209,449,854.72
2.	Free Water Volume, V_f (km^3)	1,384,120,000.00	152,253,200.00	138,412,000.00	13,841,200.00
3.	Flooded Earth Volume, V_{EF} (km^3)	1,084,593,569,854.72	1,083,361,703,054.72	1,083,347,861,854.72	1,083,223,291,054.72
4.	Flooded Earth Radius, R_{EF} (km)	6,373.71	6,371.30	6,371.27	6,371.03
5.	Water Depth, D_W (m)	2,710.00	300.00	270.00	30.00

1. $V_E = \frac{4}{3} \times \pi \times (R_E)^3$
2. From Baumgartner, A. and Reichel, E., 1975 (Ref. 12). (Includes polar ice caps, ground and soil waters.)
3. $V_{EF} = V_E + V_f$
4. $R_{EF} = \sqrt[3]{\frac{3}{4 \times \pi} \times V_{EF}}$
5. $D_W = R_{EF} - R_E$ Assumes flat earth surface, (that is, no allowance for topography).

Table 1. *Calculated water depths (above present mean sea level) for various proportions of the present free water volume.*

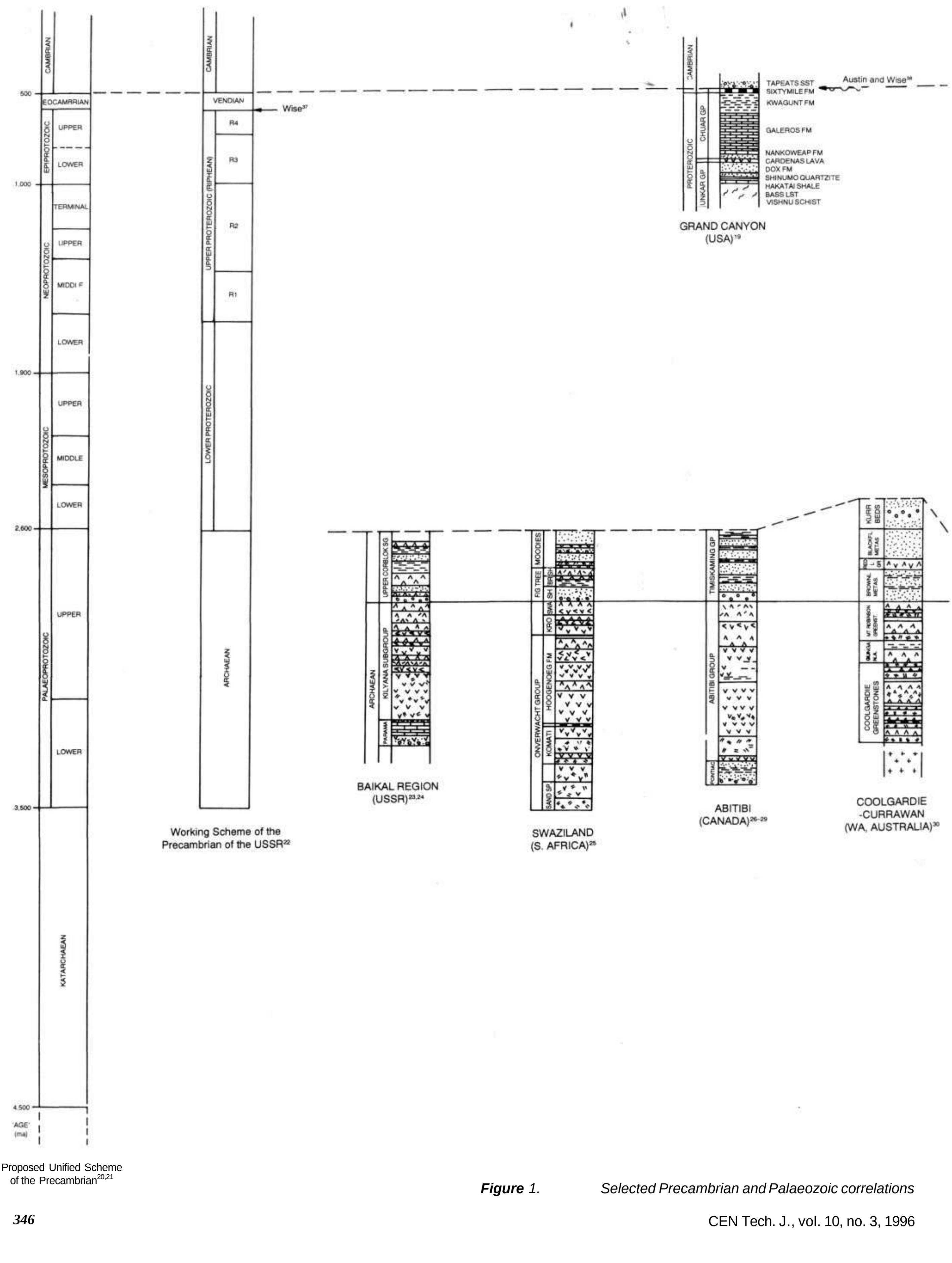
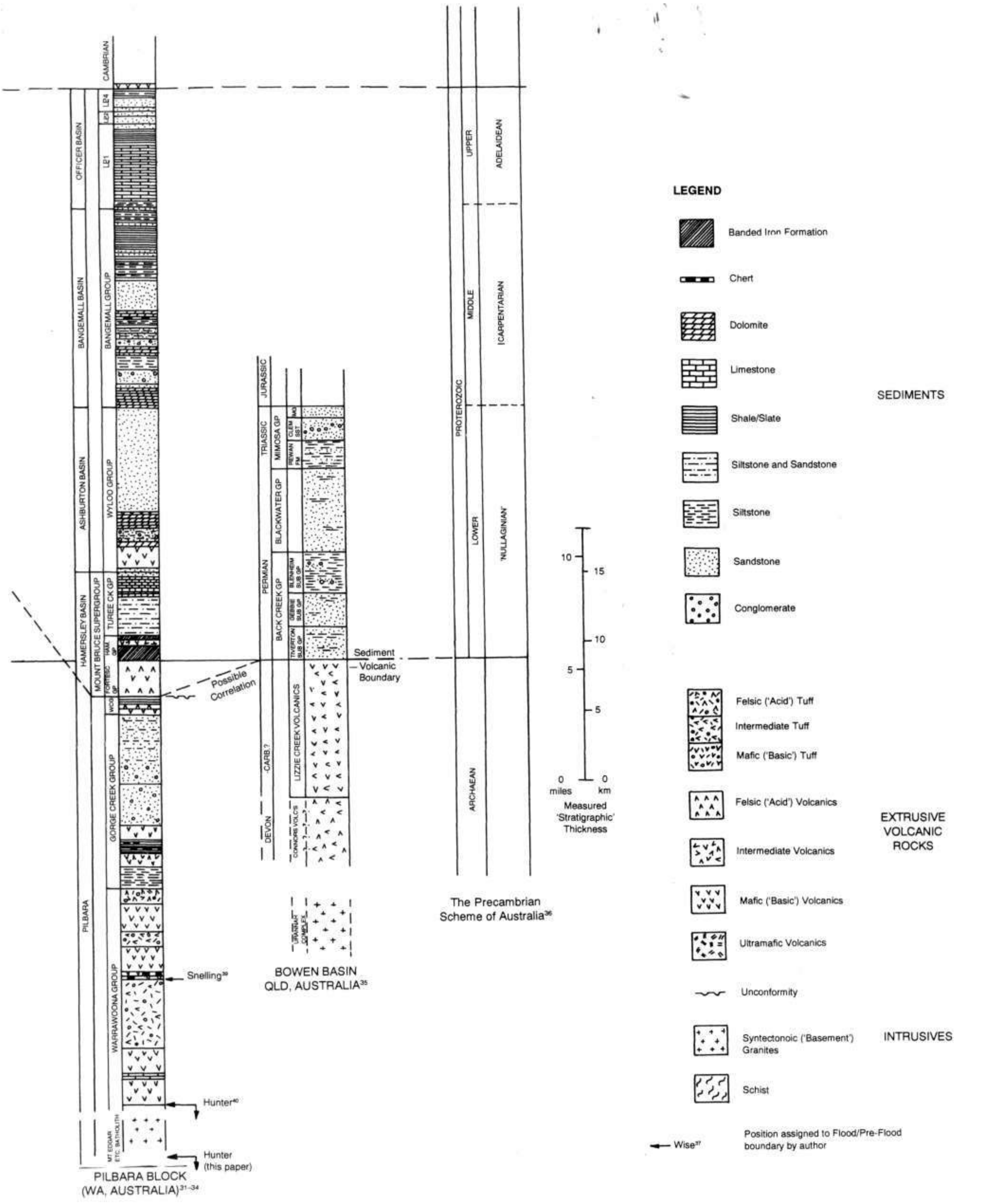


***Figure** 1.* *Selected Precambrian and Palaeozoic correlations*


CAMBRIAN
OFFICER BASIN
BANGEMALL BASIN
BANGEMALL GROUP
ASHBURTON BASIN
WYLOO GROUP
HAMERSLEY BASIN
MOUNT BRUCE SUPERGROUP
TUREE CK GP
GORGE CREEK GROUP
PILBARA
WARRAWOONA GROUP
MT EDGAR ETC. BATHOLITH
Snelling[39]
Hunter[40]
Hunter (this paper)
PILBARA BLOCK (WA, AUSTRALIA)[31-34]
Possible Correlation
JURASSIC
TRIASSIC
MIMOSA GP
PERMIAN
BLACKWATER GP
BACK CREEK GP
CARB.?
LIZZIE CREEK VOLCANICS
DEVON
Sediment
— Volcanic Boundary
BOWEN BASIN QLD, AUSTRALIA[35]
PROTEROZOIC
UPPER
ADELAIDEAN
MIDDLE
CARPENTARIAN
LOWER
'NULLAGINIAN'
ARCHAEAN
The Precambrian Scheme of Australia[36]
miles
km
Measured 'Stratigraphic' Thickness
LEGEND
Banded Iron Formation
Chert
Dolomite
Limestone
Shale/Slate
Siltstone and Sandstone
Siltstone
Sandstone
Conglomerate
SEDIMENTS
Felsic ('Acid') Tuff
Intermediate Tuff
Mafic ('Basic') Tuff
Felsic ('Acid') Volcanics
Intermediate Volcanics
Mafic ('Basic') Volcanics
Ultramafic Volcanics
EXTRUSIVE VOLCANIC ROCKS
Unconformity
Syntectonic ('Basement') Granites
Schist
INTRUSIVES
Wise[37]
Position assigned to Flood/Pre-Flood boundary by author

	Area (km²)	Average Depth (m)	Volume (km³)
pre-Flood globe*	510,100,000	—	—
pre-Flood land	255,050,000	—	—
pre-Flood sea(s)	255,050,000	—	138,412,000
pre-Flood 'canopy'	—	—	13,841,200
Total pre-Flood water	—	—	152,253,200
Total current free water	—	—	1,384,120,000
80% pre-Flood sea area	204,040,000	100	20,404,000
10% pre-Flood sea area	25,505,000	400	10,202,000
5% pre-Flood sea area	12,752,500	2,000	25,505,000
2.5% pre-Flood sea area	6,376,250	5,000	31,881,250
2.5% pre-Flood sea area	6,376,250	10,000	63,762,500
Total	255,050,000		Approx. 151,754,750

* Assumes the Earth's diameter was the same as currently. If the Earth's diameter was smaller, then greater water depths and/or areas could have occurred.

***Table 2.** Possible depth distribution of pre-Flood sea (s).*

PRECAMBRIAN STRATIGRAPHY[15-18]

Overview

In Figure 1[19-40] proposed Precambrian correlation schemes for the former USSR and Australia are shown, as well as a proposed universal scheme for the Precambrian, Also shown are five stratigraphic sections from Archaean sequences in Australia, the former USSR, Africa and Canada, and a section through Proterozoic basins in Western Australia. Stratigraphic sections through Palaeozoic strata in the Bowen Basin (Eastern Australia) and the Proterozoic Grand Canyon sequence in Arizona (USA) are also shown.

Snelling[41] has noted that much disagreement still remains between workers in the Precambrian as to how to subdivide these sequences and the terminology to be used. Figure 1 attempts to clarify the terminologies and correlations of the Precambrian.

Global correlations of the Precambrian strata in the lower part of the stratigraphic record (Proterozoic and Archaean) are based mainly on lithological (rock type), structural and tectonic similarities, and to some degree radiometric dating, rather than on fossils.

The stratigraphic sections shown in Figure 1 are constructed by adding, in correct superpositional order, the measured stratigraphic thicknesses of each lithologic unit in each basin or block. No significant changes to the superpositional order or stratigraphic thickness are anticipated due to reinterpretation of the influence of thrust faults, fossils, radiometric dating, overturning, etc.

Archaean[42-45]

Archaean volcano-sedimentary strata sequences occur on all continents and are usually deposited in discrete basins ('greenstone belts') within granite-greenstone terrains. Figure 2 shows diagrammatically the relationships between the Archaean ultramafic-mafic volcanics and overlying sediments, the early (sodic) granites ('basement granites'), and late, cross-cutting (potassic) granites.[46] The geological setting of the Precambrian 'greenstone belts' and 'basement granites' suggests a strong genetic relationship between the 'greenstones' and the 'granites'.

'Basement **Granites'**

The Archaean granites which underlie the Archaean volcano-sedimentary sequences of Precambrian shields in many parts of the world are termed the 'basement granites' by Gentry.[47] The term 'syntectonic' granites is also used in the literature to describe the apparent close genetic and deformational relationships between the 'basement granites' and the overlying Archaean volcano-sedimentary sequences.

Gentry, and Armitage[48] postulate that the occurrence of 'parentless' radiohalos of the polonium isotopes ^{210}Po,

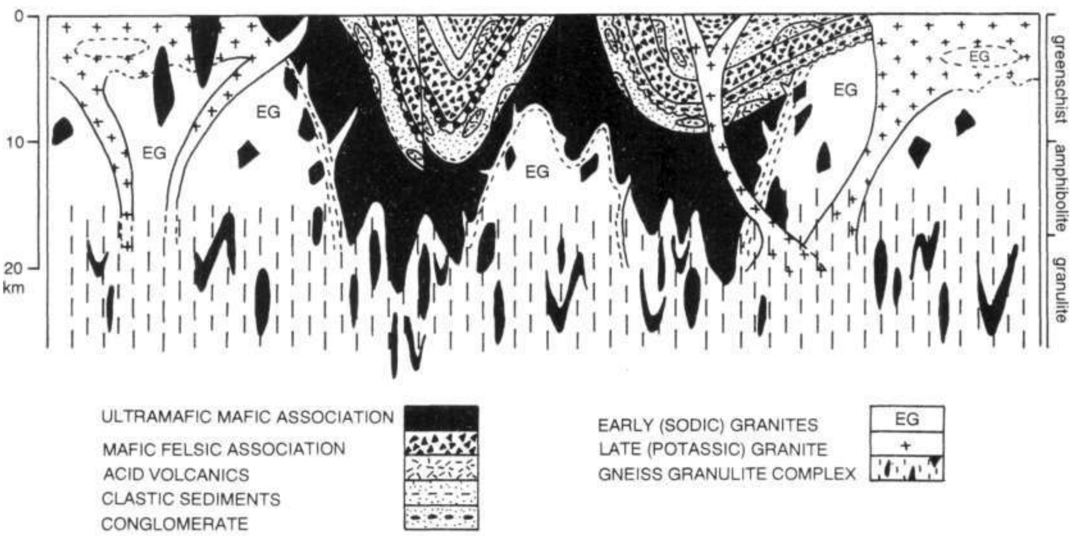


***Figure** 2. Interpretation of field relationships between major Archaean rock units in Western Australia, India and South Africa (after Windley, Ref. 46).*

^{214}Po and ^{218}Po in biotite crystals in the 'basement granites' are evidence that the granites were created near instantaneously or in a time shorter than the half-life of ^{218}Po (approximately three minutes). Gentry claims that this is in diametric conflict with the evolutionist view of slow cooling and crystallisation of these granites over 'tens of millions of years'. Wakefield and Wilkerson[49] have challenged Gentry's claim, citing field geological evidence of granites containing ^{218}Po radiohalos cross-cutting fossiliferous sedimentary (therefore younger) strata.

Snelling[50,51] and Jahns and Burnham[52] have noted that crystal formation in dykes and pegmatite bodies can be rapid. Research into current theoretical and experimental data on rates of crystal formation in large intrusive bodies may reveal that rates of biotite crystal formation are sufficiently rapid to enable entrapment of Po radiohalos by 'conventional' crystallisation, especially if a time-frame of one (Flood) year is used instead of 'tens of millions of years'. Po radiohalos in biotite crystals in Precambrian granites may be more supportive of a young-earth model than they are of 'near instantaneous' creation.

Volcano-Sedimentary Strata

The five detailed stratigraphic sections through Archaean strata shown in Figure 1 show that the lower Archaean strata are comprised dominantly of extrusive volcanics with basal conglomerates and some quartzites, cherts, graphitic shales and limestones. The volcanic sequences are usually terminated abruptly at their top by a sudden transition to sedimentary strata. This transition may have resulted from sudden cessation of the major activity of 'the fountains' at the end of Day 40 of the Flood.[53] The true stratigraphic thickness of the volcanic portions of these five Archaean sections averages about 14.5 km. A more comprehensive assessment by the author of the thickness of the volcanic portions of Archaean sequences world-wide suggests that an average thickness of about 10 km may be a more realistic (conservative?) estimate.

Levin[54] and Ronov[55] note that the Precambrian shield rocks outcrop over about 20 per cent of the Earth's land surface area. If we assume that Archaean volcanics comprise about 20 per cent of these shield rocks we can estimate the total volume of Archaean volcanics extruded globally at approximately $60 \times 10^6 km^3$, assuming an average thickness of 10 km. The temperature of these lavas at extrusion is estimated at about 1200°C.[56] The heat content of this volume of volcanics is calculated at 3.50×10^{25} calories.

Proterozoic

Figure 1 shows a composite stratigraphic section through the Proterozoic Hamersley, Ashburton, Bangemall and Officer Basins of northern Western Australia. The section is compiled from measured geological sections in each basin, and the aggregate thickness of the Proterozoic strata in this area is about 44 km. The global volume of Proterozoic sedimentary strata is estimated, empirically, at about $300 \times 10^6 km^3$ — about five times the volume of Archaean volcano-sedimentary strata.

The Proterozoic sequence exposed in the Grand Canyon (see Figure 1)[57] has an aggregate thickness of about 8 km, which is significantly less than the thickness of Proterozoic sequences in Australia and other parts of the world. The Grand Canyon sequence does not appear to have an exposed base, or a contact with older Archaean strata. The significance of the Grand Canyon sequence in Flood geological terms should be evaluated in the light of these points.

Precambrian Fossil Record

Concerning fossils in Precambrian strata, Snelling[58] in refuting creationist claims that the Precambrian strata are non-fossiliferous and, based on the criterion that the presence of fossils is evidence for Flood deposition, notes that stromatolites,

> *'layered structures formed as a result of the accretion of fine grains of sediment by matted colonies of micro-organisms, principally algae'*

are abundant in the early to mid-late (Riphean) Proterozoic strata and also occur in the mid Archaean Towers Formation, a chert-barite unit within a sequence of submarine pillow basalts 'dated' at 3.5 billion years (Ga) in the Pilbara Block of Western Australia (see Figure 1), and in Archaean strata 'dated' from 2.7 to 3.5 Ga in several other localities throughout the world.

Snelling suggests that because of the abundance of fossils in these strata creationists should stop calling them non-fossiliferous, and that the Precambrian strata from the late Archaean and early Proterozoic onwards should be considered as Flood-deposited strata. This, Snelling says, allows creationist geologists to assign other earlier non-fossiliferous Archaean strata and metamorphosed sediments to Day 3 of Creation Week or earlier.

Figure 1 shows that the earlier (and later!) non-fossiliferous Archaean strata are, almost exclusively, submarine volcanics. Environmental factors during deposition of these Archaean volcano-sedimentary strata, such as massive (explosive?) volcanism, extreme water turbulence and attrition, and hot corrosive water (due to the presence of sulphates, chlorides, etc. in solution), would prevent the preservation of fossils. In addition, the rapid upwelling of the *'the fountains of the great deep'* possibly in areas now represented by outcrop of Archaean strata, may have caused 'topographically high' water levels away from which the water flowed, carrying with it any hard-bodied organisms which were then preserved as fossils in 'Phanerozoic' strata. Subsequent metamorphism of the Archaean strata may also have obliterated fossils.

Similar conditions may have occurred, to a lesser extent, to prevent fossil preservation in the Proterozoic strata.

PALAEOZOIC STRATIGRAPHY

Included in Figure 1 is a stratigraphic section through the 'Palaeozoic' Bowen Basin in Queensland, Australia. This section is included to illustrate the marked similarity of a section through the 'Palaeozoic' to those through the Archaean-Proterozoic shown in Figure 1.

The 'Palaeozoic' section contains sub-volcanic, 'syntectonic' basement granites *(Urannah Complex)*, a thick (approximately 15 km) mafic volcanic sequence and an abrupt transition to a sedimentary pile. The similarity of this 'Palaeozoic' section to the Archaean-Proterozoic sections is interpreted to mean that the same sequence of Flood processes may have operated at the same times in both this 'Palaeozoic' section and in the Archaean-Proterozoic sections.

PRE-FLOOD ENVIRONMENT AND GEOLOGICAL ACTIVITY

Creation: Day 1 (Genesis 1:1-5 KJV)

Genesis 1:1 *'In the beginning God created the heaven and the earth.'*

Genesis 1:2 *'And the earth was without form and void; and darkness* (was) *upon the face of the deep. And the spirit of God moved upon the face of the waters.'*

Genesis 1:3 *And God said, Let there be light: and there was light.'*

Genesis 1:4 *'And God saw the light, that* (it was) *good: and God divided the light from the darkness.'*

Genesis 1:5 *'And God called the light Day, and the darkness he called Night. And the evening and the morning were the first day.'*

Most creationist writers infer from Genesis 1:1-5 that the interior (that is, the core and mantle) of the Earth, are essentially the same today as they were when created on Day 1 (see Figure 3[59]). Furthermore, most creationist authors[60-65] ascribe the formation of the Archaean (Archaeozoic) strata to the action of the primordial waters on Day 1 and/or Day 2.

The created globe was covered probably with water (Genesis 1:2), possibly about 270 m deep (see Table 1), and a cool solid 'crust' may have insulated the waters from a hot outer mantle. Today the mantle consists of the ferromagnesian minerals olivine, clinopyroxene, orthopyroxene, garnet, perovskite and magnesio-wustite, and increases in temperature and density with depth.

I think it is unlikely that any major geological work was accomplished by the global covering of water on Day 1 or Day 2 (Genesis 1:2), as the water may have only been about 270 m deep and no major currents may yet have developed due to the influence of wind, temperature variations or earth rotation.

The submarine nature of much of the Archaean volcanic sequences is evidenced by the common occurrence of 'pillowed' lavas and intercalated sediments, commonly limestones, dolomites, quartzites, cherts and ironstones. The mineralogical components of these sediments ($CaCO_3$, $MgCO_3$ SiO_2 and Fe_3O_4) are thought by some Precambrian researchers[66,69] to have been derived from hydrothermal solutions rich in these components, exsolved from the same magma that produced the lavas.

If the stratified Archaean volcanic sequences were extruded on Day 1 or 2 of Creation Week, they would have had to have been extruded into the Day 1 created waters which covered the globe on those days. The extrusion of $60 \times 10^6 km^3$ of Archaean lavas at approximately 1200°C into the postulated volume of global water covering of $152 \times 10^6 km^3$ on Day 1 or 2 would have resulted in a final equilibrium temperature of the rock-water mass in excess of 100°C. In addition, the 'basement granites' may have supplied even more heat than the volcanics, resulting in even higher temperatures.

Thus it can be inferred that the extrusion of these volumes of Archaean volcanics into the Day 1 or 2 'primordial' waters might, without miraculous intervention, eventually have resulted in either vaporisation of the waters or a water temperature so high as to preclude survival of the fish and sea creatures created on Day 5. The sea environment in such a scenario would certainly not have conformed to the 'good' description of Genesis 1:21.

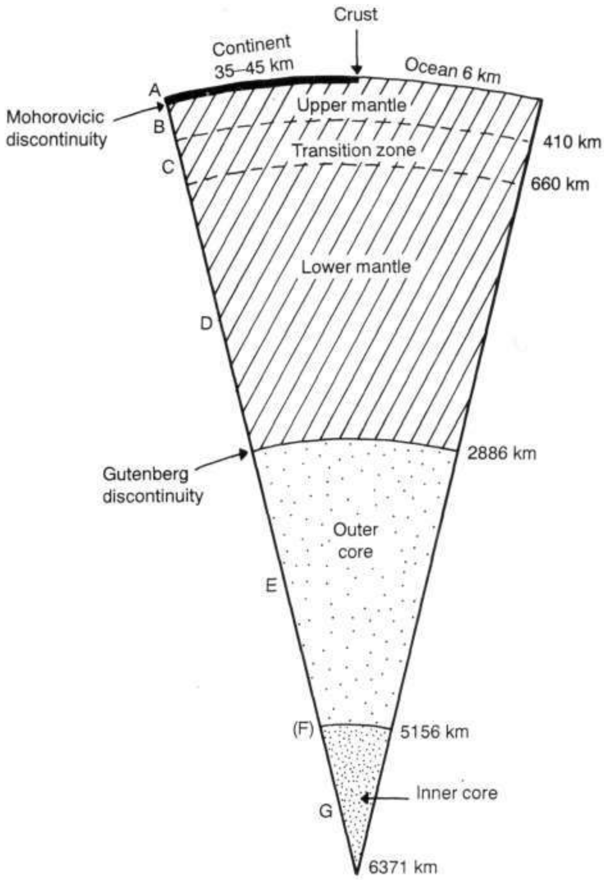


Figure 3. *The layering within the Earth (after Bott, Ref. 59).*

Creation: Day 2 (Genesis 1:6-8 KJV)

Genesis 1:6 *And God said, Let there be a firmament in the midst of the waters, and let it divide the waters from the waters.'*

Genesis 1:7 *And God made the firmament, and divided the waters which* (were) *under the firmament from the waters which* (were) *above the firmament: and it was so.'*

Genesis 1:8 *And God called the firmament heaven. And the evening and the morning were the second day.'*

Several creationist authors[70-78] have interpreted this Scripture as describing the creation of the atmosphere ('firmament') and the elevation of a portion of the Day 1 waters above the atmosphere to form a water vapour 'canopy' which assisted in maintaining a globally uniform temperate climate during the pre-Flood period, and eventually fell as rain during the first 40 days and nights of the Flood.

Humphreys[79] suggests that the 'vapour canopy' model has *'considerable biblical problems'* and proposes that a correct interpretation of Genesis 1:7,8 is that the 'expanse' (New American Standard Bible) or 'firmament' (KJV) is interstellar space, and that the *'waters which were above the expanse'* exist as 'a wall of ordinary water' at the outer boundary of the universe.

Taylor[80] suggests that a correct interpretation of the Hebrew text does allow the 'expanse' or 'firmament' to he the Earth's atmopshere, and that a water vapour canopy is not precluded by this interpretation.

The volume of water required for a water vapour 'canopy' to supply one inch of rain per hour for the first 40 days and nights of the Flood (24 m or 945 inches) is calculated at 13.84×10^6 km^3. This is about 1 per cent of the present 'free' water volume, leaving about 10 per cent for the 'sea' formed on Day 3.

With regard to geological activity on Day 2,1 believe we can only speculate that any geological or chemical processes that were initiated on Day 1, for example, radioactive heating, mantle-water reaction, etc., continued through Day 2.

Creation: Day 3 (Genesis 1:9-13 KJV)

Genesis 1:9 *And God said, Let the waters under the heaven be gathered together unto one place, and let the* **dry** (land) *appear: and it was so!*

Genesis 1:10 *And God called the* **dry** (land) *Earth: and the gathering together of the waters called he Seas: and God saw that* (it was) *good!*

Genesis 1:11 *And God said, Let the earth bring forth grass the herb yielding seed,* (and) *the fruit tree yielding fruit after his kind, whose seed* (is) *in itself, upon the earth: and it was so!*

Genesis 1:12 *And the earth brought forth grass,* (and) *herb yielding seed after his kind, and the tree yielding fruit, whose seed (was) in itself, after his kind: and God saw that* (it was) *good!*

Genesis 1:13 *And the evening and the morning were the third day* (Emphasis added.)

Most speculation by creationist geologists concerning geological activity during Creation Week centres on Day 3. Most creationist writers[81-88] infer that significant geological activity, including orogeny (mountain-building), erosion, transport, sedimentation and volcanism accompanied uplift of the land mass and formation of the sea on Day 3. Creationists generally ascribe the formation of the thick, 'non-fossiliferous', Proterozoic sedimentary strata to this period.

Oard[89] questions the need for geological activity on Day 3, noting that the Earth was in the process of being created *'very good'* (Genesis 1:9-13) and that God could have raised the dry land without erosion and sedimentation.

The Scriptural record of events of Day 3 (Genesis 1:9-13) gives no indication that the land was uplifted on that day. The Scripture states,

> *And God said, Let the waters under the heaven be* ***gathered together*** *unto one place and let the dry (land)* ***appear:*** *and it was so!* (Emphasis added.)

If the land which appeared was **dry,** how could massive erosion and transport of sediment have occurred?

The Proterozoic strata in the north of Western Australia (see Figure 1) have an aggregate thickness of about 44 km (27 miles) and the Proterozoic globally is more extensive than the Archaean strata. I estimate the volume of Proterozoic sedimentary strata at about 300×10^6 km^3, about five times the volume of Archaean strata and about twice the postulated volume of pre-Flood water.

Under a Creation Day 3 scenario, the 44 km thick Western Australian Proterozoic sequence and the remaining global Proterozoic would have had to accumulate at a rate of **1.83 km per hour** with a water:sediment volume ratio of 1:2 and a water:sediment mass ratio of 1:6. If the constituents of the Proterozoic sedimentary strata were eroded from the emergent land mass of Day 3, transported to the sea, and deposited as layered sedimentary sequences up to 44 km thick, **in a period of 24 hours (or less!),** it is difficult to believe that the emergent ***'dry'*** landmass, having suffered such massive erosion less than 24 hours previously could, **on the same day!,** provide a suitable environment for growth of the vegetation created on that day and conform to the *'good'* description of Genesis 1:21.

Only 24 hours later, on Day 5, when the sea creatures were created, the sea waters would presumably have still contained sufficient suspended mud and silt, etc., and would be rising in temperature due to the effect of the Archaean volcanics and 'basement granites' emplaced on Day 1 or 2, thus precluding survival of the fish and sea creatures created on that day and excluding conformity to the *'good'* description of Genesis 1:21.

On Day 6, when the land creatures and mankind were created, the land environment would still be essentially the same as it was on Day 3, and would not have conformed to the *'very good'* description of Genesis 1:31.

If we plead miraculous intervention to either prevent or clean up the 'mess' resulting from postulated natural geological activity on Day 3 we must then ask why God would use natural processes to uplift the land and use miraculous process(es) to clean up or prevent the resultant 'mess'.

Pre-Flood Period (Creation Day 7 to the Flood) (Genesis 2:5-25 KJV)

Creationist writers[90–100] are almost unanimous in their view of the climatic and general environmental conditions on the Earth's surface during the 'Antediluvian' (pre-Flood) period, from Creation Day 7 to the Flood, a period of approximately 1656 years.

Many writers agree that a water vapour 'canopy' assisted in maintaining a universally warm, temperate climate, with a small temperature gradient between the equator and the poles which resulted in inhibited atmospheric circulation, little or no seasonal variation and no extreme weather conditions such as storms, floods, etc. Watering of a lush 'tropical' vegetation may have been accomplished by the *'mist'* which *'went up from the earth and watered the whole face of the ground'* (Genesis 2:6).

Regarding geological activity during this period, most creationist writers[101–104] agree that 'mild' geological conditions prevailed, resulting in very little sedimentation, Snelling,[105] noting that the average sedimentation rate on the present ocean floor is about 3×10^{-5} m/yr, and that today's climatic conditions are far more extreme and harsh than what we understand from Scripture of climatic conditions in the pre-Flood era, concludes that the pre-Flood sedimentation rate would have been even less than today's average rate.

THE FLOOD (Genesis 7:1-24, 8:1-14 KJV)

Genesis 7:11 *'In the six hundredth year of Noah's life, in the second month, the seventeenth day of the month, the same day were all* ***the fountains of the great deep*** *broken up and* ***the windows of heaven*** *were opened.'*

Genesis 7:12 *'And the rain was upon the earth forty days and forty nights.'* (Emphasis added.)

The 'Windows of Heaven'

'Windows' (KJV) and *'floodgates'* (New International Version) are characterised as relatively small openings in much larger restraining structures; walls in the case of *'windows'* and dam walls in the case of *'floodgates'*. The image conveyed in Genesis 7:11 then, may be of relatively small openings allowing water to flow through a much larger restraining structure.

Such a scenario might occur if the base of a water vapour 'canopy', at an altitude of about 5-7 km was ruptured, possibly due to pressure perturbations caused by the collapse of large caldera structures on the Earth's surface and the upwelling of the *fountains of the great deep'* at the initiation of the Flood. The canopy base could, conceivably, have been drawn down to lower temperature zones by such caldera collapse processes, causing, with the aid of smoke and dust from volcanic eruptions, condensation of the water vapour in specific areas, initiating precipitation which then drew down the remainder of the water through 'holes' in the canopy base. Such restricted destabilisation of the canopy base could have spread causing more widespread 'rain' as the canopy was rapidly depleted during Stage 1 of the Flood (Day 1 to Day 40, Genesis 7:12).

The volume of water required to form a water vapour canopy sufficient to supply rainfall at an average rate of one inch per hour for 40 days and 40 nights during Stage 1 of the Flood is calculated at 14×10^6 km^3 (see Table 1). Precipitation of this volume of water would result in a global water depth of about 30 m, about 1 per cent of the Flood depth.

The 'Fountains of the Great Deep'

Job 38:30 *'The waters are hid as* (with) ***a stone,*** *and the face of the deep is frozen.'* (Emphasis added.)

The volume of water emitted by *'the fountains of the great deep'* during the early stages of the Flood can be estimated as follows:

where V_F = Volume emitted by *'the fountains'*
V_f = Present 'free' water volume
V_S = Volume of pre-Flood sea
V_c = Volume of liquid water condensed from the pre-Flood 'canopy'

This volume is thus estimated at $1{,}232 \times 10^6$ km^3.

Cox[106] has noted that Job 38:30 may give us a clue as to the origin of the waters of *'the fountains of the great deep'*. This verse describes *'the waters'* as being *'**hid** as with **a stone**'* and *'the face of the deep'* as being *'**frozen**'.* A possible interpretation of this Scripture is that the water is contained in 'solution' in the 'rocks' (*'stone'*) of the sub-crustal mantle. As such, they would be ***hid,*** in that they would not be readily visible because they would be below the earth's crust and they would be hidden within the crystal structure of the 'rock'. Also, if these mantle 'rocks' are in the solid phase, then technically they are *frozen,* that is, their temperature is below their melting point.

Water storage in mantle minerals and 'de-gassing' of the Earth's volatiles early in its history have been the subject of much recent investigation.[107–110] Although the exact amounts of water currently stored in, or historically exsolved from, the 'transition zone' and 'upper mantle'

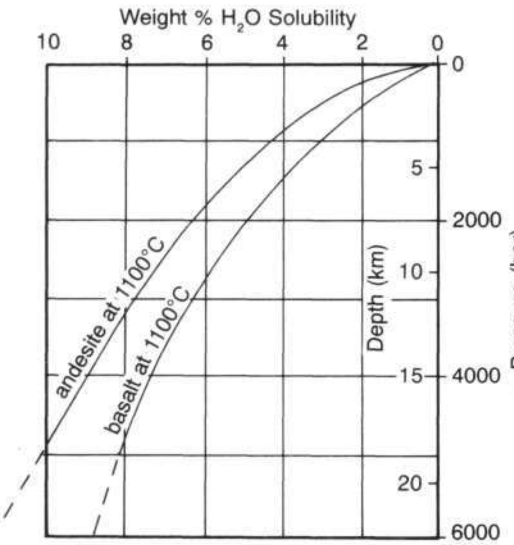


Figure 4. *Maximum solubility of water in basaltic and andesitic magmas at 1100°C as a function of pressure (adapted from Hughes, Ref. 111).*

(see Figure 3) have not yet been determined, it is fairly clear that these zones may have easily contained the amount of water postulated to have been emitted by the *'fountains of the great deep'*.

The approximate volume of mantle material with an original water content of only 0.3 wt% required to supply the *fountains of the great deep'*, if only half (0,15 wt%) of the mantle water was exsolved, is estimated at about $300x10^9$ km^3, which compares closely with the volume of the transition zone and upper mantle ($292x10^9$ km^3).

Figure 4 shows the weight% of water which can be contained in solution in andesite and basalt magmas at depths to about 22 km below the Earth's surface.[111] At 22 km, the magmas can contain 8-11 wt% water in solution. Figure 5 shows the same data for granodiorite melts up to 35 km depth, where the melt can contain about 13 per cent water.[112]

As a water saturated melt rises through the mantle toward the Earth's surface, as it would to produce Archaean volcanics and the 'basement granites', the solubility of water in the melt, which is very strongly pressure dependent (and only weakly temperature dependent) is reduced due to the decreasing confining pressure. Thus, water is exsolved from a melt, at an increasing rate as it rises.

Burnham and Ohmoto,[113] in studying the late stage processes of felsic magmatism as they relate to the formation of hydrothermal ore deposits, note that the water content of a magma has a profound effect on its melting and crystallisation characteristics, and note that the amount of initial melt produced is directly proportional to the H_20 content of the original 'parent rock'.

They show that a dioritic-granitic melt which originally contained 2 wt% H_20 would become saturated with H_20 during cooling after 33 per cent crystallisation at 2 km depth. Further cooling, associated with pressure reduction, and consequent crystallisation, they note, causes H_20 to separate from the residual melt by a process commonly called second or retrograde boiling. Eventually, they suggest, all the original H_20 content of the magma, except that bound structurally in hydrous minerals (0.5-0.8 wt% H_20) must be evolved as a separate fluid phase.

Figure 6 shows that an ascending body of granodiorite melt, 37 per cent crystallised at 4 km depth (1100 bar) and saturated with H_20, will have expanded more than 15 per cent over its original volume.[114] On complete (100%) crystallisation, having risen to 2 km depth (550 bar), the same magma, saturated at 2.7 wt% H_20, will expand nearly 50 per cent over its original volume.

At these very shallow depths, Burnham and Ohmoto note, most types of wall-rocks to magma bodies have a high rigidity and cannot accommodate such large volume changes by plastic deformation, thus brittle failure of roof-rocks occurs. The mechanical energy released by second boiling during the cooling of shallow-seated hydrous magmas is regarded as the major cause of fracturing of wall- and roof-rocks to magma bodies, at all scales from microfracturing to large scale (100 km diameter) caldera collapse structures which accompany explosive volcanism.

Such large scale fracturing and collapse of the upper 'crust' of the Earth, accompanied by exsolution of large volumes of water, could be described as *'all the fountains of the great deep broken up'* (Genesis 7:11).

Source of Precambrian Sediments

If the Archaean volcano-sedimentary strata and the Proterozoic, dominantly sedimentary, strata were not

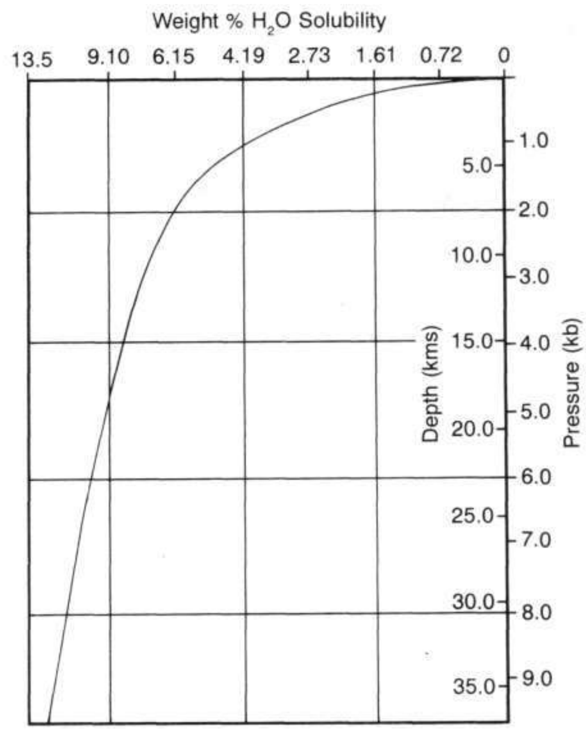


***Figure** 5. The solubility of H_20 in granodioritic melts at1100°C (adapted from Burnham and Ohmoto, Ref. 112).*

deposited prior to the Flood, the question is raised as to the origin of the constituents of the Flood-deposited Precambrian sediments if they were not eroded from previously deposited strata.

The constituents of the Archaean sediments, mainly limestone ($CaC0_3$), dolomite ($CaC0_3$, $MgC0_3$), quartzite ($Si0_2$), chert ($Si0_2$), ironstone (Fe_30_4) and graphite (C) could, with the possible exception of graphite, have been derived from magmatic fluids rich in these components. Graphite may have been derived directly from the magma, or, as postulated by Snelling,[115] could have been derived from living organisms.

Quartz, feldspar, mica and clays, the major constituents of the Proterozoic sediments, could have been derived from the Archaean 'basement granites' of the same composition. These minerals, having been prevented from inclusion in the solidifying magma by the presence of significant amounts of exsolving water, might have been carried up by the exsolving waters to be subsequently deposited as the Proterozoic sediments (?'exhaloclastics').

The 'chemical' sediments in the Proterozoic strata, such as limestone, dolomite, quartzite, chert, ironstones, etc. could have been derived, similarly to the Archaean sediments, from magmatic fluids.

The sudden transition to fossiliferous sediments at the base of the Cambrian may mark the cessation of magma-derived sediment constituents and the commencement of erosion of the Precambrian strata and their re-deposition as Palaeozoic to Recent sediments.

It is, however, conceivable that most of the constituents of the Palaeozoic sediments might also be directly derived from magma, rather than by erosion.

CONCLUSION: THE PRE-FLOOD/FLOOD BOUNDARY

When creationist writers ascribe the pre-Flood/Flood boundary to a particular location in the stratigraphic record, most assume that the first appearance of abundant macro-fossils is the most significant feature marking the beginning of Flood-deposited strata. Until 1991 creationist authors, on this basis, placed the pre-Flood/Flood boundary at the base of the Cambrian strata.

In 1983 and 1991 Snelling[116117] suggested that, on the basis of their abundant fossil stromatolite content, most of the Precambrian strata, down to the mid-upper Archaean, should be regarded as Flood-deposited strata.

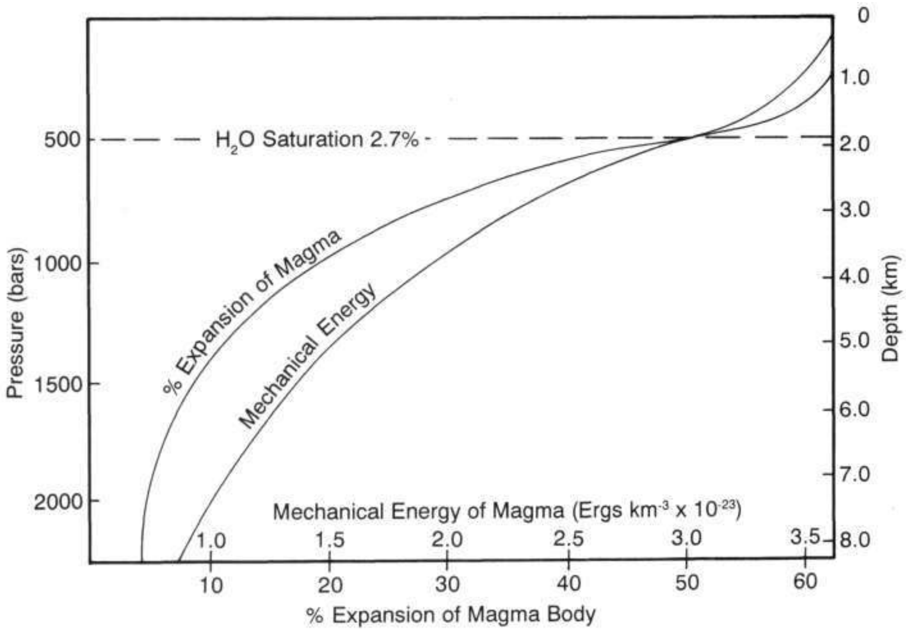
Wise,[118] in 1992, claimed that several features of the Precambrian fossil record made it difficult to explain most of the Precambrian strata as Flood sediments and suggested that the basal Vendian tillites with their Ediacaran fossils, near the top of the Proterozoic, were the first buried sediments and organisms in the Flood.

In 1992, Hunter[119] proposed that geological features of the Precambrian (and equivalent) strata should be considered as evidence for their deposition as Flood strata, and that, in particular, many features of the Archaean (and Katarchean) strata, including paucity of fossils, are the expected geological products of the intense geo-hydrologic activity which would have characterised the first 40 days and nights of the Flood, thus placing the pre-Flood/Flood boundary at least as low as the base of the complete stratigraphic record in any area.

Austin and Wise,[120] in 1994, have proposed that a geological signature with five characteristics, including an increase in abundance of fossils and the first appearance of abundant plant, animal and/or fungal fossils, should mark the beginning of Flood-deposited strata in any area. They conclude, on the basis of these criteria, that the Sixtymile Formation in the Grand Canyon (Arizona) area and the Kingston Peak Formation in the Eastern Mojave Desert (California) area, both near the top of the Proterozoic, are the oldest preserved Flood deposits in those areas.

Davison[121] has developed a system to describe the depositional history of the Genesis Flood which is independent of the evolutionary geological time-scale and of the preconceived generalisation that 'Precambrian' means pre-Flood.

Davison considers that this generalisation does not work in Southern Africa where only 25 per



20 30 40
% Expansion of Magma Body

Figure 6. *The change in volume and mechanical energy released in the second-boiling reaction: H_20 saturated melt-crystals + vapour. For complete crystallisation of a granodioritic magma with an initial H_20 content of 2.7wt.% (adapted from Burnham and Ohmoto, Ret 114).*

cent or so of the stratigraphy would thereby be considered Flood deposits, and he includes Precambrian stratigraphic sequences in his Flood model and inteprets deformed greenstones and sediments, such as those in the Barberton Greenstone Belt, as highly deformed pre-Flood sediments and volcanic rocks originally deposited during the 'Day 3 Regression' described by Wise.

It is my contention here that the volume of water available during Creation Week (and the pre-Flood period) would have been insufficient to accomplish the geological activity required to deposit the large volumes of Precambrian (Archaean and Proterozoic) strata, and that the detrimental environmental effects which would have resulted if this 'natural' geological activity occurred during Creation Week would have prevented survival of any of the living things which were being created as part of a world which was 'very good'.

These environmental constraints on significant geological activity during Creation Week are considered to confirm Snelling's assignment, on the basis of fossil content, of the Proterozoic and mid-upper Archaean strata as Flood deposits. The same environmental constraints are considered to apply to the mid-lower Archaean strata, to the base of the stratigraphic record, which should also be considered as Flood strata.

The 'basement granites' on which the Archaean strata lie are considered, along with the Archaean volcanics, the waters of the fountains of the great deep, and possibly the Proterozoic sediments, to be the products of differentiation of mantle magma. The pre-Flood/Flood boundary may thus be considered to occur at depth in the Earth's mantle where these differentiation processes were initiated.

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