Paleontologists discover fossilized embryos of oldest aquatic reptiles

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South American paleontologists report they have discovered fossilized embryos of the oldest aquatic reptiles, lagoon-dwelling "mesosaurs" that lived about 280 million years ago.

Long sought, the embryo finds may push back by 90 million years the fossil record of live birth and hatchlings from soft-shelled eggs in reptiles that were ancestral to birds, dinosaurs and mammals. And they point to the role that egg evolution played in the move of animals from the seas to land.

"An amazing discovery, more spectacular because of the quality of preservation," says paleontologist Graciela Pineiro of Uruguay's Facultad de Ciencias, who led the team that found the fossil mesosaurs, reported in the current *Historical Biology* journal. Mesosaurs were elongated galoots, crocodile-like reptiles almost five feet long that preyed on shrimp-like crustaceans. The fossil finds include an "exquisitely preserved" mesosaur embryo discovered in Uruguay - half-a-foot long but seemingly still coiled in an egg - and what resembles another such embryo carried by a pregnant female mesosaur, found in Brazil.

The finds raise at least two possibilities about how mesosaurs gave birth in their salty lagoons. The egg-like embryo suggests that they crawled on marsh land to lay their eggs shortly before they hatched. On the other hand, the seemingly pregnant mesosaur found in Brazil raises the possibility that the creatures may even have given birth to live young, which "hatched" from thin membranes encircling the eggs inside the

females.

"We have to go back to the conquest of land by four-legged animals to explain why this is so very important," says paleontologist Martin Sander of Germany's University of Bonn, who was not part of the discovery team. "A final step in this transition was when eggs evolved to be deposited on dry land."

Amphibians and fish have simpler eggs than reptiles, birds and mammals. The latter groups have a more complex egg with a yolk and an amniotic sac (hence the name "amniotes" encompassing all of those groups) that led to tougher, bigger embryos and young among land-dwelling creatures. Eventually these eggs evolved into the hard-shelled ones of birds and some reptiles, as well as the complex embryos of mammals. (Hard-shelled calcified eggs don't appear in fossils until about 210 million years ago, for anyone wondering about the whole chicken vs. egg question.) For that reason, fossil hunters have long sought these early eggs.

"Since we are paleontologists, we like to actually have the fossils," Sander says. "Now we have them," he says despite long-standing fears that the parchment-like outer membranes of the earliest amniote eggs wouldn't survive fossilization.

The search has gone on for awhile. In 1939, the late paleontologist Alfred Sherwood Romer, who founded the Society of Vertebrate Paleontology and wrote some of the field's first textbooks, reported discovery of "The Oldest Vertebrate Egg" (vertebrate means back-boned) from a fossil site in Texas in the American Journal of Science. The claim stood until 1979, when a second look at the fossil egg suggested it actually lacked the features of an amniote egg.

"The question is why didn't we find them until now, and the answer

seems to be that mesosaurs are very interesting creatures that lived in a place where eggs could more easily fossilize," Sander says. Mesosaurs are interesting because they seem to be among the first land-dwelling animals that evolved back into into living in the water, dwelling in salty marshes.

Regarding the "exquisite" preservation of the fossils, Pineiro offers "there is a direct link with the particular environment where the carcasses were deposited." The carcasses fell into very salty mud holding little oxygen, discouraging rot, worms and preserving even signs of soft tissues, "such as nerves and blood vessels," she says.

"I found the Uruguayan isolated embryo about three years ago in a pile of debris in an abandoned quarry," Pineiro says, by email. At first she thought the embryo was a "coprolite," fossilized dung (a specialty of its own in paleontology for what it says about creature diets) because it was so small. After it was cleaned and photographed a year later, she says, "I received a big shock when I realized that what I had collected was indeed a very small, curled mesosaur, the smallest I have seen ever!"

The next step for Pineiro and colleagues is finding more mesosaur fossils embedded in shale layers, rather than debris piles, at the former quarry site in Uruguay in order to confirm their finds. Since the fossilization process itself takes a long time and is very complicated, she says, finding more mesosaur hatchling embryos would add support to their suggestion that the ancient reptiles retained their eggs inside and bore live young.

Very likely, mesosaurs did bear their offspring live, instead of laying the almost fully-grown young in eggs awaiting hatching, Sander says, "but (Pineiro and colleagues) are being appropriately cautious." He points to the same adaptation, bearing live young, seen in later sea-dwelling reptiles. "This is one way that evolutionary science works: We suggest how things may have happened, we look at the fossils, and we see what

they tell us about how features really evolved."