Finding showing human ancestor older than previously thought offers new insights into evolution

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Modern humans never co-existed with Homo erectus—a finding counter to previous hypotheses of human evolution—new excavations in Indonesia and dating analyses show. The work was co-directed by NYU anthropologist Susan Antón. Pictured are skulls of Homo erectus uncovered in the 1930s in Indonesia. © Kenneth Garrett Photography (KennethGarrett.com)

(PhysOrg.com) -- Modern humans never co-existed with *Homo erectus* -- a finding counter to previous hypotheses of human evolution—new excavations in Indonesia and dating analyses show. The research, reported in the journal *PLoS One*, offers new insights into the nature of human evolution, suggesting a different role for Homo erectus than had been previously thought.

The work was conducted by the Solo River Terrace (SoRT) Project, an

international group of scientists directed by anthropologists Etty Indriati of Gadjah Mada University in Indonesia and Susan Antón of New York University.

Homo erectus is widely considered a direct human ancestor—it resembles modern humans in many respects, except for its smaller brain and differently shaped skull—and was the first of our ancestors to migrate out of Africa, approximately 1.8 million years ago. Homo erectus went extinct in Africa and much of Asia by about 500,000 years ago, but appeared to have survived in Indonesia until about 35,000 to 50,000 years ago at the site of Ngandong on the Solo River. These late members of Homo erectus would have shared the environment with early members of our own species, Homo sapiens, who arrived in Indonesia by about 40,000 years ago.

The existence of the two species simultaneously has important implications for models about the origins of modern humans. One of the models, the Out of Africa or replacement model, predicts such overlap. However, another, the multiregional model, which posits that modern humans originated as a result of genetic contributions from hominin populations all around the Old World (Africa, Asia, Europe), does not. The late survival of Homo erectus in Indonesia has been used as one line of support for the Out of Africa model.

However, findings by the SoRT Project show that Homo erectus' time in the region ended before modern humans arrived there. The analyses suggest that Homo erectus was gone by at least 143,000 years ago—and likely by more than 550,000 years ago. This means the demise of Homo erectus occurred long before the arrival of Homo sapiens.

"Thus, Homo erectus probably did not share habitats with modern humans," said Indriati.

The SoRT Project's investigations occurred in Ngandong and Jigar, two sites in the "20-meter terrace" of the Solo River, Indonesia. The sediments in the terrace were formed by the flooding of the ancient river, but currently sit above the Solo River because the river has cut downward through time. The terrace has been a rich source for the discovery of Homo erectus and other animal fossils since the 1930s.

As recently as 1996, a research team dated these sites of hominin, or early human, fossils to as young as 35,000-50,000 years old. The analyses used a technique that dates teeth, and thus provided ages for several animals discovered at the sites. However, other scholars suggested the sites included a mixture of older hominins and younger animals, raising questions about the true age of the hominin remains.

The goal of the SoRT team, which included both members of the 1996 group and its critics, was to understand how the sites in the terrace formed, whether there was evidence for mixing of older and younger remains, and just how old the sites were.

Since 2004, team members have conducted analyses of animal remains, geological surveys, trenching, and archaeological excavations. The results from all of these provide no evidence for the mixing of older and younger remains. All the evidence suggests the sites represent just a short time period.

"The postmortem damage to the animal remains is consistent and suggests very little movement of the remains by water," explained Briana Pobiner, the project's archaeologist and a paleoanthropologist at the Smithsonian Institution's National Museum of Natural History. "This means that it is unlikely that very old remains were mixed into younger ones."

In addition, clues from the sediments exposed during excavation suggest

to the projects' geoarchaeologists, Rhonda Quinn, Chris Lepre, and Craig Feibel, of Seton Hall, Columbia, and Rutgers universities, that the deposits occurred over a short time period. The teeth found in different excavation layers at Jigar are also all nearly identical in age, supporting the conclusion that mixing across geological periods did not occur.

"Whatever the geological age of the sites is, the hominins, animals, and sediments at Ngandong and Jigar are all the same age," said project co-leader Susan Antón.

The team applied two different dating techniques to the sites. Like earlier work, they used the techniques—U-series and Electron Spin Resonance, or ESR—that are applied to fossilized teeth. They also used a technique called argon-argon dating that is applied to volcanic minerals in the sediments. All three methods use radioactive decay in different ways to assess age and all yielded robust and methodologically valid results, but the ages were inconsistent with one another.

The argon-argon results yielded highly precise ages of about 550,000 years old on pumices—very light, porous volcanic products found at Ngandong and Jigar.

"Pumices are hard to rework without breaking them, and these ages are quite good, so this suggests that the hominins and fauna are this old as well," said project geochronologist Carl Swisher of Rutgers University.

By contrast, the oldest of the U-series and ESR ages, which were conducted at Australian National University by Rainer Grün, are just 143,000 years.

The difference in the ages means that one of the systems is providing an age for something other than the formation of the sites and fossils in them. One possibility is that the pumices are, in fact, reworked, or mixed

in, from older rocks. The other possibility is that the ESR and U-series ages are dating an event that occurred after the sites were formed, perhaps a change in the way groundwater moved through the sites.

Either way, the ages provide a maximum and a minimum for the sites – and both of these ages are older than the earliest Homo sapiens fossils in Indonesia. Thus, the authors concluded that the idea of a population of Homo erectus surviving until late in time in Indonesia and potentially interacting with Homo sapiens seems to have been disproven.

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