Neutrons help track down mammalian ancestors

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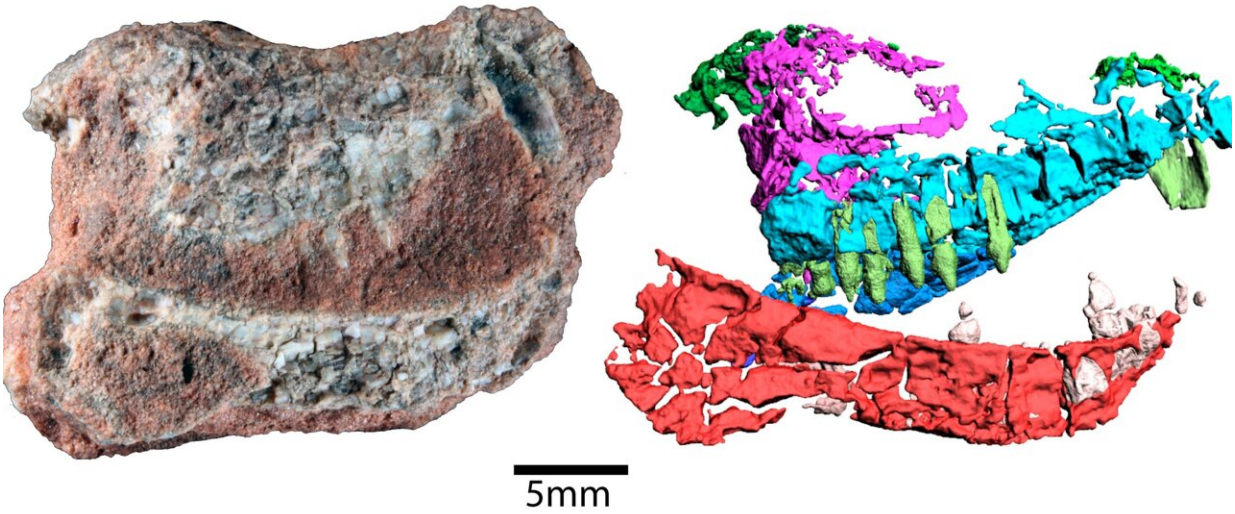

The 3D images show the surprising features of the find. Credit: *Scientific Reports* (2022). DOI: 10.1038/s41598-022-10486-4

A team of German and Argentinian researchers has used neutrons in the FRM II research neutron source at the Technical University of Munich (TUM) to identify an animal species that has been extinct for 220 million years. Findings on the new species provide surprising insights into the evolution of mammals.

A long snout, a massive jaw and sharp teeth—these are some features of the newly discovered species Tessellatia bonapartei. It belongs to the

group of Cynodontia (which literally translates to "dog teeth"), mammal -like animals from which mammals eventually evolved.

Argentinian researchers found the bones of the roughly mouse-sized cynodont species in the desert-like Talampaya National Park in the west of Argentina. "The bones were very fragile and therefore it was not possible to remove the surrounding rock without risking to damage them," explains Dr. Aureliano Tartaglione of the research neutron source Heinz Maier-Leibnitz at TUM. He worked on the project with Dr. Leandro Gaetano from CONICET (National Scientific and Technical Research Council in Argentina).

Clear images thanks to neutrons

The researchers first performed X-ray imaging to get a look at the bones. However, due to the high iron content of the petrified soil, the fossilized bones could hardly be distinguished from the surrounding earth in the X-ray images. For neutrons, in contrast, iron is no problem at all. Therefore, the researchers used neutron tomography at the RA-6 facility of the Comisión Nacional de Energía Atómica in Argentina.

RA-6's thermal neutrons produced promising images, but with low spatial resolution. Therefore, the researchers continued their analysis at ANTARES, an instrument at the research neutron source in Garching, Germany. "Here we have much better contrast using cold neutrons with a longer wavelength. Moreover, ANTARES offers higher spatial resolution," Tartaglione explains.

Whiskers and a massive jaw

It was only thanks to the high resolution of ANTARES that the paleontologists determined that the excavated bones belonged to a

previously unknown species. "This was a big surprise for us," says Tartaglione. "After all, cynodonts are globally very scarce during that particular period of the Triassic, the Norian." The newly discovered species, Tessellatia bonapartei, was named after leading Argentinian scientist Dr. José F. Bonaparte.

In Tessellatia bonapartei, the researchers found features that were not present in other findings. Surprisingly, the specimen had a greatly differing number of teeth in the upper and lower jaws, as well as a very massive lower jaw. In contrast to all previous cynodont specimens found, there is a space in the lower jaw external to the tooth row. The new specimen also had another distinctive feature: a canal in the upper jaw. When the animal was still alive, this canal was traversed by nerves. The characteristics of this canal suggest that Tessellatia bonapartei, like many of today's mammals, had whiskers.

One step closer to unraveling the mystery of the origins of mammals

The new species adds new information to the evolutionary tree of cynodonts. With this new knowledge, researchers can understand better the evolution of mammals by reconstructing evolutionary steps—like the development of whiskers—in the evolutionary tree through comparison with closely-related species as well as with others belonging to more distant branches. The results also confirm the theory that mammals originated in what is now the south of Brazil. The finding thus takes researchers one step closer to unraveling the mystery of the origins of mammals.

More information: L. C. Gaetano et al, A new cynodont from the Upper Triassic Los Colorados Formation (Argentina, South America) reveals a novel paleobiogeographic context for mammalian ancestors,

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