Chapter 8

Deposition of Widespread or Thick Precipitates

An evaporite is sedimentary rock composed primarily of minerals and chemicals. It is produced by a saline solution and is a result of extensive or total evaporation.[1] We find evaporites in areas today where a saline pond or lake has dried up, like those on the Bonneville Salt Flats (Figure 8.1) which are the remains of Ice Age Lake Bonneville. As the water dries, the minerals become more and more concentrated until they drop out of solution and sink to the bottom. This process continues until all of the water is evaporated. Evaporation generally is slow and usually takes many years and covers small areas.

According to Webster's Dictionary, "A precipitate is a substance that comes out of solution within water or a fluid and falls to the bottom." It is the opposite of the process that dissolves a chemical in water or a fluid. Precipitation can be caused by an increase in concentration of the substance, a change in temperature of the water or fluid, or some other process. It most likely occurs during the evaporation process of a pond or lake after the concentration reaches a threshold, but it is not necessarily caused by the evaporation of the water or fluid.

It is interesting that the term *precipitate* is not even in the *Glossary of Geology*, which means that geologists believe salt and other chemicals in sedimentary rocks are a result of a shrinking body of water and not dropping from solution.

Huge Continental "Evaporites"

The primary rock "evaporites" are salt and gypsum. Anhydrite is the same as gypsum but without water. If the present is the key to the past, then we would expect to see evaporites over relatively small areas with little volume within the sedimentary rocks. However, some of the "evaporites" in the rock record are huge, covering tens to hundreds of thousands of square miles and over 0.6 mile (1 km) thick.[2] A good example of this is the Paradox Formation. It is found within the Paradox sedimentary basin in southeast Utah and southwest Colorado. The formation covers an area of about 3,900 mi^2 (10,000 km^2) and is over 660 feet (200 m) thick.[3]

Salt is also found in the subsurface of the southern Midwest, like in Texas and Kansas. The Hutchinson Salt member in the subsurface of central and south-central Kansas covers about 37,000 mi^2 (94,700 km^2) and is more than 500 feet (150 m) thick.[4]

A small but amazingly thick "evaporite" occupies the Hualapai Basin of northwestern Arizona, just west of the Grand Wash Cliffs southeast of Lake Meade.[5] The salt deposit covers an area of about 78 mi^2 (200 km^2) but is 1.5 miles (2.5 km) thick! It is considered a "non-marine" continental salt deposit and is dated as Miocene, the early part of the Late Cenozoic.

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[1] Neuendorf, K.K.E., Mehl., Jr., J.P., and Jackson, J.A., 2005. *Glossary of Geology*, fifth edition, American Geological Institute, Alexandria, VA, p. 221.
[2] Warren, J.K., 2010. Evaporites through time: tectonic, climatic and eustatic controls in marine and nonmarine deposits. *Earth-Science Reviews* 98:217-268.
[3] Williams-Stroud, S.C., 1994. Solution to the paradox? results for some chemical equilibrium and mass balance calculations applied to the Paradox Basin evaporite deposit. *American Journal of Science* 294:1,189-1,228.
[4] Sawin, R.S.. and R.C. Buchanan, 2002. Salt in Kansas. *Kansas Geological Survey Public Information Circular 21*, Kansas Geological Survey, Lawrence, KS.
[5] Faulds, J.E., B.C. Schreiber, S.J. Reynolds, L.A. González, and D. Okaya, 1997. Origin and Paleogeography of an immense, nonmarine Miocene salt deposit in the Basin and Range (Western USA), *Journal of Geology* 105:19-36.

Another recently discovered Miocene salt layer was discovered in the Guaymas Basin of the Gulf of California.[6] This so-called evaporite is 1.25 miles (2 km) thick and covers a small area of about 1,950 mi^2(5,000 km^2).

Figure 8.1 The Bonneville Salt Flats, western Utah.

Thick salt deposits have been found in many continental basins around the world. Some of these basins have been uplifted and are now mountain ranges. These “evaporites” were generally deposited in the lowest parts of the basin and later deformed into salt intrusions as more sediment was added. One of the lowest layers in the deep sedimentary rock in the southwest Zagros Mountains of southwest Iran consist of a widespread thick salt deposit called the Hormoz salt.[7] It is believed that much of the strata of this area slid southwest to form a large fold and thrust belt in the late Cenozoic. This salt has intruded the sedimentary rocks and has flowed on the surface

[6] Miller, N.C. and Lizarralde, D., 2013. Thick evaporites and early rifting in the Guaymas Basin, Gulf of California. *Geology* 41(2):283–286.
[7] Mouthereau, F., J. Tensi, N. Bellahsen, O. Lacombe, T. De Boisgrollier, and S. Kargar, 2007. Tertiary sequence of deformation in a thin-skinned/thick-skinned collision belt: the Zagros folded belt (Fars, Iran). *Tectonics* 26 TC5006.

like a glacier.[8] It is interesting that the Hormoz salt is dated as late Precambrian to early Cambrian.[9]

In the Flinders Ranges of South Australia, another salt deposit is around 2 miles (3.2 km) thick before deforming.[10]

Continental Margin "Evaporites"

"Evaporites" are common deep within the continental margin sediments, off of what are called passive margins.[11] Generally the margins lack an offshore trench. They include the Gulf of Mexico and the margins around the Atlantic Ocean. Similar to continental sedimentary rocks, the salt has deformed, with the formation of salt diapirs, which are upward salt intrusions. These are considered "marine evaporites" and are generally ten times the size of "continental evaporites."[2] Extensive "evaporites" have been detected by seismic methods up to a few miles (3 km) thick offshore of West Africa.[12,13] They have been dated as very late Mesozoic because the lowest sedimentary rocks along the margin of the Atlantic are dated late Mesozoic from the plate tectonic, sea floor spreading model.

The Gulf of Mexico is famous for its "evaporites" which extend onshore to the north.[14] They are believed to date to the late Mesozoic or Tertiary and have been reported to be up to 20,000 feet (6,100 m) thick.[15]

The Most Amazing "Evaporite" of All

Probably the most widespread and amazing "evaporite" of all is the one formed in and around the Mediterranean Sea.[16] It is composed of salt and gypsum and covers about *one million square miles (2.5 million km^2) and is up to about one to 2.2 miles (1.6 to 3.5km) thick!*[17] Such a deposit is attributed to the "Messinian salinity crisis" (MSC) and is dated at about 5.6 million years ago in the late Miocene, the middle part of the late Cenozoic. The Messinian "evaporites" were later elevated and exposed on Sicily and in northern Italy. In addition, at the bottom of the Mediterranean Sea there is another 0.6 miles (1 km) of sediments on top of the "evaporites" dated as Pliocene, that needs to be explained.

Uniformitarian scientists are greatly flummoxed over the origin of these chemical deposits. To them it implies the Mediterranean Sea has dried up—numerous times. Based on the amount

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[8] Talbot, C., Extensional evolution of the Gulf of Mexico basin and the deposition of Tertiary evaporites, by H.H. Wilson: Discussion. *Journal of Petroleum Geology* 27(1):95-104.

[9] Rowan, M.G. and B.C. Vendeville, 2006. Foldbelts with early salt withdrawal and diapirism: physical models and examples form the northern Gulf of Mexico and the Flinders Ranges, Australia. *Marine and Petroleum Geology* 23:871-891.

[10] Rowan and Vendeville, Ref. 9, p. 883.

[11] Rowan and Vendeville, Ref. 9, p. 885.

[12] Watts, A.B. and J. Steward, 1998. Gravity anomalies and segmentation of the continental margin offshore West Africa. *Earth and Planetary Science Letters* 156:239-252.

[13] Lavier, L.L., M.S. Steckler, and F. Brigaud, 2001. Climatic and tectonic control on the Cenozoic evolution of the West African margin. *Marine Geology* 178:63-80.

[14] Wilson, H.H, 2003. Extensional evolution of the Gulf of Mexxico basin and the deposition of Tertiary evaporites. *Journal of Petroleum Geology* 26(4):403-428.

[15] Wilson, H.H., 2004. Extensional evolution of the Gulf of Mexico basin and the deposition of Tertiary evaporites: reply to discussion. *Journal of Petroleum Geology* 27(1):105-110.

[16] Oard, M.J., 2005. The Messinian salinity crisis questioned. *Journal of Creation* 19(1):11-13.

[17] Govers, R., P. Meijer, and W. Krijgsman, 2009. Regional isostatic response to Messinian Salinity Crisis events. *Tectonophysics* 463:109-129.

of salt in the Mediterranean Sea, just one drying would produce a layer of salt only 200 feet (60 m) thick. So, numerous desiccations of the Mediterranean Sea are required under this hypothesis. Some geologists are uneasy with so many desiccations in a brief time, in their timescale and instead suggest that few if any desiccations occurred.[18] They need to come up with a precipitation hypothesis, which will be hard for them to do for reasons stated below.

Numerous Paradoxes for Uniformitarian Mechanisms

"Evaporites" in sedimentary rocks are very difficult for uniformitarian scientists to explain. Hovland and others state:

> Solar evaporation of seawater has long been established as the main process for the formation of salt deposits; mainly halite (HaCl) and anhydrite ($CaSO_4$). There are however, numerous paradoxes and unresolved problems associated with this model as discussed by Warren (1999), Wilson (2003, 2004) and Talbot (2004) that clearly illustrate a lack of fundamental data, especially from the deepest portions of the salt basins, to verify this evaporite hypothesis as the general model for salt formation.[19]

The "evaporites" in the rock record are huge compared to those formed during recent time or during the Ice Age. It is difficult to imagine how an evaporating mechanism can form these widespread, thick chemical deposits. So, "evaporites" defy uniformitarianism itself.

"Evaporites" Must Be Deposited during the Flood

Many creationists believe "evaporites" in the rock record are *precipitates* that fell out of solution during the Flood by widespread chemical and/or temperature changes. So far, it has been difficult to come up with a viable hypothesis on the formation of precipitates during the Flood, although the scale of the deposits goes along with other huge sedimentary deposits that are expected during the Flood. Very few creation researchers have worked on precipitates, so much work still needs to be done. Another suggested mechanism in the creationist technical literature is that salt is related to igneous activity.[20]

If the salt and gypsum are precipitates, it would require very hot water in the neighborhood of about 700°F (400°C) in deep water or from boiling seawater near the surface to form them.[21] Hot water and high pressure was also the deduction of Aaron Hutchinson, a chemist at Cedarville University in a study of precipitates (2010, personal communication).

Based on this research and the fact that many precipitates are found deep within basins suggests they formed when the basin was first shaped by rifting, impact cratering, etc. Thus, chemical sediments probably were deposited by contact with very hot rocks or the extrusion of hot brines or even igneous salt in deep water. Figure 8.2 presents a schematic of the formation of precipitates during the Flood in deep basins with the subsequent burial of the chemicals and formation of intrusions and diapirs.

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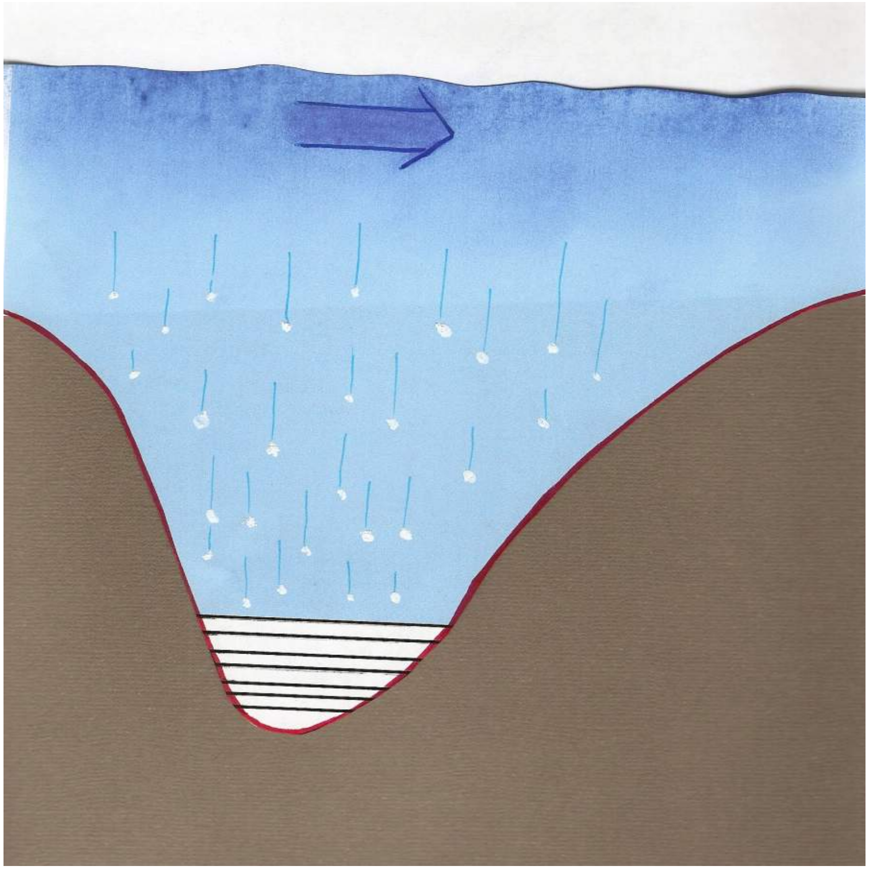
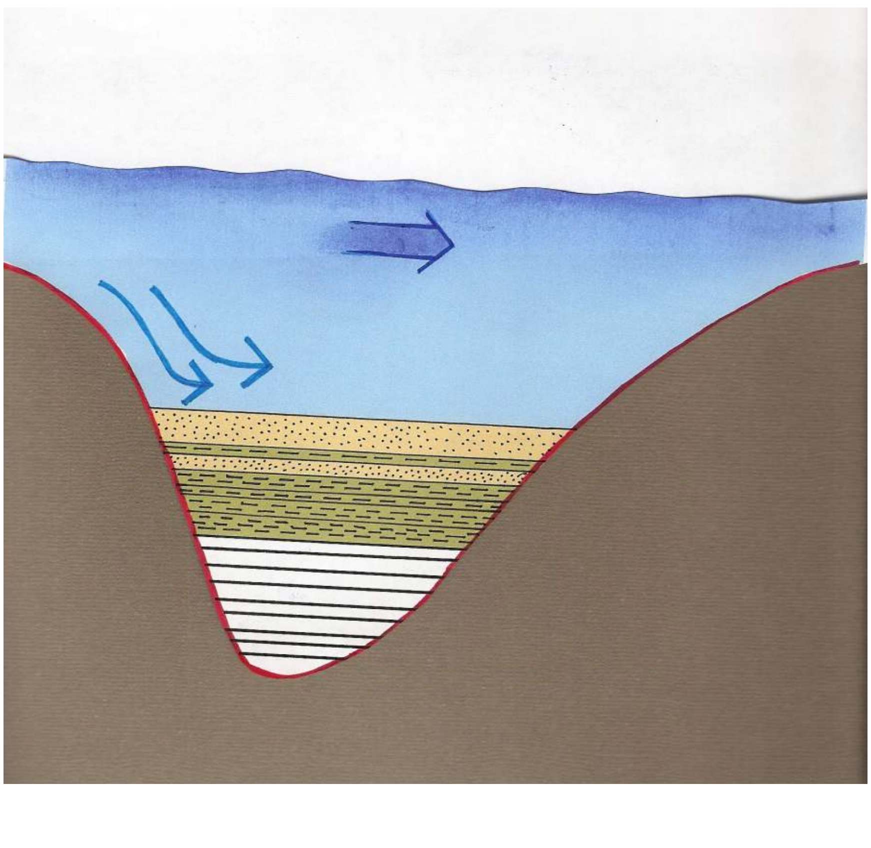
[18] Hardie, L.A. and T.K. Lowenstein, 2004. Did the Mediterranean Sea dry out during the Miocene? a reassessment of the evaporite evidence from DSDP legs 13 and 42A cores. *Journal of Sedimentary Research* **74** (4):453-461.

[19] Hovland, M., H.G. Rueslåtten, H.K. Johnsen, B. Kvamme, and T. Kuznetsova, 2006. Salt formation associated with sub-surface boiling and supercritical water. *Marine and Petroleum Geology* 23, p. 855.

[20] Heerema, S, 2009. A magmatic model for the origin of large salt formations, *Journal of Creation* 23(3):116–118.

[21] Hovland *et al.*, Ref. 19, pp. 855-869.





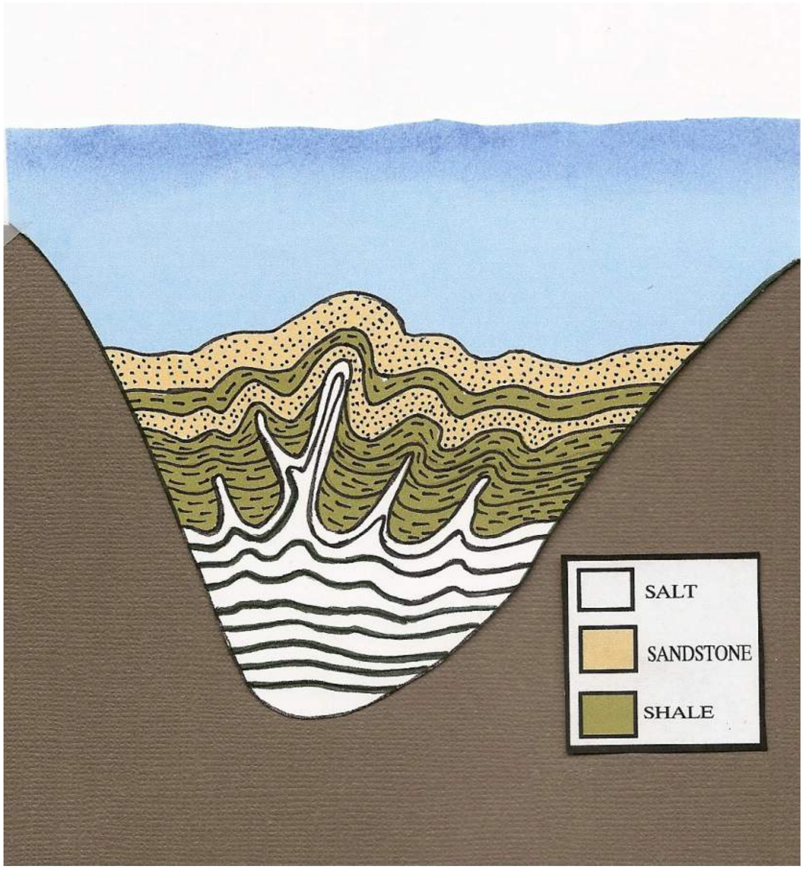


Figure 8.2. Schematics of salt deposition in a basin, followed by sedimentation, and finally by the formation of salt diapirs (drawn by Mrs. Melanie Richard).

How Could "Evaporites" Be Deposited after the Flood?

Post-Flood catastrophists have to believe true evaporates or precipitates, other than the recent or Ice Age examples, formed after the Flood. Regardless, chemical sedimentary rocks require a very special environment. If the boundary is in the Precambrian or late Paleozoic, numerous huge, thick "evaporites" need explaining. This appears to be an impossible task.

Advocates of the K/T Boundary Model have fewer 'evaporites' to explain, but nevertheless, they have the same problem as those who place the Flood/post-Flood boundary further down in the geological column, for example explaining the Messinian salinity crisis.

Let's take for example the "evaporite" southeast of Lake Mead that is 78 mi^2 (200 km^2) and 1.5 miles (2.5 km) thick. This is considered a continental evaporite and currently occupies a very dry area. Since this salt was deposited in the Miocene, the early part of the late Cenozoic, it would be deposited well after the Flood, assuming the Cenozoic is a record of the first 200 to 300 years after the Flood. How can any post-Flood catastrophe account for it? How would the salt continually recharge so that 1.5 miles (2.5 km) collected? From where would the salt come? There is not enough time after the Flood for this salt deposit to form. Therefore, this chemical deposit by necessity must be from the Flood. Since the "evaporite" is dated as late Miocene in this area, the Flood/post-Flood boundary would be in the late Cenozoic.

A second example is the Messinian Salinity Crisis in and around the Mediterranean Sea, considered one of the greatest "evaporites" of all. This is even more challenging.

> The Messinian salinity crisis (MSC) of the Mediterranean is one of the greatest evaporitic events of earth's history, especially when considering its very short duration, i.e., 640 kyr [to deposit].[22]

Since the MSC is dated at about 5.5 Ma and the K/T boundary is at 65 Ma, it would be logical to assume that the MSC was deposited well after the Flood.[23] What post-Flood mechanism could explain the deposition of this thick, widespread evaporite about 200 years after the Flood? There are also thick sediments or sedimentary rocks on top of the evaporites on the bottom of the Mediterranean Sea. These sediments are dated as Pliocene or younger and commonly are 0.6 miles (1 km) deep based on seismic data.[24] How are sediments that top the evaporites explained after the Flood? What would explain the significant elevation of parts of the strata after deposition? What effects would these mechanisms have had on humans living near the Mediterranean, and why would these significant "catastrophes" not be recorded by people of that time, assuming the people survived? A mechanism must explain the generation, transport, and deposition of vast quantities of salt and gypsum. Furthermore, if the secular scientists are correct in thinking that the Mediterranean was drained and dried prior to deposition, what post-Flood catastrophe would cause it to drain? So, the Flood/post-Flood boundary must be in the late Cenozoic across the Earth and very likely in the very late Cenozoic in the Mediterranean Sea area.

"Evaporites" Make an Excellent Criterion for the Flood/post-Flood Boundary

Because "evaporites" can potentially be explained by the Flood and seem impossible to explain after the Flood, the existence of widespread or thick evaporites provides an excellent criterion for the location of the Flood/post-Flood boundary. The boundary must be above them and in some areas this would be in the very late Cenozoic.

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[22] Rouchy, J.M. and A. Caruso, 2006. The Messinian salinity crisis in the Mediterranean basin: a reassessment of the data and an integrated scenario. *Sedimentary Geology* 188-189:36.

[23] Whitmore, J.H. and Wise, K.P., 2008. Rapid and early post-Flood mammalian diversification evidenced in the Green River Formation; in: Snelling, A.A. (Ed.), *Proceedings of the Sixth International Conference on Creationism*, Creation Science Fellowship, Pittsburgh, PA, pp. 449–457.

[24] Rouchy and Caruso, Ref. 22, pp. 35–67.