Glacial tillites, geologic history, and biblical scientific accuracy

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April 4, 2018

The following is information partly gained from a talk that I heard given by a geology professor, Roberta Rudnick, from U.C. Santa Barbara. She, colleagues, and her students have been studying glacial tillites (diamictites) from around the world (China, Canada, Africa, Bolivia, Australia, and India) that were deposited during different geological ages (the recent Ice Age to the Paleozoic Era and then far back into older and older times in the Precambrian).[1,2,3,]

When a continental ice mass moves across the Earth's surface, it erodes and grinds the crustal rocks to a powder that is mixed in with grooved and striated boulders. These boulders became grooved and striated as they were dragged, frozen in the bottom of the glacial ice, over the crustal rocks. The resulting mixed rock (powder and boulders) is called tillite. (Images of tillite can be found by doing a search on Google for "tillite image".) Tillites are dumped by the glacier when the ice melts at its farthest margin, and the contents of tillites are completely unsorted and unstratified in contrast to stream-deposited sediments in which the eroded fragments are sorted according to grain size and laid down in stratified layers.

There are places in the world where tillites are found at the Earth's equator, and from this knowledge, we know that there was a possible time of a "snowball" Earth (first proposed by Joseph Kirschvink[4]) in which the whole Earth was covered with ice.[5] Eventually, volcanic eruptions spewed enough carbon dioxide, methane, hydrogen sulfide, and other gases into the atmosphere to create a global warming that caused this snowball to melt.

At any rate, by examining the elemental compositions of the powdered rock in tillites by chemical methods, she could tell how the Earth's crust has changed in composition through time. Early on, the crust was very rich in iron and

magnesium when the Earth's crust was mostly composed of basalt. As time progressed, the elements potassium, uranium, and thorium moved up from the mantle to the Earth's surface to produce granite that is found in the cores of all continents that we see today.

Some elements in the periodic table have many different isotopes (kinds) with different amounts of neutrons in their nuclei. Some of these isotopes are radioactive, and some are insoluble in water while others are soluble when combined with oxygen as oxides.

What was interesting to me was that by studying the changes in the elemental compositions in these tillites through the geologic ages, she could tell that early in the Precambrian there was no oxygen in the atmosphere, and she could pinpoint the time in which oxygen appeared, because the abundance and distribution of the different isotopes changed as some of them began to combine with oxygen and became soluble in water and were removed from the tillites. (Search for "The Great Oxidation Event" on Google.) That is, these soluble oxides were carried to the oceans as the crustal rocks were weathered to form clay-rich soils from which these oxides were transported to the oceans, and the tillites, therefore, had lesser amounts of the soluble elements.

The young-earth creationists, whom I am battling with, condense all of Earth's history into 6,000 to 10,000 years.[6] That is, their biblical history is confined to this short time period that is about 12 percent of Earth's history (time during the Paleozoic, Mesozoic, and Cenozoic Eras to the present). This short time supposedly occurred when Noah's Flood distributed the various sedimentary rocks with their plant and animal fossils around the world, like those in the Grand Canyon. The other 88 percent is restricted, unrealistically, to Day Three of the Genesis Week. Their making the Bible a perfect science textbook really demands more faith than I can muster. Where is the "snowball" Earth described in the Bible and where does the Bible mention when the Earth's atmosphere did not have any oxygen?

Another aspect of the talk by Roberta Rudnick that I did not mention is that early in the Earth's history, when the atmosphere had no oxygen, there also was no ozone high in the stratosphere. Therefore, ultraviolet light could freely penetrate to

the Earth's surface. As you may recall, because of the presence of an ozone hole in the Polar Regions in recent years, people living there could get sunburned from ultraviolet radiation and get skin cancer. At any rate, early life probably had to develop in the oceans rather than on land because the water there could act as a sunscreen for the ultraviolet radiation.

It also should be recognized that when oxygen first appeared, it was a poison for life and not a necessity for life. That is, early bacteria living in the oceans were anaerobic, and they produced methane as a waste product in their metabolism. When **cyanobacteria** evolved in which photosynthesis was part of their metabolism, oxygen was released as a waste product. This oxygen killed the anaerobic bacteria, and this became the first mass extinction of life on Earth. Only in deeper parts of the ocean where oxygen is not present could the anaerobic bacteria survive.

Later on, organisms had to develop in such a way that they could tolerate the oxygen, but when this happened, the incorporation of the oxygen, combining with carbon, generated energy which promoted the further evolution of life. When these new kinds of organisms were formed, their metabolism combined oxygen with carbon and produced carbon dioxide as a waste product, which in turn had new consequences. The abundant methane in the early Earth's atmosphere absorbed the energy from the sun and kept the Earth warm, but when carbon dioxide increased in the atmosphere, although this gas also absorbs the sun's energy, it does not do so as efficiently as does methane. Therefore, the Earth cooled such that this cooling may have caused the snowball Earth to form.

(A big concern for us today is the increased amounts of methane that is being released from decaying organic matter in thawing permafrost in Canada and Siberia, and this extra methane will accelerate global warming. The resulting rise in annual worldwide temperatures will melt sea ice and ice in continental glaciers in Greenland and Antarctica, which in turn will cause the sea level to rise. That rise could potentially be as much as 13 to 20 feet and the higher water will submerge many populous coastal cities around the world, displacing hundreds of thousands of people. Such cities, among others, include Singapore, Osaka, Tokyo, Miami, New Orleans, most of New York City, Venice, London, and Shanghai.[7]

Most of Florida will be under water because the average elevation in Florida is 6 feet.)

Another aspect of the early history of the Earth is that the water in the oceans had abundant dissolved iron in its +2 valent state, and when oxygen became available this iron was oxidized in the +3 valent state to cause the iron to precipitate as red hematite and black magnetite in the banded iron formations that became abundant in the Precambrian at that time.[8] In that way the oxygen, as poison, was reduced in the atmosphere which in turn gave future evolved organisms more time to develop a tolerance to the oxygen. Eventually, most of the iron in the +2 valent state was eliminated in the oceanic water, and from then on the oxygen in the atmosphere increased so that future life really had to develop a tolerance for it, which otherwise was a poison.

Amazing that the Creator had to solve all these problems for life to evolve on Earth, and it took billions of years, but the Creator was not in any hurry. Certainly, this evolution of life did not happen in 6,000 to 10,000 years if the Creator's natural laws were obeyed.

Notes

[1]R. M. Gaschnig, Roberta L. Rudnick, William F. McDonough, Alan J. Kaufman, John W. Valley, Zhaochu Hu, Shan Gao, and Michelle L. Beck, 2016, Compositional evolution of the upper continental crust through time, as constrained by ancient glacial diamictites, *Geochimica et Cosmochimica*, March, v. 186, p. 316-343.

See: https://www.researchgate.net/publication/299421228_Compositional_evolution_of_the_upper_continental_crust_through_time_as_constrained_by_ancient_glacial_diamictites

[2]Su Li, Richard M. Gaschnig, Roberta L. Rudnick, 2016, Insights into chemical weathering of the upper continental crust from the geochemistry of ancient glacial diamictites, *Geochimica et Cosmochimica Acta*, v. 176, p. 96-117.

[3]Richard M. Gaschnig, Roberta L. Rudnick, William F. McDonough, Alan J. Kaufman, Zhaochu Hu, and Shan Gao, 2014, Onset of oxidative weathering of

continents recorded in the geochemistry of ancient glacial diamictites, *Earth and Planetary Science Letters*, v. 408, p. 87-89.

[4]Snowball Earth. See: http://www.snowballearth.org/who.html.

[5]Snowball Earth. See: https://en.wikipedia.org/wiki/Snowball_Earth

[6]Carol Hill, Gregg Davidson, Tim Helble, and Wayne Ranney, (editors). *The Grand Canyon − Monument to an ancient Earth – Can Noah's flood explain the Grand Canyon?* 2016. Kregel Publications.

[7]Jennifer A. Francis, 2018, The Arctic climate is shattering record after record, altering weather worldwide – MELTDOWN, Scientific American, v. 318, n. 4, p. 48-53.

[8]Banded iron formation. See: http://jersey.uoregon.edu/~mstrick/RogueComCollege/RCC_Lectures/Banded_Iron.html.