

13. Post-impact Lake



Barringer (1905) recognized ~70 ft of lake sediments on the crater floor and reported they contained fresh-water shells and microscopic organisms with siliceous skeletons. Sketchy reports of the lake sediments were included in several other papers about the crater (*e.g.*, Tilghman, 1905; Fairchild, 1907; Merrill, 1908; Barringer, 1910, 1914; and Jakosky *et al.*, 1932), including the work of Shoemaker (1960), who included them in his cross-section of the crater (Fig. 3.4).

The lake sediments indicate climatic conditions were wetter at some point in the past and potentially at the time of the impact. Today the water table is far below the crater floor. In the well for the museum complex, the water table is 186 m deep, which places it about 183 m beneath the average pre-impact surface. Based largely on the presence of lake sediments, Shoemaker and Kieffer (1974) estimated the water table was about 30 m higher at the time of impact, arguing further that the impact occurred during a pluvial period in the late Pleistocene.

They made two important observations: the lake sediments are deposited directly on the fall-out debris unit without any intervening alluvium; and there is a concentration of fragile, pumiceous lechatellierite in those basal lake sediments, as if it floated before being buried. They concluded the lake must have formed immediately after impact. Roddy (1978) concurred, suggesting the water table may have been as much as 43 m higher than it is today to generate a 10 m deep lake. This puts the water table well up into the walls of Coconino and one can envision a ring of artesian fed springs or water falls around the crater. These springs and the lake they created produced a new habitat in the region. They may have also begun to dissect impact breccias on the crater walls. The lake sediments are continuous laterally across the crater floor based on exploration shafts and drilling. They also are stratigraphically continuous, with breaks only composed of volcanic ash. The lake eventually disappeared as climatic conditions became arid and the water table fell. A series of playa deposits were produced during the transition.

I suspect these lake sediments may provide one of the best climatic records on the Colorado Plateau for the late Pleistocene, at least from the time the impact occurred (50 ka?) until the lake disappeared (11 ka?). For that reason, efforts are underway to restore access to the lake sediments in the two surviving shafts in the crater floor. Access will permit detailed sampling of macro- and micro-fauna and the rich stable isotope record that those types of specimens can provide.

Only a small amount of data exists from previous fossil collections and the documentation is poor. Many samples were collected from dumps around the shafts and without reliable stratigraphic control.

One of the most interesting reports was generated by Reger and Batchelder (1971) who re-examined the collection of fossils that Holsinger made for Barringer. They identified the species of molluscs in two shafts (#1 and #3), a pit and cut near Silica Hill, and drill hole number 28. They separated the molluscs into groups that inhabit terrestrial, fluctuating water, and perennial water environments. Molluscs that favor perennial water habitats were found at all stratigraphic depths, including the deepest level analyzed (73 ft in Shaft #3).

Another interesting report, albeit brief (3 paragraphs) was written by Forester (1987). He received a collection of lake sediments from Shoemaker, who is said to have collected them from the wall of one of the shafts. Unfortunately, no details about sample depths or sample density is available, nor do we even know if more than one shaft was sampled. Nonetheless, he tried to reconstruct the evolution of the lacustrine system based on available material. The samples contain a diverse assemblage of ostracodes (19 species) and diatoms. One sample also contained benthic foraminifera. He suggests that the earliest

ostracodes are consistent with a saline lacustrine or spring environment, from which he infers the system was shallow. The water freshened resulting in a truly freshwater lake that hosted ostracodes that prefer cold water. He envisions the lake was fed by freshwater springs or seeps around the perimeter. The next ostracode assemblage is dominated by species that only inhabit freshwater springs or seeps, from which he suggests the lake had evolved into a marsh. This assemblage was eventually extinguished, when conditions became too arid to support any aquatic activity and, instead, transitioned to a dry playa environment.

It is unfortunate that the sample suite is not tied to the stratigraphy of the lake sediments. Taken at face value, the first assemblage suggests a lower water table than that inferred by Shoemaker and Kieffer (1974) and Roddy (1978). It is also seemingly inconsistent with the observations of Reger and Batchelder (1971). Because of the uncertainties involved in existing data and the importance of the issues involved, a new set of samples with good stratigraphic control is clearly needed. In addition, any new sampling should be coordinated with a large number of investigators to ensure that all fauna and flora in the samples are studied and integrated together to provide the best environmental and climatic reconstruction possible. A nascent team has been assembled, but we are still trying to secure funds to re-crib Shaft #2 and the Main Shaft so that the appropriate samples can be collected.