Hot-spring fossils preserve complete Jurassic ecosystem

March 2 2012, By Tom Marshall

Geothermal wetlands in Yellowstone National Park.

Scientists are uncovering a beautifully-preserved ecosystem from around a Jurassic hot spring, helping fill a gap in the fossil record of more than 300 million years.

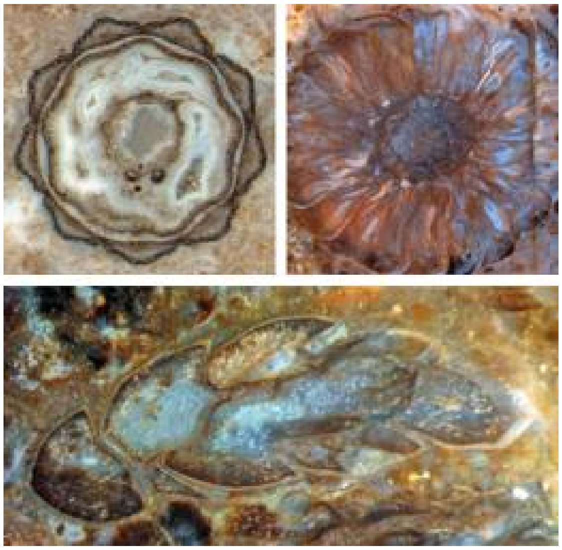
Discovered in Patagonia in southern Argentina, the San Agustin geothermal deposits include animals, plants, fungi and bacteria, preserved in three dimensions and with their internal structure largely intact.

The fossils date from around 150 million years ago, and formed around an area where water heated deep underground rose to the surface. This is the first time a hot-spring habitat from the Mesozoic era (from about 250 to 65 million years ago) has ever been discovered. And what has been catalogued so far is probably only the beginning, as the researchers are still working through their finds.

Hot springs are rare habitats at any particular moment, but they are treasure troves for palaeontologists, because the dissolved silica in their waters quickly penetrates and preserves the bodies of living things that die there. This means they are preserved in three dimensions rather than crushed into a two-dimensional film in the rock like organisms that are fossilised in other ways, such as by being buried in a mudslide.

"There's a lot more to come. It's a near-intact ecosystem that's beautifully preserved," says Dr. Alan Channing of Cardiff University, a member of the international team that's analyzing the fossils. "We have the remains of everything from the bacteria living right around the hot spring vents all the way to the plants, crustaceans and insects living in wetlands further away and the trees and ferns from the forests around the margins. We also have evidence of how all these organisms interacted. It's a Mesozoic version of the Rhynie deposits in Scotland, which are the most amazing early terrestrial ecosystem we have, and ultimately it's going to be just as important."

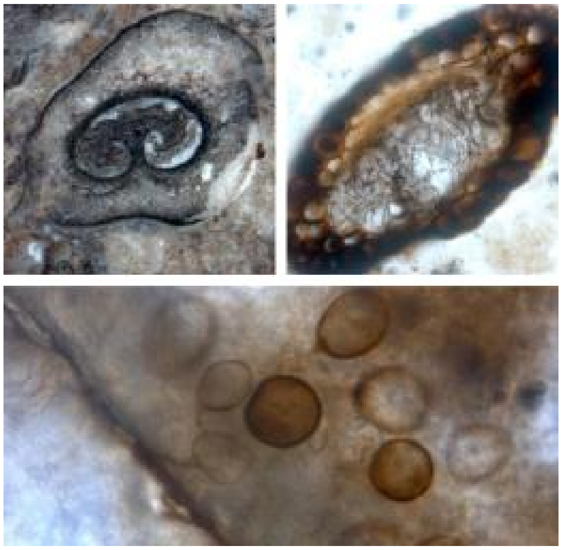
Before this discovery, the so-called Rhynie cherts were the source of almost everything we knew about the very early history of these environments and the things living in them. Formed in the Palaeozoic era more than 400 million years ago, they are far older than the recent discoveries.



Top left: Cross-section of the stem of the new species Equisetum thermal. Top right: Cross-section of a fossil conifer cone. Bottom: Longitudinal section of fossil conifer foliage.

After this, the fossil record was effectively blank until much younger hot spring deposits in the USA and New Zealand, laid down around 13 million years ago in the Cenozoic era that we're still in today. The discovery of a rich assemblage of fossils from between these extremes could transform scientists' understanding of a vital stage in life's development.

In some ways the San Agustin deposits are even more valuable than the Rhynie cherts; the latter are buried several metres underfoot so most of what we know of them comes from digging trenches or drilling cores. The Patagonian fossil beds are at the surface, so palaeontologists can walk among them and understand the makeup of the whole linked series of ecosystems far more readily.



Top left: Stem of a fossil aquatic fern. Top right: Fossil Equisetum leaf, showing fungal hyphae within its structure. Bottom: Chytrid fungus fossilised within decaying plant.

Channing has worked alongside Argentinian colleagues, many of them from the National University of La Plata, to gather and analyse the fossils. The team's latest paper, published in the journal *PALAIOS*, details just one aspect of the long-dead hot spring ecosystem - its fungi.

These include many members of groups that are still thriving in the modern world. Often they were already present in the Rhynie cherts, suggesting that these ancient lineages of fungi and the ecological roles they perform have been remarkably stable over very long periods and over very large areas.

Another publication by the same team last year focused on the site's plants - specifically, on members of the Equisetum family, still represented today by the horsetails. These living fossils are very different from most plants in existence today, and particularly from all members of the angiosperms, or flowering plants, which scientists think appeared around 100 million years ago.

The team has identified a new member of the family, Equisetum thermale, named for its love of these geothermal environments. Channing says it won't be the last new species to emerge from the San Agustin deposits.

It seems the plant life around hot springs underwent much greater changes than the fungi. The basic ecological niches remained the same, but plants from very different groups seem to have evolved to fill it, ending up with similar adaptations that let them deal with heat, saltiness and high metal content.

"The stage remains the same, but the players change," as Channing puts it. He adds that these plants weren't just hot-spring specialists, but generalists that would have been found much more widely in other habitats like coastal marshes. So these fossils can help us understand ancient ecosystems much more generally.

Because they often sit over deposits of gold brought near the surface by the geothermally-heated waters, active hot springs and their dormant remains are both eagerly sought by mining prospectors. Their investigations often give palaeontologists clues to where they should look for new deposits of fossils. Channing is still monitoring reports from these sources, and hopes to find more around the volcanically-active Pacific Rim that will illuminate the Cenozoic rise of the angiosperms, which is still not fully understood.

More information: Garcia Massini J, et al. 2012. First report of fungi and fungus-like organisms from Mesozoic hot springs. *Palaios* January 2012 v. 27 no. 1 p. 55-62. doi: 10.2110/¿palo.2011.p11-076r

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