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Initial Flood Deposits of the Western North American Cordillera: California, Utah and Idaho

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INITIAL FLOOD DEPOSITS OF THE WESTERN NORTH AMERICAN CORDILLERA: CALIFORNIA, UTAH AND IDAHO

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KEYWORDS:
Diamictite, Debris Flows, Pocatello Formation, Dutch Peak Formation, Kingston Peak Formation, Neoproterozoic, Pre-Flood/Flood Boundary Criteria, Discontinuity, Clastic Wedge, Sheeprock Mountains, Bannock Range, North American Cordillera, Pillow Lava, Sauk Sequence

ABSTRACT
Discontinuous but widespread coherent packages (unbroken by major unconformities) of Neoproterozoic sedimentary strata, recognized by basal diamictite deposits (debris flows), outcrop throughout the western North American Cordillera. These phenomenal clastic packages, which represent high-energy sedimentary environments, overlie older sedimentary, metamorphic and igneous rocks, and underlie younger regionally widespread fossiliferous sandstone, carbonate and shale. The basal, high-energy debris flow deposits sporadically occur throughout the length of the western North American Cordillera and locally contain submarine volcanic extrusive and igneous intrusive rocks.

Geological activity during the start of the Flood when, "all the fountains of the great deep burst forth" necessitates a record of geologic signatures or discontinuities on a grand scale. Explanation for these high-energy geologic events needs to proceed from a Biblical worldview supported by the empirical data contained within the rocks. High-energy catastrophic processes recorded: mechanical-erosional, time-age, tectonic, sedimentary, and paleontologic discontinuities in the western North American Cordillera. Clastic sedimentary rocks underlying the western Cordillera thicken remarkably while the same sediments thin towards the east and truncate with regional fossiliferous sandstones. Igneous activity and contemporaneous deposition across fault-bounded basins record tectonic discontinuities. The coarse to fine megasuccession found in the North American Cordillera characterize initial and early Flood deposits.

Three rock units are considered: the Kingston Peak Formation in the Death Valley region of California, the Dutch Peak Formation in the Sheeprock Mountains in central Utah, and the Pocatello Formation in the vicinity of Pocatello, Idaho. These formations display abrupt thickening of sediments towards presumed fault-bounded basins, overlie older sedimentary, igneous or metamorphic rocks, and underlie thick successions of clastic rock with increasing megafossil content upwards. Additionally, some of the debris flows contain evidence of contemporaneous submarine volcanic activity. The high-energy debris flow deposits found in the Kingston Peak, Dutch Peak and Pocatello Formations mark the catastrophic events occurring at the initial stages of the Flood.

INTRODUCTION
The North American Cordillera "mountain chain," extends from northern Mexico, traverses the western United States then crosses up through Canada and into Alaska. Neoproterozoic and Cambrian sedimentary rocks (Sauk Sequence), composed predominantly of clastic material with carbonate, outcrop in various mountain ranges within the Cordillera. These sedimentary successions record continuous deposition of deep-water facies in the west and a shallow-water facies in the east of the Cordillera. In addition, sediments thicken remarkably in the west and thin out in the east forming a clastic wedge. At the base of these sedimentary successions, unique deposits of diamictites, conglomerates and volcanic rocks outcrop. Figure 1 shows the geographical extent and thickness of the sedimentary wedge and the outcrop occurrences of basal diamictite and volcanic rocks in the western Cordillera.

Evolutionary geologists theorize that the western edge of the North American continent split apart or rifted during the Neoproterozoic [17]. Substantial evidence supports this view. Basaltic flows, pillow lavas, mafic dikes and sills (diabase and amphibolite) either cut or intercalate (interstratify) the diamictite deposits in southeastern Idaho and northern Utah [9,10,2]. Locally, lower stratigraphic units, including the basal diamictite, appear to thicken towards the center of local basins and abruptly thin out towards the edges of local basins or where they cross faults [3]. The Neoproterozoic and Cambrian sedimentary (Sauk Sequence) deposits cut the structural grain of the older, underlying rocks indicating a structural change before and during their deposition [17,4]. Abundant diamictite and conglomerate suggests faulting and uplifting occurred during the deposition of these sediments. Pull-apart tectonics (rifting) thins the earth's crust allowing magma to up well, bulge the crust, producing block faults. Diamictite, and conglomerate, in most cases, indicate the beginning of this synsedimentary tectonic event. A megasuccession of clastic sediments overlie the basal diamictites and conglomerates, and grade into late Cambrian and early Paleozoic regional deposits of sandstone, shale and carbonate [17]. The striking similarity in depositional patterns between the lower Neoproterozoic and early Cambrian deposits with the overlying late Cambrian to early Paleozoic deposits suggests that sedimentation was continuous.

The Sauk Sequence can be traced onto the North American Craton and the placement of the pre-Flood/Flood boundary is straightforward. Due to tectonic upheaval along the continental edge, the pre-Flood/Flood boundary is obscure and not readily apparent. Accordingly, discernment should follow when correlating stratigraphic relationships from region to region.

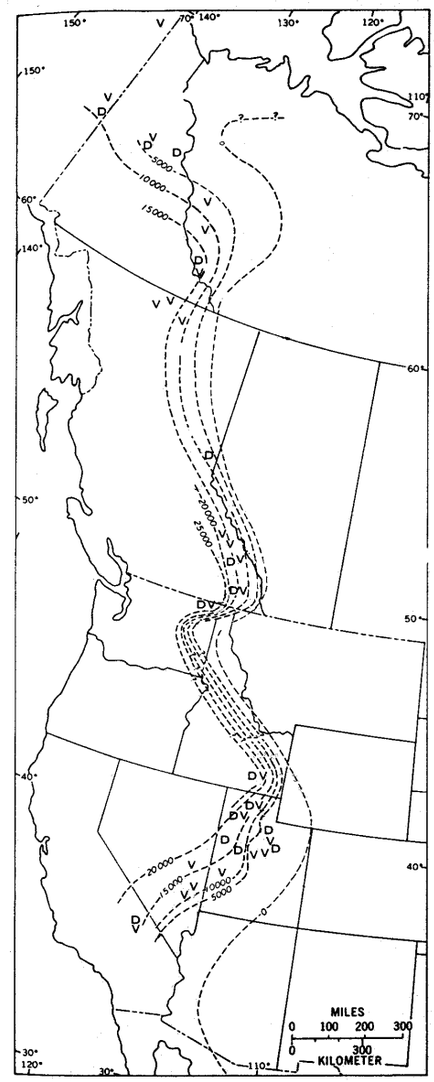

Figure 1. Geographical extent and thickness (feet) of the sedimentary wedge and diamictite (D)and associated volcanic (V) rocks in the western USA. Modified after Stewart [17].

Reference to geologic column and evolutionary nomenclature in this paper excludes the acceptance of evolutionary ages and philosophy. Many a trained geologic eye have painstakingly described, mapped and worked out the relative stratigraphic positions of the Neoproterozoic and Cambrian (Sauk Sequence) deposits in the North American Cordillera. Even though most of these geologists probably are evolutionists, young-earth creationists can benefit from their work by analysis of the descriptive data and reinterpretation within a Biblical geologic framework

Biblical Based Geology

Young earth Flood geologists begin investigation from a Biblical worldview, accepting the fact that a global Flood was a real event in earth's history. Consequently, certain predictions regarding the nature of the rocks found at the pre-Flood/Flood boundary can be made. Only empirical evidence will lead to the advancement of Biblical geologic models. Unsubstantiated claims or generalizations about the nature of the pre-Flood/Flood rocks are worthless in developing

Table 1. Pre-Flood/Flood Boundary Criteria after Austin and Wise [1].

Mechanical - Erosional Discontinuity (ED)	Floodwaters are likely to have caused enormous mechanical erosion leaving significant regional erosional unconformities larger than any that follow.
Time – Age Discontinuity (AD)	Above the erosional unconformity, coarse sediments should contain lithic fragments of formations found below the unconformity unlike any which follow.
Tectonic Discontinuity (TD)	At or in close proximity to the erosional unconformity, evidence for tectonic disruption should exist. Near the continental margins, tectonic disruption would be the greatest.
Sedimentary Discontinuity (SD)	A thick megasuccession of fining upwards, clastic to chemical strata of regional extent should occur above the erosional unconformity larger than any that follow.
Paleontological Discontinuity (PD)	Strata below the discontinuity either contain microfossils or are devoid of fossil content. Strata above the discontinuity contain significant macrofossils and plant debris.

Biblical geologic models. Austin and Wise [1] outline five criteria that are useful when looking for the pre-Flood/Flood boundary in the rock record. These are summarized in Table 1 and applied to the Neoproterozoic strata found in California, central Utah and southern Idaho.

Diamictite

Diamictite is a non-sorted, matrix-supported deposit, containing foreign clasts ranging from pebble to boulder size. Figure 2 shows a diamictite deposit from the southern Salt Spring Hills with a large percentage of granitic clasts. The term diamictite is descriptive only; however, many geologists consider all diamictites a product of glacial processes such as glacial till or glacial outwash. Iceberg rafting and the release of clasts, called dropstones, are also invoked to explain the random occurrence of exotic clasts within a massive fine-grained matrix. Consequently, the term diamictite has taken on genetic meanings. Other workers consider at least some of the diamictite deposits products of subaqueous debris flows [6,15,19,21]. Evidence which documents glacial activity, such as striated and faceted clasts, and chattermarks, are also found in debris flow deposits [14,15].

Figure 2. Diamictite deposit with rounded to sub-angular clasts within a fine-grained matrix. Southern Salt Spring Hills, Death Valley region, CA.

In the study areas, diamictites are massive and thick, containing a sparse to conglomeratic abundance of clasts. Furthermore, diamictites may contain interbeds of matrix to clast-supported conglomerates, breccias and coarse sandstones. Available source material and flow rheology during deposition probably account for the differences in deposit type. According to Hintze [8, p.15], Precambrian diamictites are unique because they "provide the best correlation within the late Proterozoic" if one assumes an ice age of regional extent during the time of their deposition. Conversely, if one assumes a worldwide Noachian Flood as described in the Bible, then diamictites and related coarse sediments may provide a means of correlating early Flood deposits.

The Kingston Peak Formation of the Death Valley Region, California

In the Death Valley area, the Neoproterozoic Pahrump Group contains from oldest to youngest the Crystal Spring Formation, Beck Spring Dolomite and the Kingston Peak Formation, the last of which contains diamictite. Figure 3 shows the geographical extent of the Kingston Peak Formation within the Death Valley region including the Panamint Mountains, Funeral Mountains, Kingston Range and several small ranges southeast of Death Valley proper [12]. The Noonday Dolomite overlies the Kingston Peak Formation in most areas, which is in turn overlain by a megasuccession of clastic to carbonate formations, which are recognized to correlate on a regional scale. Throughout the last century, much attention was directed to unraveling the sedimentology of the Pahrump Group – mainly due to the significant talc and other economic ore deposits found therein. In the Kingston Range, Sigler and Wingerden [16] informally named four members of the Kingston

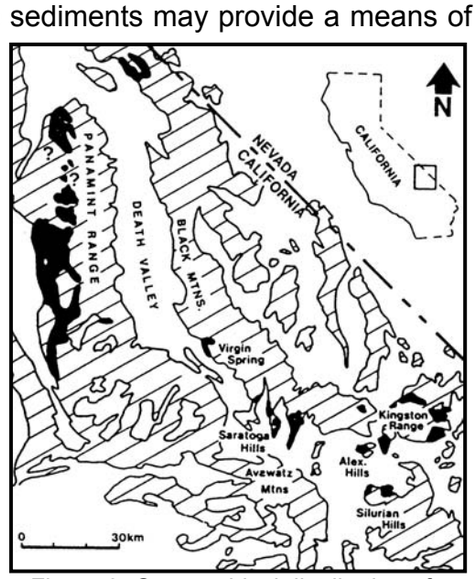

Figure 3. Geographical distribution of the Kingston Peak FM within the Death Valley region. From Miller et al. [12].

Peak Formation. The thickest units are exposed in the northeast part of the range, and these were described by Wingerden [20] as follows. The lower sandstone unit consists of 535 feet of brown, light brown, fine-grained sandstone and siltstone with interbedded shale. This unit interfingers with the upper Beck Spring Dolomite at this location. The puddingstone unit (diamictite) overlies the lower sandstone and reaches a thickness of 200 feet. Pebbles and cobbles of quartzite, dolomite, metagranite and chert are dispersed within a dark to light brown and gray matrix. Overlying the puddingstone is the megabreccia unit with numerous megaclasts of Beck Spring, Crystal Spring, diabase and carbonate. This unit is 4400 feet thick and contains numerous interbeds of vari-colored breccia, conglomerate, sandstone and shale. Brown, dark brown and gray repetitive beds of megabreccias, breccias, conglomerates, sandstones and shales totaling 2540 feet in thickness make up the upper conglomeratic sandstone unit. Figure 7 contains generalized lithostratigraphic columns for each of the study areas.

The Otts Canyon and Dutch Peak Formations of the Sheeprock Mountains, Utah

The Sheeprock Mountains, located in west central Utah approximately 65 miles south of Salt Lake City, contain exposures of Neoproterozoic rocks divided into two groups: the Sheeprock Group and the Brigham Group. Three Formations make up the lower Sheeprock Group, from oldest to youngest these are: the Otts Canyon Formation, the Dutch Peak Formation and the Kelly Canyon Formation. Both the Otts Canyon and Dutch Peak Formations contain diamictites and conglomerates. Sedimentary rocks in the Sheeprock Mountains have undergone Mesozoic to Cenozoic Sevier folding and faulting coupled by Cenozoic Basin and Range extensional tectonics, and have reached greenschist grade metamorphism. [13]. All detailed descriptions of these formations are taken from [2,3] but were field checked and amended by the author.

The Otts Canyon Formation contains three members, a lower black to gray-banded slate, a middle diamictite, and an upper gray quartzite with interbedded conglomerate, slate and shale. Massive diabase up to 490 feet in thickness cuts the upper quartzite. Diamictite in the middle member ranges in thickness from 0 to 1640 feet and contains interbeds of graywacke, quartzite, and vari-colored slate [2]. Contact with the lower slate and upper quartzite is sharp to gradational [13]. Conformably overlying the Otts Canyon Formation, the Dutch Peak Formation contains 5740 feet of diamictite, conglomerate, graywacke, sandstone, siltstone, quartzite and shale. Three members of the Dutch Peak Formation were observed in the Sheeprock Mountains: a lower laminated siltstone and sandstone, a middle diamictite and an upper graywacke. The middle olive green, gray to brown diamictite varies in thickness from 0 to 2952 feet. Most of the diamictite is pebbly but contains rounded to sub-rounded sand-sized to boulder-sized clasts of quartzite, schist, granite, carbonate, volcanic rock and intraformational sedimentary rocks. All clasts are set in a fine-grained phyllitic matrix [2,3]. A massive graywacke member, up to 2952 feet thick overlies the diamictite and contains lenses of gray to white quartzite and shaly interbeds of diamictite. Fine-grained siltstones and shales of the Kelly Canyon Formation overlie the Dutch Peak Formation. The Brigham Group, approximately 12,000 feet thick, overlies the Kelly Canyon Formation and contains voluminous amounts of quartzite and shale. Because of the lithologic similarity and consistency of quartzite units such as the Caddy Canyon and Prospect Mountain Quartzites, some formations in the Brigham Group may correlate regionally into Idaho, Utah, Nevada, and California [5,17,11]. See Figure 7. Late Cambrian and early Paleozoic mega-fossiliferous rocks overlie the Brigham Group. The base of the Otts Canyon Formation is not exposed in the Sheeprock Mountains.

The Pocatello Formation of the Bannock Range, Idaho

Exposed in the Bannock Range just south of the City of Pocatello, Idaho is a package of Neoproterozoic sedimentary and volcanic rocks named the Pocatello Formation. The Pocatello Formation here contains excellent exposures of Neoproterozoic sediments and serves as a representative for other sections in southeast Idaho [5]. Three members make up the Pocatello Formation: the lower Scout Mountain member, a Bannock Volcanic member, and an upper phyllitic argillite and shale member. The formation has undergone greenschist grade metamorphism and has been faulted and folded due to the Sevier orogenic event and Basin and Range extension and volcanism [10].

The lower Scout Mountain member contains at least 2952 feet of detrital and carbonate strata. At the base is a heterogeneous succession of quartzite, siltstone, diamictite, limestone, conglomerate and sandstone. Diamictite is dark brown, purplish to greenish, massive, contains pebble to boulder-sized clasts in a fine-grained matrix and is interbedded with dolomite. The massive diamictite is overlain by a fining succession of sandstone, siltstone and limestone. The middle Bannock Volcanic member is lenticular shaped and forms a wedge which interfingers with the Scout Mountain member. The volcanics comprise up to 1310 feet of mafic porphyritic lava, pillow lava, volcaniclastic breccia, and brecciated pillow lava. The upper member of the Pocatello Formation consists of 2000 feet of black, phyllitic argillite

with interbedded quartzite. In this area, the Blackrock Limestone, a fine-grained limestone with interbedded quartzite and vari-colored argillite, caps the Pocatello Formation, and serves as a regional marker bed for correlation [5].

DISCUSSION

Pre-Flood/Flood boundary criteria set forth by [1] have previously been applied to the Death Valley region and are included here. If the assumption is made that the megasuccession in the Death Valley region represents the pre-Flood/Flood boundary, it can then serve as a chronostratigraphic type section. A significant mechanical erosional surface was not observed in either the Sheeprock Mountains or the Bannock Range. Nevertheless, significant erosional discontinuities are present nearby in the Wasatch Range and on islands in the Great Salt Lake, Utah [11]. Strata at these locations may correlate with the megasuccession in the Death Valley region. The following will discuss the study areas in the context of each pre-Flood/Flood boundary criterion.

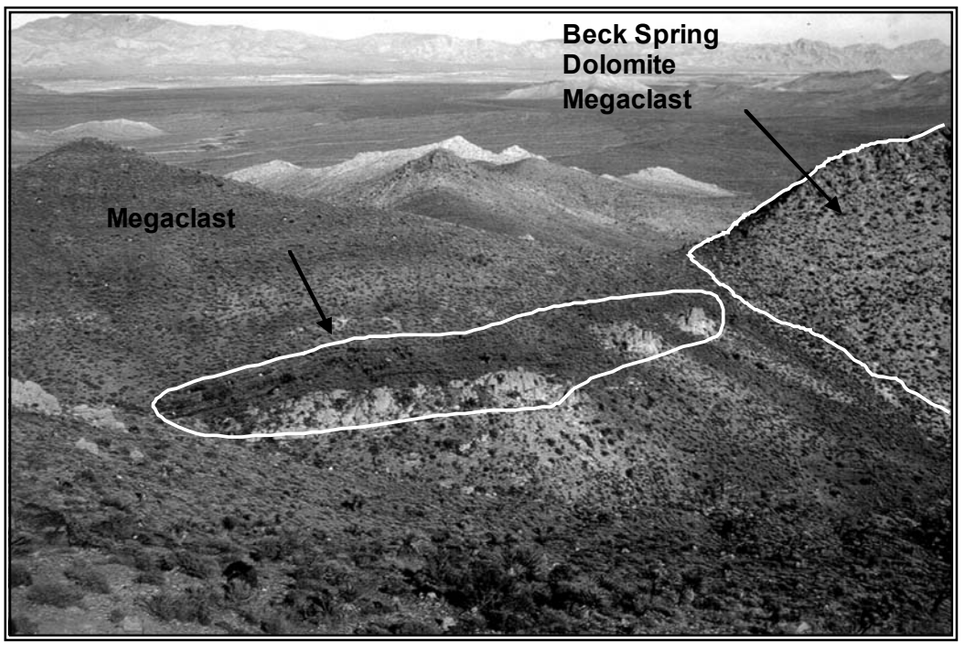

Figure 4. Megaclasts of underlying formations deposited in the Kingston Peak Formation, northeast Kingston Range, Death Valley region.

Time-Age Discontinuity (AD)

Some of the most remarkable evidence for catastrophic sedimentary process is found in the Kingston Peak Formation in the Death Valley region. Megaclasts, some reaching hundred's of feet in length (Figure 4), boulders, and cobbles of the underlying Beck Spring Dolomite, Crystal Spring Formation and basement complex are deposited in the Kingston Peak Formation [12,20,21]. The underlying formations were consolidated and lithified in order to survive the hydraulic forces impinged upon them. Even so, some of the underlying material was pulverized into smaller fragments of pebble to clay size. Older lithic fragments found in the Kingston Peak Formation provide substantial evidence for a time-age discontinuity (AD) between the Kingston Peak Formation and underlying formations. Igneous rocks, schist, and gneiss make up many of the clasts. Neodymium isotopic studies on igneous clasts within the Pahrump Group suggest that they were derived from local basement terranes of continental crust affinity [7]. These and megaclasts, boulders, and cobbles of Crystal Spring diabase and Beck Spring Dolomite, reworked and deposited in the Kingston Peak Formation, signify a time-age discontinuity (AD).

In the Sheeprock Mountains, the Dutch Peak Formation looks remarkably similar to the Kingston Peak Formation; however, megaclasts, hundred's of feet in length of the underlying formation, are absent and the basement complex is not exposed. Dutch Peak diamictite, conglomerate, and graywacke contain abundant coarse material – some megaclasts reach 10 feet in length. Clasts of plutonic rock, gneiss, schist, quartzite, dolomite, and diabase are older than the sediment containing them and therefore represent a time-age discontinuity (AD). The upper Otts Canyon Formation contains diabase sills; this diabase is probably the local source for the diabase found in the Dutch Peak Formation [2]. In order for diabase to become clasts within the Dutch Peak Formation, the diabase had to cool and harden, suggesting significant time (AD) between emplacement of the igneous rock and deposition of clasts derived from this rock.

Some metamorphic clasts contained in the Dutch Peak Formation display preexisting fabric. Two fabrics are observed in thin section: aggregates of recrystallized fine-grained quartz and a mylonitic structure of stretched or ribbon quartz [13]. These fabrics do not extend into the sediments surrounding the clasts [13] and indicate that the clasts were derived from a source terrane that had undergone metamorphism in the past. The recrystallized and ribbon quartz indicate greenschist to amphibolite grade

metamorphism. Time is needed to form the metamorphic fabric, and then expose it to produce clasts, and, therefore, represents a time-age discontinuity (AD).

Diamictite of the Pocatello Formation contains a variety of intrabasinal siltstone and volcanic clasts in addition to extrabasinal quartzite, gneiss, and schist clasts [10]. This is the same trend in clast type found in central Utah and Death Valley and signifies the erosion of older basement rock terranes, again demonstrating a time-age discontinuity (AD).

Tectonic Discontinuity (TD)

In the northeast Kingston Range, the Kingston Peak Formation abruptly thickens from approximately 10 to 6825 feet over a distance of approximately 5.5 miles [16,18]. Other areas within the Death Valley region show the same abrupt thickening of the Kingston Peak Formation. This may suggest active block faulting and basinal subsidence during the deposition of the Kingston Peak Formation. Tectonic adjustment may have been occurring on a regional scale, while uplifting and faulting shed debris into the offshore basins. Large megaclasts of underlying formations have been observed at many Kingston Peak Formation exposures in the Death Valley region, signifying the regional extent of tectonic activity during Kingston Peak deposition. Unroofing of the underlying formations and redeposition represents a tectonic discontinuity (TD).

Figure 5. Outsized clasts in Dutch Peak diamictite. The white clast is metagranite, above right is mafic igneous, and above left is a rounded quartzite. The strength of the debris flow carried these clasts.

The Dutch Peak Formation contains thick successions of interbedded coarse debris and massive sandstones. See figure 5. All members of the Dutch Peak Formation thin and interfinger towards the northwest. The conglomerate and graywacke members interfinger with quartzite while the diamictite wedges out completely [2,3]. Christie-Blick [2,3] suggests that the sediments were deposited within a subsiding basin – although growth faults have not been observed. One line of reasoning for this is the diabase found in the Otts Canyon Formation lies in the thickest part of the formation suggesting rifting during differential basin subsidence. Christie-Blick [2,3] applied sequence stratigraphy to explain the unconformable boundaries as products of high stand or low stand during transgressive or regressive events.

The abrupt thickening of the sediments, abrupt changes in facies, abundant coarse material and exotic clasts, and clasts of underlying diabase suggests that the entire Dutch Peak Formation formed as a result of a continuous series of debris flows into a deep basin. The sedimentology of the Dutch Peak Formation argues for syndepositional faulting and tectonic discontinuity between the Dutch Peak Formation and the underlying Otts Canyon Formation (TD). Older basement or sedimentary rocks are not exposed in the Sheeprock Mountains.

About 160 miles north of the Sheeprock Mountains, the massive, thick Pocatello Formation contains abundant coarse debris. The lower Scout member diamictite is considered a subaqueous debris flow in a deep-water marine and turbidite environment [9]. The thick lenticular wedge of Bannock Volcanics indicates active volcanism during deposition (figure 6). Greenstones above the volcanic flows were observed and grade from amygdaloidal basalt to volcaniclastic sediments. The chloritic color of the greenstone grades into a light brown-gray in the upper Scout member diamictite.

Adjacent uplifted areas supplied the coarse debris found in the diamictite, conglomerates and graywackes. The basement is not exposed at any locality beneath the Pocatello Formation. The upper

and lower Scout Member diamictite is 100's of feet thick and is interpreted as a continuous series of debris flows occurring in a deep-water environment during active volcanism.

Sedimentary Discontinuity (SD)

All of the diamictite deposits referred to in this report grade into a fining-upwards megasuccession of quartzite, siltstone, shale and carbonate. Stewart [18] refers to this megasuccession as the "terrigenous detrital succession", and it thickens to approximately 20,000 feet in the western Cordillera. This megasuccession of strata is overlain by Cambrian (Sauk Sequence) sandstone, shale and carbonate containing megafossils. Individual formations within the megasuccession can be correlated on a regional scale. This clastic to carbonate megasuccession represents a sedimentological discontinuity (SD) as shown to occur above the Kingston Peak Formation in the Death Valley region.

Figure 6. Pillow lava structures in the Bannock Volcanic Member of the Pocatello Formation. The black-dashed lines outline pillow structures.

Paleontological Discontinuity (PD)

A paleontologic discontinuity (PD) is found in all three locations. Above the Kingston Peak Formation, the upper Wood Canyon Formation in the Death Valley region contains fossil invertebrates [1]. Below this horizon, few macrofossils have been found but microfossils occur [1]. In the Sheeprock Mountains, the unfossiliferous Prospect Mountain Quartzite, which lies at the top of the Brigham Group, is overlain by the Pioche shale. The Pioche shale contains fucoids and possible trilobite tracks [5]. Overlying the Brigham Group in the Pocatello area, a Cambrian arthropod *naroia* was found in argillaceous siltstone of the Gibson Jack Formation. In all areas, the sediments containing megafossils are separated by 1000's of feet of sediments lying above diamictite and contain either microfossils or else are void of fossil content. The thick overlying megasuccession of microfossil to macrofossil content represents a paleontologic discontinuity (PD).

Mechanical – Erosional Discontinuity (ED)

Substantial mechanical-erosional discontinuity exists within the Pahrump Group and below it [1]. All three Pahrump formations, with a combined thickness of thousands of feet, rest unconformably on the basement complex [12], indicating 1000's of feet of erosional relief [1]. The Dutch Peak Formation and Pocatello Formation do not contain regional erosional boundaries, and the crystalline basement is not exposed. Numerous local unconformities are present however, and the existence of metamorphic and igneous clasts suggests substantial erosion.

In the Sheeprock Mountains, middle Otts Canyon diamictite fragments occur in upper Otts Canyon conglomerate confirming an unconformable boundary. Additionally, upper Otts Canyon diabase is found in lower Dutch Peak conglomerate. A mechanical-erosional boundary occurs somewhere from the lower black shales in Otts Canyon through the Dutch Peak Formation but none of them are traced on a regional scale due to limited exposure. At Scout Mountain in the Bannock Range of southern Idaho, the Pocatello Formation contains a lowermost quartzite. This unit may record the lowest unconformity exposed if the quartzite is in depositional contact [10]. As in the Sheeprock Mountains, crystalline basement is not exposed below the Neoproterozoic in southern Idaho. These two areas probably were located in deep marine environments and received abundant debris washed off the continental shelf. However, thousand's of feet of diamictite, volcanic flows, shale and sandstone are preserved in thrust sheets in the vicinity of Salt Lake City and either rest on older basement complex or older sedimentary rock (Farmington Complex) [10,11]. This may suggest that significant erosional relief occurred between diamictites and basement complex in Utah and Idaho.

CONCLUSION

God spoke the dry land into existence on the third day of Creation. Could this supernatural event and the geologic processes associated with it have formed the diamictite deposits and other coarse debris that occur in the North American Cordillera? Older rock clasts derived from underlying formations are found in the diamictites. If the diamictites formed on the third day of Creation, then the sedimentary strata below the diamictite deposits would have had to form prior to the Third Day. In the Death Valley region, the Crystal Spring Formation contains conglomerates near its base and in close proximity to crystalline basement rock. Strata below the diamictite in the Death Valley area are best explained as pre-Flood.

Could the diamictite and associated conglomerate deposits found below the base of the Sauk Sequence have formed later in the Flood? Conglomeratic deposits are found layered within most of the earth's strata – this would be expected during a catastrophic, world-engulfing Flood. Evolutionary geologists think that diamictite deposits found in the Ordovician and Permian rocks indicate ancient ice ages, but [14] clearly demonstrates that these deposits are products of the global Flood and not glacial. The Permian diamictites are found packaged with rocks containing a variety of marine fossils and plant debris; therefore, stratigraphically the Permian diamictites are considerably above the sedimentary discontinuity described in this paper. Many creationists concur that these strata are middle or latter Flood deposits.

The stratigraphy and sedimentology of coarse clastic to carbonate megasuccession of stratified rock in the Western North American Cordillera satisfy criteria used to predict the placement of pre-Flood/Flood boundary. These criteria: mechanical erosional (ED), time-age (AD), sedimentary (SD), tectonic (TD), and paleontologic (PD) discontinuities were established by young earth Flood geologists and derived from a Biblical worldview.

Coarse basal deposits found in the Neoproterozoic of western North America were rapidly laid down catastrophically in syntectonic, erosional and depositional environments, occurring on the continental shelf and slope. Debris flows intercalated with subaqueous volcanic eruptions demonstrate deep marine environments. Massive diamictite, with outsized foreign clasts demonstrate high strength debris flow deposits. Older clasts and gigantic blocks of underlying formation contained in the debris flows demonstrate (AD), (TD), and (ED) discontinuity between underlying pre-Flood and Flood sediments. Thick successions of sandstones, shales, and carbonate with increasing megafossil content stratigraphically up section demonstrate (SD) and (PD) discontinuity between underlying pre-Flood and Flood sediments.

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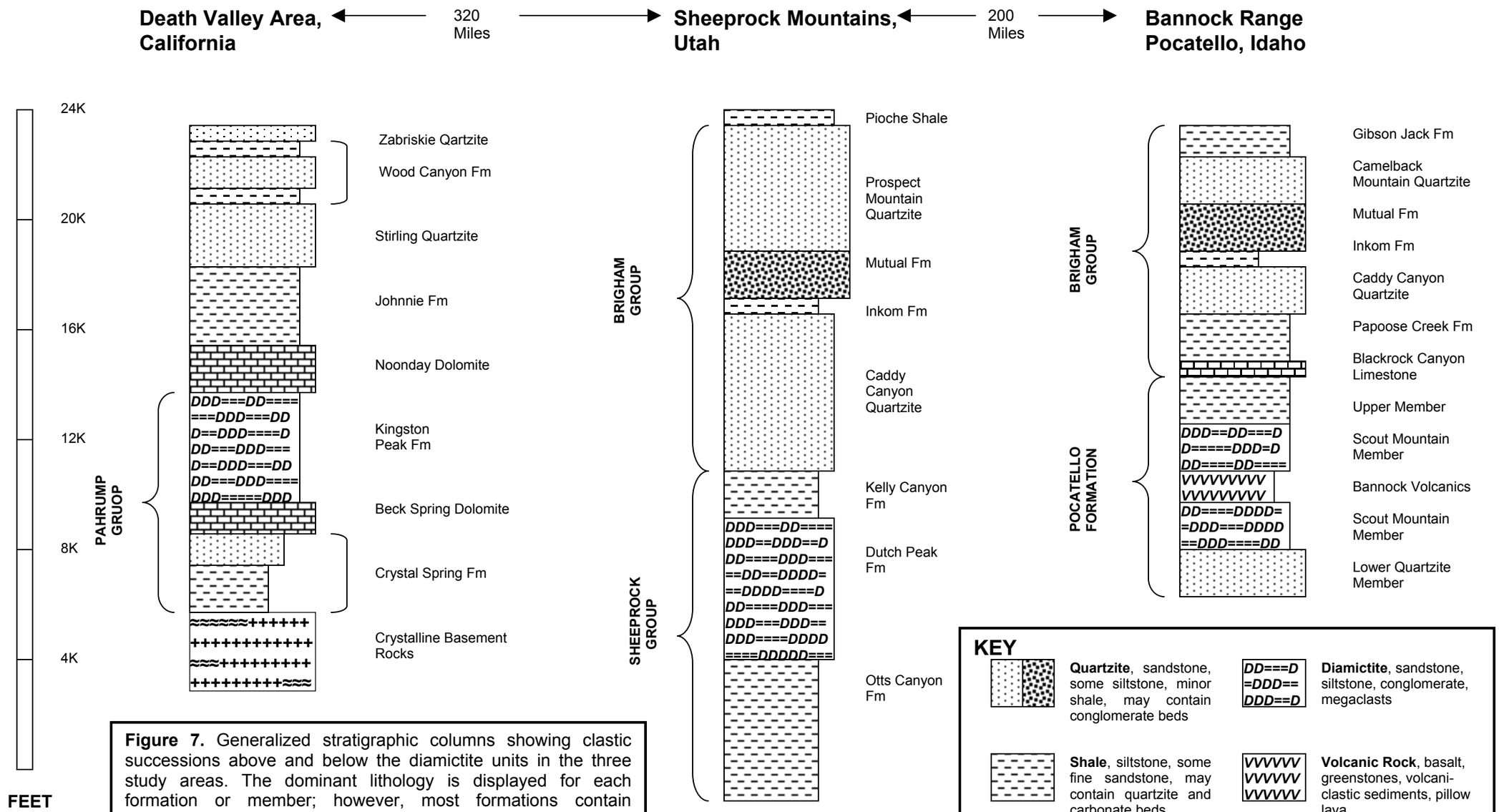

Figure 7. Generalized stratigraphic columns showing clastic successions above and below the diamictite units in the three study areas. The dominant lithology is displayed for each formation or member; however, most formations contain heterogeneous lithologies. For graphical purposes, formations containing diamictite are represented by diamictite symbols throughout. In actuality, diamictite occurs in beds separated by sandstone, siltstone or conglomerate. Data used to compile these stratigraphic columns were taken and modified from the following sources: [10,2,8,19,11].