Megachirella wachtleri - The history of discovery

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Abstract

In 1999, Michael Wachtler recovered a partially preserved reptile-skeleton from the Kühwiesenkopf (Prà della Vacca) in the Pragser Dolomites. It was described by Silvio Renesto and Renato Posenato in 2003 as *Megachirella wachtleri*. Immediately, the importance of this fossil was recognized as pertaining to the crown group of squamata and also the lepidosauromorpha. But only in 2018, a group of scientists under the overall control of Tiago Simões were able to classify *Megachirella wachtleri* as the oldest known stem squamate by using the new high-resolution microfocus X-ray computed tomography data. This paper deals with the exciting found-history of Megachirella and the chronological course of research.

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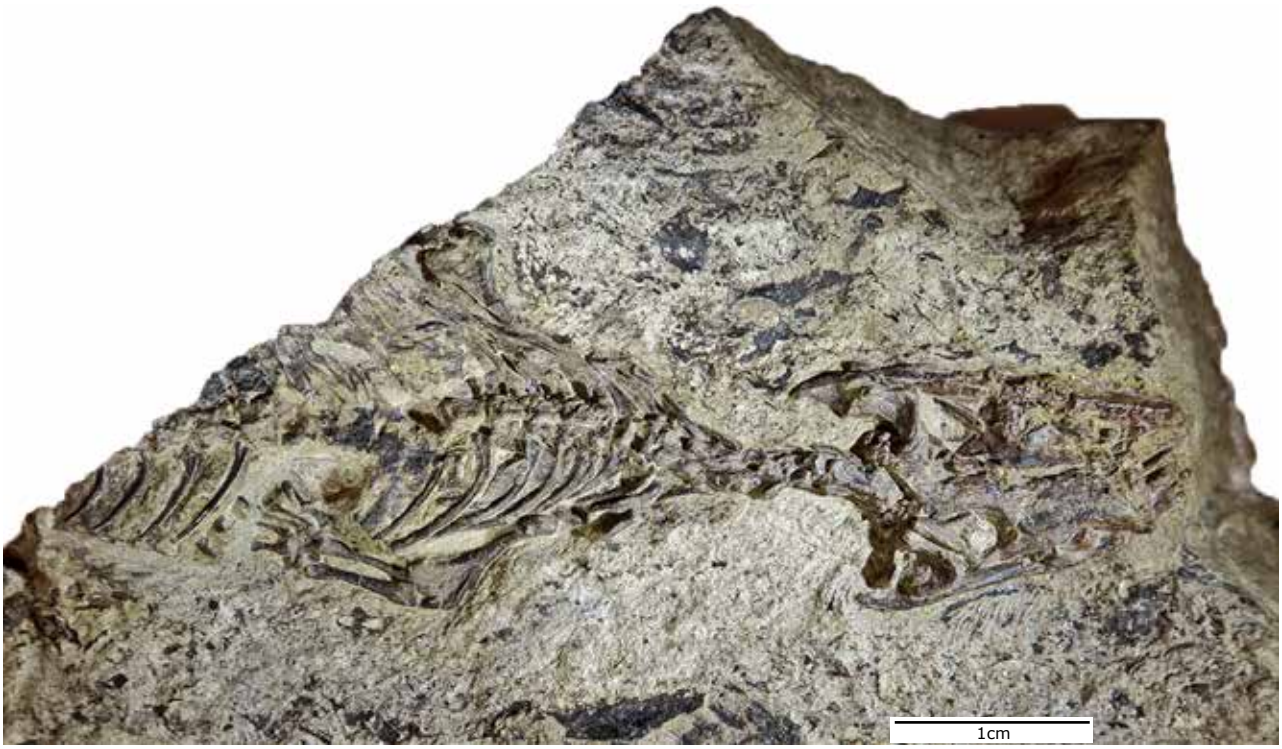

The holotype of *Megachirella wachtleri*. On the sides plant fragments are visible

Geological overview

The lowest parts of this sediments, having a varying thickness of about 200 m, was first named by Julius Pia in 1937 Pragser Schichten and consists of hemipelagic carbonate-terrigenous sequence of a marginal basin environment with some lens-shaped plant layers concentrated in centimetres-thick sediments of siltstone, marly siltstone, and carbonate siltstone. They overlie a carbonate platform consisting mainly of calcareous algae, called also by Pia as Unterer Sarldolomit. Successive to this, Prags Formation was reclassified under various names like Algenwellenkalk (Bechstadt & Brandner, 1970), and after that divided from Italian geologists in several sub-layers like Gracilis Formation, Dont Formation, Voltago Conglomerate, and Voltzia Beds of Recoaro (De Zanche et al., 1992; De Zanche et al., 1993).
Probably maintaining the original (De Zanche et al., 1992) '*Pragser Schichten*', given by Pia, due to its priority-rule would be the best. Some terms introduced like Voltzia Beds (originally from Recoaro) are effectively younger in age or they do not correspond to the real facts of this area because they are completely marine like the Dont Formation or the Voltago Conglomerate.
This Prags Formation can be followed in the Pragser Dolomites mainly from the Prags Lake (Gstattl) over the Kühwiesenkopf, across all other mountains like Hochalpenkopf and Maurerkopf till the Piz da Peres. Originally in the Anisian beach, basins were filled with varying thickness and, therefore, the layers are never uniform and alternate with silty and marly limestone, in which only sparse terrestrial plant remains occur; other sediments are rich in marine biota bivalves (mainly *Neoschizodus laevigatus elongates, Plagiostoma striatum*), brachiopods (*Coenothyris vulgaris, Punctospirella fragilis, Tetractinella trigonella, Spiriferina palaeotypus*), ammonoids, gastropods (*Naticella costata, Loxonema obsoletum*), encrinites (*Encrinites lilliformis*), and change in various occasions to hemipelagic carbonate-terrigenous sequences of a marginal basin environment with only a scarce fossil content. Also, several times, plant-bearing lenses in varying thickness are inserted.
Some of them can be distinguished by their different plant composition. Good indicators are the various *Voltzia*-conifers, or some ferns like *Anomopteris* or *Wachtleria* that oc-

The Kühwiesenkopf (Prà della Vacca). X indicates the exact position of *Megachirella*-finding point. The reefs on the lower left side pertain to the Anisian Sarl-Dolomite.

cur only in the upper layers. Also, the features of the plant-lenses vary considerably. Some can reach a thickness of 1 m evidencing several distinctive layers with good and entire preserved plants, alternating with plant-debris, probably as a result of frequent inundations, others consist of about 50 cm till 100 cm of material deposited during one huge flood evidencing chaotic muddled entire plants or parts of them.

The found history of *Megachirella wachtleri*

On the base of the Prags Formation, only about 10 m above the transition from the Sarl-Dolomite, Michael Wachtler recovered a part of a reptile in 1999. The exact locality was under the Kühwiesenkopf (Prà della Vacca) in the Braies Dolomites but pertaining to the municipality of Olang (it. Valdaora, Südtirol, Northern Italy). The small-sized slab lies between the fragments of cycads (*Bjuvia olangensis, Nilssonia primitiva, Pseudoctenis braiesensis, Taeniopteris simplex*, Wachtler, 2010) ferns (*Gordonopteris lorigae, Neuropteridium elegans, N. voltzii*), and conifers (*Voltzia unescoensis*). Only some rib fragments were observable in the beginning, the other remained hidden under the covering marl. Unfortunately, the second part of the slab holding a part of the back, the hind-limbs, and the tail remained enclosed in the rocks, and due to the fact that Wachtler was forbidden future research, this persisted till the present.
The specimen became the Dolomythos Museum-number KÜH 1501 (for Kühwiesenkopf) from Wachtler, which after was modified from the Museo di Scienze Naturali dell'Alto Adige/Naturmuseum Südtirol, Bolzano/Bozen, Italy, to the catalogue number PZO628.
The small slab was handed to the fossil vertebrate-specialist Silvio Renesto, who made, in 2003, a first publication with Renato Posenato, naming the reptile *Megachirella* (for Mega (large) cheiros (hand): little animal with large hand, referred to the shape and robustness of the manus) and dedicated it to Wachtler who discovered the specimen.
In the publication, the *'small diapsid reptile'* was just classified right as *'Megachirella does not show any significant synapomorphy of the Archosauromorpha, while it shares some of the derived characters diagnosing the Lepidosauromorpha, namely: a postfrontal which enters the upper temporal fenestra with loss of postorbital-parietal contact, the presence of paired sternal plates, and an interclavicle with an elongate*

The basal hemipelagic carbonate-terrigenous layers were named by Pia in 1937 Pragser Schichten. Now will be used also the name Gracilis-Formation being of Anisian-Bythinian age.

posterior stem'. But there were also some doubts: 'Other characters speak against close relationships with rhynchocephalians. Namely: the few preserved teeth are stout but not achrodont and there are no remains of a palatine tooth row'.

After consulting Silvio Renesto, in 2004, Wachtler published a popular scientific article on National Geographic. The title in the German version was 'Der Urahn von Schlangen und Echsen' (the ancestor of snakes and lizards). Wachtler wrote: '*Der nur eidechsengroße Saurier steht am Anfang einer Entwicklung, aus der dann Schlangen, Eidechsen und Leguane hervorgingen' (The small-sized reptile stays at the beginning of an evolution, from which lizards, snakes, and iguanas originated*). The same title was also chosen for the Italian issue ('*Il sauro che era grande come una lucertola, si colloca all'inizio della linea evolutiva da cui hanno avuto origine gli squamati, gruppo che comprende tra l'altro serpenti, lucertole e iguana*') with also the same message about the origin of squamata (Wachtler, 2004). Therefore, in 2004, the importance of Megachirella wachtleri and its classification as the crown-group of the squamata was spreading.

For about 10 years, the studies about this reptile was in a standstill till Silvio Renesto and Massimo Bernardi in 2013 published the article '*Redescription and phylogenetic relationships of Megachirella wachtleri Renesto et Posenato, 2003 (Reptilia, Diapsida*)' in which they tried to come closer to the enigma of the origins of this animal. But despite intense research, they were not able to determine the exact family-position, and staying vague by inserting *Megachirella* as ancestor of lepidosaurs: '*Phylogenetic analyses confirm that Megachirella is a lepidosauromorph close to the crown group lepidosaurs (Squamata? Rhynchocephalia). Megachirella enhances our knowledge of the series of morphological modifications that led to the origin of the Lepidosauria, the most diverse clade of extant reptiles.*' Finally, Renesto and Bernardi concluded that '*more data are needed to univocally assess the position of Megachirella with respect to the Squamata.*'

In 2018, a group of researchers, including Michael W. Caldwell, Mateusz Tałanda, Oksana Vernygora, Massimo Bernardi, Alessandro Palci, Federico Bernardini, Lucia Mancini, Randall L. Nydam, and led by Tiago Simões published '*The origin of squamates revealed by a Middle Triassic lizard from the Italian Alps*' and concluded the last big step. In a research letter published in the journal '*Nature'*, with the cover image made by the Italian paleo-artist Davide Bonadonna, they were able to summarize: *'Megachirella provides unique insights into the early acquisition of squamatan features, as it is the first unequivocal squamate from the Triassic*.'

Megachirella wachtleri, the first photo after the preparation (Archive Dolomythos)

GEOGRAPHICA

PALÄONTOLOGIE

Der Urahn von Schlangen und Echsen

Fossilienfund in den Dolomiten öffnet ein neues Fenster in die Evolution

Der Tod kam vermutlich schnell. Vielleicht raste ein tropischer Sturm über die Inseln, die vor mehr als 240 Millionen Jahren den Grundstock der heutigen Dolomiten bildeten. Er fegte den kleinen Saurier ins Meer. Sein Körper wurde im Schlick begraben, samt abgerissenen Farnen (Cycadeen), Bärlappgewächsen und Nadelbäumen. Das geschah kurz nach dem größten Massensterben der Erdgeschichte, an der Grenze vom Perm zur Trias. Diese Ära markiert den Beginn einer neuen Epoche der Evolution. Der nur eidechsengroße Saurier (rechts Mitte) steht am Anfang einer Entwicklung, aus der dann Schlangen, Eidechsen und Leguane hervorgingen.

Gefunden hat ihn der Südtiroler Michael Wachtler, als er in den Hängen der Olanger Dolomiten (oben) Versteinerungen suchte. Dabei wurde er auf eine Felsplatte aufmerksam, aus der einige kleine Rippen herausragten. Das Fossil (unten) schickte er dem italienischen Spezialisten Silvio Renesto von der Universität Mailand. Inzwischen heißt es offiziell *Megachirella wachtleri*. Das wegen seiner großen Krallen so benannte Tier konnte auf Bäume klettern, wo es vermutlich urzeitliche Insekten jagte – bis der Sturm es fortriss.

Megachirella, das „kleine Tier mit großer Hand", wie der Paläontologe Silvio Renesto es sich vorstellt.

Bottom: The reconstruction of *Megachirella wachtleri* made by Silvio Renesto. The cover-shield of Nature with the illustration of Davide Bonadonna. Both suggest that also insects were found, what does not reflect the real facts. The article in National Geographic written in 2004 by Michael Wachtler anticipated just the later research: "The ancestor of snakes and lizards". Michael Wachtler on the dangerous slops of the Kühwiesenkopf.

Juridical problems

After the finding and the first description of Renesto and Posenato in 2003, Wachtler was involved in juristic disputes regarding his research for many years. Big parts of Wachtler's collection stored in the Museum Dolomythos in Innichen were confiscated and about 5,000 objects removed and put to magazines in Bozen. Wachtler was forbidden to continue his studies regarding fossil plants and the palaeontology of the Dolomites or to take photographs of his objects. Meanwhile, other researchers were allowed to make publications about Wachtler's findings and collection. He was also condemned to an eight-month prison sentence and the Autonomous Province of Südtirol claimed extensive indemnity payments of about 240,000 Euros from Wachtler stating that his studies and discoveries had damaged the reputation of the country. For Wachtler, as the discoverer of Megachirella wachtleri, and also from many other holotypes of fishes and plants, it is important to leave all the detailed informations and also the exact position of Megachirella's finding place. Probably so that the missing second part of this ancestor of squamates can also be found.

The importance of Megachirella wachtleri

The most interesting conclusions were:
- The more than 242-million-year-old fossil, *Megachirella wachtleri,* is the most ancient ancestor of all modern lizards and snakes, iguanas, chameleons, geckos, known as squamates.
- *Megachirella* is about 75 million years older than what was thought were the oldest fossil squamata in the world.
- The CT scans revealed features that are only found together in squamates: a lower jawbone, a specific type of braincase structure, a unique collarbone, and some other small but significant details in the fossil's limbs.
- Molecular and skeletal clues revealed that geckos lie among the earliest lizards to evolve among the modern families and that iguanians (which includes iguanas, anoles, and chameleons) are more deeply nested inside the lizard tree of life.
- It can be estimated that the origin of the major groups of reptiles indicate a much older origin than previously imagined: before the Permian-Triassic Mass extinction almost 252 million years ago.
- *Megachirella wachtleri* lived in a time when the last aborescent *Lepidodendron* lycopods - probably two m to three m high growing *Lycopia dezanchei* - had its last apparition on Earth and with *Sigillcampeia nana* also the last representatives of the Sigillaria-lycopods.
- Gymnosperms like many conifer-families and also Cycads dominated the tropical beaches where *Megachirella wachtleri* evolved.
- In the Permo-Triassic transition in Europe and America, no flowering plants or ancestors of them were recovered. Otherwise, many plant-tribes of the former Angara-Land (Now the Fore-Urals) evidence angiosperm- features.
- *Megachirella wachtleri* provided the palaeontological world with a sort of 'Rosetta Stone' for reptile evolution.

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