The Proceedings of the International Conference on Creationism

Volume 8
Print Reference: Pages 327-350

Article 28

2018

Global Stratigraphy and the Fossil Record Validate a Flood Origin for the Geologic Column

Timothy L. Clarey
Institute for Creation Research

Davis J. Werner
Institute for creation Research

Clarey, T.L., and D.J. Werner. 2018. Global stratigraphy and the fossil record validate a Flood origin for the geologic column. In *Proceedings of the Eighth International Conference on Creationism*, ed. J.H. Whitmore, pp. 327–350. Pittsburgh, Pennsylvania: Creation Science Fellowship.

GLOBAL STRATIGRAPHY AND THE FOSSIL RECORD VALIDATE A FLOOD ORIGIN FOR THE GEOLOGIC COLUMN

Timothy L. Clarey, Institute for Creation Research, 1806 Royal Lane, Dallas, TX 75229 USA, tclarey@icr.org
Davis J. Werner, Institute for Creation Research, 1806 Royal Lane, Dallas, TX 75229 USA

ABSTRACT

The geologic column has been under the scrutiny of numerous creationists for many decades. Critics have claimed the column is intimately tied to the evolutionary worldview and deep time, and cannot be trusted or used by creation scientists. Other creation scientists have argued that the geologic column, although incomplete at most locations, can provide useful correlations of rocks and fossils across the globe. This paper examines the sedimentary rocks across three continents in an attempt to test the validity of the global geologic column. We attempted to assess the data primarily from a lithologic viewpoint, and as independent of the fossil data as possible. To accomplish this, we constructed a new data set of over 1500 local, stratigraphic columns across three continents, recording the detailed lithologic information and Sloss-type megasequence boundaries at each site. A detailed 3-D lithology model was created for each continent using the local columns. We also constructed maps of the basal lithology for each megasequence. Unique lithologic units, like salt and chert-rich layers were also tracked from column to column. Results show extensive lithologic units (i.e. blanket sandstones) covered portions of every continent and are correlative across vast regions and even continent to continent. The correlation of these stacked basal megasequence units, and other unique lithologies (i.e. salt and chert layers) within the megasequences, confirm the validity of the geologic column on a global scale. The observable pattern in the fossil record further confirms these findings. Indeed, a global Flood could produce globally extensive, stacked lithologic units on an intercontinental scale. Creationists should not be critical of the geologic column, but embrace it as evidence of a global Flood event.

KEY WORDS

correlation, geologic column, fossil record, stratigraphy, megasequences, ecological zonation, Sloss sequences, North America, South America, Africa

INTRODUCTION

The geologic column has been criticized by many creationists over the past 50 years (Whitcomb and Morris 1961). A decade ago, an entire book was published by the Creation Research Society in an attempt to tackle this issue (Reed and Oard 2006). The nature of the geologic column has been questioned due to its obvious ties to evolutionary theory (Matthews 2011, 2016; Oard 2010; Woodmorappe 1999). Unfortunately, some of these critics still use arguments that have been invalidated in recent years such as so-called out-of-place fossils due to overthrusting. Clarey (2013) has demonstrated that the vast majority of overthrusts are in fact, real features, and have been drilled and imaged seismically for decades by oil company geologists. Clarey (2013) noted, however, that the necessary requirements for overthrusting can only be explained by the conditions produced by the global Flood.

Recently, the use of sequences or megasequences to study Flood sedimentation has been criticized by some creation scientists (Froede *et al*. 2015). These creationists claim "The heart of the issue of using Sloss-based megasequences is their dependence on the geological timescale" (Froede *et al*. 2015, p. 21). Others, like Ross (2014) have championed the robustness of the global geologic column based on comparisons and coincidence of both paleontological and physical geologic data. He emphasized that "The ability to correlate rocks on the basis of fossils contained is not dependent on evolutionary reasoning. Rather it is based on sound recognition of similar *patterns of fossils* found in disparate locations" (emphasis in original, Ross 2013, p. 43). He argued that the type of rocks, and distinctive chemical signals in some of the rocks, also allow consistent correlations. It is not just the fossils that are compared from place to place (Ross 2014).

Nonetheless, the general pattern of the fossils within the geologic column remains a mainstay of secular geologic education and practice (Fig. 1). And many creation geologists do support the notion of the geologic column, recognizing that many fossils do not reflect evolutionary patterns or time periods, but are indicative of the order of burial during a one-year, global Flood (Austin *et al.* 1994; Snelling 2009).

This paper tests the validity of the global geologic column by examining rocks and depositional architecture across three continents. It uses the results of a compiled database of over 1500 stratigraphic columns to compare lithologic data across individual continents, and from continent to continent. Sequences are defined as discrete packages of sedimentary rock bounded top and bottom by erosional surfaces, with coarse sandstone layers at the bottom (deposited first) followed by shales and then limestone at the top (deposited last) (Sloss 1963). The corresponding size of the sedimentary particles is also thought to decrease upward in each package of rock, although this may not always be true. Basal sandstone layers are conventionally thought to represent the shallowest sea level or a highest energy environment, the shale—a little deeper water and less energetic environment, and the

limestone the deepest water and likely least energetic environment in each sequence. By tracking these changes in rock types, geologists are able to define each sequence, or discrete package of sediments. And by tracking each sequence from column to column, the sequences can be correlated on a continental-scale and even on an intercontinental scale.

The terminology associated with sequence stratigraphy has ballooned in the past decades, causing some to use the term 'megasequence' for the most prominent regional unconformities (Hubbard 1988). Haq et al. (1988) then used the term 'megasequence' to designate their First Order sequences, or their largest scale sequences, equivalent to Sloss sequences. Other secular and creation scientists have followed, using the term 'megasequence' to describe rock-stratigraphic units traceable over vast areas bounded by unconformities (or their correlative conformities) (Davison 1995; McDonough et al. 2013; Reijers 2011; Thomson and Underhill 1999). Hereafter, this term will be used to designate the six, Sloss-defined megasequences.

Megasequences supersede and include multiple geologic systems and in many instances can be recognized by their bounding erosional surfaces and sudden changes in rock type, independent of fossil content (Fig. 2). Many creationists believe megasequences record the sedimentology of the Flood, while fossils record what flora and fauna was buried within each megasequence. They differ from the standard geologic time scale in that they are not based on changes of fossil content as are the Eras, Periods and Epochs (Sloss 1963) (Fig. 2).

Although Sloss (1963) initially defined his megasequences across only the interior of North America, oil industry geologists quickly

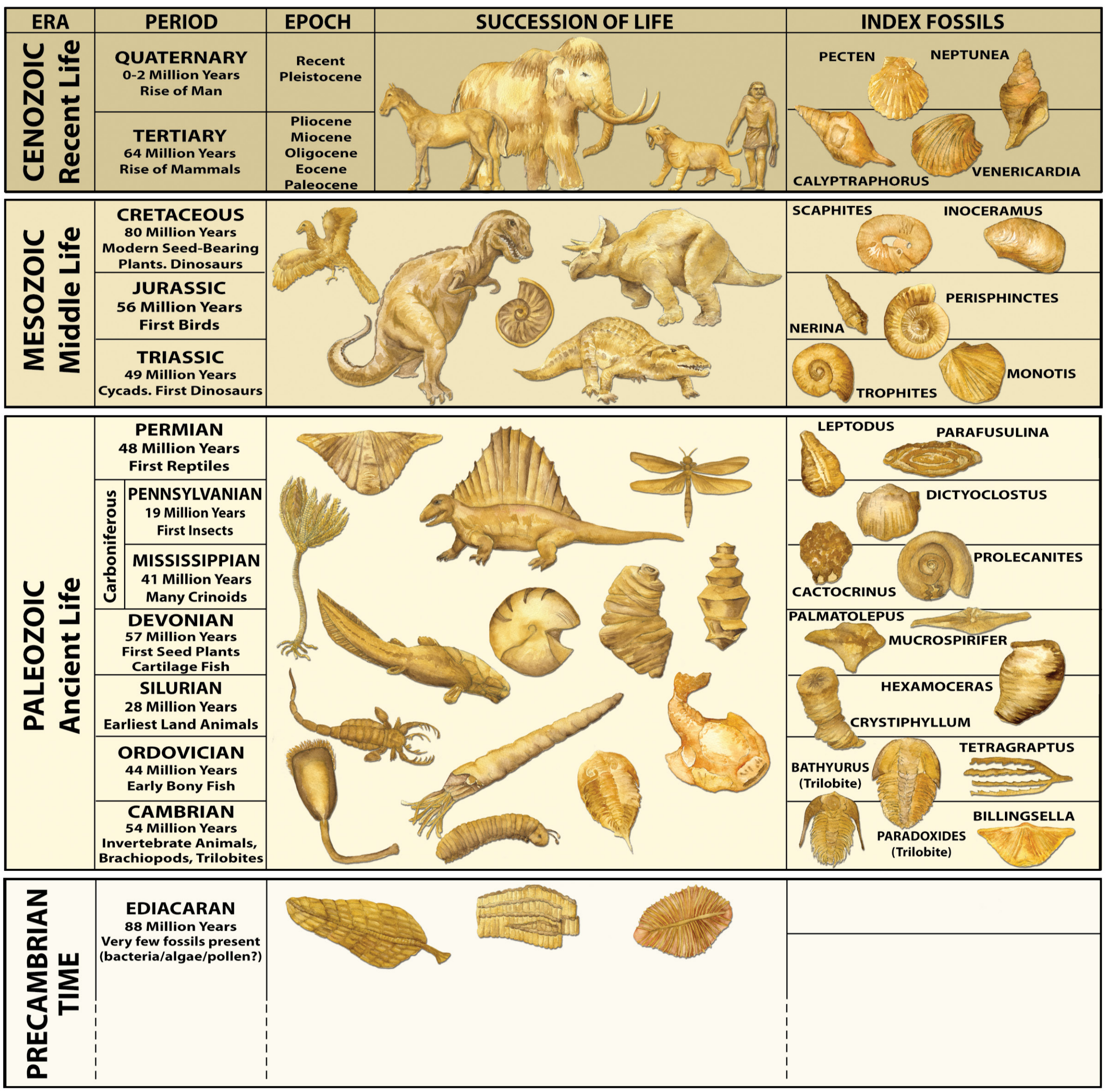

Figure 1. Secular geologic column showing the uniformitarian timescale and representative fossils. Illustration courtesy of ICR and Susan Windsor. © 2017 Institute for Creation Research. Used by permission.

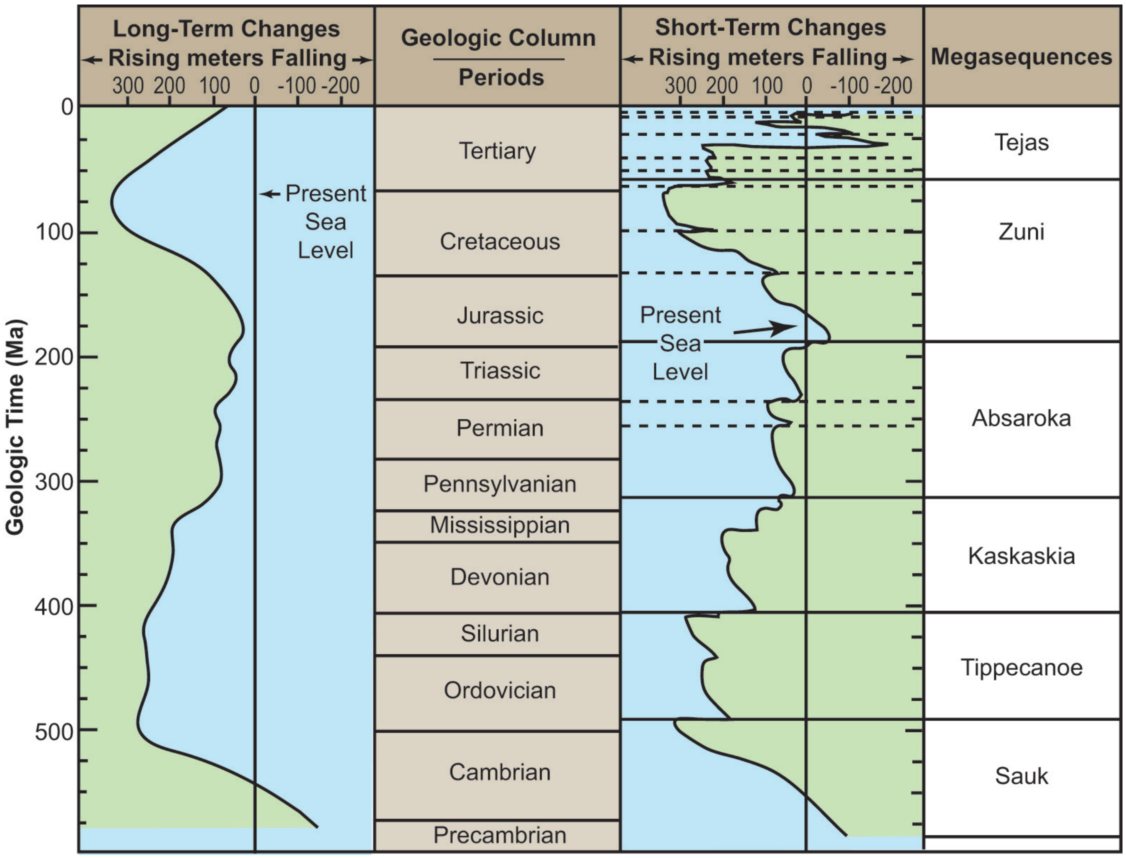

Figure 2. Chart showing the secular timescale, presumed sea level curve, and the six megasequences (Modified from Snelling 2014).

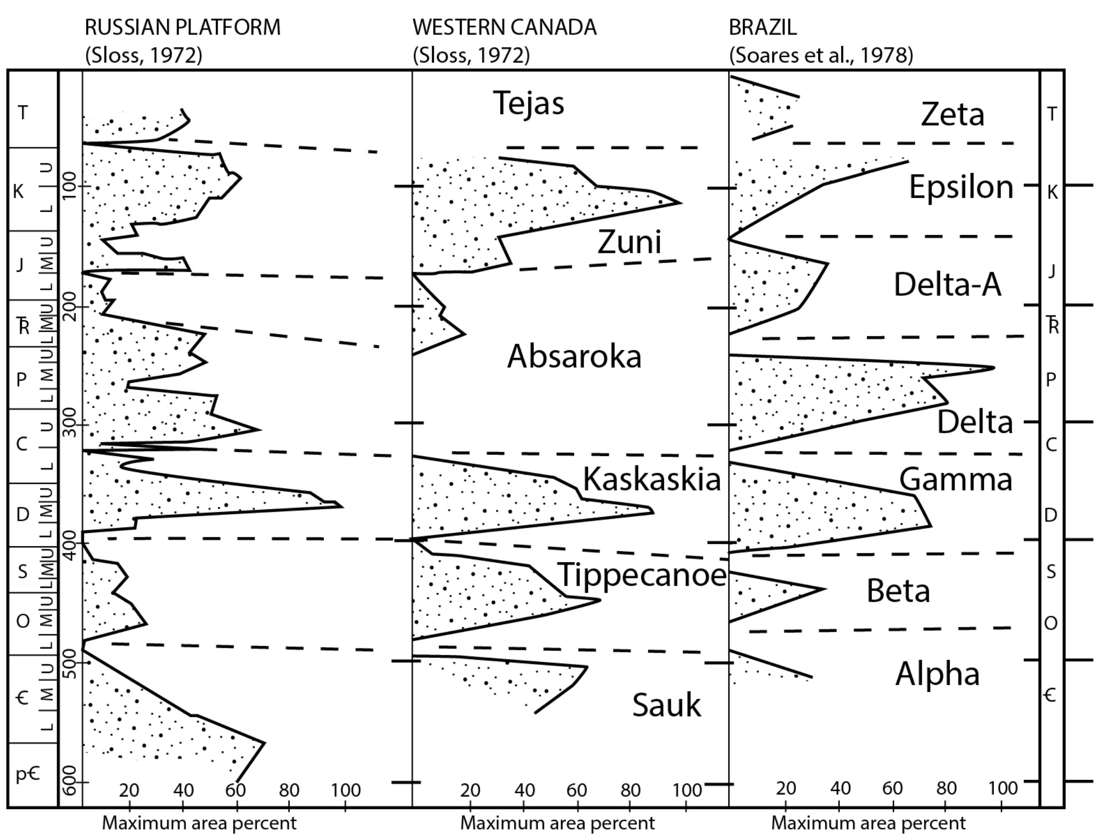

Figure 3. Chart showing the correlation of megasequence boundaries across three of the major continents. Generally accepted secular time scale is shown on left side. The shaded areas represent the percentage of preserved sedimentary deposits. Modified from Soares et al. (1978). Illustration courtesy of Susan Windsor.

extended these sequence boundaries to the offshore regions surrounding North America and to adjacent continents (Sloss 1972; Soares *et al.* 1978; Hubbard 1988) (Fig. 3). Oil industry geologists have tracked the megasequence boundaries from the craton to the ocean shelves on the basis of distinctive seismic reflection patterns (many due to abrupt truncations) as well as lithologic changes in oil well bores (using downhole well logs, biostratigraphy data and cores) (Hubbard 1988; Van Wagoner *et al.* 1990). These same Sloss-megasequence boundaries were correlated to at least three other continents based on seismic data and oil well drilling results (Sloss 1972; Soares *et al.* 1978; Hubbard 1988; Van Wagoner *et al.* 1990). In fact, nearly identical megasequence boundaries were identified and aligned to global tectonic events in North America, the Russian Platform, Brazil, and Africa (Soares *et al*. 1978) (Fig. 3).

The goal of this paper is to examine the validity of the global geologic column from a young earth creationist context. In other words, can much of the geologic column be produced and explained by the activity of the Flood? A second goal is to follow up on the work of Davison (1995) and "describe the depositional history of the Genesis Flood without being dependent on the evolutionary geologic timescale" (Davison 1995, p. 223). To accomplish these goals, we reconstructed the stratigraphic architecture, megasequence by megasequence, across three continents using newly-compiled stratigraphic columns. Essentially, we examined the sedimentary "rocks in place" at over 1500 sites across three continents.

METHODS

1. **Three-dimensional lithology models**

Stratigraphic columns were compiled from published outcrop data, oil well boreholes, cores, cross-sections and/or seismic data tied to boreholes. Lithologic and stratigraphic interval data (megasequence boundaries) were input into a database, allowing the creation of a three-dimensional lithologic model for each of the three continents in this study. These models also allow the correlation of rock types within individual megasequences and along their bounding surfaces.

Our database consisted of selected COSUNA (Correlation of Stratigraphic Units of North America) (Childs 1985; Salvador 1985) stratigraphic columns across the United States, stratigraphic data from the Geological Atlas of Western Canada Sedimentary Basin (Mossop and Shetsen 1994), and numerous well logs and hundreds of other available online sources. Using these data, we constructed 710 stratigraphic columns across North America, 429 across Africa, and 405 across South and Central America from the pre-Pleistocene, meter-by-meter, down to local basement. We input detailed lithologic data, megasequence boundaries and latitude and longitude coordinates into RockWorks 17, a commercial software program for geologic data, available from RockWare, Inc. Golden, CO, USA. Fig. 4 is an example stratigraphic column from the Michigan Basin, showing the 16 types of lithology that were used for classification and the sequences. Depths shown in all diagrams are in meters.

Each column recorded the complete record of sedimentary rocks at that location from surface to crystalline basement along with the corresponding Sloss megasequence boundaries (1963). Any erosional "gaps" in the COSUNA columns were collapsed so that only the rocks present at each location were used in the study.

Megasequences were used in this study because they reflect major shifts in depositional patterns as the seas transgressed and subsequently regressed off the continents. Many of these shifts left

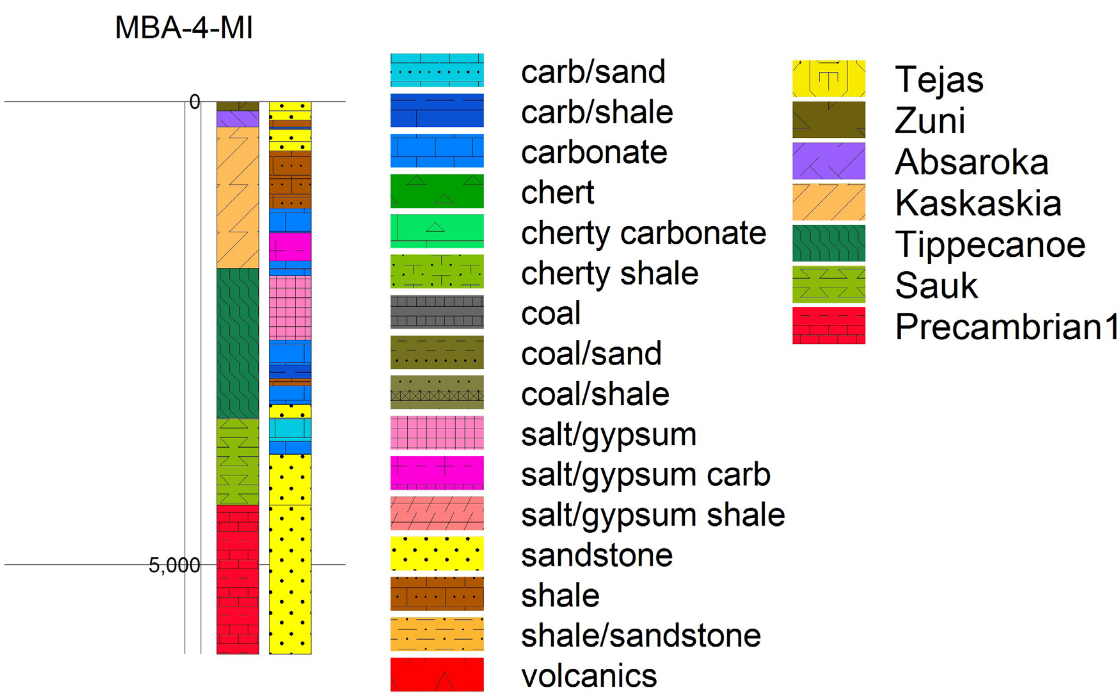

Figure 4. Example stratigraphic column from the Michigan Basin illustrating the16 types of lithology that were used for classification and the six megasequences that were used in this study. Depth is in meters. © 2017 Institute for Creation Research. Used by permission.

behind erosional surfaces at the top and base of the megasequences and changed the rock type abruptly (called xenoconformities, Carroll 2017). These major shifts in depositional architecture are recognizable and traceable across continents and offshore alike using distinctive characteristics observed on seismic reflection data, such as abrupt truncations and strong reflecting horizons. Because this method concentrates on the changes in the physical attributes of the rocks, it is less dependent on the fossil record for correlations (Sloss 1963).

2. Construction of basal lithology maps

Of particular interest were the basal rock types in each megasequence, deposited as the ocean water transgressed across the continents. The basal rock types were most likely the best preserved of any interval within each megasequence as all subsequent erosion from regressive phases eroded from the top of the megasequence down. That is not to say that all the basal rocks in each megasequence were preserved because the regressive phase may have removed all of the preceding megasequence rock in some locations. Accordingly, maps of the basal rock type in each megasequence and stratigraphic cross sections were constructed that allowed continent-scale correlations of the basal stratigraphy for each megasequence.

3. Construction of maps of unique sediments of semi-regional extent

We also compiled maps of distinctive rock types, like bedded chert layers and salt and gypsum-rich layers, keeping track of each by megasequence. These unique lithologic units also allowed us to test our megasequence boundary picks on a regional scale. For example, we assumed megasequence correlations were validated if the salt-rich or chert-rich layers remained in the same relative location within the megasequences, from column to column, and did not cross-cut the megasequence layering up or down in the stratigraphic section. We also examined published maps of extensive and lithologically distinct rock units, like the Morrison Formation and Pierre Shale in the Western USA. These semi-regional (multi-state units in the USA) formations were also tracked within the confines of the megasequence boundaries to test the validity of the correlations.

RESULTS

1. Lithologic patterns in the megasequences

A. Three-dimensional lithology models

We created 3-D lithology models for each of the three continents (Figs. 5, 6, 7). The RockWorks 17 program allowed a constrained interpolation between the detailed columns and filled in the lithologic information from the closest column data.

For each continent, we constructed a 3-D model that we can rotate using the RockWorks software and view from any angle. We chose to include snapshots of each of the continents viewed from two different, but consistent angles, first viewed from 225 degrees, looking northeast and from 135 degrees, looking northwest, both viewed downward at 30 degrees from horizontal. These large-scale lithologic models demonstrate the overall consistent correlation of many of the rock types across significant distances on every continent. However, as these are so large, it becomes difficult to illustrate the internal correlations from column to column. For that we constructed additional maps and cross-sections as discussed below.

B. Basal lithology maps

Stratigraphic depositional patterns were examined by creating basal lithology maps for all six megasequences across the continents of North America, Africa and South America (Figs. 8, 9, 10). Some of the most prominent patterns we observed within each megasequence are discussed below.

The Sauk megasequence extends from the Lower Cambrian system to the Lower Ordovician system (Fig. 2). The basal Sauk lithology across North America consists of the Tapeats equivalent sandstones (Fig. 8a). This megasequence has the most extensive sandstone layer at its base compared to all subsequent megasequences across North America. However, much of this sandstone layer is very thin, often less than 100 m. This is especially true along the NE-SW-trending Transcontinental Arch that runs from Minnesota to New Mexico. Here, the Sauk megasequence thins to just a few 10s of meters in many places or is non-existent altogether. The thickest deposits of the basal sandstone of the Sauk megasequence are found in northernmost Canada and isolated locations along the East Coast and some of the Western states and Alberta, with thicknesses exceeding 3 km.

The continuity of the basal Sauk sandstone layer across the North American continent is a testimony to the extent and uniformity of the first marine transgression of the Phanerozoic. In many places, the base of this layer is also known as the Great Unconformity. It has been mapped across multiple continents, including the other two in this study (Peters and Gaines 2012). Many creationists recognize this layer as the first extensive deposit of the Flood across major segments of the continents, with some local exceptions (Snelling 2009).

This same basal Sauk sandstone layer also extends across North Africa and the Middle East (Fig. 9a). A similar pattern is observed across South America where the Sauk is only found within portions of Peru, Bolivia and northern Argentina (Fig. 10a). The basal Sauk in South America is also composed of less sandstone and more shale compared to the other continents. These maps verify the extent of the basal Sauk sandstone layers (Tapeats equivalent) and their correlation and existence across multiple continents.

The demonstrable correlation of the basal Sauk sandstone beds across vast areas of three continents illustrates the common starting point for a global geologic column. In many locations, the basal Sauk megasequence is also coincident with the Great Unconformity, and in some locations the so-called Cambrian Explosion, where marine fossils representing all animal phyla suddenly appear in the rock record.

The Tippecanoe sequence extends from the Middle Ordovician system to the top of the Silurian system (Fig. 2). It has a fairly extensive basal sandstone layer that can be traced from column to column across the Midcontinent region of the USA (St. Peter Sandstone and equivalent), including an incursion into Hudson Bay. This sandstone layer is also quite thin, often less than 100 m.

Some earlier maps published by creation scientists show the St. Peter Sandstone to be much more extensive than the actual

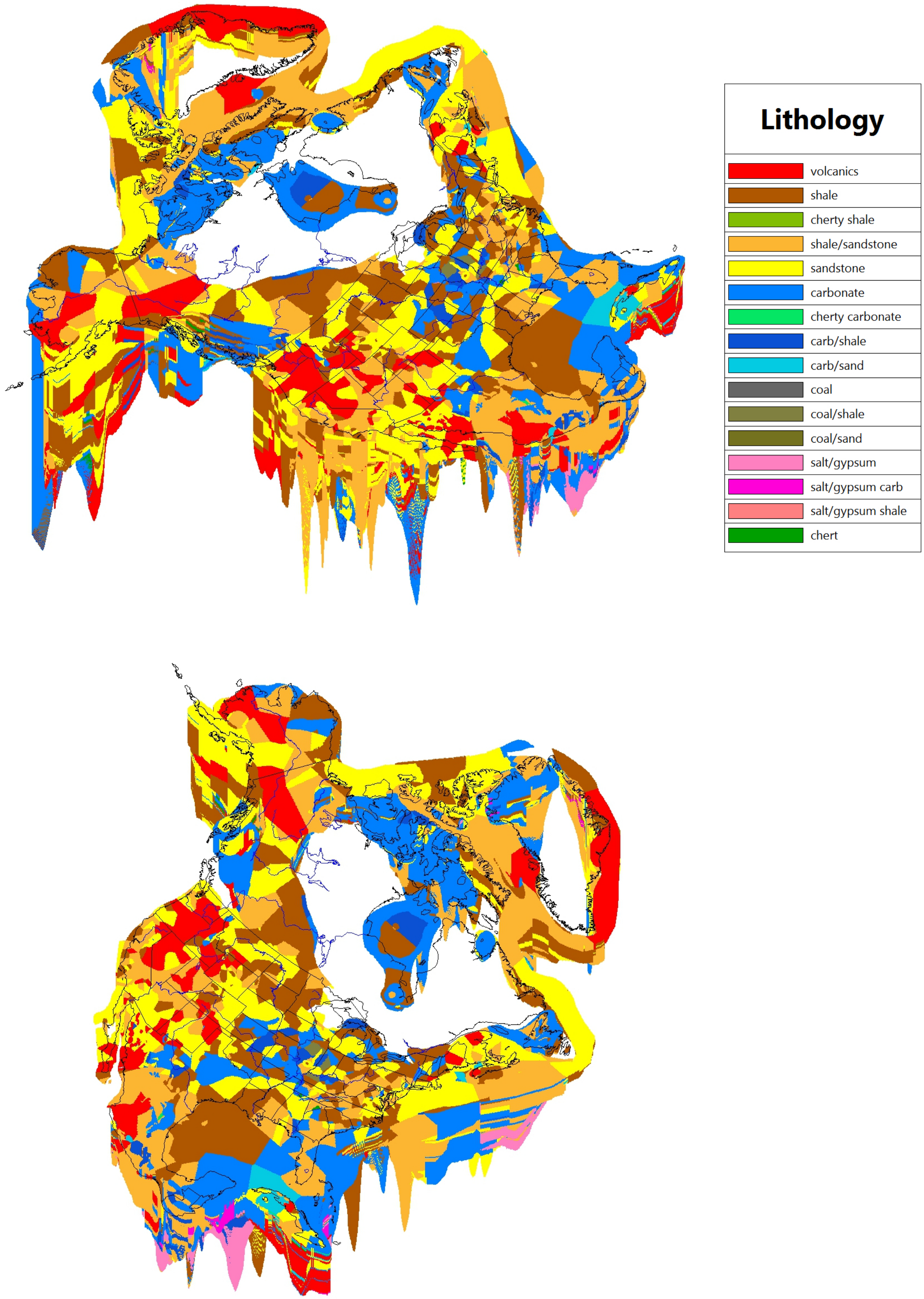

Figure 5. Three-dimensional lithological model of North America showing all six megasequences, viewed from 225 degrees and 135 degrees and 30 degrees from horizontal. Vertical exaggeration approximately 260x. © 2017 Institute for Creation Research. Used by permission.

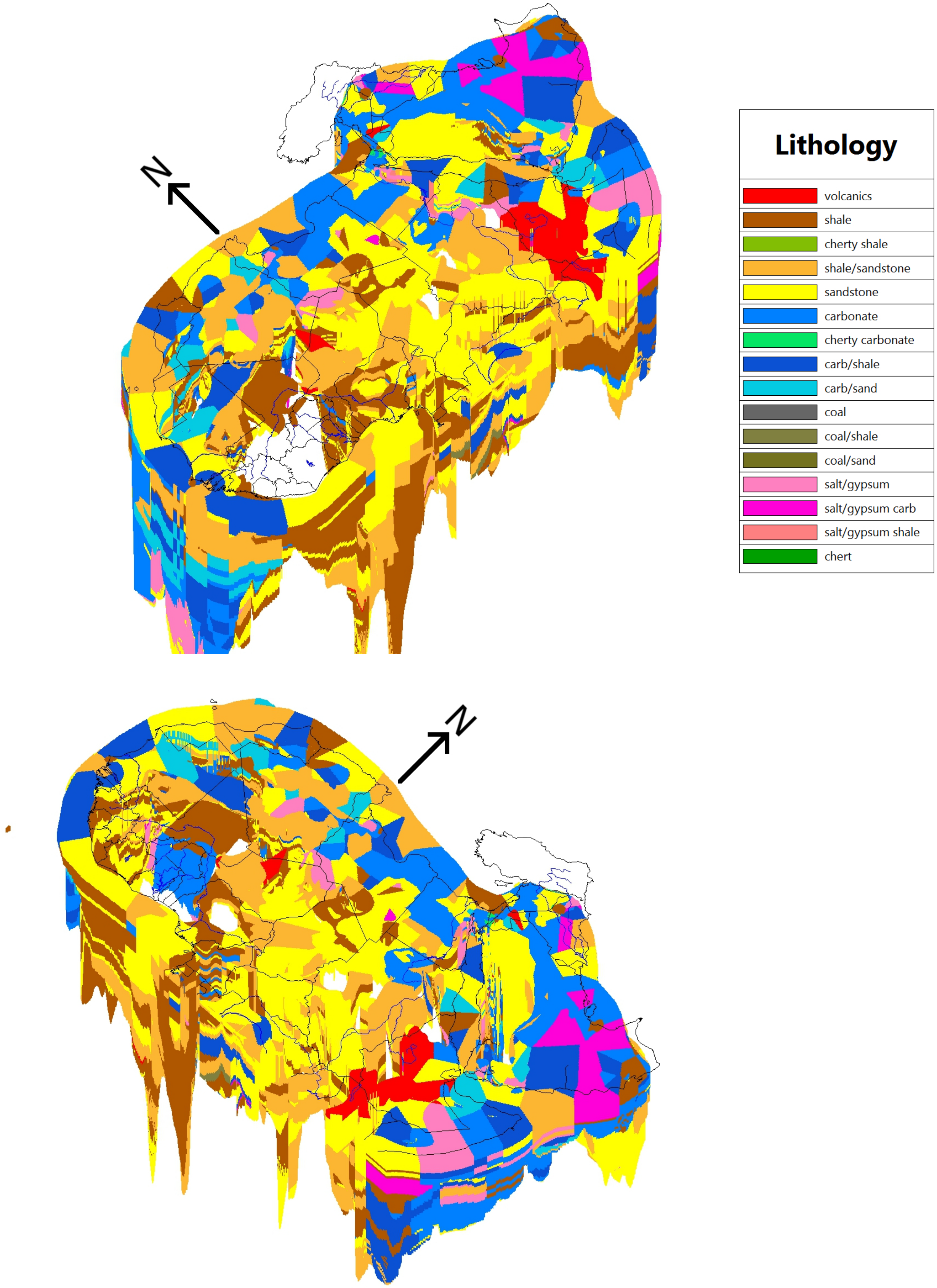

Figure 6. Three-dimensional lithological model of North Africa (above the Equator only) showing all six megasequences, viewed from 225 degrees and 135 degrees and 30 degrees from horizontal. Note Turkey is shown blank as it was not part of this study to date. Vertical exaggeration approximately 540x. © 2017 Institute for Creation Research. Used by permission.

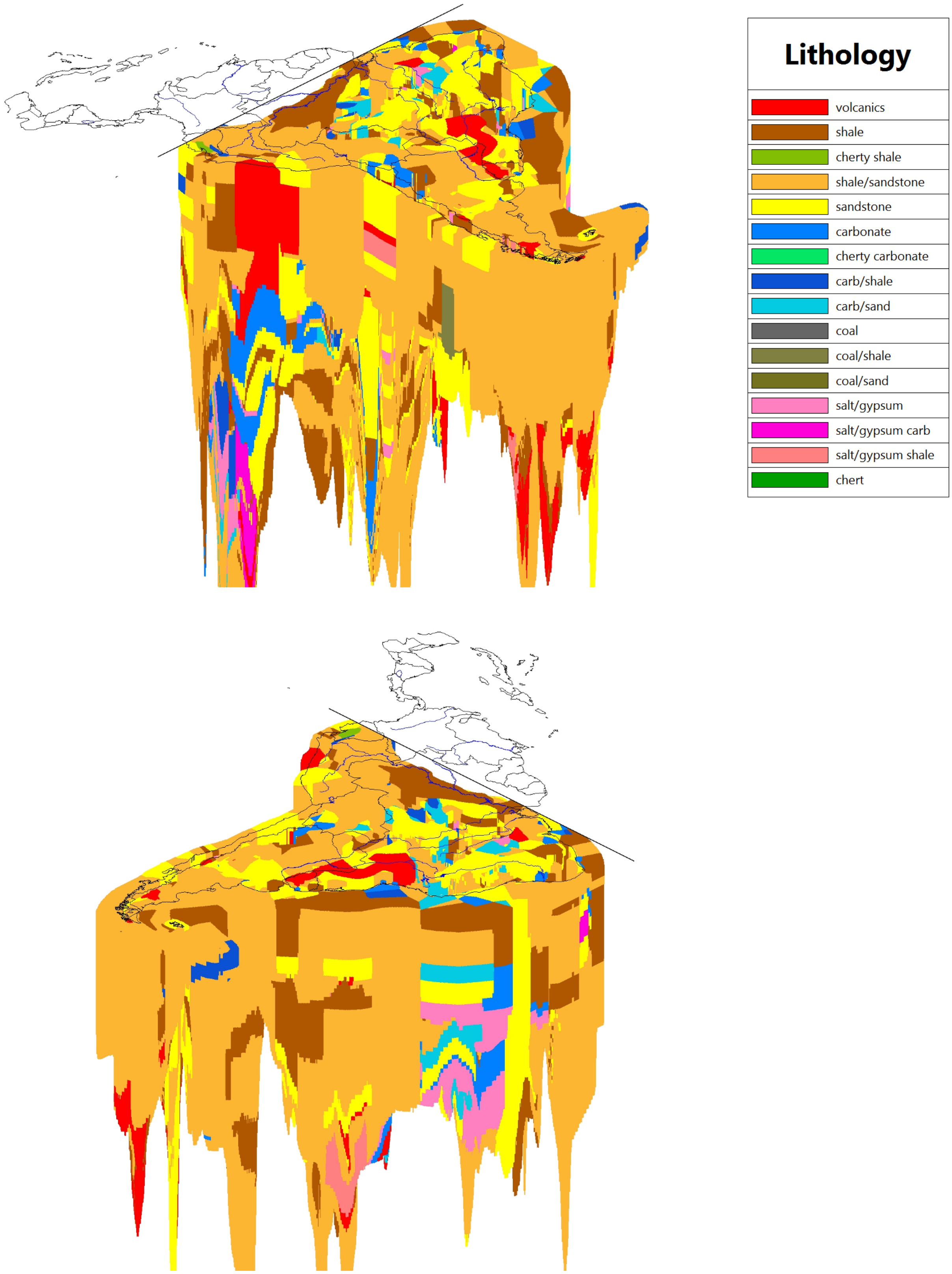

Figure 7. Three-dimensional lithological model of South America (south of the Equator only) showing all six megasequences, viewed from 225 degrees and 135 degrees and 30 degrees from horizontal. Vertical exaggeration approximately 450x. © 2017 Institute for Creation Research. Used by permission.

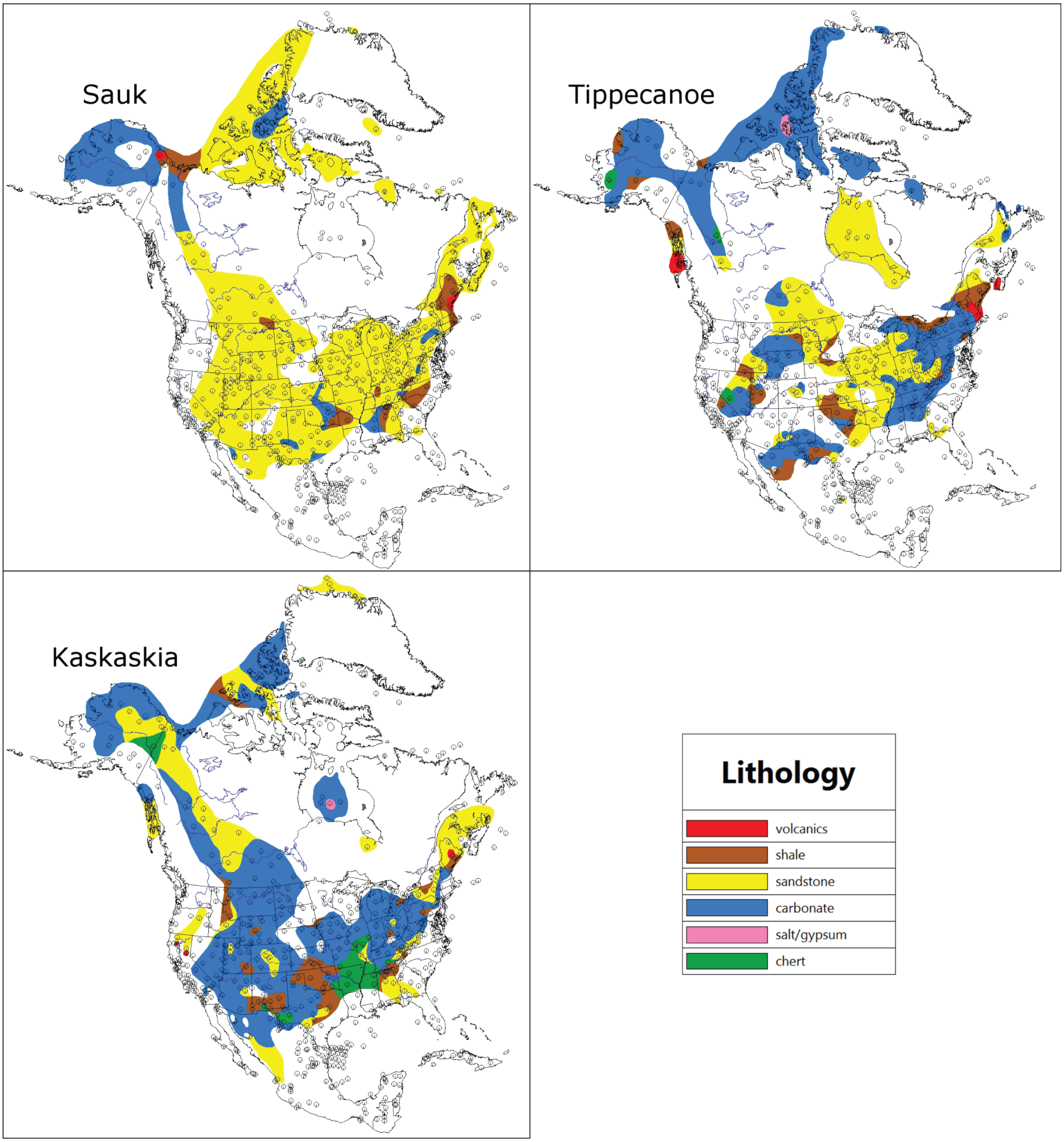

Figure 8a. Basal lithology maps for the Sauk, Tippecanoe, and Kaskaskia megasequences for North America. © 2017 Institute for Creation Research. Used by permission.

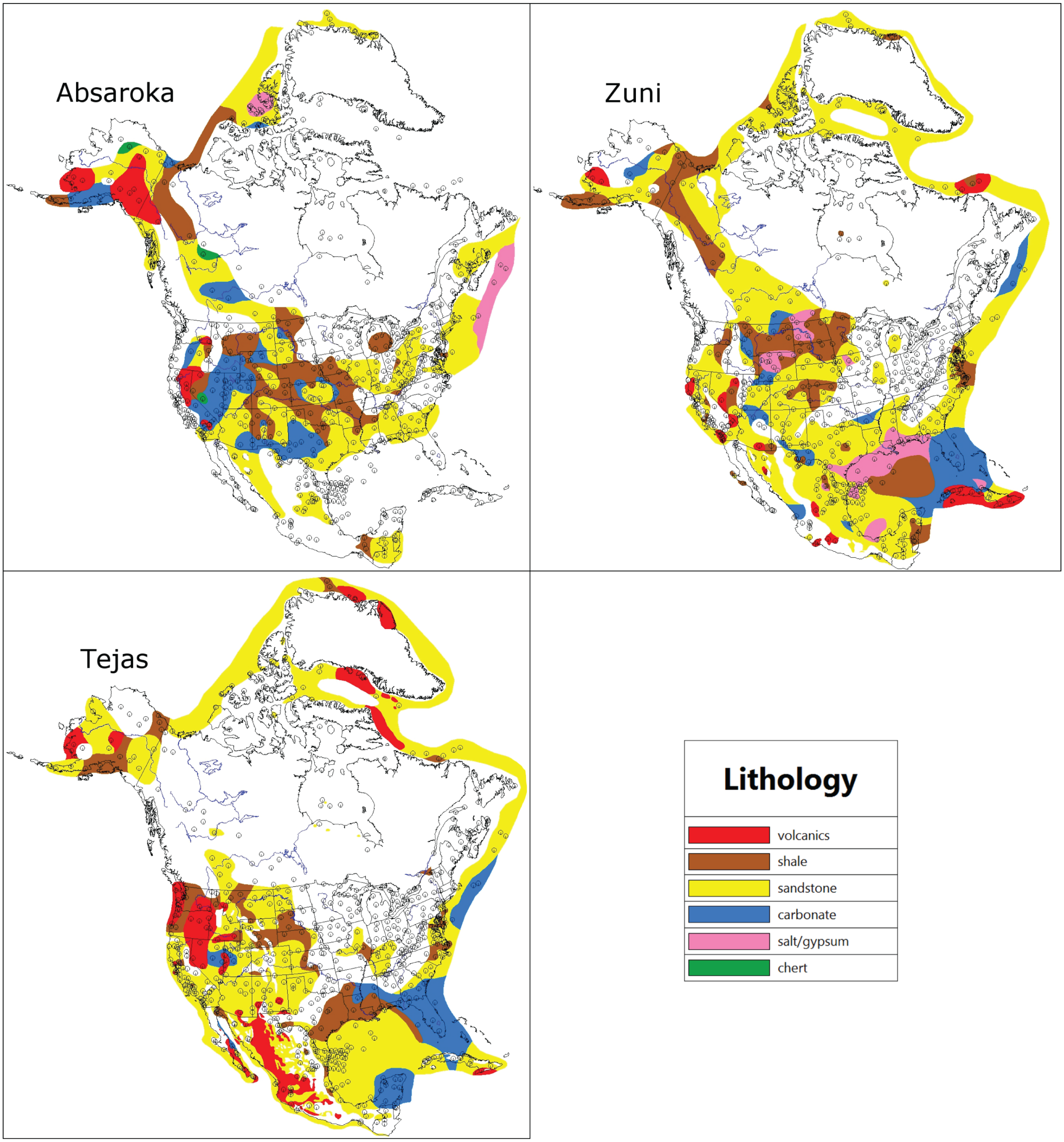

Figure 8b. Basal lithology maps for the Absaroka, Zuni, and Tejas megasequences for North America. © 2017 Institute for Creation Research. Used by permission.

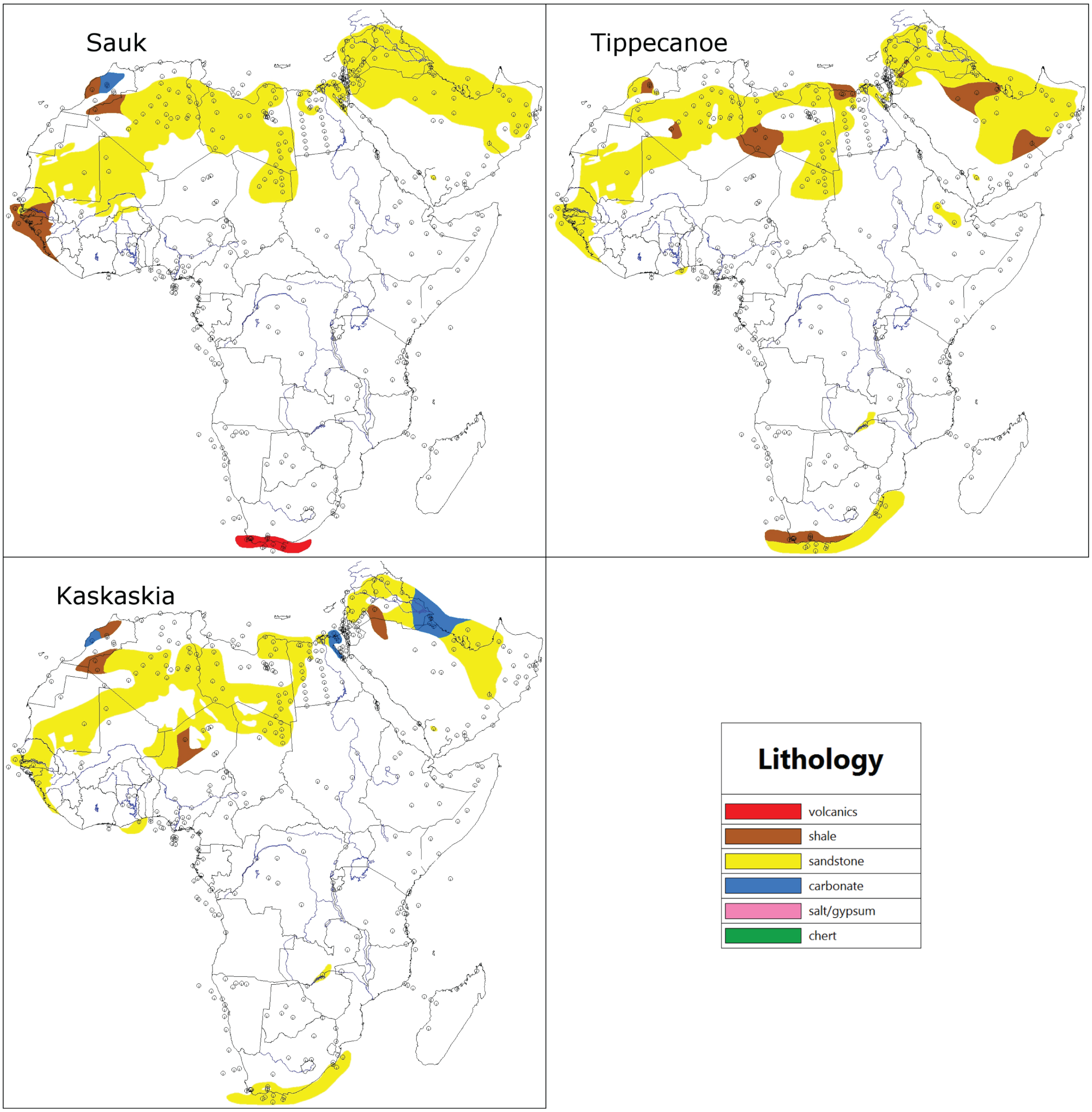

Figure 9a. Basal lithology maps for the Sauk, Tippecanoe, and Kaskaskia megasequences for Africa. © 2017 Institute for Creation Research. Used by permission.

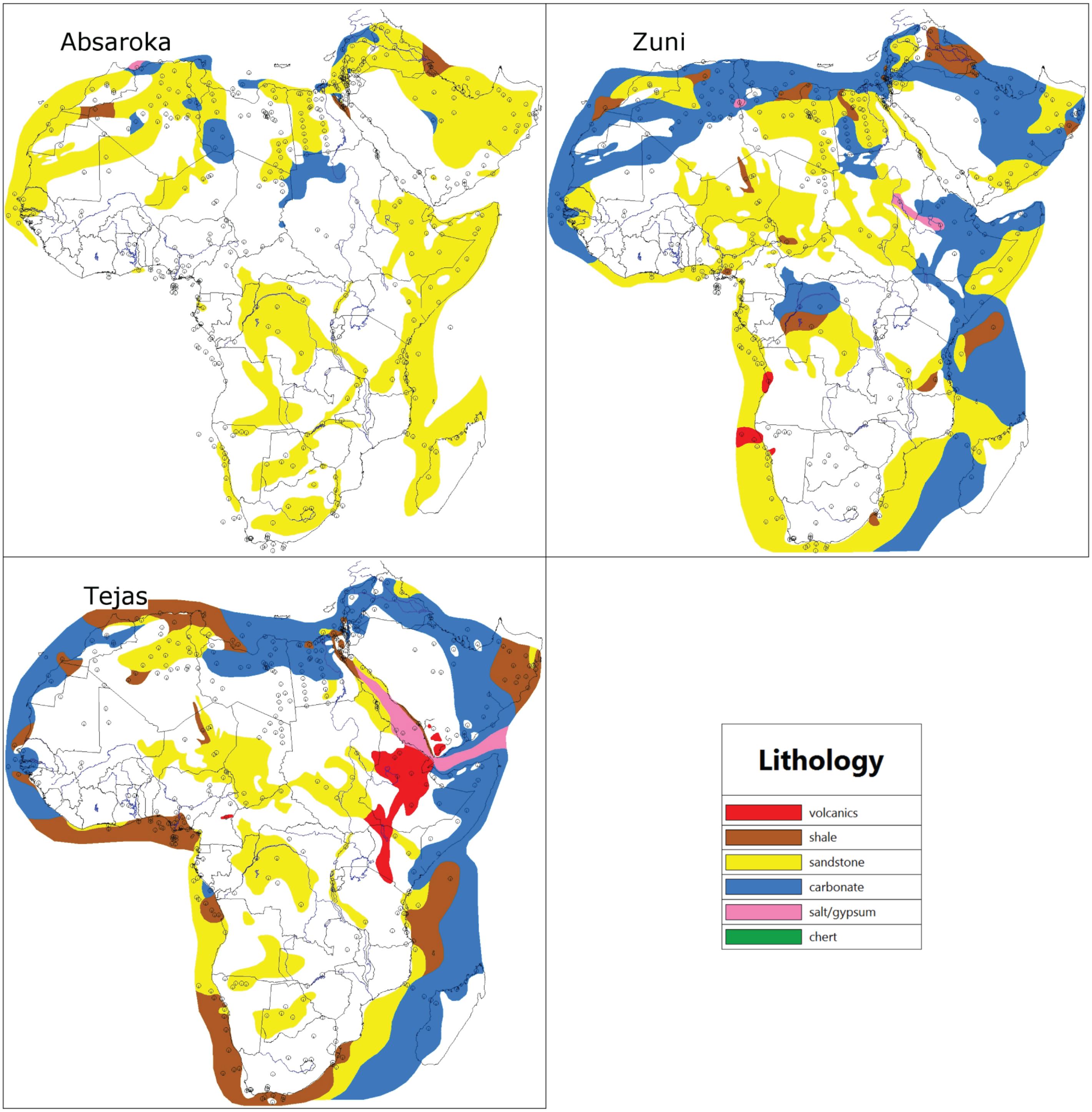

Figure 9b. Basal lithology maps for the Absaroka, Zuni, and Tejas megasequences for Africa. © 2017 Institute for Creation Research. © 2017 Institute for Creation Research. Used by permission.

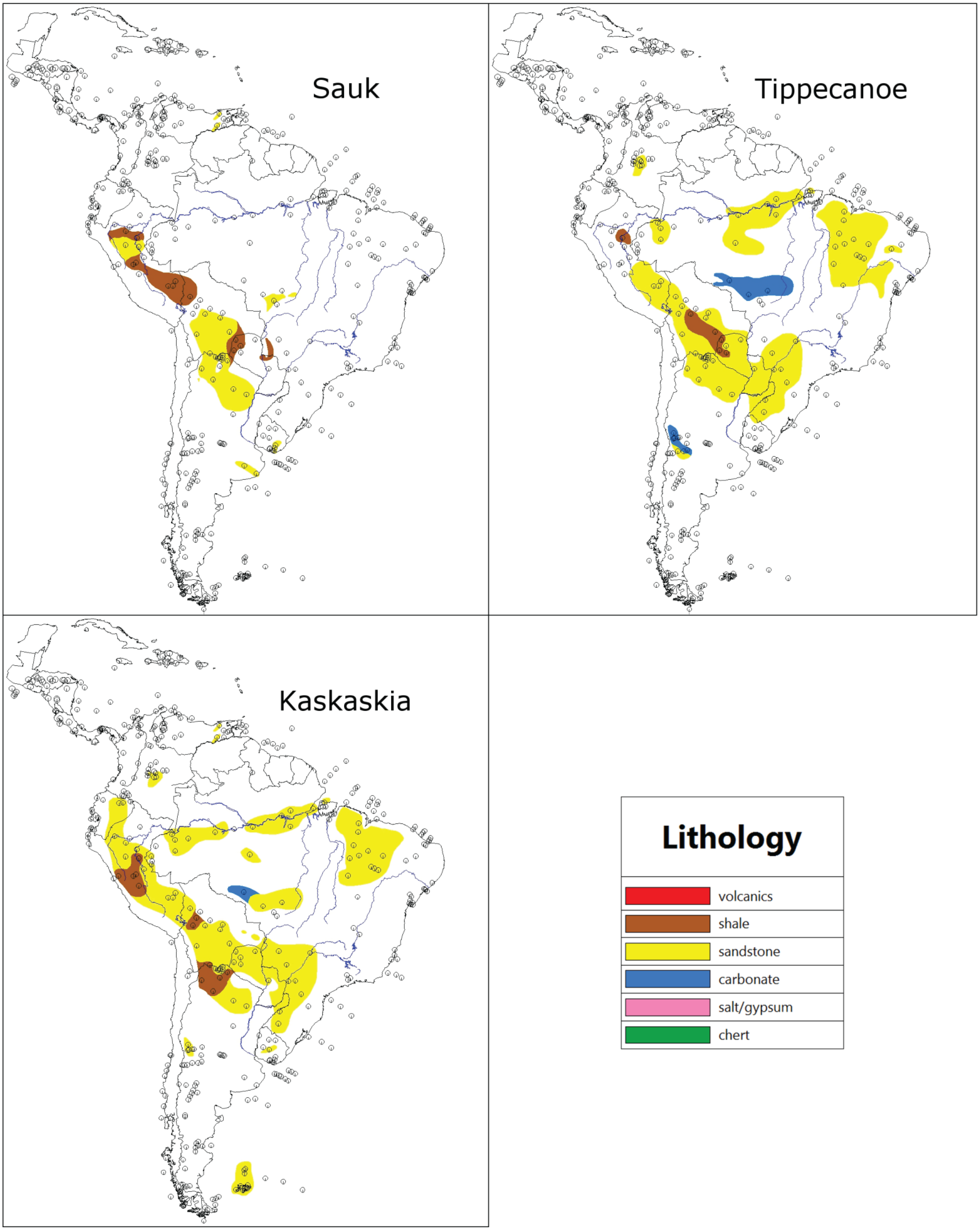

Figure 10a. Fig. 10a. Basal lithology maps for the Sauk, Tippecanoe, and Kaskaskia megasequences for South America. © 2017 Institute for Creation Research. Used by permission.

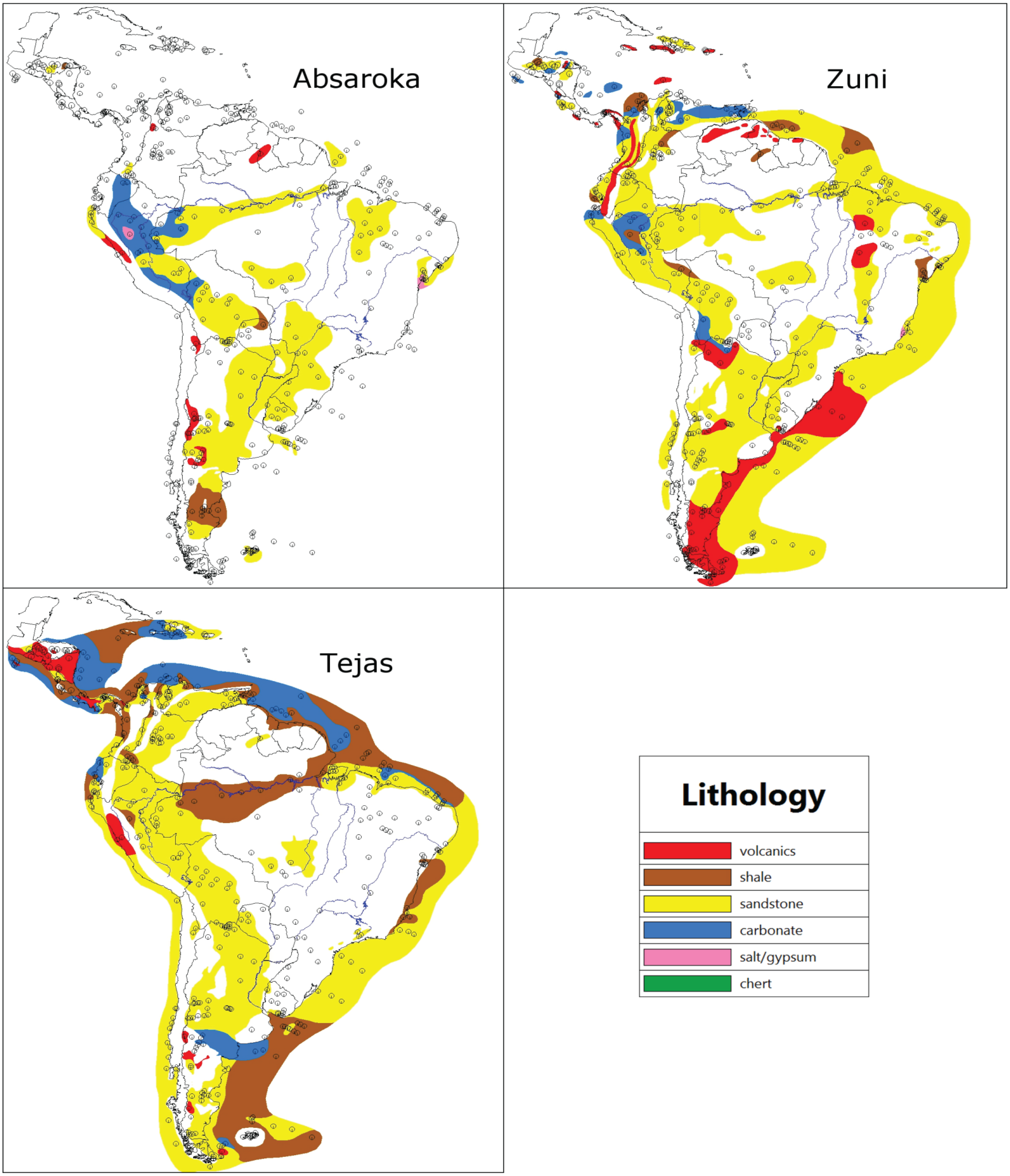

Figure 10b. Basal lithology maps for the Absaroka, Zuni, and Tejas megasequences for South America. © 2017 Institute for Creation Research. Used by permission.

traceable sandstone lithology (Morris 2012) (Fig. 8a). The St. Peter Sandstone is confined to the midsection of the North American continent only. That is not to say it was not extensive. There is still a correlative sandstone layer from Canada to Texas, and Montana to West Virginia (Fig. 8a). In addition, Figure 8a shows that a rather vast basal Tippecanoe limestone layer extends from Alaska to Greenland and another vast limestone layer can be correlated across much of the Appalachian Mountains region.

The basal Tippecanoe sandstone is again found across North Africa and the Middle East, in similar location and extent as the Sauk sandstone (Fig. 9a). We were able to correlate this second basal sandstone layer across South America also, and like the Sauk, it was most prominent along the western edge of the continent. However, the extent of this basal sandstone in SA increased as it also spread across the parts of the Amazon Basin and further south into Paraguay and southernmost Brazil (Fig. 10a).

The Kaskaskia megasequence extends from the Devonian to the top of the Mississippian System (Fig. 2). This megasequence contains the most extensive basal layer of carbonate rock, although this seems to be unique to North America (Fig. 8a). However, some basal sandstone was deposited in western Canada and along the East Coast of the USA. This basal carbonate layer is as extensive as the basal Sauk sandstone across the North American Continent. It can be correlated from Canada south to New Mexico and Texas and northeastward to Michigan and Pennsylvania. In addition, part of the basal Kaskaskia is composed of chert-rich beds. These extend across Arkansas and up to Illinois. More chert-rich rocks found in multiple columns at the base of the megasequence are found in West Texas and even Alaska (Fig. 8a). Admittedly, chert beds are not unique to the base of the Kaskaskia, but those found at the base in these locations add strength to these correlations at least regionally.

The basal Kaskaskia is again, primarily a blanket sandstone bed that is spread across all of North Africa and the Middle East, following nearly the same extent as the earlier Sauk and Tippecanoe basal sandstone beds (Fig 9a). These three basal sandstones collectively allow readily verifiable correlations of stratigraphic columns across this heavily oil and gas productive region.

The basal Kaskaskia sandstone bed across South America is more extensive than that exhibited by the earlier two megasequences (Fig. 10a). The basal Kaskaskia sandstone layer extended to northeastern Brazil and was more continuous across the Amazon Basin than earlier megasequences. This additional extent likely reflects a higher water level was achieved at this point across SA during the Flood.

The Absaroka megasequence extends from the Pennsylvanian System to the Lower Jurassic System (Fig. 2). This megasequence marks a major shift in depositional pattern in North America (and the globe) and initiated the renewal of siliciclastic deposition across North America (Fig. 8b). The basal layer is predominantly sandstone and shale, but significant deposits of volcanic rocks also mark some locations along the West Coast and Alaska (Fig. 8b). These volcanic rocks are part of the subduction and accretion process that initiated along the Western Cordillera during the Absaroka megasequence. This megasequence also recorded the opening of the Atlantic Ocean on the East Coast, the split from Africa, and the formation of a new passive margin.

The basal Absaroka megasequence in Africa also reflects a major shift in areal extent (Fig 9b). Although a similar blanket sandstone layer is again found across North Africa and the Middle East, we now see a new, vast sandstone layer has extended across much of southern Africa as well (Fig. 9b). This represents rocks of the Karoo Supergroup. The result is a single sandstone layer, correlative from column to column at the base of the Absaroka, across most of the continent of Africa.

In South America, the basal Absaroka also reflects much more coverage for this megasequence compared to all earlier megasequences (Fig 10b). The basal blanket sandstone extended down the length of Argentina and increased its coverage in Brazil. A regional basal Absaroka carbonate layer was also identified and correlated across much of Peru (Fig. 10b).

The Zuni megasequence extends from the Middle Jurassic to the lowermost Paleogene System (post Cretaceous) (Fig. 2). This megasequence continued the dominance of siliciclastic deposition across western North America, with a slight shift in pattern to the northern Rocky Mountains and Canada. The Zuni deposits also buried the last of the dinosaurs. The basal Zuni layer is predominantly sandstone and shale, but shifted to extensive salt deposition in the northern Gulf of Mexico (GOM) (the Louann salt) and the southernmost GOM (Fig. 8). Siliciclastic deposition continued to spread across the passive Atlantic margin, recording the timing of the split of Greenland and Canada. Although the Appalachian uplift seems to have prevented extensive deposition across the eastern states, there are limited Zuni deposits preserved in the Illinois and Michigan Basins and remnants near Hudson Bay.

According to Clarey and Werner (2017, 2018) the Zuni megasequence not only exhibits the maximum coverage across North America, it also documents a sharp increase in volume of the total amount of sedimentary rocks. In fact, excluding the volcanic rocks, this megasequence has the maximum volume of sedimentary rocks preserved across North America (Clarey and Werner 2017, 2018).

The basal Zuni also reflects changes in the level and type of coverage across Africa (Fig. 9b). We again observe that the maximum areal coverage occurred during the Zuni across the African continent and the maximum volume of sediment also (Clarey and Werner 2017, 2018). A blanket sandstone layer was deposited across the center (Niger and Nigeria) and southern sections of Africa at the onset of this megasequence. An extensive, basal Zuni carbonate blanketed North Africa, the Middle East and East Africa (Fig. 9b). In fact, carbonate deposition was nearly continuous through much of the Zuni megasequence across parts of North Africa.

In South America, the basal Zuni megasequence spread a basal blanket sandstone layer across much of the continent and even offshore to the east (Fig. 10b). Offshore to the southeast a substantial amount of lava and volcanic rocks were deposited in the basal Zuni megasequence. These rocks likely reflect the split of SA from Africa that occurred during the Zuni. Clarey and Werner (2017, 2018) also found this megasequence to contain the maximum volume of sediment and the maximum coverage of the continent.

The Tejas megasequence extends from near the base of the Paleogene System to the top of the Neogene (Fig. 2). This megasequence documents another shift in depositional pattern in North America (Fig. 8b). The uplift of the Rocky Mountains shed millions of km^3 of shale and sandstone across the Western States. A notable shift in drainage to the south during the early Tejas (Blum and Pecha 2014) also poured tremendous amounts of siliciclastics into the GOM, including the basal Tejas Whopper Sand (Wilcox), which covers the deep, central GOM with a blanket sand exceeding 300 m in thickness (Clarey and Werner 2018). Siliciclastic deposition continued to spread across the continental shelf along much of the Atlantic seaboard, offshore northern Canada and Greenland. Few deposits were preserved in the eastern USA and across Canada, other than offshore.

The basal Tejas in Africa again shows a fairly extensive sandstone deposit across the center of the continent (Fig. 9b). And a blanket of continuous carbonate deposition still dominated North Africa and offshore East Africa during the Tejas, as observed in the preceding Zuni megasequence. Figure 11 shows the carbonate deposition across major portions of North Africa never ceased throughout the entire Zuni and through the entire record of the Tejas. This continuous deposition of marine, carbonate rock continued all the way up from the Cretaceous system to the top or middle of the Miocene in many countries like Libya, Iraq, Iran, southeast Turkey, Qatar and Oman (Fig. 11 and Kendall *et al*. 2014).

Interestingly, the stratigraphic columns in the Red Sea record 3000 m of continual salt deposition starting at the base of the Tejas. Oil geologists from Aramco claim there are areas with even thicker salt (up to 5000 m) in the Red Sea (personal communication, 2016). This extensive salt deposit marked the split of the Saudi Arabian Peninsula from the Horn of Africa during the Tejas megasequence. It also suggests that this area was still under marine influence like much of North Africa during the salt deposition.

The Tejas megasequence across South America shows an extensive sandstone layer running the length of the continent and east of the Andes Mountains (Fig. 10b). It is likely this deposit was from sediment eroded off the uplifting mountains and shed eastward, similar to the deposits in the Tejas east of the Rocky Mountains

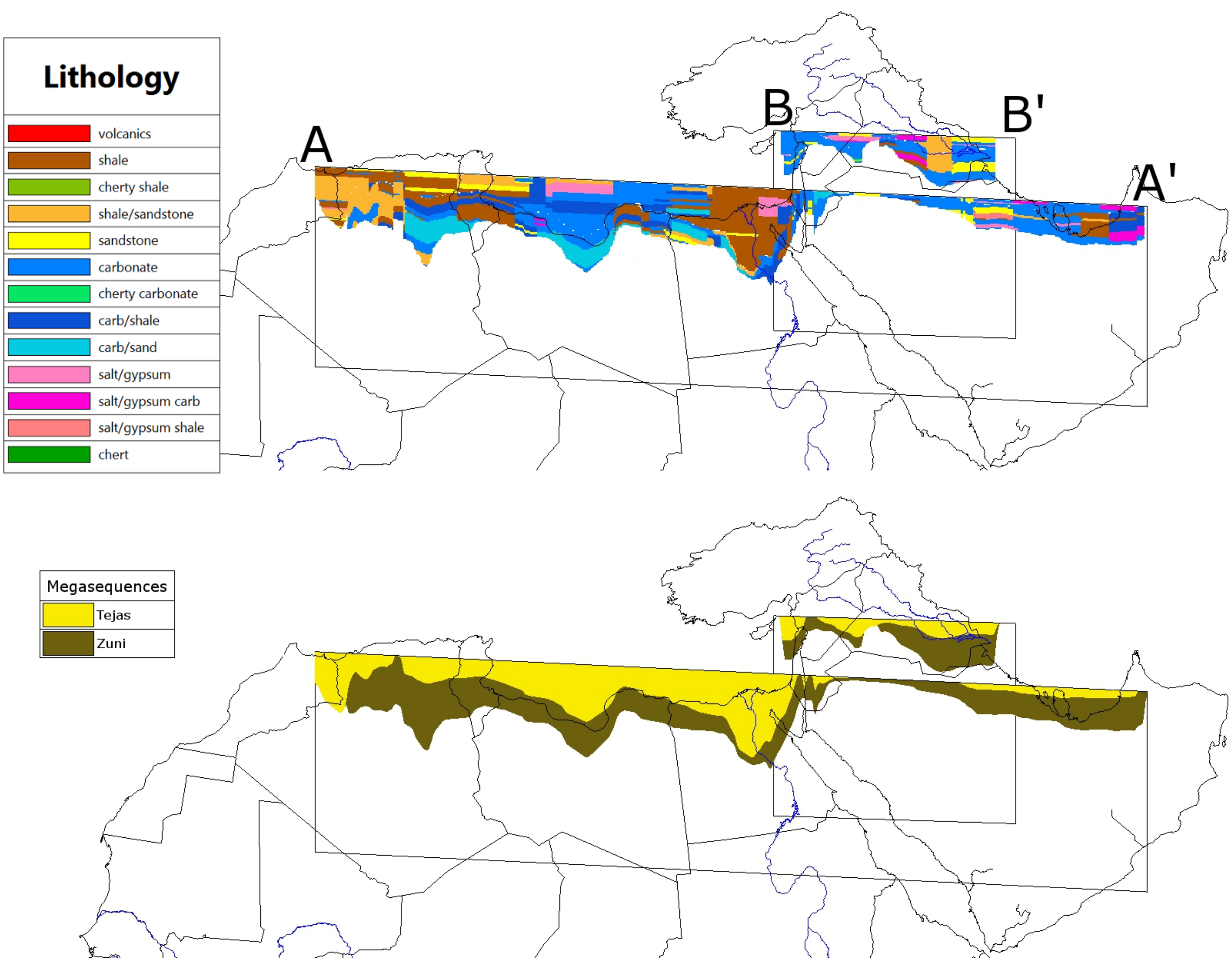

Figure 11. Stratigraphic sections A-A’ and B-B’ showing the lithology (upper) and the megasequences (lower) across North Africa and the Middle East. Note the carbonate rocks (in blue) in the Zuni megasequence extend upward continually to the top of the Tejas in many locations on the section. The uppermost Tejas in this area is primarily Miocene and commonly contains salt (in pink) deposits associated with the Mediterranean region. © 2017 Institute for Creation Research. Used by permission.

in North America at the same time. Extensive sandstones are also found along large segments of the offshore shelf regions of SA. Areas of extensive shale and/or carbonate deposition also dominated the basal Tejas in the Amazon Basin and along the northeast and extreme southeast parts of the offshore, including the Caribbean.

C. Distinctive layers of unique lithology and characteristic

Although not visible in the large, continent-scale 3-D lithology models, there are extensive chert beds at the base of the Kaskaskia megasequence (Fig. 12) and salt beds within the Tippecanoe (Fig. 13) across large segments of North America. These unique lithologic units allowed correlation from column to column, and verified and confirmed the megasequence boundaries surfaces and the correlations of their respective basal sandstones.

Stratigraphic section C-C' (Fig. 14) shows the salt and gypsum rocks (Salina) within the Tippecanoe megasequence. Note how the salt layer correlates to the same level within the Tippecanoe from column to column, from Michigan to New York. These units independently confirm and validate the correlation of the megasequence boundaries.

Stratigraphic section D-D' (Fig. 15) shows chert-rich layers within the Kaskaskia at the base of the megasequence from Arkansas to Illinois. As noted above, there are additional chert-rich layers at different stratigraphic levels elsewhere also. However, the consistency of these chert-rich layers at the base of the Kaskaskia and at the top of the Tippecanoe megasequence strengthens the correlation of the basal Kaskaskia boundary, independent of fossil content.

We also correlated several recognizable and regionally extensive Zuni rock formations, like the Morrison Formation (Fig. 16) and the Pierre Shale (Fig. 17) that extend across numerous states. We also found that the Ordovician Utica Shale (Tippecanoe) and several Devonian shales (Kaskaskia) extend for 100s of kilometers along the western flank of the Appalachians (Marcellus Shale and Chattanooga Shale). Between these units and the chert and salt-rich rocks, we were able to verify the correlations independent from the sequence boundaries and from any reference to fossils. And the results showed a remarkable match. Each of the semi-regional and distinctive rock units correlated consistently within the same relative section within the megasequence boundaries.

Correlations of the Morrison Formation and the Pierre Shale (including individual bentonite-rich beds, Bertog et al. 2007) across the American West confirmed and validated the Zuni megasequence boundaries as they also are found in the same relative locations within the megasequence. The Morrison Formation is always near the base of the Zuni megasequence and the Pierre Shale is always near the top. Each of these units can be recognized in the field and well bores by their unique characteristics and even electric log signals. In addition, many of the Cretaceous system (Zuni) shales found across the American West have unique highly radioactive well log signals that also allow correlation across vast regions. These units also fall in the same relative locations within the Zuni megasequence, not cutting up or down within the megasequence. All of these aforementioned correlations are independent of any fossil content. These rocks are as empirical and factual as any data set.

2. Fossil patterns in the megasequences

Although the intent of this study was to examine the validity of the megasequences independent of fossil content, we found that indeed, the fossils also reflect a pattern and can be used as additional correlation tools just as geologists have been doing since the days of William Smith in the early 19th Century in England (Ross 2014).

The first three megasequences (Sauk, Tippecanoe, Kaskaskia) contain about 99% marine fossils and are limited to select locations on the present-day continents (Clarey and Werner 2017). By the fourth megasequence (Absaroka), fossils of terrestrial flora and fauna became deposited in significant amounts, although mixed with marine organisms. Globally, the Absaroka megasequence contains the first massive coals and large clastic deposits were observed to spread across much more of the continents. The Zuni deposition (5th megasequence) shows the most extensive coverage of the continents. This megasequence contains the last of the dinosaur fossils and reflects a major shift in flora and fauna.

DISCUSSION

Our multi-continent study demonstrates that megasequences are related to major changes in the global sedimentary pattern. In addition they record major shifts in the global fossil record. In fact, many of the claimed largest mass extinction horizons correlate closely with the highest water levels of each megasequence cycle (Snelling 2017) (Fig. 18, p.157, Clarey 2015). Flood geologists dispute that these represent true extinction events however, and instead, interpret them as abrupt changes in the types of fossils deposited during the Flood year. In this regard, it is no surprise a connection is observed between megasequences and the fossil record as both reflect sudden shifts in depositional pattern, including water volume and energy.

The fossil pattern observed across three continents is best explained by the systematic flooding of progressively higher and higher elevations of the pre-Flood continents as described in Genesis 7 (Clarey and Werner 2018). As water levels increased and coverage became more extensive, the observable pattern of fossils changed accordingly. We observe the same progressive pattern across each of the three continents in this study. In fact, one could build an independent geologic column on each of the three continents. Comparison of these would result in essentially the same 'global' column across each continent.

The lowermost extensive Flood sediments (Sauk megasequence) contain the same fossil taxa on each continent. And each subsequent megasequence on top of the Sauk contains the same fossil taxa, and in the same order on all three continents. This is the very basis for the Principle of Faunal Succession; the recognition of a global pattern of fossils that abruptly changes with deposition of subsequent sedimentary layers. Macro-evolution is not observed as the fossils merely appear and disappear in the order of burial in the rock record.

The extent of the Sauk, Tippecanoe and Kaskaskia megasequences across North America, Africa and South America are shown in Figures 8a, 9a and 10a, respectively. Note that the majority of the basal rock types in each of the megasequences are sandstone layers.

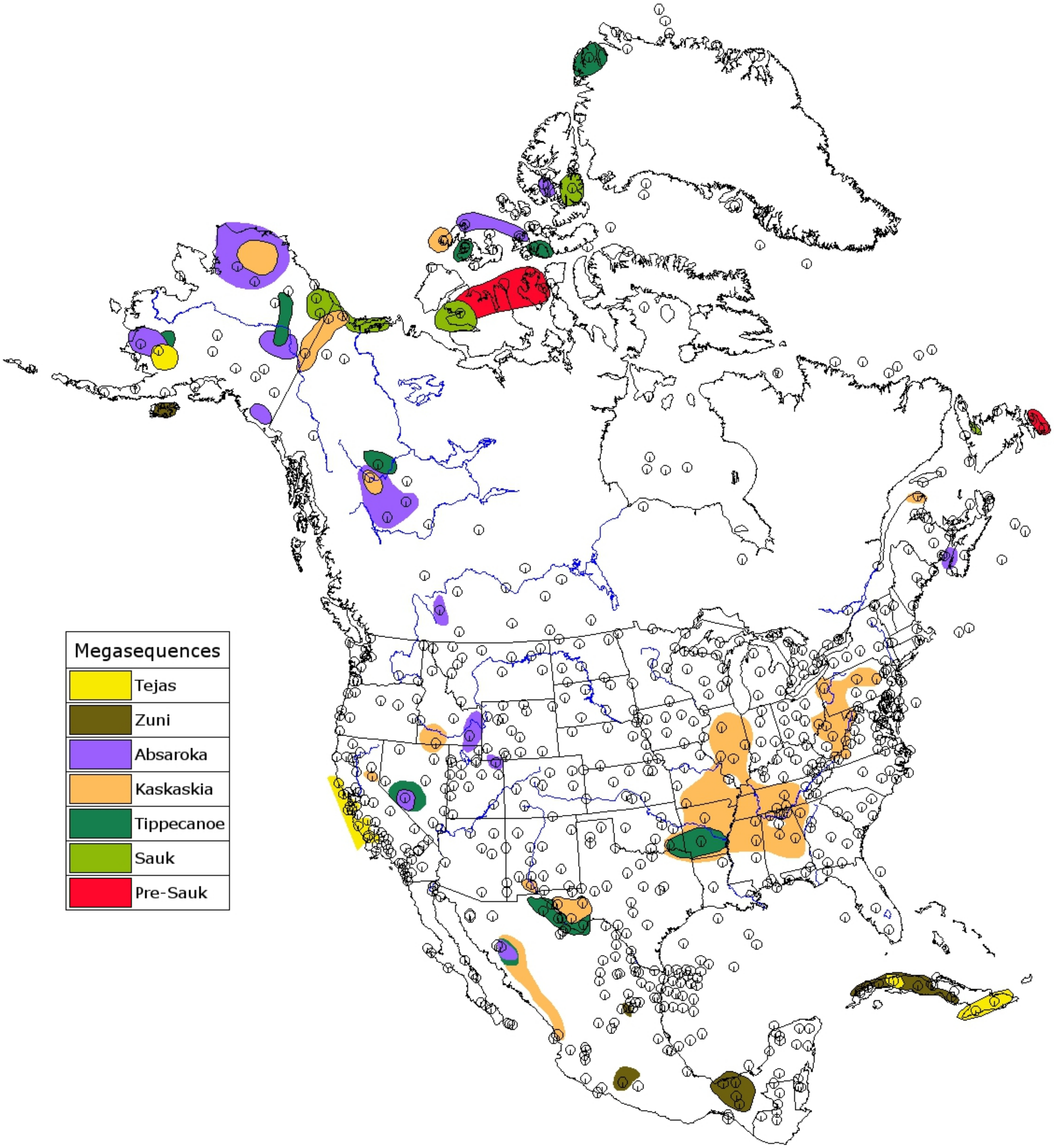

Figure 12. Chert-rich rock map for North America by megasequence. © 2017 Institute for Creation Research. Used by permission.

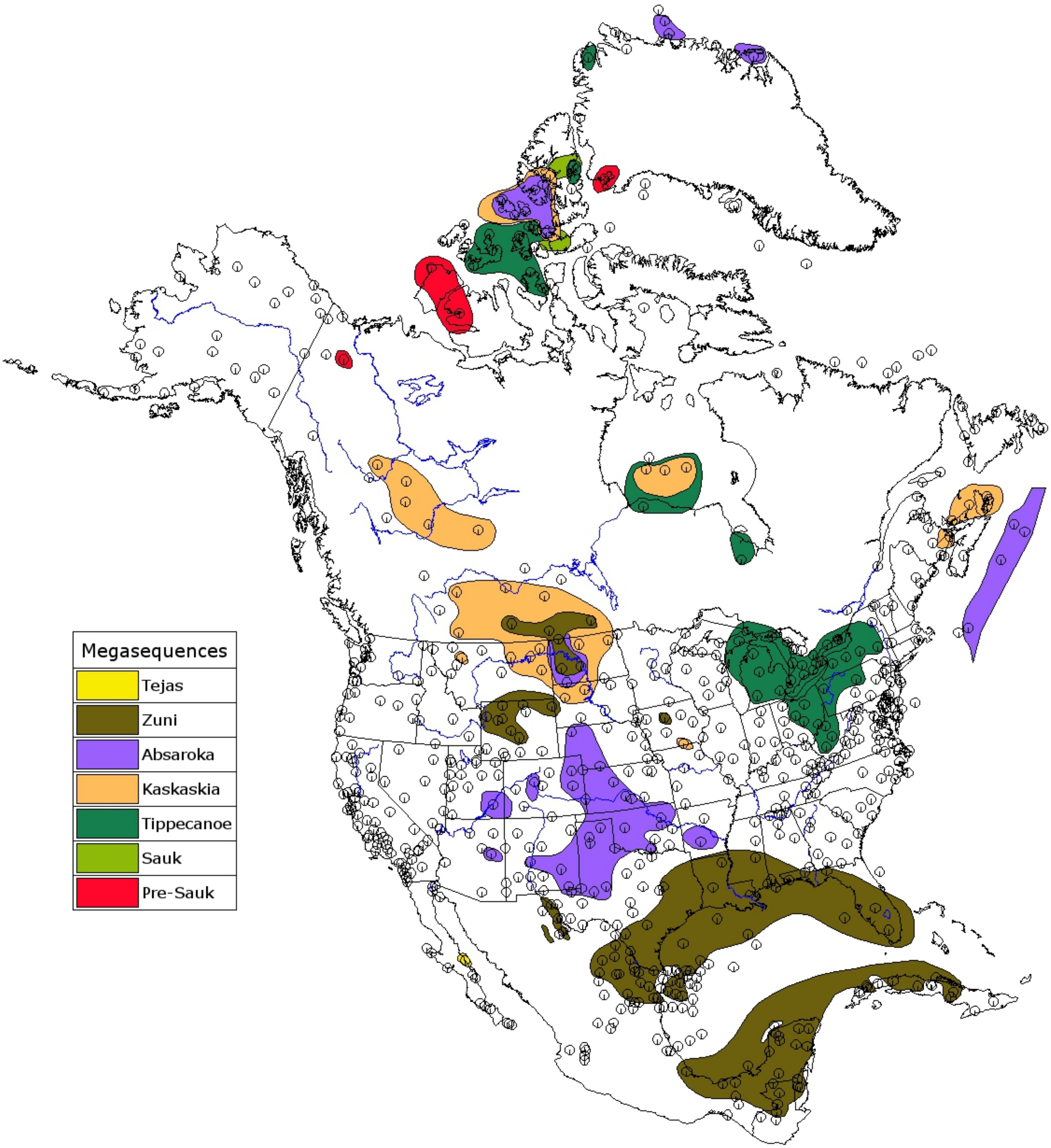

Figure 13. Salt/gypsum map for North America by megasequence. © 2017 Institute for Creation Research. Used by permission.

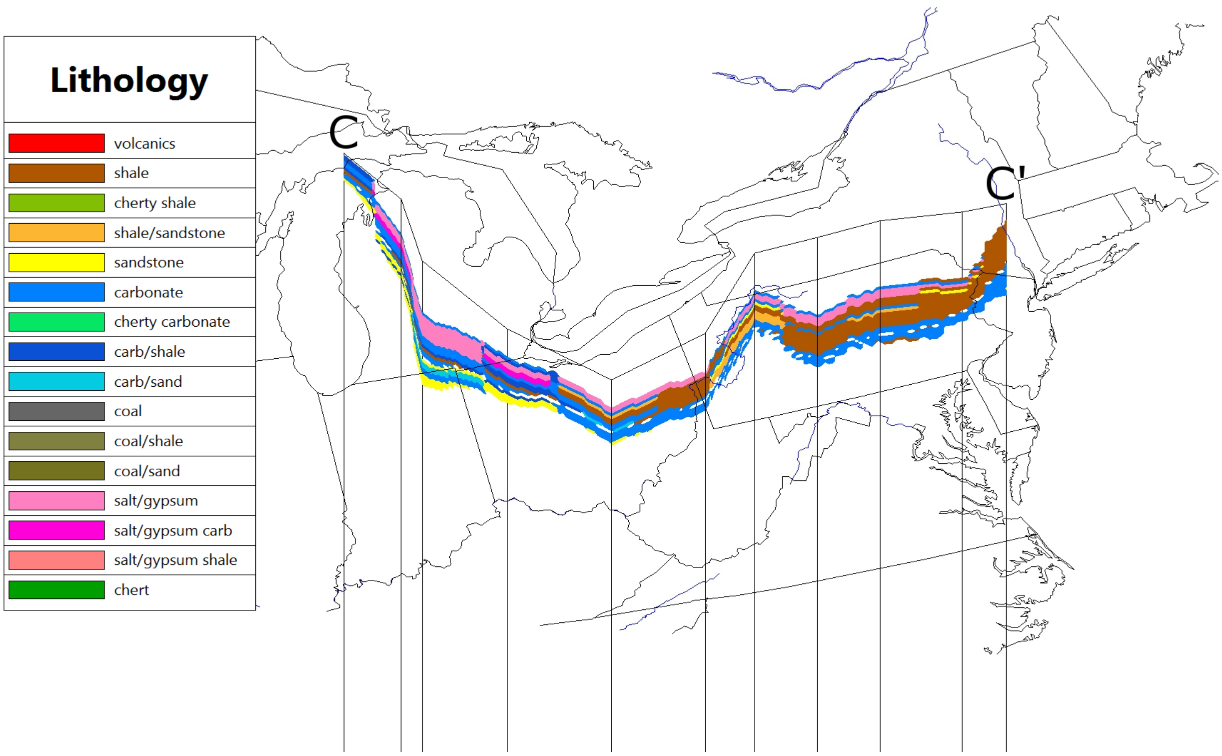

Figure 14. Stratigraphic section C-C' from Michigan to New York showing the lithology of theTippecanoe and Sauk megasequences. Note the pink-colored, salt/gypsum-rich layers (Tippecanoe) are continuous from column to column and remain in the same relative position between the megasequence boundaries. Also, note the basal Sauk sand is continuous across Michigan, Ohio and New York, but is too thin to see past Ohio. © 2017 Institute for Creation Research. Used by permission.

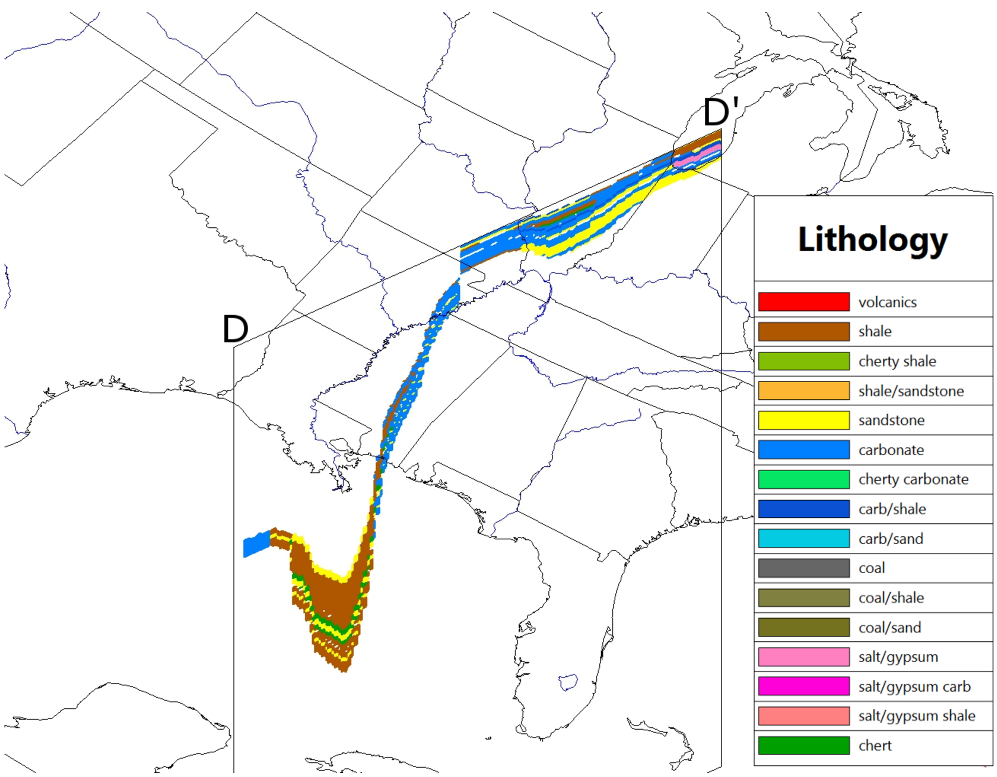

Figure 15. Stratigraphic section D-D' from East Texas to Lake Michigan showing the lithology of the Sauk, Tippecanoe and Kaskaskia megasequnces. Green-colored, chert-rich layers at the base of the Kaskaskia and top of the Tippecanoe megasequences are continuous from column to column and remain in the same relative position at the megasequence boundary. © 2017 Institute for Creation Research. Used by permission.

These basal sandstone layers are easily correlated across vast areas of the continents, helping to confirm the identification of the megasequence boundaries. In contrast to the other two continents however, North America has much more extensive carbonate rock in the lowermost Tippecanoe and Kaskaskia layers (Fig. 8a). The reason for this is not fully clear. Indeed, we do observe a carbonate layer in the uppermost Sauk across much of North America (Muav Limestone and equivalent). It may be that the Flood waters did not fully drain off of the North American continent at the end of the Sauk megasequence. This may have allowed continual carbonate deposition along the edges of the continent from the upper Sauk through the earliest Tippecanoe transgression. A similar process may have then repeated in the Kaskaskia where an even more extensive carbonate layer was deposited at the onset of the third megasequence (Fig. 8a). This also may imply that the Flood waters drained off even to a lesser degree at the end of the Tippecanoe, resulting in continual carbonate deposition through the onset of the Kaskaskia transgression.

Africa (Fig. 9a) and South America (Fig. 10a) preserve much less extensive deposits of the Sauk, Tippecanoe and Kaskaskia megasequences compared to North America. These two continents apparently experienced much less Flooding at this juncture of the Flood (Clarey and Werner 2017). Indeed, each of the first three megasequences across Africa and South America stack one on top of the other fairly uniformly. This is especially noticeable across North Africa where nearly identical locations are blanketed again and again, by the Sauk, Tippecanoe and Kaskaskia (Fig. 9a). The similar extent of each of these first three megasequences also argues against erosion as the major factor explaining their present distribution. Erosive processes would tend to leave more randomly distributed remnants and not the consistency that is observed (Clarey and Werner 2017). These first three megasequences likely represent the earliest and lowest Flood levels (Clarey and Werner 2017) and were deposited in areas that were possibly pre-Flood shallow seas (Clarey and Werner 2018).

Figures 8b, 9b and 10b show the Absaroka, Zuni and Tejas basal rock types and their present extent across North America, Africa and South America, respectively. Again, there are extensive basal sandstones that can be correlated at the base of the Absaroka across the central African and South American continents (Fig 9b and 10b). These blanket sandstones also allow easy correlation of the latter three megasequence boundaries across vast areas of the continents. And again, North America seems to be a bit of an exception as it contains a mixed sandstone and shale lithology at the base of the Absaroka, Zuni and Tejas megasequences (Fig. 8b). The reason for this difference is not immediately clear, but is possibly related to tectonic activity and/or subduction along the West Coast.

Figures 8b, 9b and 10b also detail the break-up of Pangaea as the Flood progressed. The first offshore sediments along the East

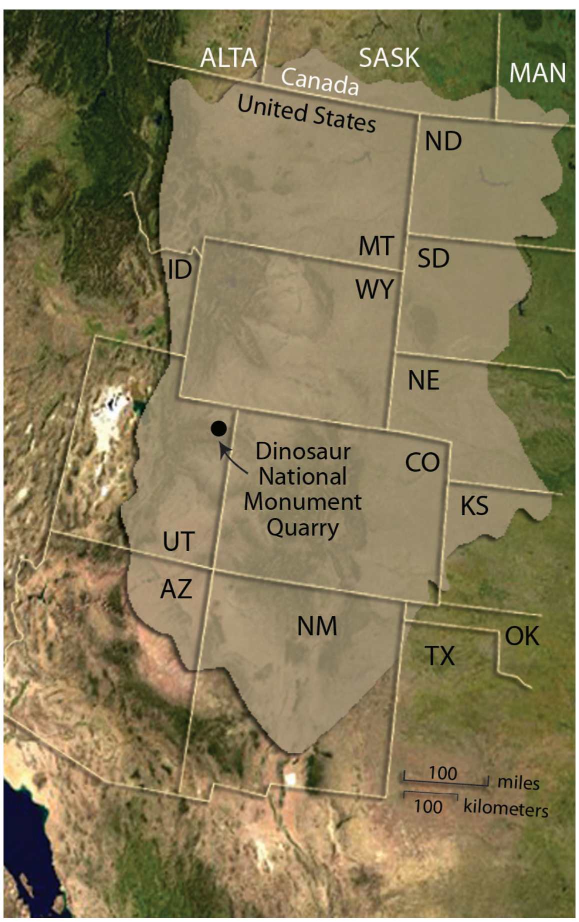

Figure 16. Map of the extent of the Morrison Formation across the American West (Zuni megasequence). Taken by permission from Morris (2012).

Figure 17. Map of the extent of the Pierre Shale across the American West (Zuni megasequence). Modified from St-Onge (2017) by Susan Windsor. © 2017 Institute for Creation Research. Used by permission.

Coast of North America and the West Coast of Africa appear in the Absaroka rock record (Figs. 8b and 9b), indicating the opening of the North Atlantic Ocean began at this time. Later in the Flood, during the time of Zuni deposition, the Southern Atlantic also began to form as sediments first appear off of eastern South America and southwestern Africa simultaneously (Figs. 9b, 10b). The split of Greenland from North America is also indicated by deposits that first appear offshore Greenland and Canada during the Zuni (Fig. 8b). And even the opening of the Red Sea is indicated by the abrupt appearance of a thick layer of salt during the Tejas (Fig. 9b).

The Absaroka also documents a dramatic shift from almost exclusively marine fossils in the first three megasequences to a more mixed land and marine fauna (Clarey and Werner 2018). This trend of more and more land animal fossils also continued upward through the deposition of the Zuni and Tejas (Clarey and Werner 2018). The increasing numbers of coal beds and land animal fossils, combined with more extensive sedimentation across the continents, all indicate that the Flood waters were likely impacting significant portions of the pre-Flood land surfaces during the deposition of the Absaroka megasequence (Clarey and Werner 2018). Figures 8b, 9b and 10b also indicate that the maximum Flood coverage of the continents was likely reached at the time of Zuni deposition. This is confirmed by the findings of Clarey and Werner (2017) who demonstrated that the global volume of sedimentation also peaked during the Zuni megasequence. Therefore, the Zuni is likely reflective of the Flood waters reaching and inundating the highest pre-Flood land elevations (Clarey and Werner 2018). For these reasons, we interpret the Zuni as the high water level of the Flood.

Figure 11 shows a nearly continuous carbonate layer, correlated across North Africa and the Middle East, indicating that the Flood waters likely never fully receded from these locations during the deposition of the entire Zuni interval. This is consistent with the above observations suggesting that the Zuni was the likely highest water level of the Flood.

Although not the intent of this paper, the findings from this study have implications for the Flood/post-Flood boundary. The record of continuous carbonate deposition from the Zuni through the Tejas in North Africa and the Middle East (Fig. 11) indicates that the Flood waters could not have receded fully from this area until the Late Miocene and possibly even later. The thick Tejas salt deposit in the Red Sea further supports that this area was still under marine influence also. This finding is similar to the conclusion reached by Snelling (2010) for Israel, but to a greater degree. Snelling (2010) documented continuous carbonate deposition from the Cretaceous through the Eocene in Israel, and accordingly, picked the Flood/post-Flood boundary in or atop the Oligocene. Our findings suggest a much more extensive and continuous cycle of carbonate rock was deposited across much of North Africa and the Middle East. In accordance with the conclusion of Snelling (2010), this would place the Flood/post-Flood boundary as high as the Miocene and possibly higher across the entire southern Mediterranean region. Incidentally, this is also the area just to the south of Turkey, which

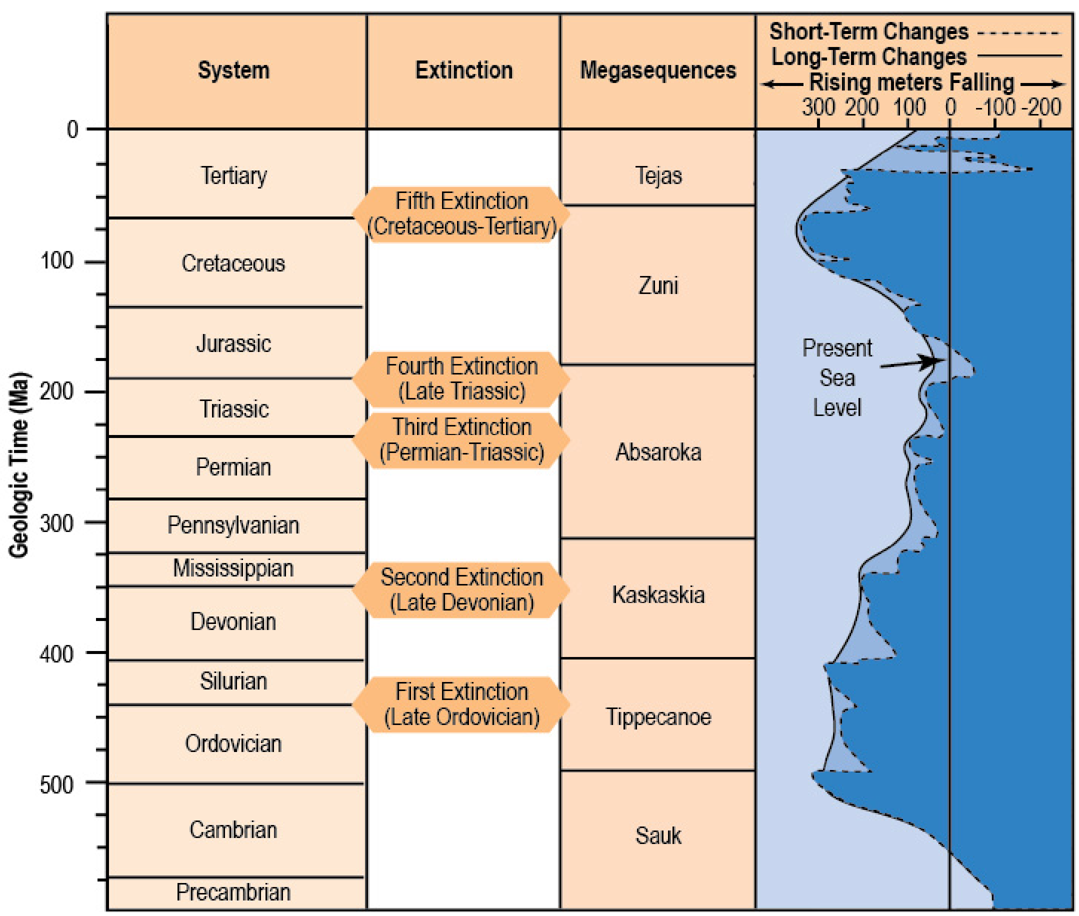

Figure 19. Chart showing the relationship of the so-called five great extinctions to the megasequences. Taken from Clarey (2015).

was not included in our study, but where the Bible describes the landing site of the ark.

CONCLUSIONS

This paper demonstrates the reality of the geologic column using geological data from three continents and evidence from sequence stratigraphy. It should be no surprise that the fossils on all continents show the same basic patterns as sea level rose and flooded each continent simultaneously. As each unique ecological level was inundated, similar environments became entombed globally, creating a common and recognizable rock and fossil record across all continents. The use of megasequences is the best way to examine the global geologic record, as they are as independent of fossils as possible.

Finally, megasequences reflect major advances and shifts in Flood depositional patterns and exhibit distinctive lithologic patterns that allow intercontinental correlations using seismic and well data. Results show extensively consistent lithologic units (i.e. blanket sandstones) covered portions of every continent and are correlative across vast regions and even continent to continent. These include sandstones like the Tapeats equivalent across North America. The correlation of these stacked basal megasequence units, from column to column, and the correlation of other unique rock types (i.e. salt and chert layers) within the megasequences, confirm the validity of the geologic column on a global scale. The fossils contained within the megasequences are merely the passive results of these major sedimentological events as the Flood waters rose higher and higher. Creationists should embrace the geologic column as it is robust evidence of a global Flood.

REFERENCES

Austin, S.A., J.R. Baumgardner, D.R. Humphreys, A.A. Snelling, L. Vardiman, and K.P. Wise. 1994. Catastrophic plate tectonics: A global Flood model of earth history. In *Proceedings of the Third International Conference on Creationism*, ed. R.E. Walsh, pp. 609-621. Pittsburgh, Pennsylvania: Creation Science Fellowship.

Bertog, J., W. Huff, and J.E. Martin. 2007. Geochemical and mineralogical recognition of the bentonites in the lower Pierre Shale Group and their use in regional stratigraphic correlation. In *The Geology and Paleontology of the Late Cretaceous Marine Deposits of the Dakotas,* eds. J.E. Martin, and D.C. Parris, pp. 23-50. Boulder, Colorado: Geological Society of America Special Paper 427.

Blum, M., and M. Pecha. 2014. Mid-Cretaceous to Paleocene North American drainage reorganization from detrital zircons. *Geology* 42, no. 7:607-610.

Carroll, A.R. 2017. Xenoconformities and the stratigraphic record of paleoenvironmental change. *Geology* 45, no. 7:639-642.

Childs, O.E. 1985. Correlation of stratigraphic units of North America-COSUNA. *American Association of Petroleum Geologists Bulletin* 69, no. 2: 173-180.

Clarey, T.L. 2013. South Fork and Heart Mountain Faults: Examples of catastrophic, gravity-driven "overthrusts," northwest Wyoming, USA. In *Proceedings of the Seventh International Conference on Creationism,* ed. M.F. Horstemeyer, Pittsburgh, Pennsylvania: Creation Science Fellowship.

Clarey, T. 2015. D*inosaurs: Marvels of God's Design.* Green Forest, Arkansas: Master Books.

Clarey, T.L., and D.J. Werner. 2017. The sedimentary record demonstrates minimal flooding of the continents during Sauk deposition. *Answers Research Journal* 10:271-283.

Clarey, T.L., and D.J. Werner. 2018. Use of sedimentary megasequences to re-create pre-Flood geography. In *Proceedings of the Eighth International Conference on Creationism,* ed. J.H. Whitmore. pp. 351-372. Pittsburgh, Pennsylvania: Creation Science Fellowship.

Davison, G.E. 1995. The importance of unconformity-bounded sequences in Flood stratigraphy. *Journal of Creation* 9, no. 2:223-243.

Froede, C.R., Jr., A.J. Akridge, and J.K. Reed. 2015. Can 'megasequences' help define biblical geologic history? *Journal of Creation* 29, no. 2:16-25.

Haq, B.U., J. Hardenbol, and P.R. Vail. 1988. Mesozoic and Cenozoic chronostratigraphy and cycles of sea-level change. In *Sea-Level Changes: An Integrated Approach*: SEPM Special Publication 42:71-108.

Hubbard, R.J. 1988. Age and significance of sequence boundaries on Jurassic and Early Cretaceous rifted continental margins. *American Association of Petroleum Geologists Bulletin* 72, no. 1:49-72.

Kendall, C. G.C., A.S. Alsharhan, and L. Marlow. 2014. Stratigraphy and depositional systems of the southern Tethyan region. In *Petroleum Systems of the Tethyan Region,* eds. L. Marlow, C.C.G. Kendall, and L.A. Yose, pp. 29-57. Tulsa, Oklahoma: American Association of Petroleum Geologists Memoir 106.

Matthews, J.D. 2016. The overthrusting paradox: a challenge to uniformitarian geology and evolution. *Journal of Creation* 30, no. 2:83-91.

Matthews, J.D. 2011. The stratigraphic column-a dead end. *Journal of Creation* 25, no. 1:98-103.

McDonough, K., E. Bouanga, C. Pierard, B. Horn, P. Emmet, J. Gross, A. Danforth, N. Sterne, and J. Granath. 2013. Wheeler-transformed 2D seismic data yield fan chronostratigraphy of offshore Tanzania. *The Leading Edge* 32, no. 2:162-170.

Morris, J.D. 2012. *The Global Flood: Unlocking Earth's Geologic History.* Dallas, Texas: Institute for Creation Research.

Mossop, G.D. and I. Shetsen. 1994. *Geological atlas of the Western Canada Sedimentary Basin*. Calgary, Alberta, Canada: Canadian Society of Petroleum Geologists and Alberta Research Council.

Oard, M.J. 2010. Is the geological column a global sequence? *Journal of Creation* 24, no. 1:56-64.

Peters, S.E., and R.R. Gaines. 2012. Formation of the 'Great Unconformity' as a trigger for the Cambrian explosion. *Nature* 484:363-366.

Pimiento, C., J.N. Griffin, C.F. Clements, D. Silvestro, S. Varela, M. Uhen, and C. Jaramillo. 2017. The Pliocene marine megafauna extinction and its impact on functional diversity. *Nature Ecology & Evolution* 1:1100-1106. Doi:10.1038/s41559-017-0223-6.

Reed, J.K., and M.J. Oard. 2006. Introduction. In *The Geologic Column: Perspectives Within Diluvial Geology*, eds. J.K. Reed, and M.J. Oard, pp. 1-6. Chino Valley, Arizona: Creation Research Society Books.

Reijers, T.J.A. 2011. Stratigraphy and sedimentology of the Niger Delta. *Geologos* 17, no. 3:133-162.

Ross, M. 2013. The Flood/post-Flood boundary [letter to the editor], *Journal of Creation* 27, no. 2:43-44.

Ross, M.R. 2014. Improving our understanding of creation and its history. *Journal of Creation* 28, no. 2:62-63.

Salvador, A. 1985. Chronostratigraphic and geochronometric scales in

COSUNA stratigraphic correlation charts of the United States. *American Association of Petroleum Geologists Bulletin* 69, no. 2:181-189.

Sloss, L.L. 1963. Sequences in the cratonic interior of North America. *Geological Society of America Bulletin* 74, no. 2:93-114.

Sloss, L. L. 1972. Synchrony of Phanerozoic sedimentary-tectonic events of the North American craton and the Russian platform. *International Geological Congress, 24th*, Montreal, Canada, Sec. 6, pp. 24-32.

Snelling, A.A. 2009. *Earth's Catastrophic Past: Geology, Creation & the Flood* [2 volumes]. Dallas, Texas: Institute for Creation Research.

Snelling, A.A. 2010. The geology of Israel within the Biblical Creation-Flood framework of history: 2. The Flood rocks. *Answers Research Journal* 3:267–309. Retrieved August 14, 2017 from www.answersingenesis.org/arj/v3/geology-israel-flood.pdf

Snelling, A.A. 2014. Geological issues: Charting a scheme for correlating the rock layers with the Biblical record. In *Grappling with the Chronology of the Genesis Flood*, eds. S.W. Boyd and A.A. Snelling, pp. 77-109. Green Forest, Arkansas: Master Books

Snelling, A.A. 2017. Five mass extinctions or one cataclysmic event? *Answers Magazine*. Retrieved August 2, 2017 from https://answersingenesis.org/geology/catastrophism/five-mass-extinctions-or-one-cataclysmic-event/

Soares, P.C., P.M. B. Landim, and V.J. Fulfaro. 1978. Tectonic cycles and sedimentary sequences in the Brazilian intracratonic basins. *Geological Society of America Bulletin* 89, no. 2:181-191.

St-Onge, A. 2017. A Late Cretaceous polygonal fault system in central North America. *Geological Society of America Bulletin* 129, no. 5/6:582-593.

Thomson, K., and J.R. Underhill. 1999. Frontier exploration in the South Atlantic: Structural prospectivity in the North Falkland Basin. *American Association of Petroleum Geologists Bulletin* 83, no. 5:778-797.

Van Wagoner, J.C., R.M. Mitchum, Jr., K.M. Campion, and V.D. Rahmanian. 1990. *Siliciclastic Sequence Stratigraphy in Well Logs, Cores, and Outcrops: Concepts for High-Resolution Correlation of Time and Facies.* Tulsa, Oklahoma: American Association of Petroleum Geologists [Methods of Exploration Series, no.7].

Whitcomb, J.C., and H.M. Morris. 1961. *The Genesis Flood*. Philadelphia, Pennsylvania: The Presbyterian and Reformed Publishing Company.

Woodmorappe, J. 1999. The geologic column: does it exist? *Journal of Creation* 13, no. 2:77-82.

THE AUTHORS

Timothy L. Clarey earned a Ph.D. and B.S. (summa cum laude) from Western Michigan University, and a M.S. from University of Wyoming all in geology. He worked for nearly a decade as an exploration geologist for Chevron and 17 years as a college professor. His publications include numerous articles on the geology of the Rocky Mountain region. He has written and/or co-authored four books, including Guide to Dinosaurs (ICR). His latest book, Dinosaurs: Marvels of God's Design, was published by Master Books in 2015. Tim has worked as Research Associate for ICR since 2013.

Davis J. Werner is an undergraduate at a community college in Texas, with the goal of earning a degree in geology. He has worked at ICR since 2015 as a research assistant.