

RESOLVING THE RIDDLE OF THE SPHINX

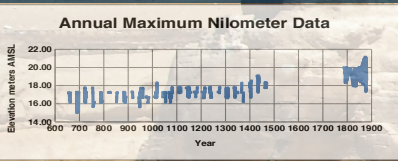
Egyptologists place construction of the Sphinx around the time of the pyramids, about 4,500 years ago. But based on the degree and type of weathering Dr. Robert M. Schoch¹, a geophysicist claims the Sphinx was exposed to prolonged periods of higher precipitation. There is no doubt that such conditions existed until the end of the last ice age about 9,000 to 12,000 years ago. At first this assumption appears plausible as even in desert environments weathering is typically dominated by precipitation. The riddle is humans were not capable of constructing anything so complex at that time. Such an early date would require construction by a lost civilization or perhaps even ancient astronauts. Some have even claimed the weathering is proof of Noah’s Flood. The Internet is full of wild speculation but the true cause of ancient weathering remains elusive.

WEATHERING TODAY

Today the Sphinx is under attack by shallow salty groundwater that wicks up and evaporates at the surface. As is does salt precipitates in the pore spaces causing the rock to exfoliate. This is a common problem in the Cairo area. Dewatering is being used to lower the water table and reduce this threat. Modeling was performed to evaluate the influence of dewatering.

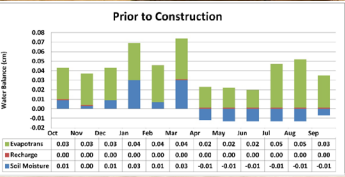
WEATHERING & AGE OF THE SPHINX

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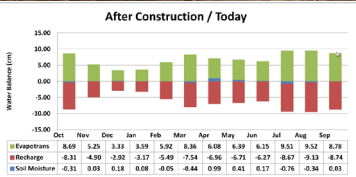


THE NILOMETER

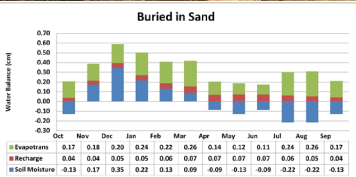
The Nilometer used to measure the level of the Nile River from 622 to 1921 AD. Nilometer floods average 17.6 m AMSL (21.4 m max). Located side gradient to the Sphinx. Levels above 20 m would flood the Sphinx excavation.



Proto-Sphinx likely a topographic high with elevations between 33 to 40 m AMSL. Surrounded by quarries used to build the pyramids. Water table at 17 m. Predicted annual recharge +0.01 cm.



Base of the Sphinx excavation now at 20 m AMSL. Nilometer floods average 17.6 m AMSL between 622 and 1921. Water table set to 17 m AMSL. Predicted annual recharge -78.78 cm.



The Sphinx spends most of the last 4,500 years partially buried sand. Surface elevation at 30 m with groundwater at 17 m AMSL. Predicted annual recharge +0.66 cm.

CONSTRUCTION

Unlike the pyramids the Sphinx is a statue carved from limestone bedrock. The excavation significantly decreased the depth to the water table putting the Sphinx within the upper limits of the annual Nile flood waters.

REPAIRS

Due to extensive bottom up weathering repairs have been documented on at least three occasions between 1,400 BC and today. If weathering was due to precipitation, simply diverting runoff could have resolved the problem.

PROPOSED SPHINX WEATHERING PROCESSES

PRECIPITATION: About 2.7 cm annually for the last 5,000 years. Much higher prior to 3,500 BC.

AEOLIAN: Removal of limestone bedrock via “sandblasting” by windborne particles.

DEW: Nightly dew dissolves salt that is redeposited in the morning causing exfoliation. How is the salt replenished?

GROUNDWATER: Upward wicking of shallow salty groundwater that evaporates at the surface depositing salt causing the rock to exfoliate.

NILE FLOODING: Annual flood water is funneled via the Nile River past Giza.

ANCIENT NILE FLOODING: 8,000 to 3,500 BC higher rates of precipitation produce extremely high floods. Likely would have inundated the Sphinx excavation if it existed.

SESOIL RESULTS

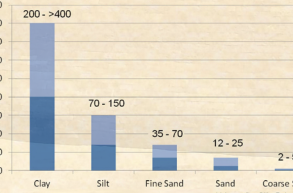
SESOIL vadose zone modeling was performed to evaluate groundwater recharge for various scenarios.

Results indicate that in carving the Sphinx the floor of the excavation encountered the capillary rise zone. This turned on weathering as shallow groundwater wicked up and evaporated at the surface. The wicking process was turned off whenever the excavation filled with sand. Only to be turned on again once the sand was removed. Even with only 2.7 cm of annual precipitation recharge though the sand could create a perched water table. This would depend on the properties of the limestone beneath and may have changed over time. Simulated dewatering groundwater depths of 0 to 10 m beneath Sphinx.

SESOIL DEWATERING RESULTS

Water Table Elevation (m AMSL)	Annual Groundwater Recharge (cm)
20	-125.07
19	-125.53
18	-125.63
17	-78.78
16	-35.03
15	-17.36
14	-9.70
13	-5.88
12	-3.78
11	-2.56
10	-0.01

Capillary Fringe Thickness



CONCLUSIONS

- Weathering appears to be the combination of wicking groundwater and Nile floods, not precipitation.
- Explains the bottom-up weathering without resorting to recarving the head.
- Weathering is the result of a sporadic interaction of various processes; thus weathering cannot to be used to estimate the age of the Sphinx.
- Today the sand is gone, so weathering is turned on.
- Not seen on other monuments as they are high and dry.
- Precipitation recharging through the sand may have soaked the Sphinx in a perched water table.
- Excess precipitation that supposedly weathered an older Sphinx would likely flood the excavation.
- Dewatering should reduce and eventually halt groundwater wicking.

1. R. M. Schoch and J. A. West, 1991, Redating the Great Sphinx of Giza, Egypt. Geological Society of America Annual Meeting, San Diego, October 1991, v. 23, no. 5, p. A253