The Haymond Formation Boulder Beds of Marathon Basin, West Texas: Theories on Origin and Catastrophic Deposition

George F. Howe and Carl R. Froede Jr.*

Abstract

The Haymond Formation exposed within the Marathon Basin contains blocks and boulders derived from at least three different source areas. Uniformitarian geologists have proposed several different depositional settings in an effort to understand the origin of these blocks and associated boulder beds. This article reviews those models, explains their shortcomings, and proposes a solution within the framework and time frames of the Young-Earth Flood model. We propose that these blocks and boulders were locally derived and subaqueously deposited during the global Flood, within at least two different yet related settings: 1) as boulders within turbidity-currents, 2) and as slump and/or slide blocks derived from the rim of the basin and from upturned thrust blocks due to tectonism associated with the Ouachita Orogeny (viewed as a Flood tectonic event).

Introduction

The Haymond Formation found within the Marathon Basin in southwest Texas, has been the subject of numerous uniformitarian investigations, spanning many decades (Figure 1). As a stratigraphic unit, the Haymond Formation contains individual layers composed of large-scale blocks and associated boulder beds of enigmatic origin. The block and boulder beds primarily occur around the rim of the basin and in the area adjacent to Housetop Mountain (Figures 2 and 3). Various studies have been conducted in an attempt to comprehend the depositional and paleoenvironmental setting in which these sediments were originally formed. Recently, creationists have brought these depositional models under scrutiny in an attempt to determine their applicability within the Young-Earth Flood model (Froede, Williams, Howe, and Goette, 1998; Howe and Williams, 1994; 1995).

Several uniformitarian geologists have proposed that some strata within the Marathon Basin reflect turbidity-current deposition (Denison, Kenny, Burke, and Hetherington, 1969; King, 1978; McBride, 1966; Thomson and McBride, 1964). Many creationists would agree, but add that the majority of the strata within the Marathon Basin was locally tectonically derived and was deposited via Flood generated turbidity-currents[1].

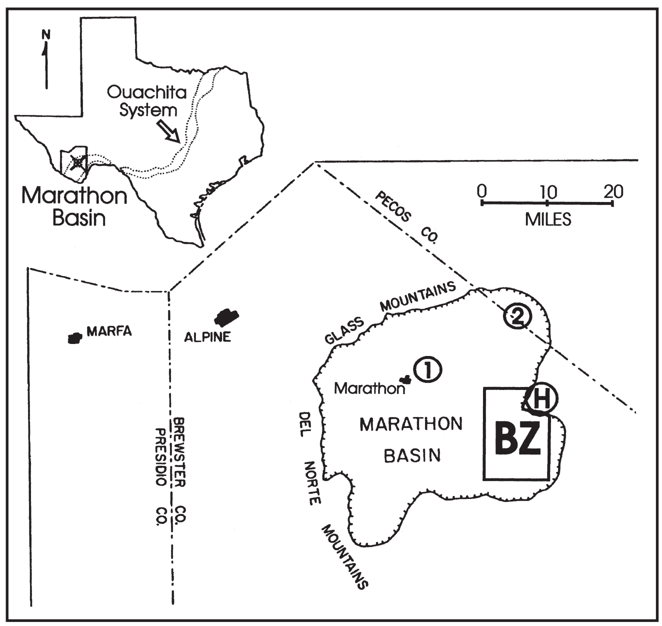

Figure 1. Location map showing the most prominent Boulder-bed zone (BZ) within the Marathon Basin, adjacent to Housetop Mountain (H). Boulders were also noted in the Haymond Formation exposed at location No. 1, [reported in Froede, Williams, Howe, and Goette (1998)] and No. 2 [McBride, 1966, p. 6]. This figure is adapted from McBride 1969b (p. 2, Figure 1).

*George F. Howe, Ph.D., 24635 Apple St., Newhall, CA 91321-2614

Carl R. Froede, Jr., B.S., P.G., 2895 Emerson Lake Drive, Snellville, GA 30078-6644

Received 26 February 1998; Revised 19 January 1999.

[1]A creationist overview of turbidity currents and their resulting deposits can be found in Froede, 1998. Large-scale submarine debris flows, misidentified as glacial deposits, are described and discussed in Oard, 1997.

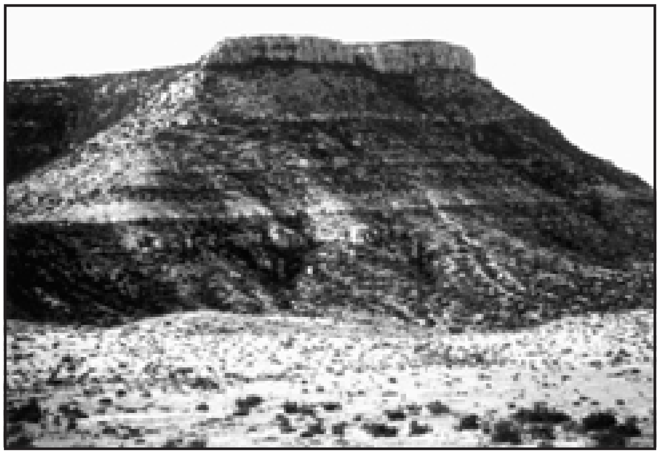

Figure 2. Housetop Mountain. Around the base of this flat-topped mesa lie isolated outcrops of blocks and boulder beds derived from still enigmatic source areas.

Figure 3. Isolated blocks of rock believed to be Haymond flysch boulders. These slabs of strata are estimated to be six to ten feet in diameter and lie less than one-half mile from the base of House Top Mountain.

Previously, Howe and Williams (1995) reported on a section of the Haymond Formation called the Housetop Mountain Boulder Beds Member. They described its alternating layers of turbidity-current-derived flysch, composed of arkose, conglomerates, and boulder-bearing mudstone. Their report centered on the twofold nature of the boulder beds in mudstone strata: (1) large fragments of limestone and novaculite and (2) smaller cobbles of igneous and metamorphic origin. They concluded that the energy needed to deposit the boulders and blocks (some up to 40 feet in size), within such mudstone beds supports a high-energy (catastrophic) depositional setting. This mixture of cobbles and boulders within the mud matrix is identified as wildflysch. Limestone and other large boulders in the wildflysch apparently came from considerable distances away from the place of final deposition, and the source of the smaller exotic cobbles remains unknown (Howe and Williams, 1995).

This article will examine several depositional models that have been proposed by uniformitarian geologists in an attempt to explain how the Haymond Formation wildflysch formed. We will comment on the numerous shortcomings provided by these theories in addressing the block and associated boulder beds. Additionally, we will provide a valid and defensible solution to the possible origins of the Haymond Formation wildflysch, within the framework of the Young-Earth Flood Model.

Possible Origins of the Haymond Formation Boulder Beds

From 1931 to 1975, uniformitarian geologists evaluated the Haymond Formation wildflysch layers and promoted widely diverse theories about their origin, and method of emplacement. Advocates of each hypothesis marshaled various items of supporting evidence in an effort to address the physical evidence. What follows is an examination and evaluation of several of these uniformitarian theories.

A Glacial Theory

According to Baker (1932, pp. 598, 602) there are at least nine characteristics of the boulder beds that support a glacial mechanism of emplacement. He noted that ice, not water, would produce a deposit that is unsorted, like these boulder beds. Baker also asserted that ice would have been capable of moving even the largest of the sedimentary blocks. The flysch interbeds (layers above and below the boulder beds) had "…a typical varve structure" which would likewise fit with Baker's idea that these strata were glacially formed (1932, pp. 579-580).

Perhaps the strongest evidence favoring possible glacial deposition are the scouring, cross-striations, and percussion marks which Baker (1932, pp. 586, 588) found on certain exotic cobbles. The flattening (known as soling) was most pronounced on certain quartzite and chert cobbles that contained from one to seven flattened surfaces on a given rock. According to Baker (1932, pp. 595-596), soling occurred when the rocks were held in ice (which temporarily prevented them from changing position) while they were being flattened. He admitted, however, that soling could have been caused by faulting or by "interstitial movement" in the rocks.

Carney (1934, p. 70) wrote a brief note in which he too affirmed a glacial mechanism. He called the boulder beds "tillites" of "aqueoglacial" origin. From the mid-1920's throughout the 1930's it was common for uniformitarian geologists to attribute the transport of large boulders in boulder beds to a glacial setting (see also Powers, 1928, p. 1046).

The Glacial Mechanism Evaluated

Problems with the glacial model became apparent when this evidence was more closely examined and compared to other similar settings. The number of soling marks and other indicators of glacial activity on the boulders/blocks within the Haymond Formation were found to be lacking for the most part. The few features that did exist could have been produced by mudflows or other mechanisms. Crowell (1957, p. 993) noted that episodes of glaciation may have been wrongly proposed, based on the assumption that such marks are necessarily caused by glaciers:

> In fact, some glacial episodes may have been introduced into geologic history based on the interpretation of such rocks as tillites without independent supporting evidence. Such "tillites" should therefore be restudied, for they may have originated by slumping and mixing of interbedded gravel and mud precontemporaneously with deposition.

It is worth noting that Lehman (1945) rejected a similar glacial transport setting for erratic masses of rock in the Arbuckle Mountains of Oklahoma. At present there is little support for the idea that the Marathon Basin experienced glaciation at any time in the past.

It is the contention of Oard (1997) that none of the evidence for worldwide pre-Pleistocene glaciation is compelling. Rather, he has proposed (and we agree) that the physical evidence used to support glaciation is better explained by invoking large-scale submarine landslides globally within the framework of the Flood of Genesis. We applaud Oard's work and find it directly applicable to the Haymond Formation wildflysch.

A Mudflow Theory

King (1937, p. 91) asserted that all evidence for glacial origins "…could equally well be interpreted as the work of mud flows." He cited reports from California and Nevada in which gigantic blocks "…as large as most of those in the Haymond formation" (King 1937, p. 91) had been transported for many miles in mud-filled streams.

King also argued that the boulders in the Housetop Mountain beds were not transported by flowing water because the boulders are "intraformational" (occurring throughout a single stratum) while boulders in water-formed conglomerates are ordinarily "basal"—occurring at the bottom of a stratum only (King, 1937, p. 90). The mudstone layers are found repeatedly throughout a thickness of about 275 m (see Howe and Williams, 1995, Figure 11). The presence of a mudstone matrix is itself strong evidence favoring a mudflow origin.

Tectonism versus Mudflows: A Published Debate

There was a hiatus in the literature (perhaps related to World War II) from the late 1930s to the middle 1950s, after which interest again centered on the boulder beds. Hall (1956, p. 2254) first referred to tectonism as the sole cause of the boulder beds. In concluding a paper on orogeny, Hall (1956, p. 2254) remarked that:

> …the Haymond conglomerates were formed in response to Upper Pennsylvanian epeirogenic movements…

A year later Hall (1957, pp. 16331634) further suggested that the large sedimentary fragments were derived from the denuded cores of faulted folds. He proposed that the boulders were not transported and bedded, but fault breccia and outcrops of Paleozoic strata brought to their present location by faulting and folding. Hall pointed to breccia in the Housetop Mountain beds as a clear indication of their tectonic origin (Hall, 1957, p. 1635). Some of the breccia was even further brecciated, suggesting two separate fault movements.

Commenting on Hall's tectonic model, King (1958) noted that the idea these beds are the remnants of faulted folds had been previously considered by several investigators, but was discarded based on a detailed examination of the boulder bed strata. King (1958, p. 1733) admitted that many of the large novaculite and chert boulders were brecciated but he asserted that the brecciation:

> ...occurred before they arrived at their present positions: ...cherts and novaculites were faulted *in situ* before or during deposition of the boulder beds.

Flawn (1958) sided with King, expressing disagreement with Hall's idea that the large boulders are merely the eroded remnants of faulted cores. Flawn pointed to the interspersion of igneous and metamorphic cobbles in these same beds as support for a mudflow rather than simple tectonic origin (1958, p. 1735).

The published dialogue ended in 1959 when Hall repeated his view that the "big boulders" are merely the *in situ* remnants of previous tectonism. He conceded, however, that the smaller metamorphic and igneous rocks might have been added later by a mudflow (Hall, 1959, p. 239).

Through the 1960's and 1970's, McBride elaborated on the evidence used to support the concept of gigantic mudflows as the agency of deposition (1964; 1966; 1969a; 1970; 1978). He envisioned a deep-water turbidity current depositional environment as the setting for the Haymond Formation, including the boulder beds. He proposed that major mudflows originated as the product of submarine slides triggered by earthquakes.

We believe that King, Flawn, and McBride are correct in arguing that the blocks and boulder beds cannot be explained as merely the *in situ* remnants of faulted and eroded ridges. The large blocks are not connected to any adjacent formation but are completely surrounded by the mudstone matrix.

Catastrophic Tectonism as the Source of the Large Limestone Boulders

While it appears unlikely that the giant boulders are the remnants of faulted folds; many of the geologists who have worked on the Haymond Formation boulder beds saw a diastrophic source for the Pennsylvanian limestone blocks. Sellards (1931, p. 18) proposed that the largest boulders, which he called "erratics" are:

> ...evidence of uplifts, mountainous in character, adjacent to the Marathon region ...The erratics, therefore are evidence of mountain-making movements affecting the ancient land masses lying to the south and east of the Marathon region.

He believed that these limestone fragments originated by way of folding and overthrusting. Baker (1932, p. 593) likewise proposed that there was an original diastrophism which is reflected in the underlying Tesnus deposits, and then a second diastrophic event that brought on the "Haymond deposition":

> A second epoch of diastrophism, or the extension of diastrophism farther northwest, is demonstrated by the boulder deposits of the Haymond. This diastrophism was intense, since the novaculite was greatly deformed before boulders derived from it were deposited in the Haymond, and there must have been land of high relief to furnish the extremely coarse detritals from the thick suspension of rocks which are found in the Haymond boulder beds.

King, Baker, and Sellards (1931) wrote about the uplift of a source area in west Texas, probably to the south of the present day boulder beds. They expressed the belief that the boulders were produced and moved by diastrophism and uplift, not by streams, currents, or landslides. King (1937) envisioned overthrusts on the Hell's Half Acre fault (south and southeast of Marathon Basin) as a southeasterly source of the large boulders. More recent work conducted by Palmer, Demis, Muehlberger, and Robison (1984) supports this southeasterly source.

Tectonism May Have Produced the Basin

Ross wrote of thrust faulting as providing the mechanism for the development of the Marathon Basin. He described the northwestward growth of a series of shallow marine shelves by tectonic movements. These shallow shelves were progressively thrust northwestward, one over the other. At this time, a trough called a "fore-deep" was formed:

> The general relationships are such that the uplifted and deformed sediments of the geosynclinal facies were progressively thrust northward in a series of steps onto the craton and that the weight of the thrusted materials caused the depression of the craton margin to give rise to a narrow fore-deep which, in turn, received deepwater turbidites, black shales, and related deposits (Ross, 1981, p. 135).

King (1958, p. 1734) referred to the Marathon Basin as a deep, rapidly subsiding trough. Even as late as 1978, King still believed that the flysch sequence (including the boulder beds) were created by:

> ...quickening tectonic activity. An exaggerated phase is the wild-flysch of the Haymond, whose small to giant clasts were derived partly from uplifts within the trough, and partly from the foreland and backland (p. 5).

A Second Debate: Mudflows Versus Stream Deltas

McBride (1966) claimed that deep-water turbidity currents produced the Haymond flysch with its wild-flysch beds. In 1970, Flores and Ferm attempted to show that the Haymond interbeds were deposited in the shallow water of prograding deltas. Flores attributed various portions of the Haymond Formation to delta-front, delta, or delta plain sedimentation (Flores, 1975a, pp. 2299–2301). In Flores' view (1975a, p. 2294), the boulder beds were formed in a small cul-de-sac of slack water where deposition occurred only during periods of high-energy runoff:

> ...the Housetop middle-upper interval of black carbonaceous shale, gravelly siltstone, bouldery beds, and conglomerate probably represented deposits of cul-de-sac of slack water on the delta plain which was reached only during periods of greatest runoff and high-velocity currents.

Flores and Ferm (1970) presented what they believed to be a contemporary example of a delta model for boulder bed genesis in a short-headed stream (Canadaway Creek, New York) that flows into Lake Erie. Flores (1975a, p. 2297) summarized this delta-related boulder bed analogue by noting that the:

> ...Devonian and Pleistocene deposits are incised by short-headed streams (average of 50 km) with steep gradients. The narrow valleys are choked with gravels including boulders which are flushed down-

Table I. Reported Sizes of Erratic and Exotic Clasts in the Haymond Formation Boulder Beds.*

Rock Type	Maximum Size Feet	Maximum Size Inches
Dimple limestone	130	
Pennsylvanian limestones	100	
Caballos chert and novaculite	40	
Tesnus sandstone	35	
Maravillas chert	5	
Other sandstones		24
Middle Cambrian (*Bolaspidella* Zone) limestone		24
Gneissic granite-granodiorite		10
Sheared porphyritic rhyolite		10
Vein quartz		6
Dimple chert		4
Schist		3

*This table provides a summary of the maximum size blocks and boulders encountered within the Haymond Formation across the Marathon Basin. We would agree with certain uniformitarian geologists that these blocks and boulders were likely derived due to the result of orogenic processes associated with the Ouachita Orogeny. We also agree that these blocks and boulders were derived from massive upturned strata that were faulted and thrusted over one another, and whose exposed upper surfaces served as the source for sediments filling the adjacent Marathon Basin. However, we believe that the formation and filling of the Marathon Basin happened rapidly during the Flood-based Ouachita Orogeny. The table is derived from Denison et al., (1969, p. 246), McBride (1966, p. 26), and Palmer et al., (1984, p. 91).

> stream into small deltas during periods of high runoff some of the large boulders simply sink into the salty to sandy nearshore deposits

Flores and Ferm (1970, p. 626) attributed the large accumulation of boulders in the walled valleys of the river to "episodes of heavy rainfall, and reworking of headland and wave cut scree detritus." They believed that " ...the Lake Erie model may supply a reasonable approximation of the Haymond sedimentary conditions."

In the same year that Flores and Ferm released their views concerning Canadaway Creek, McBride promoted a river in France (the Var) as a modern analogue for a deep-water turbidite mudflow mechanism. McBride (1970, p. 80) asserted that where the Var River enters the Atlantic Ocean it demonstrates how the Haymond boulder beds may have formed:

> ...the blocks and associated finer debris were carried in submarine slumps, debris flows, and mudflows from shallow water into deeper water. The huge rocks churned through unconsolidated sandstone and shale beds and generated mudstone that helped carry the blocks further. The occurrence of chert and novaculite breccias and the presence of formations that normally lie 1,000 to 3,000 m stratigraphically below the boulder beds suggests the fragments were derived from thrust sheets...

McBride envisioned thrust sheets as the source for the large sedimentary blocks, and he believed that the boulder beds formed within turbidity currents operating in deep water. The debate between Flores and McBride on the issue of possible depositional settings for the block and boulder beds occurred again in 1975, with no further resolution (McBride, 1975; Flores, 1975b).

In an effort to recognize Flores' work, King (1975, p. 8) suggested that certain sandstone beds in the *upper half* of the Haymond may have been formed on a delta:

> Flores proposes that these are delta front and delta-plain deposits; this is plausible, as by late Haymond time the flysch trough had been nearly filled, especially along its northern margin.

In our evaluation of the two depositional settings, we agree with the position advocated by McBride that the preponderance of evidence used to define the Haymond Formation, is better supported invoking turbidity current deposition for the majority of the Haymond Formation wildflysch and blocks. In our catastrophic scenario, a few rapidly prograding delta-fed deposits could have formed at the top of the Marathon Basin stratigraphic sequence. However, we do not believe that a typical "uniformitarian" delta by its own actions could form the block and boulder beds of the Haymond flysch deposits as Flores has suggested.

Boulder/Block Source and Transportation Problems

Recent studies within the Marathon Basin, regarding the composition and age of the various boulders and blocks found within the Haymond wildflysch, have raised even greater confusion about their possible source areas and transport distances. According to Palmer et al., (1984, p. 94), there are three populations (see Table I) of boulders within the Haymond flysch:

- Angular to rounded clasts of older Marathon Basin formations
- Well-rounded exotic clasts of sedimentary, igneous, and metamorphic rocks
- Exotic unmetamorphosed Middle Cambrian (*Bolaspidella* Zone) limestone boulders

In 1969, Denison et al., reported on the radioactive isotope dating of igneous and metamorphic boulders collected from the Haymond Formation. Their results determined that the source of the igneous and metamorphic boulders could not be clearly defined within the local area immediately around the basin (based on comparing rocks with presumed similar age-dates). They also examined outcrops of similar types of igneous and metamorphic rocks from as far away as 300 miles to the south (in Mexico) and 100 miles to the west (Texas and Mexico), and found nothing which yielded similar age-dates (using the Rubidium-Strontium dating method). It was concluded that the source for these Haymond Formation boulders could not be identified (Denison et al., 1969, p. 245). In attempting to determine the travel distance of these igneous and metamorphic boulders, Denison et al., (1969, p. 250) stated:

> A germane question is the distance which boulders of this type and size in the Haymond Formation can be transported. The answer cannot be strictly quantitative, but the distance is certainly considerably in excess of 100 miles.

The source areas for these igneous and metamorphic rocks remains undetermined despite projected transport distances.

In a more recent paper on the boulder beds, Palmer et al., (1984) identified limestone boulders within certain areas of the Haymond wildflysch that contained well preserved phosphatic fossils of Middle Cambrian trilobites and brachiopod taxa. It is interesting to note that they could not account for the source of these limestone boulders, although the fossils correspond directly to those found:

> ...not only from Utah but also from Alaska, northern Greenland, Quebec, and the southern Appalachians (Palmer et al., 1984, p. 91).

Looking for a closer source area for these Middle Cambrian limestone boulders Palmer et al., (1984, p. 94) stated:

> However, no source for the unmetamorphosed Cambrian boulders is apparent, and their parent rocks were originally southeast of the present location of the Devil's River uplift (approximately 125 miles to the southeast). The limited age range of these boulders suggests that they may have come from a tectonic slice. (Parenthesis ours)

To account for these fossil-rich Middle Cambrian limestone boulders uniformitarians appeal to uplifted and thrusted blocks adjacent to the Marathon Basin (southeast). However, none of the original *in situ* limestone strata outcrop in or around the basin, in any of the upturned strata. The fossiliferous Middle Cambrian limestone source area remains unidentified.

While we do not think it unreasonable to invoke "a tectonic slice" origin for the fossiliferous Middle Cambrian limestone, it does appear to require tectonism and erosion at a far greater rate than is currently recognized within the uniformitarian model. The Middle Cambrian fossiliferous limestone is unmetamorphosed, which implies shallow burial, and that it experienced little to no heat or pressure. Yet the source strata for this limestone is projected as being approximately 125 miles away (Palmer et al., 1984, p. 93) and several thousand feet beneath the surface. Hence, in order to account for the presence of the limestone boulders within the Haymond Formation the limestone source must have moved 125 miles northwestward, while experiencing tectonic uplift and thrusting, followed by rotation, erosion, transport, and deposition (within a turbidity-current setting). This speaks of large-scale catastrophism. An alternative uniformitarian interpretation might suggest that the limestone boulders were derived from sources around western Utah and then transported approximately 870 miles!

A Young-Earth Flood Model Approach to Understanding the Haymond Formation

Viewed individually, the sedimentary blocks and boulder beds present a seemingly minor problem to the uniformitarian model. However, the required large-scale tectonism coupled with a deep-water turbidity-current depositional setting creates problems that we believe are insurmountable. Invoking millions of years of slow uniformitarian tectonism (both compression and uplift), erosion, transportation, and deposition within a deep-water turbidity-current paleoenvironment requires much imagination and no common sense! For example, many of the wildflysch boulders found within the Haymond Formation could not have traveled very far without being destroyed (Figures 2 and 3). Creationist studies into such matters supports this claim (Chui, 1997, 1998). Yet, uniformitarians tell us that many of these blocks and boulders traveled potentially tens to hundreds of miles.

The authors believe that the stratigraphic evidence (beds, translational slides/slumps, and exotic boulders) suggests that the Haymond Formation formed under catastrophic forces and process which operated during the global Flood of Genesis (see Froede et al., 1998, Figure 2, p. 96). The massive blocks and exotic boulders found within the Haymond Formation turbidites are easily explained as the remains of broken blocks or slump blocks which were derived from eroded up-dip source areas (see Morgenstern, 1967) during the Flood. Tectonism in operation during the Flood create source areas immediately adjacent to the Marathon Basin, and these locally-derived blocks and boulders simply moved under gravitation into the basin (Froede et al., 1998). These clasts and megaclasts were then rapidly buried under additional turbidites also derived from nearby source areas that ex-

Figure 4. Boulders of novaculite chert found within the Haymond Formation turbidites exposed along U.S. Highway 385, approximately 600 feet north of the intersection with U.S. Highway 90, just east of the town of Marathon (Location 1 in Figure 1). Note the one massive chert boulder on the left side of the photograph. The scale to the right of that boulder is three feet long, divided in six-inch units. Several other rounded chert boulders can be seen within the strata.

Figure 5. Various boulders of novaculite chert exposed in the turbidite deposits of the Haymond Formation. A six-inch scale rests on top of a chert boulder on the right side of the photograph. Same locale as Figure 2.

perienced tremendous erosion and transport during the Flood (Figures 4 and 5).

Conclusion

Numerous ideas have been proposed by uniformitarian geologists in an effort to explain the origin and depositional environment of the Haymond Formation boulder beds. Our review noted a blend of three different components: (1) experimentally based science, (2) uniformitarian philosophy, and (3) origin by analogy. Concerning experimental science, various workers have produced field and laboratory analyses of the lithology, tectonics, stratigraphy, and even the chemistry of these boulder beds. Woven into their technical scientific reports, however, is the philosophical "immense periods of time" to which most geologists attempt to tie their labors. Every uniformitarian geologist studying the Haymond Formation has likewise attempted to deduce an "origin" model involving glacial ice, tectonism, mudflows, prograding deltas, and/or turbidity currents using the modern depositional environment analogy as the most credible means to account for the block and associated boulders beds.

We propose that the most plausible theory for the origin of the Haymond Formation blocks and boulder beds exists within a turbidity-current depositional setting. The greatest problem now facing uniformitarians is to account for the different source areas of the three boulder populations using uniformitarianism—it simply does not work. Rather, we believe that the Marathon Basin and all of its infilling materials (sediments, blocks and boulder beds) reflect the global Flood of Genesis.

We further believe that the stratigraphic record found within the Marathon Basin represents high-energy erosional and depositional forces coupled with short-period tectonism (the Flood-Event based Ouachita Orogeny). These catastrophic forces and processes resulted in the emplacement of locally-derived blocks, slumps, boulders, and mudflows (via turbidity currents) into the Marathon Basin. This setting clearly fits within the short-term high-energy framework expected within the global Flood.

References

Am. Assoc. Petro. Geol. Bull.—*American Association of Petroleum Geologists Bulletin*

CRSQ—Creation Research Society Quarterly

Geol. Soc. Am. Bull.—*Geological Society of America Bulletin*

Baker, C. L. 1932. Erratic arid in the Middle Pennsylvanian Haymond Formation of the Marathon area, Trans-Pecos, Texas. *Journal of Geology* 40:577–603.

Carney, F. 1934. Glacial beds of Pennsylvanian age in Texas (abstract). *Geol. Soc. Am. Bull.* p. 70.

Chui, C. 1997. An experiment on the erosion rates of rocks. *Creation Ex Nihilo Technical Journal* 11(3): 335–343.

———. 1998. A study of the erosion rates of several kinds of rock. *CRSQ* 35: 39–41.

Crowell, J. C. 1957. Origin of pebbly mudstones. *Geol. Soc. Am. Bull.* 66:993–1010.

Denison, R. E., G. S. Kenny, W. H. Burke, Jr., E. A. Hetherington, Jr. 1969. Isotopic ages of igneous and metamorphic boulders from the Haymond Formation (Pennsylvanian), Marathon Basin, Texas, and their significance. *Geol. Soc. Am. Bull.* 80:245–256.

Flawn, P. T. 1958. Genesis of Haymond Boulder Beds (Discussion). *Am. Assoc. Petro. Geol. Bull.* 42:1734–1735.

Flores, R. M. 1975a. Short-headed stream delta: Model for Pennsylvanian Haymond Formation, West Texas. *Am. Assoc. Petro. Geol. Bull.* 59:2288–2301.

———. 1975b. Characteristics of the Pennsylvanian Lower-Middle delta-front sandstones, Marathon Basin, West Texas (Reply). *Geol. Soc. Am. Bull.* 86:265–266.

Flores, R. M. and J. C. . 1970. A recent model for Pennsylvanian deposition in the Marathon Basin, West Texas. *Journal of Sedimentary Petrology* 40:621–625.

Froede, C. R., Jr. 1998. Turbidites in the stratigraphic record. *Field studies in catastrophic geology*. Creation Research Society Books. St. Joseph, MO. pp. 63–71.

Froede, C. R., Jr., E. L. Williams, G. F. Howe, and R. Goette. 1998. Flysch/Turbidite Deposits and Translational Sliding in Marathon Basin, Texas. *CRSQ* 35:95–98.

Hall, W. E. 1956. Marathon folded belt in Big Bend area of Texas. *Am. Assoc. Petro. Geol. Bull.* 40: 2247–2255.

———. 1957. Genesis of "Haymond Boulder Beds," Marathon Basin, west Texas. *Am. Assoc. Petro. Geol. Bull.* 41:1633–1637.

———. 1959. Genesis of "Haymond Boulder Beds," Marathon Basin, west Texas (Discussion). *Am. Assoc. Petro. Geol. Bull.* 43:238–239.

Howe, G. F. and E. L. Williams. 1994. The evolution of geological origins theories: Part 1—The Interbeds, Marathon Basin, Texas. *CRSQ* 31:25–31.

———. 1995. The Housetop Mountain Boulder Bed Member described Part II on the Haymond Formation, Marathon Basin, Texas. *CRSQ* 32:148–154.

King, P. B. 1937. *Geology of the Marathon Region, Texas*. U.S. Geological Survey Professional Paper 187. Washington, D.C.

———. 1958. Problems of boulder beds of Haymond Formation, Marathon Basin, Texas (Discussion). *Am. Assoc. Petro. Geol. Bull.* 42:1731–1734.

———. 1975. Marathon revisited and Ouachita and Appalachian belts. *The Geology of the Ouachita Mountains*. Arkansas Geological Commission, Little Rock, Arkansas. 1:1–90.

———. 1978. Tectonics and sedimentation of the Paleozoic rocks in the Marathon region, west Texas. In Mazzullo, S.J. (editor), *Tectonics and Paleozoic facies of the Marathon Geosyncline, west Texas*. Field conference guidebook for the Permian Basin Section of the Society of Economic Paleontologists and Mineralogists. Publication No. 78–17. Midland, TX. pp. 5–37.

King, P. B., C. L. Baker, and E. H. Sellards. 1931. Erratic boulders of large size in the west Texas Carboniferous (Abstract). *Geol. Soc. Am. Bull.* 42:200.

Lehman, R. 1945. Thrust faulting in Arbuckle Mountains, Oklahoma. *Am. Assoc. Petro. Geol. Bull.* 29: 187–209.

McBride, E. F. 1964. Stratigraphy and sedimentology of the Haymond Formation, Marathon Basin, Texas. In *The filling of the Marathon Geosyncline*. Permian Basin Section of the Society of Economic Paleontologists and Mineralogists. Midland, TX. pp. 35–40.

———. 1966. *Sedimentary petrology and history of the Haymond Formation (Pennsylvanian), Marathon Basin, Texas*. Bureau of Economic Geology. University of Texas Report of Investigations No. 57. Austin.

———. 1969a. Stratigraphy and sedimentology of the Haymond Formation. In McBride, E. F. (editor), *A guidebook to the stratigraphy, sedimentary structures and origin of flysch and pre-flysch rocks of the Marathon Basin, Texas*. Dallas Geological Society. pp. 86–92.

———. 1969b. Introduction. In McBride, E. F. (editor), A *guidebook to the stratigraphy, sedimentary structures and origin of flysch and pre-flysch rocks of the Marathon Basin, Texas*. Dallas Geological Society. pp. 1–5.

———. 1970. Flysch sedimentation in the Marathon Region, Texas. In Lajoie, J. (editor), *Flysch sedimentology in North America*. The Geological Association of Canada Special Paper 7:67–83.

———. 1975. Characteristics of the Pennsylvanian Lower-Middle delta-front sandstones, Marathon Basin, West Texas (Discussion). *Geol. Soc. Am. Bull.* 86: 264–265.

———. 1978. Tesnus and Haymond formations Siliciclastic flysch. In Mazzullo, S. J. (editor), *Tectonics and Paleozoic facies of the Marathon Geosyncline, west Texas*. Field conference guidebook. Permian Basin Section of the Society of Economic Paleontologists and Mineralogists. pp. 131–147.

Morgenstern, N. R. 1967. Submarine slumping and the initiation of turbidity currents. In Richards, A. F. (editor), *Marine geotechnique*. University of Illinois Press. Urbana. pp. 189–220.

Oard, M. J. 1997. *Ancient ice ages or gigantic submarine landslides?* Creation Research Society Books. Technical Monograph Series No. 6. Chino Valley, AZ.

Palmer, A. R., W. D. DeMis, W. R. Muehlberger, and R. A. Robison. 1984. Geological implications of Middle Cambrian boulders from the Haymond Formation (Pennsylvanian) in the Marathon Basin, west Texas. *Geology* 12:91–94.

Powers, S. 1928. Age of the founding of the Oklahoma Mountains—the Ouachita, Arbuckle, Wichita Mountains of Oklahoma and the Llano-Burnet and Marathon Uplifts of Texas. *Geol. Soc. Am. Bull.* 39:1031-1072.

Ross, C. A. 1981. Pennsylvanian and Early Permian history of the Marathon Basin, West Texas. In Permian Basin Section of the Society of Economic Paleontologists and Mineralogists. *Symposium and guidebook to the Marathon — Marfa Region of West Texas*. pp. 135–144.

Sellards, E. H. 1931. Erratics in the Pennsylvanian of Texas. *University of Texas Bulletin* 3101:9–17.

Thomson, A. and E. F. McBride. 1964. Summary of the geologic history of the Marathon Geosyncline. In *The filling of the Marathon Geosyncline*. Permian Basin Section of the Society of Economic Paleontologists and Mineralogists. Midland, TX. pp. 52–60.

Book Review

Nature's Destiny—How the Laws of Biology Reveal Purpose in the Universe **by Michael J. Denton**
Free Press, New York. 1998, 448 pages, $27.50
Reviewed by Michael J. Oard

Michael Denton is familiar to most creationists as the author of *Evolution: A Theory in Crisis* (1985) that is devastating to the theory of evolution. In many ways, his second book is also a great book for creationists, but in some ways it is a very big disappointment.

Most of the book, Part 1, details the ubiquitous complexity of nature and how it is fine-tuned and uniquely fit for carbon-based life. This is called the anthropic principle, which Denton takes as evidence of teleology:

> The aim of this book is, first, to present the scientific evidence for believing that the cosmos is uniquely fit for life as it exists on earth and for organisms of design and biology very similar to our own species, Homo *sapiens*, and second, to argue that this "unique fitness' of tne laws of nature for life is entirely consistent with the older teleological religious concept of the cosmos as a specially designed whole, with life and mankind as its primary goal and purpose (p. xi).

He has chapters on the teleology of the cosmos, water, light, the inorganic elements of the earth, carbon, vital gases, DNA, the amazing protein molecules, metals, cells, and the human body. Denton convincingly shows that chance evolution cannot even come close to evolving such a multitude of fine-tuned coincidences.

Part 2 of the book goes downhill from its beginning. One would suppose that Denton would become a creationist after researching and detailing the mass of information for design. But no, after demolishing evolution in his first book, he turns 180 degrees and accepts almost all of the theory of evolution and gives the credit for the tremendous teleological evidence to "directed evolution."

What is directed evolution? It is "...an immense built-in generative program" (p. 265) that guides evolution from chemicals to life as well as the whole subsequent process of organic evolution, all without a Creator! Is there any evidence for directed evolution? The evidence Denton presents is circumstantial at best. For the origin of life he states:

> But even if it seems very likely that the becoming of life is built in, it has to be admitted that at present, despite an enormous effort, we still have no idea how this occurred, and the event remains as enigmatic as ever (p. 292,293)

Concerning directed evolution after the first life supposedly evolved, he says:

> Although there is no direct evidence that mutational processes were directed during the course of evolution, there are two curious aspects of molecular evolution which strongly hint at the possibility (p. 288)

These two "strong" hints for directed evolution are: 1) the rate of evolutionary substitution is almost equal to the mutation rate, and 2) the rate of change in many genes is regulated by some kind of molecular clock that ticks at a constant rate (p. 292) . These questionable "facts" assume evolution in the first place.

Although Denton sees the multitudinous evidence for design, he is steeped in the philosophy of naturalism and cannot seem to extricate himself:

> Assuming that life arose as a result of natural processes, and nearly everyone working in the field accepts this assumption, then the very intractable nature of the problem raises the possibility that abiogenesis requires a completely new set of natural phenomena and processes, of which we have at present no idea (p. 295)

So Michael Denton has faith in naturalism, despite the overwhelming evidence for design. To me, this is irrational. I could not help but think of Esau who traded his special birthright for a bowl of stew.