Jökullhlaups and Catastrophic Coal Formation

Carl R. Froede Jr.*

Abstract

Coal deposits within the Paraná Basin, Brazil apparently formed as a result of large-scale catastrophic deposition. The strata in the basin contain diamictites, turbidites, and coal layers exhibiting hummocky cross stratification, and are interpreted by uniformitarian geoscientists as having formed within a depositional setting analogous to catastrophic floods caused by one or more prehistoric jökullhlaups—an Icelandic term for glacial outburst. Naturalists speculate that extensive alpine glaciation created conditions where considerable volumes of water became trapped behind large glaciers. The catastrophic release of the water washed forests of spore-bearing plants into the basin's fluvial-deltaic glacial environment. This combination of sedimentary and organic material was buried by successive catastrophic event deposits and resulted in the creation of coaly siltstone deposits. Although uniformitarians must strain their paradigm to propose such a mechanism, their conclusions are predicted by the global Flood. These sedimentary deposits and associated coal layers formed during the Middle Flood Event Timeframe when tectonism and erosion created destabilizing conditions in areas that experienced uplift. The erosion and transport of material into the adjoining basin resulted in the formation of strata that reflect catastrophic Flood conditions.

Introduction

Uniformitarian geoscientists have many depositional models for coal-bearing strata. Interestingly, McCabe (1984) has reviewed several and found them unable to satisfactorily explain coal formation. I will not review that work here, but it is important to note that the various models of coal formation are typically not based on the specific coal layers, but rather on the overlying and underlying strata. The most popular model of coal formation came from the cyclothem concept which later developed into specific depositional paleoenvironments (Rahmani and Flores, 1984). Today, uniformitarians acknowledge that no one single depositional model adequately addresses all coal deposits.

In a recent article on high-energy deposits associated with coal layers in the Paraná Basin, Brazil, Begossi and Della Fávera (2002) proposed a setting comparable to the catastrophic floods that formed the Columbia River Valley Scablands. They suggested that these deposits could have formed due to jökullhlaups—an Icelandic term for catastrophic glacial outbursts which originate from the release of large volumes of stored melt water coming from nearby mountain glaciers (Begossi and Della Fávera, 2002). How do these deposits and the uniformitarian interpretation fit the Flood framework?

Paraná Basin, Brazil

The Paraná Basin is located in southern Brazil (Figure 1). It is believed by uniformitarian geologists to contain some of the thickest accumulations of glacially-influenced strata in the largest glaciated basin on the former Gondwana continent—covering approximately 618,000 mi^2 (França and Potter, 1991). As a result of extensive petroleum investigation starting in the late 1800s, a wealth of recorded subsurface data has been produced from this area (Eyles, Eyles, and França, 1993). The basin contains approximately 16,400 feet of Paleozoic and Mesozoic sedimentary fill covered by as much as 5,600 feet of Jurassic-Cretaceous flood basalt which is overlain in places by a thin mid-Cretaceous sandstone (França and Potter, 1991; Eyles, Eyles, and França, 1993)* [*Review França and Potter (1991) for additional information regarding sedimentary source areas, materials, and information on syntectonism in the Paraná Basin]. The flood basalt is believed to be one of the most voluminous and extensive flows of its type on Earth, covering as much as 95% of the basin (Eyles, Eyles, and França, 1993; França and Potter, 1991). The Itararé Group, along with the overlying Rio Bonito Formation (Late Carboniferous to Early Permian age—Figure 2), contains coal deposits interpreted to have been formed by one or more jökullhlaups.

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

Accepted for publication: December 1, 2003

Figure 1. The Paraná Basin (shaded) occupies southern Brazil, and parts of Uruguay (U), Paraguay (P), and Argentina. Most of the exploration for hydrocarbon and coal has occurred in Brazil. Figure modified from França and Potter (1991), and Eyles, Eyles, and França (1993).

System	Series	Stage	Group	Formation	Timeframe
PERMIAN	LATE	Tatarian		Irati Fm	Middle Flood Event
		Kazanian		Palermo Fm	
	EARLY	Kungurian	Itararé Group	Rio Bonito	
		Artinskian		TACIBA FM	
		Sakmarian			
		Asselian		CAMPO MOURAO FM	
CARBONIFEROUS	LATE	Stephanian			
		Westphalian		LAGOA AZUL FM	

Figure 2. Generalized stratigraphic column showing the position of the two primary coal-bearing units (i.e., the Rio Bonito Formation and the Itararé Group) found within the Paraná Basin in Brazil. Figure modified from França and Potter (1991), Begossi and Della Fávera (2002). Flood framework interpretation from Froede (1995; 1998). Beneath the Carboniferous coal deposits is a major unconformity (not illustrated) with what are interpreted by uniformitarian geoscientists as Ordovician glaciated deposits, Silurian sandstones, and Devonian shales (believed to be the primary source for hydrocarbons) [França and Potter, 1991; Eyles, Eyles, and França, 1993].

The silty-coal deposits found in the Paraná Basin are best understood as having occurred under catastrophic conditions, where materials were eroded from upland areas by gigantic floods, and transported and deposited in a marginal-marine fluvial-deltaic setting. Soon thereafter, destabilizing conditions must have occurred where the newly deposited clastics and organic materials were transported further offshore by turbidity currents. This is a dramatic departure from the standard uniformitarian model of a coastal swamp with occasional marine incursions resulting in the burial of organic layers later forming coal deposits (see McCabe, 1984).

The Rio Bonito Formation

The Rio Bonito Formation is lower Permian in age and lies within the western portion of the Paraná Basin (França and Potter, 1991). According to Begossi and Fávera (2002), coals from the Rio Bonito Formation are better identified as coaly siltstone than coal. Hummocky cross-stratified fine-grained sandstones and siltstones associated with coal layers in the Rio Bonito Formation provide sedimentary evidence of high-energy depositional conditions (Begossi and Fávera, 2002). They further state:

> The peculiar character, plus the overall occurrence of hummocky cross stratification (HCS) in the Rio Bonito Formation's coal... and close association with diamictites, suggesting lateral passages between these two lithological types, lead to an interpretation of deposition under high energy conditions... (Begossi and Fávera, 2002, p. 84)

The Itararé Group

The Itararé Group is the thickest unit in the Paraná Basin with up to 4,300 feet of sedimentary strata believed to have

been catastrophically deposited over the course of 36 million years (Figure 3) [França and Potter, 1991]. According to Eyles, Eyles, and França (1993), the facies are interpreted to be the result of sedimentary gravity flows in a glacially-dominated marine basin. Sediments comprising this group can be subdivided into four types: diamictites, conglomerates, sandstones, and fine-grained deposits (Eyles, Eyles, and França, 1993). Interestingly, coal was not mentioned in the early studies of the sedimentary rock types examined from this group. This oversight is likely due to the extensive flood basalt cover and limited availability of outcrops.

The Recreio and Faxinal Mines, in Rio Grande do Sul State, Brazil

Begossi and Fávera (2002) focused their investigation on the sedimentary content of the Brazilian coal to the areas around two coal mines: Recreio and Faxinal. There they found high-energy sedimentary deposits (e.g., diamictites, hummocky cross stratification of fine-grain siliciclastics, and turbidites) in close association with the coal layers. The formation of these deposits requires a catastrophic interpretation. They state:

> Diamictites grade, laterally, to pebbly sandstones, indicating a flow transformation from debris-flow to high-density gravelly turbidity currents... Logs of trees, presumably taller than 30 m *(98 feet)*, appear to be floating in the diamictites, indicating that trees were plucked in catastrophic processes. Faceted and, possibly, striated clasts strongly suggest a glacial origin... (Begossi and Fávera, 2002, p. 87) [italics mine]

They conclude their investigation by stating:

> Catastrophic floods could be (sic) possibly be related to melting mountain glaciers, situated in the basin margins. These floods generated water and sediment admixtures with velocity and sediment concentration to produce hyperpicnal (sic) inflows and self-maintained turbidity currents. The resultant organic matter concentration in prodelta would be in the form of HCS coal layers (Begossi and Fávera, 2002, p. 89).

This catastrophic interpretation, placed within a glacial setting and entwined with uniformitarian assumptions, is an acceptable (though unusual) interpretation to most naturalists. However, it is important to notice the difference between what was observed and the uniformitarian

Itararé Group	TACIBA FM	CHAPEU DO SUL Mbr. Blanket-like massive diamictite; some deposited by suspension resettlement and minor resedimentation.
		RIO SEGREDO Mbr. Massive and graded sandstones; Turbidite deposits, Rare shallow water marine features.
	CAMPO MOURAO FM	CAMPO MOURAO Fm. Interbedded stratified diamictites and graded/massive/slumped sandstones and conglomerates; Turbidite and debris flow deposits. Evidence for rapid sedimentation along with the first marine fossils.
	LAGOA AZUL FM	TARABAI Mbr. Stratified diamictites; Debris flows along with some minor deposition by suspension resettlement.
		CUIABA PAULISTA Mbr. Massive and poorly graded sandstones, minor conglomerates; Turbidite deposits.

Figure 3. A generalized description of the stratigraphic units that compose the Itararé Group. The strata are interpreted by uniformitarian geoscientists to represent at least one if not two episodes of catastrophic glacial-marine deposition. However, if the naturalist interpretation is accepted, deposition would have been highly episodic with many millions of years of stasis between each depositional event. The Flood framework eliminates this unusual cycle of high and low (no?) energy by eliminating the excessive time (not reflected in the sediments) and is more consistent with the expectations of Occam's Razor. Figure modified from Eyles, Eyles, and França (1993) and França and Potter (1991).

interpretation. Although the data indicate a catastrophic setting, uniformitarian beliefs force the interpretation back to familiar ground.

Catastrophic Formation of Brazilian Coal Within A Young-Earth Flood Framework

Young-Earth creationists and naturalists observe the same physical features, but differ in conceptual frameworks. While naturalists assume history and science are the same, creationists use science as a forensic tool in the investigation of natural history. However, neither of these groups would disagree that the strata found in association with coal layers in both the Rio Bonito Formation and the underlying Itararé Group reflect a high-energy depositional setting. However, to equate diamictites with a prehistoric glacial paleoenvironment is an interpretative step not required by the data.

Several years ago, young-Earth creationist Michael Oard (1997) published an excellent monograph on the topic of prehistoric ice ages as interpreted by uniformitarian geoscientists. He showed how sedimentary features attributed to the so-called ancient ice ages could best be understood within the framework of the global Flood of Genesis. In a somewhat related effort, Howe and Froede (1999) discussed the various uniformitarian theories for the formation of the Haymond Formation boulder beds—one of which (now rejected by uniformitarians) was of a glacial origin. Both works demonstrated that physical features commonly attributed to glacial processes could have formed as a result of high-energy erosion, transport and deposition of sediments in the global Flood.

Austin (1986; 1991) documented the effect that changing energy levels, as a result of the explosion of the Mount St. Helens volcano, had on the deposition of volcaniclastics. This work compares favorably to the depositional energy found in the Paraná Basin. Likely a succession of large-scale volcanic-ash eruptions (i.e., pyroclastic flows) and accompanying deciduous material deposited within Spirit Lake could create similar sedimentary conditions now found in the coal-bearing strata in the Paraná Basin. Coffin (1969; 1983) documented the occurrence of poly-strata trees, and attributed them to a high-energy depositional setting associated with the Flood. Similarly, Ager (1993) also admitted that poly-strata trees reflect high-energy conditions, but clung to uniformitarianism.

Turbidites, though widely recognized in the uniformitarian understanding of Earth history, remain a mystery due to limited occurrences and varying stratigraphic signatures. Froede (1998) has reviewed the subject and determined that turbidites are best understood within the catastrophic global Flood of Genesis. Turbidite deposition of the Paraná coal-bearing strata would require the erosion, transport and deposition of clastic sediments and associated plant material—*twice*. The passage of time between the initial and turbidite depositional episodes must have been short to minimize diagenetic or compaction processes. This succession of events would require an unstable shelf setting and an adjacent basin undergoing some form of active tectonism. All of these conditions are predicted in the Flood framework.

An interpretation of the Brazilian coal layers can be accommodated within a biblical framework. Tectonism associated with the Flood created uplift around the incipient basin. Floodwater then eroded and transported materials (sediments and organic plant detritus) from the elevated areas into the Paraná Basin (A similar model for the southern Appalachian coal deposits was proposed for a locale near Spencer, TN—Froede, 2000b). At some later period during the Flood, rifting occurred in the basin which resulted in the extrusion of flood basalt which almost covered the entire basin. It is not currently clear whether the basalts were deposited during the Flood or after the marine water withdrew. The timing could be better constrained by the nature of the basalt/sediment contact (i.e., was the sediment lithified or not prior to basalt emplacement) and the nature/morphology of the volcanic deposits (e.g., pillow features, glassy rinds, etc.) [see Froede, 2000a].

The vertical succession of high-energy deposits (i.e., clastic sediments followed by volcanic outpourings) found within the Paraná Basin would suggest that the majority of the materials were deposited and emplaced during periods of accelerated tectonism initiated during the Middle Flood Event Timeframe (see Reed et al., 1996; Froede, 1998).

Acknowledgments

I thank Emmett Williams, Jerry Akridge, and John Reed for their very helpful comments. Mrs. Thajura Harmon provided excellent assistance in securing key references for me and I thank her for this help. As always, I thank my wife Susan for allowing me the time and opportunity to research and write this article. Any mistakes that may remain are my own. Glory to God in the highest! (Prov. 3:5–6).

References

CRSQ: Creation Research Society Quarterly

Ager, D. V. 1993. The new catastrophism. The importance of

the rare event in geological history. Cambridge University Press, Cambridge, MA.

Austin, S. A. 1986. *Mount St. Helens and catastrophism*. Impact No. 157. Institute for Creation Research, El Cajon, CA. http://www.icr.org/pubs/imp/imp-157.htm.

———. 1991. Mount St. Helens–geologic evidence for catastrophism. In *Mount St. Helens: A slide collection for educators*. pp. 1–25. Geology Education Materials. El Cajon, CA.

Begossi, R., and J. C. Della Fávera. 2002. Catastrophic floods as a possible cause of organic matter accumulation giving rise to coal, Paraná Basin, Brazil. *International Journal of Coal Geology* 52:83–89.

Coffin, H. G. 1969. Research on the classic Joggins petrified trees. In Howe, G. F. (Editor). 1989. *Speak to the Earth*. pp. 60–85. Creation Research Society Books. St. Joseph, MO.

Coffin, H., with R. H. Brown. 1983. *Origin by design*. Review and Herald Publishing, Washington, D.C.

Eyles, C.H., N. Eyles, and A.B. França. 1993. Glaciation and tectonics in an active intracratonic basin: The Late Palaeozoic Itararé Group, Paraná Basin, Brazil. *Sedimentology* 40:1–25.

França, A. B., and P. E. Potter. 1991. Stratigraphy and reservoir potential of glacial deposits of the Itararé group (Carboniferous-Permian), Paraná Basin, Brazil. *American Association of Petroleum Geologists Bulletin* 75:62–85.

Froede, C. R., Jr.1998. *Field studies in catastrophic geology*. Creation Research Society Books. St. Joseph, MO.

———. 2000a. Submarine volcanism, Part I–Subaqueous basalt eruptions and lava flows. *CRSQ* 37:22–35.

———. 200b. Coal-bearing strata within an in-situ(?) Fossilized paleo-fern-tree forest: Which models and settings apply? *CRSQ* 37:123–127.

Howe, G. F., and C. R. Froede Jr. 1999. The Haymond Formation boulder beds of Marathon Basin, west Texas: Theories on origin and catastrophic deposition. *CRSQ* 36:17–25.

McCabe, P. J. 1984. Depositional environments of coal and coal-bearing strata. In Rahmani, R. A., and R. M. Flores (Editors). *Sedimentology of coal and coal-bearing sequences*. pp. 13–42. Special publication Number 7. International Association of Sedimentologists. Blackwell Scientific Publications, Boston, MA.

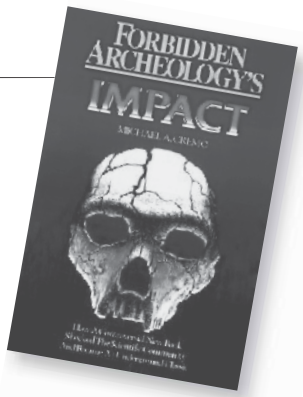
Oard, M. J. 1997. *Ancient ice ages or gigantic submarine landslides*. Creation Research Society Books. St. Joseph, MO.

Rahmani, R. A., and R. M. Flores. 1984. Sedimentology of coal and coal-bearing sequences of North America: A historical review. In Rahmani, R. A., and R. M. Flores (Editors). *Sedimentology of coal and coal-bearing sequences*. pp. 3–10. Special publication Number 7. International Association of Sedimentologists. Blackwell Scientific Publications, Boston, MA.

Reed, J. K.., C. R. Froede, Jr., C. B. Bennett. 1996. The role of geologic energy in interpreting the stratigraphic record. *CRSQ* 33:97–101.

Book Review

***Forbidden Archeology's Impact* by Michael Cremo**
Bhaktivedanta Book Publishing Co., Los Angeles, CA. 1998, 569 pages, $35



Cremo makes the charge that evolutionists have borrowed their view of linear historical progress from Christianity. Instead, he believes in cyclical history in accordance with his Hindu religion to which he converted from "liberal Roman Catholicism" (pp. 57–58). His Hindu belief led to his search for evidence of people in geologic strata that is too early for conventional Darwinism (p. xxxiii). The results were chronicled in his first book, *Forbidden Archeology* (*FA*, 1993) which was "an exercise in apologetics [for the] Vedic texts of India" (p. 199). Peter Line (1995) reviewed that book from a creation perspective. Cremo's new book discusses the reception accorded *FA*. His next intended book *Human Devolution* will attempt to explain the scientific origins of people, *billions* of years ago, in accordance with his Hindu worldview. Cremo has been effective promoting his beliefs at the popular level, and has been given access, appearing on more than 150 radio/TV broadcasts, guest-lecturing at universities, and publishing more than 35,000 copies of *FA*.

It does not appear that Hindus would be good allies for Christians against Naturalism. The reason is that they are attempting to move the scientific center further from Christianity than it is now. Dr. Howells (Harvard) thought that the *FA* research would cause problems for scientific creation (p. 334). That is only true, though, for those varieties (theistic evolution and old-earth creation) that accept the uniformitarian interpretation of the geologic column. Dr. Roger Wescott (p. 427) recognized that the evidence for man in ancient geological strata could be interpreted as evidence *against the supposed great ages* (which is the way young earth creation scientists see these anomalies). What is interesting is that Cremo did not answer Wescott. Though welcoming Cremo's deconstruction of evolutionist arche-