Evaluation of Other Book of Mormon Geographic Models

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Chapter 14
Evaluation of Other Book of Mormon Geographic Models

Regardless of location, based on geologic analysis, a basic screening for any proposed model must have:

- A volcano in the land northward, active and with eruptions during the 3rd Nephi time frame
- A regional fault system in the land northward with a presence or effect in the land southward capable of generating minimum intensities of Level VIII on the Mercalli intensity scale
- The city of Ammonihah must be in an area capable of producing an earthquake with a minimum intensity of Level VIII on the Mercalli intensity scale
- The land of Nephi must be located adjacent to a volcano active during the first century BC

Once the basic screening criteria are met, the actual locations of cities and geological occurrences would then need to be evaluated within the model.

The active volcano requirement essentially eliminates all Book of Mormon geologic models located in the central or eastern United States, Baja California, and any area in Central America south of Costa Rica from being viable models as a location for the Book of Mormon.

Other Isthmus Models

As has been discussed, the Sorenson model was used because it has extensive sets of detailed maps with meticulously documented references and sources, with multiple supporting books and documentation. It has specific locations identified where geologic events intersect the Book of Mormon record. There are other models of varying specificity in the Isthmus of Tehuantepec that differ from the Sorenson model. For the most part, the alternative models developed to map form differ from the Sorenson model in that the Usumacinta River is assumed to be the River Sidon as opposed to the Grijalva River. In addition, in varying degrees, the alternate models interpret the east sea to be on the east side of the Yucatan Peninsula with the locations of many of the Book of Mormon cities running along the coast starting in the Bay of Honduras and running northward, with other cities located in the south and central portion of the Yucatan Peninsula.

This inquiry is not designed to analyze all other models, in fact the principal purpose of the inquiry is to lay out the geologic framework so that others can utilize it to evaluate their own models if they choose. However, it would be useful to compare at least one of the academically developed models that relies on the Usumacinta River as the River Sidon and the east sea setting as the east side of the Yucatan Peninsula. The model proposed by V. Garth Norman, a recognized Mesoamerican archeologist, seemed an appropriately developed model to use as it provides a detailed map and sufficiently detailed discussion upon which to make a comparison. Kirk Magleby, another Book of Mormon geographic modeler has apparently endorsed the V. Garth Norman map (Magleby 2014),

but has also developed different maps of his own, and though he does not appear to have formally published his maps in a printed form they are extant in the form of Google Earth overlay sketches as part of an internet blog site entitled bookofmormonresources.blogspot.com.

It is not necessary to write another book to make a comparison to the Norman model; in fact, many of the locations are essentially identical to the Sorenson model. As the geologic comparison is limited only to cities or areas where geologic events are described in the Book of Mormon to have taken place, the comparison can be thorough as well as being brief, and it will only be necessary to deal with locations that are not identical and also have geologic implications.

The following locations are essentially identical under the Norman and Sorenson models:
Land northward
City of Lehi-Nephi
City of Jerusalem

The following locations are entirely different:
City of Bountiful
City of Ammonihah
Great City of Moroni
Great City of Zarahemla
Great City of Moronihah

The land southward is not entirely different in the Norman model, but it does shift the main population centers to the Usumacinta river drainage and the south/center portion of the eastern Yucatan peninsula (the Sorenson model does not consider any of the eastern Yucatan peninsula). Locations from the Norman model map for geologic analysis are shown on figure 89.

Figure 89 - Locations Referenced from the V. Grant Norman Model

City of Bountiful and East Sea Cities under the Norman Model

As discussed in chapter 12, the main geologic criteria regarding the location of the city of Bountiful was that it be located in a zone that would have been expected to escape major earthquake damage but that it be close enough that observation of areas with major damage could be visually observed up to a year after the event. The location of the city of Bountiful under the Norman model is directly in the center of the Veracruz fault system. In this location, there would be little expectation that Bountiful would have been spared destruction, in fact, the opposite is the case in that the location would be expected to have maintained a maximum level of destruction.

The Norman model location for Bountiful is not a best fit location; the geologic evidence indicates that the city of Bountiful would not have been at this location.

City of Ammonihah under the Norman Model

As discussed in chapter 13, the requirements for the city of Ammonihah are that it be located in an area on or adjacent to faults sufficient to generate earthquakes of a magnitude high enough to cause the collapse of a prison (approximately Level VIII on the Mercalli scale). In addition, the underlying geology would need to be the type where fault movement could generate an earthquake boom. A map of the underlying geology for Ammonihah is shown in figure 90. The area is not seismically active. An analysis of the current earthquake data from the USGS Hazards program database shows that there have been no historical earthquakes measured within 100 miles of this location.

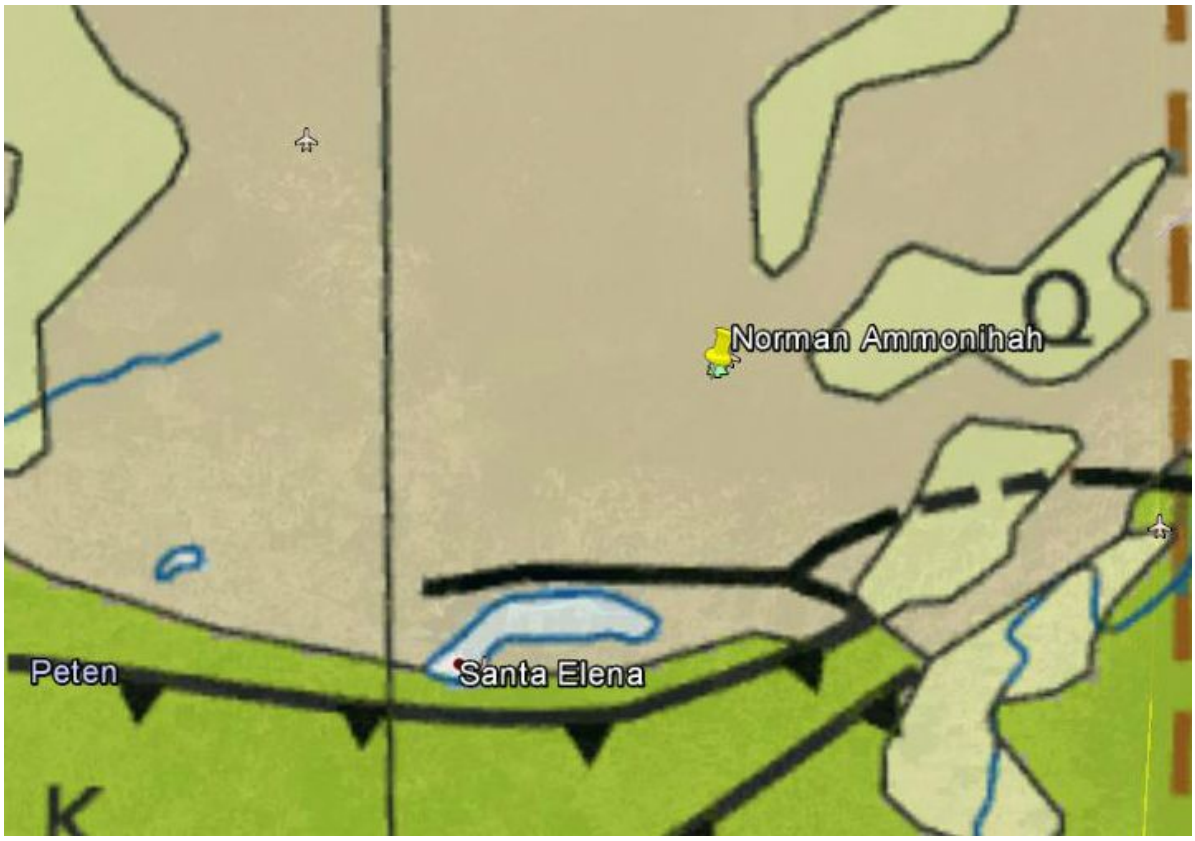

Figure 90. Geology of the Ammonihah area under the Norman model (USGS, 2005)

There is one minor combined normal/thrust fault located approximately 25 km to the south, but the fault is determined to be inactive as there has been no apparent offset of overlying quaternary deposits (within the last 2.6 million years). Liminological core studies in Lake Petén Itzá, Guatemala, which is located immediately adjacent to the fault, show no evidence of any earthquakes during Book of Mormon times or otherwise (Anselmetti et al., 2006).

The underlying geology is a sedimentary series of rocks, which is not the preferred environment for earthquake boom generation. In addition, earthquake booms exclusively occur in strike-slip fault regimes and the faults in this location are not strike-slip faults.

The location of the city of Ammonihah under the Norman model is not a "best fit" location. The geologic evidence would indicate that it is impossible that the city of Ammonihah was at this location.

Magleby (2011) does have a different location than Norman for the city of Ammonihah. Magleby's Ammonihah is located at approximately latitude 17° 14' 25" N longitude 90° 56' 00" W, 13 km west of the town of El Naranjo, Guatemala. Magleby's Ammonihah is adjacent to and just north east of the Reverse Faults Province, which experiences low level seismic activity from compressional reverse (thrust) faults (See chapter 3, figure 12).

Any location for Ammonihah must be in a seismic setting capable of generating a ground shaking of Level VIII on the Mercalli scale to account for the collapse of the prison structure as described in the Book of Mormon. In support of this location, Magleby has posted on the blogsite an earthquake hazard map created by the Global Seismic Hazard Assessment Program (GSHAP) (see figure 91). While the map is based on incomplete data in some areas of the Isthmus, it appears to reflect accurately the expected seismic activity in this area.

The map is a "10% in 50 years PGA" map type. The location Magleby has selected for Ammonihah falls in the 1.6 %g range on the map. PGA is an abbreviation for "peak ground acceleration," which is a method of measuring earthquake intensity. The Mercalli intensity scale uses personal reports and observations to measure earthquake intensity but PGA is measured by instruments, such as accelerographs, and PGA generally correlates well with the Mercalli scale. A 1.6 %g is equivalent to a very low Level IV intensity on the Mercalli scale. A complete comparison of the two scales is shown at the base of all of the Shakemaps shown in chapter 6 in figure 56. The "10% in 50 years" is a probability statement. It means that the location selected for Ammonihah has a probability of 10% of a Level IV earthquake occurring at least once within a period of 50 years. This is based on the scientific determination that every 500 years, one would expect one Level IV earthquake at this location. A Level IV earthquake is one that is:

> Felt indoors by many to all people, and outdoors by few people. Some awakened. Dishes, windows, and doors disturbed, and walls make cracking sounds. Chandeliers and indoor objects shake noticeably. The sensation is more like a heavy truck striking building. Standing automobiles rock noticeably. Dishes and windows rattle alarmingly. Damage none.

A Level VIII earthquake as described in the Book of Mormon in Ammonihah is roughly 20 times more powerful than a Level IV when utilizing comparative PGA measurements. The hazard map utilized by

Magleby shows, in fact, that the likelihood of a Level VIII earthquake at that location is extremely, extremely low.

As previously discussed, a useful determinant in evaluating any location for Ammonihah is the ability of the location to generate a supershear earthquake capable of creating an earthquake boom as described in the Book of Mormon. Supershear earthquakes occur almost exclusively on strike-slip faults. There are no strike-slip faults in the vicinity of Magleby's location for Ammonihah.

The location of the city of Ammonihah under the Magleby model, while faring better than the Norman model, still does not meet best fit requirements for Ammonihah. The geologic evidence would indicate that the city of Ammonihah was not at this location.

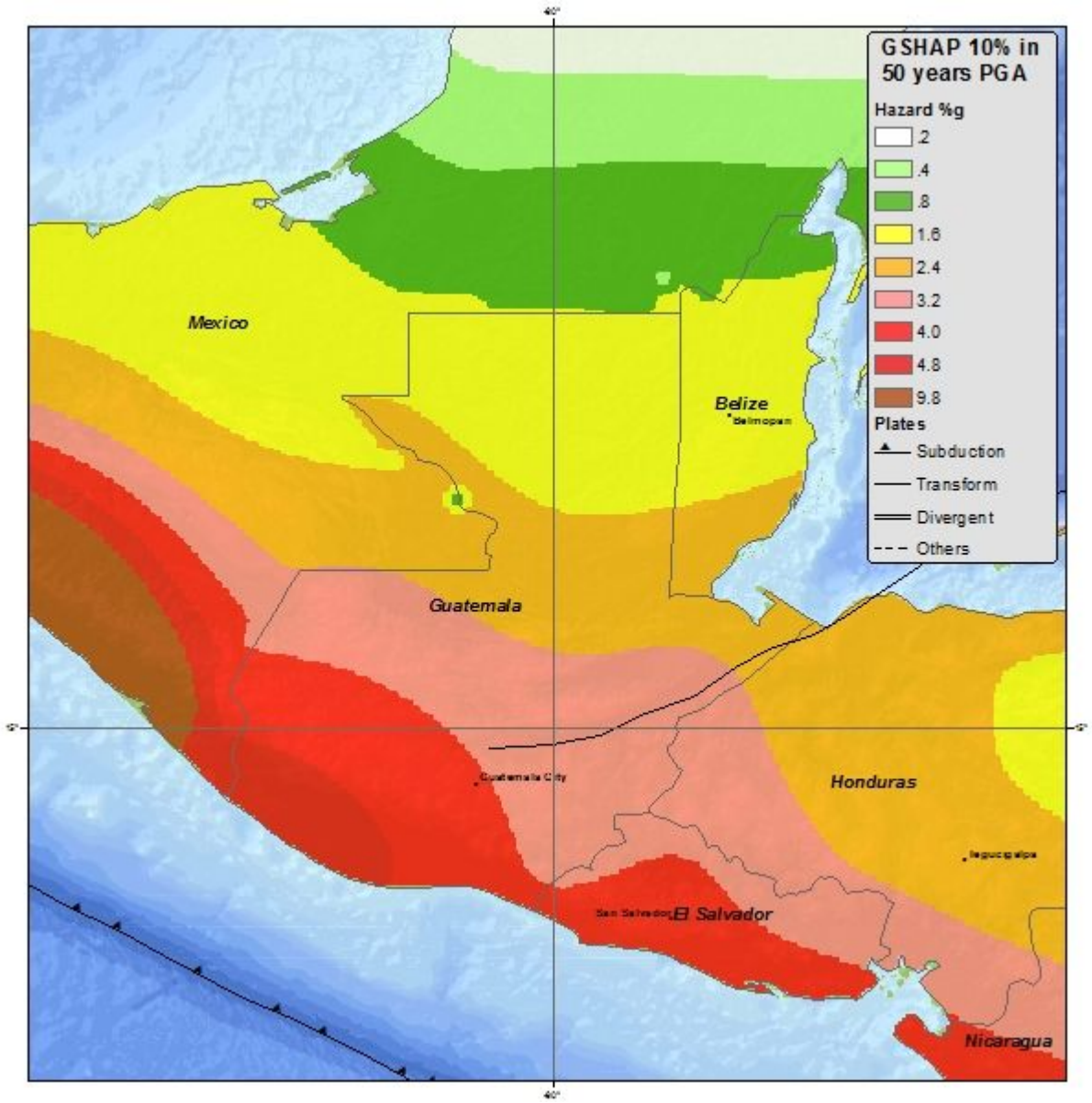

Figure 91. Earthquake hazard map from Magleby's blogsite (Magleby 2014)

City of Moroni under the Norman Model

The city of Moroni in the Norman model is located along the east sea. The location is within the Polochic/ Motagua fault system segment and could experience a significant earthquake and potential subsidence. However, this would require the occurrence of a large earthquake along this section in the land southward in addition to the earthquake occurring on the Veracruz fault system to the north.

Risk of a tsunami is also possible because of the offshore location of the fault system. Unlike the location of this city under the Sorenson model, there is no possibility of a volcano generated tsunami. Studies on soil conditions relative to liquefaction potential are not available as the scale of the map does not allow for a location specific analysis, so sinking caused by lateral spreading or liquefaction was not evaluated. The likelihood of a hurricane being a possible 3rd Nephi event are eliminated under the Norman model as discussed below.

The location of the city of Moroni under the Norman model currently meets the best fit standard pending a more specific location analysis.

City of Zarahemla under the Norman Model

The location of the city of Zarahemla under the Norman model is on the Usumacinta River at a location 7 km north of the town of Emiliana Zapata, at approximately latitude 17° 14’ 25” N longitude 90° 56’ 00” W. The most likely methods for Zarahemla to have taken fire and have had accelerated burning are lightening or earthquake induced ignition from existing human sources of fire in conjunction with high winds. A volcanic ignition does not seem likely as the Norman model location is far removed from any volcano.

An earthquake-assisted ignition (overturning candles or other such elements of fire) is plausible based on the intensity equations and intensity calculations discussed in chapter 10, indicating a Mercalli intensity of Level 4 to 5 because the city lies within 190 km of the Veracruz fault system.

The location of Zarahemla under the Sorenson model does sit closer to the Veracruz fault system than the Norman model, and the Sorenson location actually sits directly on the Polochic/ Motagua fault system, and so would have a greater probability of earthquake effect than the Norman model. Nevertheless, the location of Zarahemla in the Norman model is reasonably consistent with the geological conditions of the Book of Mormon.

City of Moronihah under the Norman Model

Norman has located the city of Moronihah at the extreme southern end of the land southward near a large group of volcanoes. Unfortunately, the scale of the map and explanations given on the map do not indicate which volcano is proximate to the location. As previously discussed in chapter 12, the possibilities for the destruction of Moronihah are a large landslide in a river valley within the Mercalli intensity level 8 zone of the regional earthquake, a mud volcano, or a volcanic debris avalanche. The Norman location of Moronihah is not in an oil and gas province, so a mud volcano is not a possibility.

The location is also too far removed from the Polochic/ Motagua fault system for a landslide triggered by an earthquake to be a possibility. The location requires that a second volcano eruption occur in addition to the volcano in the land northward, which provides less probability for the location under the best fit analysis. Presuming that one of the many volcanos in the area was active during the appropriate time period, then the location of Moronihah as shown in the Norman model is a geologic possibility.

The land southward under the Norman model

The Norman model of the land southward, differing from the Sorenson model, places the majority of the cities in the land southward in the Usumacinta River drainage and the south/central Yucatan Peninsula with a population concentration along the east coast of the Yucatan Peninsula. This expansion of the size of the land southward essentially eliminates the possibility of a hurricane being an element in the 3rd Nephi destruction involving the land southward; as discussed in chapter 7, the fastest forward speed ever measured for a hurricane is less than 70 miles per hour. It would not be possible for the hurricane to traverse even the land southward (let alone the land northward) on any hurricane path coming from the north or east within the 3 to 3.5 hour time limit, as the land southward under the Norman model is over 400 miles in width. As was previously mentioned, a hurricane is not an essential element to describe disaster events in 3rd Nephi, provided that the model locates cities and lands in places where a volcano and/or earthquake can account for the damage described.

Third Nephi requires that there was “thick darkness upon all the face of the land” with the only known phenomenon matching the description being distribution of ash from a volcanic eruption. Though the term “all the face of the land” does not necessarily mean that every square mile is contemplated, the description does imply that it is widespread over most of the face of the land. The size of the land southward under the Norman model necessitates the eruption of volcanoes in the land southward in order to accommodate the much larger area of the land southward. As discussed in chapter 8, a multiple volcano phenomenon is not unknown, but under the best fit analysis it is less probable. The descriptions given in 3rd Nephi indicate a volcano in the land northward, but no specific and unique volcanic damage of any sort (unlike specific cities in the land northward) is indicated in the land southward. If a significant eruption did occur in the land southward, it would need to be some distance from populated areas, as no cities were apparently buried by pyroclastic or surge flows.

While the Book of Mormon only provides a specific damage report for three cities in the land southward the Book of Mormon does state (3 Nephi 8:11) that “there was a great and terrible destruction in the land southward.” Under the Norman model, the bulk of the population is located beyond the reach of any volcano (except for windborne ash distribution). As has already been discussed, a hurricane is also not consistent with the Norman model, which leaves the only possibility for great and terrible destruction to be caused by an earthquake.

The Norman model positions significant population in the central or north part of the Yucatan peninsula, where there is virtually no possibility of damage from earthquake as this area is completely inactive seismically and considered the most stable seismic area in the entire Isthmus.

There have been virtually no historical earthquakes along the east margin of the Yucatan peninsula except on the very southern end where the Polochic/Motagua strike-slip fault system enters the Caribbean Sea. Nearly all of the cities on the eastern Yucatan are located significantly inland beyond the reach of an earthquake-generated tsunami from the Polochic/Motagua fault system. In any event, paleotempestology core studies have shown no evidence of a significant tsunami along the eastern Yucatan Peninsula (McCloskey, 2009).

In addition, the Norman model places much of the population along the Usumacinta River, a location in excess of 100 km from the center of the main strike-slip fault system in the land southward, and based on attenuation factors even the most catastrophic earthquake on the Polochic/Motagua strike-slip fault system would be at a Level VI intensity. A Level VI earthquake on the Mercalli scale can expect the following lower level of damage:

> Felt by everyone, outside or inside; many frightened and run outdoors, walk unsteadily. Windows, dishes, glassware broken; books fall off shelves; some heavy furniture moved or overturned; a few instances of fallen plaster. Damage slight to moderate to poorly designed buildings; all others receive none to slight damage.

Along the lower stretches of the Usumacinta drainage there are some areas of soils that could amplify and increase the intensity, but those areas are even further away from the main fault system at approximately 170 km. The Usumacinta drainage (see figure 12) would be located northeast of the Reverse Faults Province, running from southeast to the northwest. As is noted in the figure, the Reverse Faults Province recorded only minor seismic activity and would not be expected to have earthquakes reaching an elevated intensity level. There are deep subduction zone related earthquakes that do occur in the Usumacinta drainage (as well as within the Grijalva drainage that is central to the Sorenson model) but because of their depth they are significantly attenuated on the surface and do not typically generate extensive surface rupture.

When evaluating best fit, the land southward under the Norman model would only meet the requirement of “a great and terrible destruction” if an interpretation is made of the Book of Mormon text that includes only a lesser portion of the land southward. The Sorenson model for the land southward would be the best fit with regards to potential destruction of population centers both by earthquake or volcanic eruption.