Floating a New Theory

Archaeologists are now starting to piece together how ancient Egyptians were able to transport massive stones from distant quarries to the building site for the pyramids of Giza.

Hadeer Sheisha, a geologist and physical geographer from the University of Marseilles, and ten other scientists, including geomorphologists, biostatisticians, and philologists, studied the history of the Khufu branch of the Nile River.

Tracking the peregrinations and evolutions of riverine streams through a desert is a challenging task. The Khufu branch, which has since dried up and disappeared, has long been a scientific mystery. But, because archaeologists suspected that the branch might have been close enough to the pyramids to assist by floating two-ton stones, the team persisted in plotting its course.

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Artist's depiction of the now defunct Khufu branch of the Nile River

Analysis of pollens found in the sediments of sample cores allowed the researchers to reconstruct the environment and fill in the picture of the ancient landscape. Pollens of plants such as papyrus (*Cyperus papyrus*), a sedge that requires wetter environments to grow, as well as pollens from upstream tropical plants that could only have been carried downstream by a significant volume of water, helped them map this lost branch of the Nile. The results established that thousands of years ago it flowed very close to the site of the pyramids.

"Our 8,000-year reconstruction of Khufu-branch levels improves understanding of fluvial landscapes at the time of the construction of the Giza Pyramid Complex, and demonstrates that Old Kingdom engineers harnessed the fluvial environment—the Nile and its annual floods—to exploit the plateau area overlooking the floodplain for monumental construction," said Sheisha.

Located along a famously large and shifting river, situated between a floodplain and a desert, the pyramids occupy a dynamic environment. Understanding how the rivers may have flowed, changed, and affected the construction of the monuments changes archeologists' understanding of ancient Egyptians and their capacity for large engineering projects.

Sheisha and his team are now researching the lost Khufu City, the earliest settlement along the Khufu River, to reconstruct the history of human occupation of the area since the Neolithic period. (*Proceedings of the National Academy of Sciences*)

—Brittany Steff

On the Origins of the Continents

To date, Earth is the only world known to have continents—elevated landmasses with distinct chemistries compared to the rest of the low-lying lithosphere or planetary crust. The seven continents are composed mostly of lighter, granitic materials in contrast to terrestrial ocean floors, which are made of dense basaltic rock. The geophysical mechanism for these lighter materials to have begun "floating" atop the heavier materials of Earth's crust has long been debated.

Depiction of a meteor burning as it heads towards Earth

SOLARSEVE/SHUTTERSTOCK

There is now key evidence for a compelling theory that points to an external trigger—namely, the impacts of massive meteorites—for the rise of Earth's continents. The theory suggests that meteorites gouged out tremendous amounts of material that underwent melting, a process allowing the more buoyant granite to ascend to and to solidify into continental structures.

"This idea that the landmasses on which each of us live formed at the sites where giant meteorites . . . smashed into Earth has been around for many decades," said Tim Johnson, an associate professor in the School of Earth and Planetary Sciences at the Curtin University in Australia, and the lead author of a recent study of how continents formed or evolved. "But there has been little hard evidence to support it . . . until now."

To arrive at their findings, Johnson and colleagues examined grains of zircon, the oldest-known material available in Earth's crust, recovered from the Pilbara Craton in Western Australia. Previous work had dated the formation of this craton—a stable piece of lithosphere—to as long ago as four billion years, making the Pilbara Craton the oldest-known continental crust.

The scientists measured the ratios of oxygen isotopes, or elemental varieties, contained within the zircons. The older zircon grains contained greater amounts of lighter oxygen isotopes compared to the younger grains. These results point to a "top-down" melting process, consistent with giant meteorite impacts on the young crust, versus a "bottom-up" melting process driven by internal activity deeper within Earth.

Additional evidence comes from groups of the recovered zircons with the same age. The shared ages show that the zircons formed and were then distributed over what is now the Pilbara during distinct periods. This evidence bolsters the hypothesis of major one-off impact events blasting out cohorts of zircons, and not with continuous, long-term geophysical evolution.

Detailed future analyses of ancient continental crust in Canada and Greenland, noted the researchers, could put the Pilbara-supported giant impact theory on even firmer footing. (*Nature*)

—Adam Hadhazy