Michael Wachtler

Some new and exciting Triassic Archosauria from the Dolomites (Northern Italy)

DOLOMYTHOS-Museum

Megachirella wachtleri - The history of discovery

by
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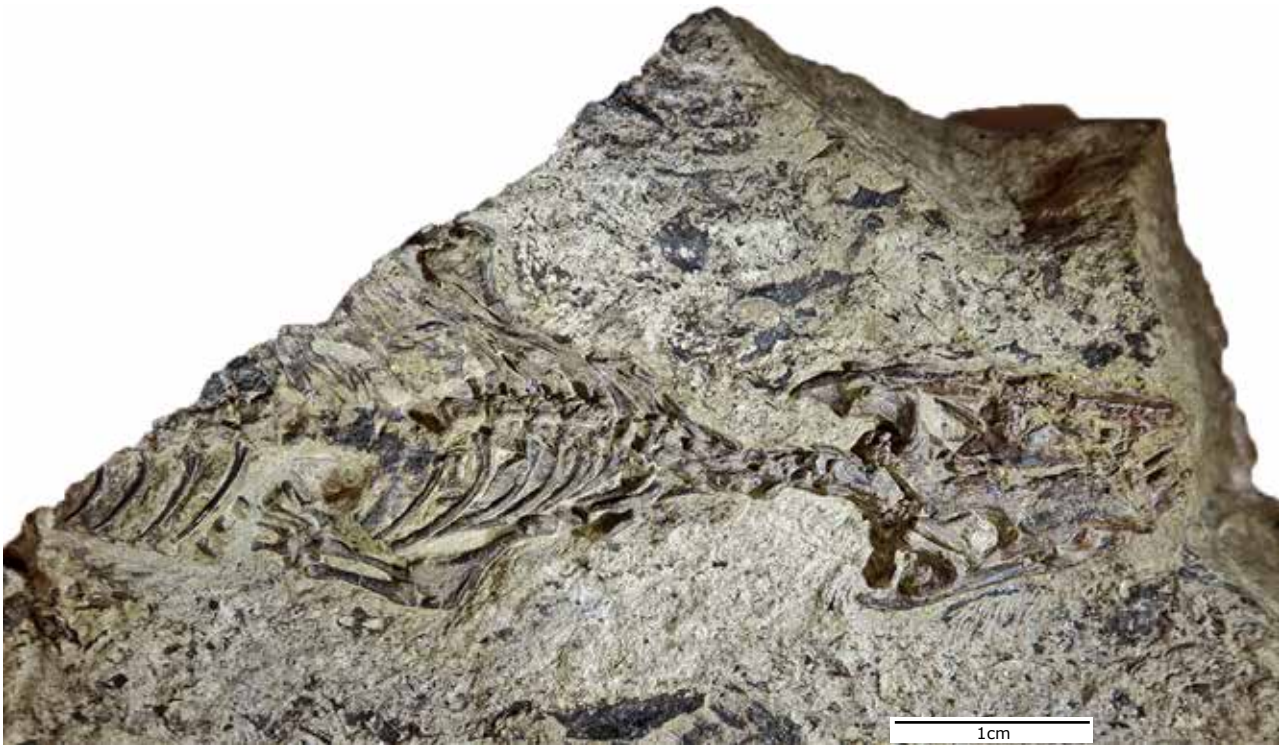
Abstract

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 („mega" and „cheiros" are ancient Greek words for „large" and „hand," respectively). Immediately, the importance of this fossil was recognized 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. It is the oldest and most primitive lizard known to date, a finding that earned the cover of the most accredited scientific magazine Nature. The fossil is important not only because its anatomy bridges a gap between two major groups of reptiles, much like Archeopteryx, but also because it extends the fossil record of lizards back in time by about 75 million years, into the middle Triassic (~242 million years ago). However, the oldest known fossil lizards before Megachirella were frustratingly "young", coming from rocks that originated in the Jurassic, only about 167 million years ago.



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

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 posterior stem'. But there were also some*

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.

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 wachtler*i 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.'*

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 340,000 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.
- 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 lycopods - probably two m to three m high growing *Lycopia* - had its last apparition on Earth and with *Sigillcampeia* 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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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 unzählige Insekten jagte – bis der Sturm es fortriss.

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

NATIONAL GEOGRAPHIC • JULI 2004

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.

Early-Middle Triassic vertebrate tracksites from the Dolomites (Northern Italy)

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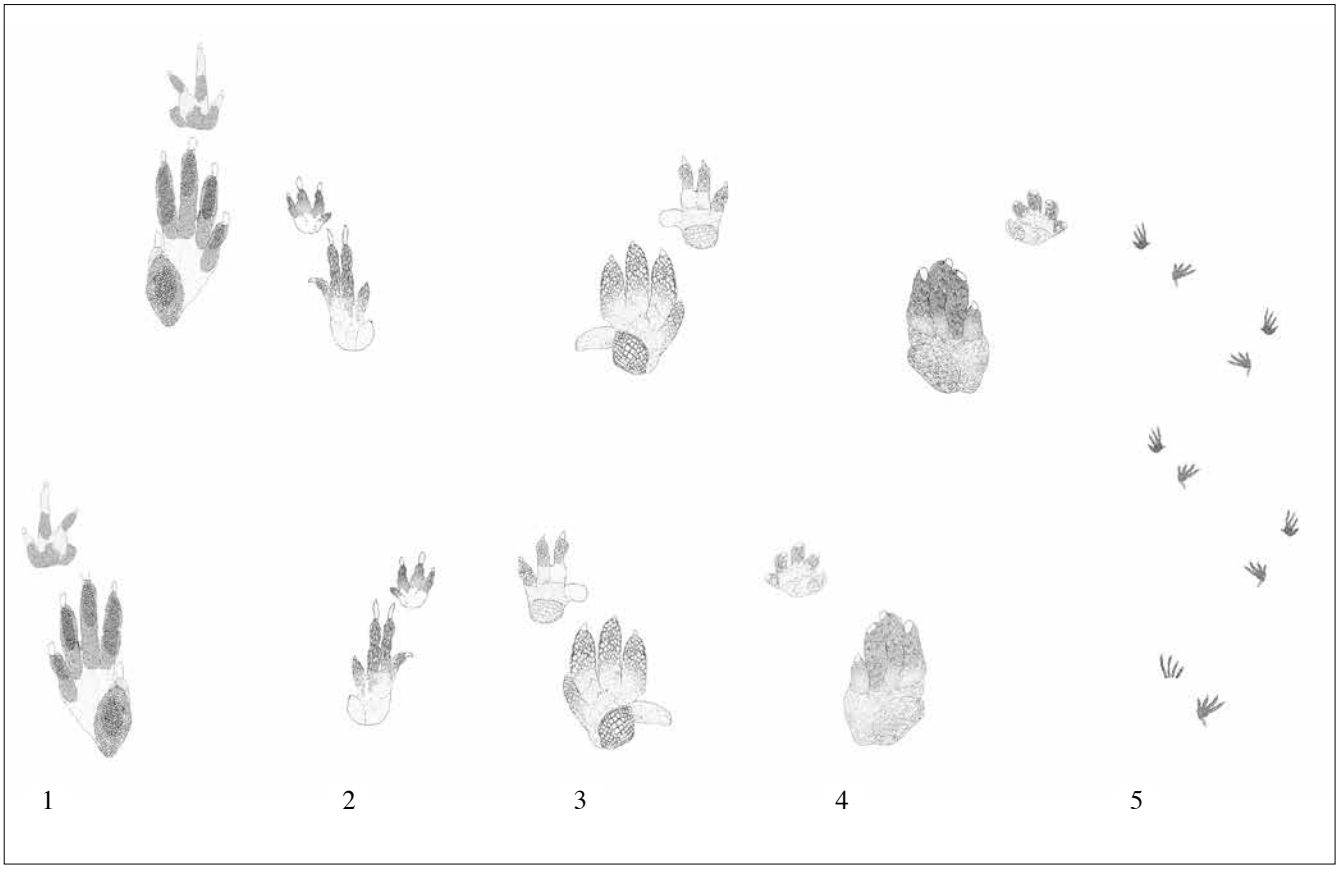
Abstract

The Dolomites are rich in Paleozoic-Mesozoic ichno-associations, which can be followed in the rock-sediments from the Early Permian till the Middle Triassic. Several well-preserved Anisian footprints were analysed and brought in the context to its paleoecosystem. In addition to the dominant *Rhynchosauroides tirolicus* imprints, the attention focuses especially on the larger-sized tracks from suggested archosaurs like *Isochirotherium delicatum, Chirotherium barthiii, Brachychirotherium parvum,* and especially on the only known ichno-species from the Dolomites – *Sphingopus ladinicus.* Mainly, all tracks evidence a clear tendency towards bipedalism with a functionally three-toed pes as is possible in the synapomorphies of basal dinosaurs.

Online: August 2018
Key words: *Rhyncosauroides*, *Chirotherium, Isochirotherium, Sphingopus,* archosaurs, Dolomites, Triassic



Different trackways from the Middle Triassic of the Dolomites: All are characterized by different skin-pattern: 1. *Sphingopus ladinicus* (ellipsoid pattern); 2. *Isochirotherium delicatum* (reticulate); *Chirotherium barthiii* (mosaic-shaped; 4. *Brachychirotherium parvum* (punctate to small rounded scales); *Rhyncosauroides tirolicus* (rectangular scales outlined in two parallel lines on the digits and rounded scales close to each palm).

Introduction

In the first decade of 1900, the Austrian geologist Julius von Pia, while working as a war field geologist in the Dolomites, recovered the first footprints of Triassic tetrapods from the Southern Alps in fine grained sediments near Lapadures (1850 m) over the hamlet of Olang. He handed the material to the scientist-colleague Othenio Abel, who on 25 September 1923, in occasion of the annual meeting of the Paleontological Society in Vienna (*Vorträge und Diskussionen auf der Wiener Tagung*), organized by himself, held a conference with the title '*Der erste Fund einer Tetrapodenfährte in der alpinen Trias*' (The first finding of a tetrapod-imprint in the Alpine Trias).

Julius von Pia, Josef Felix Pompeckj, and Gustav Arthaber added, in the same discussion, a brief written comment: 'The discovery is also geologically interesting because the sediments are a red till dark-grey sediment holding many carbonised plant remains and ripple-marks.' The entire presentation was published in 1926 in the '*Palaeontologische Zeitschrift*' in Berlin. Therefore, more correctly, the publication date will be 1923. Abel described the tracks as 'Similar to those that Beasley defined as rhynchosauroid trackways from the Trias of England' and added '*It can be stated that the prints of the posterior foot are characterised by an increase in the size of the digits from one to the fourth like in todays Sphenodon.*

The young Othenio Abel (Vienna, 1875 – Mondsee, 1946), founder of the paleobiology, which studies the life and environment of fossilized organisms. The slab with Rhyncosauroides-tracks was handled him by the Austrian geologist Julius Pia, married with Dr. Marianne Möller, a women scientist with parental origins in the Puster-Valley. The first presentation of this discovery was given on 25. September 1923 in a meeting of the Paleontological Society (Courtesy GBA, Vienna).

TAGUNG IN WIEN

vom 24. bis 29. September 1923.

Montag, den 24. September.

3 Uhr: Sitzung des Vorstandes und Beirats im Palaeobiologischen Lehrapparat der Universität (Stiege IX, Hochparterre).

4 Uhr: Jahresversammlung im Hörsaale des geol., pal. u. palaeobiol. Instituts.

6 Uhr: Eröffnungssitzung im großen Festsaal der Universität:

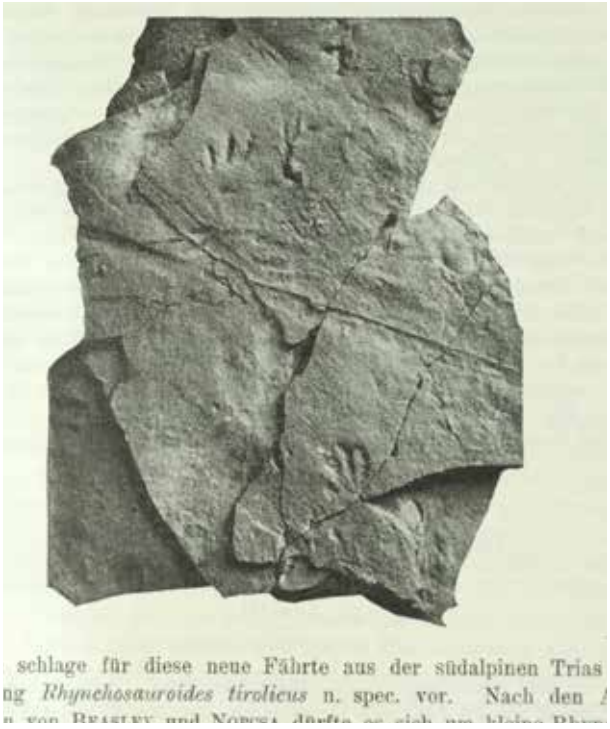
a) Begrüßungs-Ansprachen,

b) J. F. Pompeckj-Berlin: Die Anfänge des Lebens.

Dienstag, den 25. September.

9—1 Uhr im Hörsaal des Instituts:

O. Abel-Wien: Der erste Fund einer Tetrapodenfährte in der alpinen Trias.



Two sites of Anisian trackmakers, both first discovered by Michael Wachtler in 2007:

The Furkel-Pass-Piz da Peres. The terrigenous grey till red sediments hold rich ichnofaunas. The beautiful *Sphingopus*-imprints were found in the upper layers. The big *Rhyncosauorides* slabs came from the lower parts.

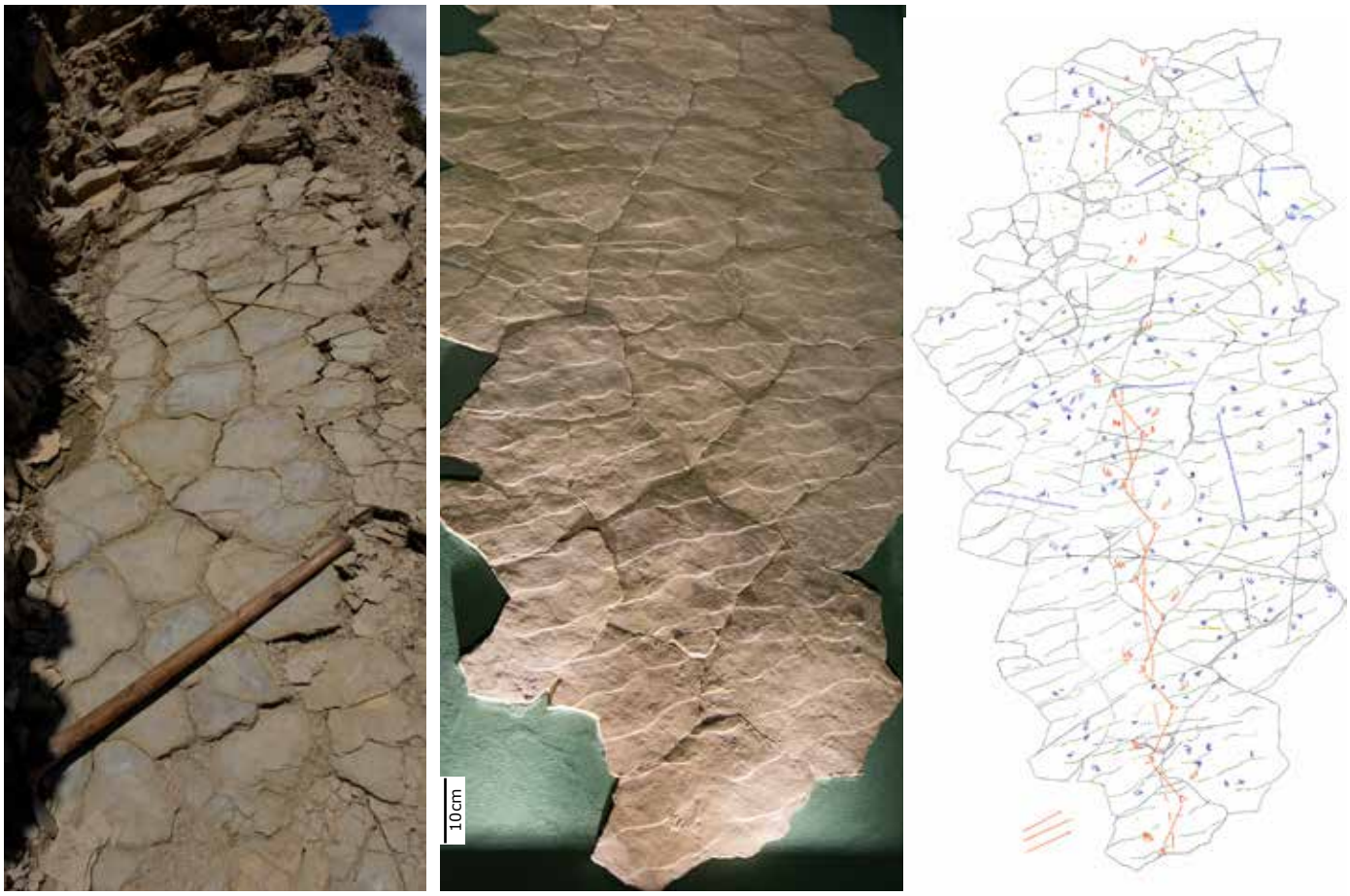
The locality Pozates in the Val Duron (Fassa-Valley), also discovered in 2007 by Michael Wachtler. There we encounter a fair amount of *Rhyncosauroides tirolicus* imprints together with *Chirotherium*, *Isochirotherium* and *Brachychirotherium.*

The hands have the same dimensional characteristics of the feet but are situated closer. I propose for these new tracks from the South-Alpine Trias the name Rhynchosauroides tirolicus. In agreement with Beasley and Nopcsa, these should be referable to a small Rhynchocephalian reptile that left its traces in the Triassic rocks.'

We had to wait until 1970 when Thilo Bechstädt and Rainer Brandner, in their PhD dissertation, recognized other footprints in the same area of Lapadures. Together with abundant *Rhynchosauroides tirolicus* imprints, Brandner (1973) described well-preserved chirotherian tracks defined as *Brachychirotherium parvum* (Hitchcock, 1889) and *Chirotherium rex.*

Then, in 2007, Wachtler discovered a new fossil site with interesting ichnospecies in a nearby area – the Furkel Pass in the direction to the Piz da Peres mountain (46°42'52.94"N, 11°58'38.13"E, 2202 m), holding an exhausting near-shore paleoecosystem with numerous tetrapod tracks (*Rhynchosauroides, Procolophonichnium, Chirotherium, Isochirotherium, Brachychirotherium, Sphingopus,* and *Rotodactylus*), marine biota (jellyfish, bivalves, etc.) and a rich flora, composed of conifers, ferns, horsetails, lycopods, and especially cycads (Todesco et al., 2008).

The strata belonged to the Obere Peresschichten sensu. Pia (1937) and Bechstädt & Brandner (1970) called it Richthofen Conglomerate and Morbiac Dark Limestone (Delfrati & Farabegoli, 2000) in the Italian stratigraphical nomenclature (both Illyrian in age). The Richthofen Conglomerate is dominated by red sandstones and siltstones and subordinate conglomerate beds. This unit has been interpreted as having been deposited in a relatively arid fluvial or in a tran-



A huge slab with R*hyncosauroides tirolicus* tracks. Right: In nature on the Furkel-Pass-Piz da Peres; middle: assembled (Coll. Michael Wachtler, Museum Dolomythos; right: drawing of the traces; green colour: ripple marks, red: continuous tracks and tail-drags, blue: other imprints, partly from juvenile animals. In the upper part invertebrate-traces, anellids, suggesting a small puddle.

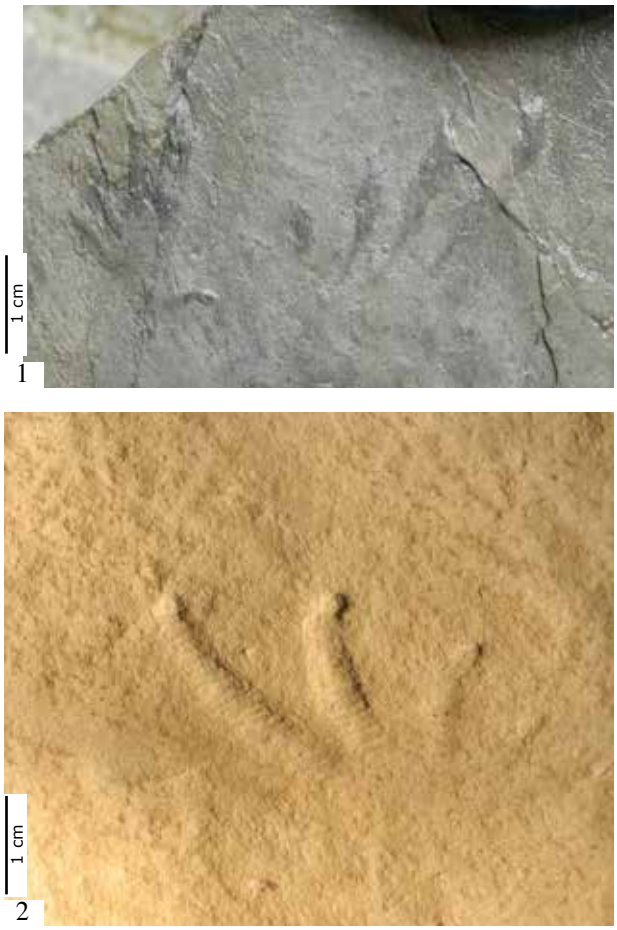
sitional continental to marine environment (Todesco et al., 2008).

The depositional environment is referable to a marine marginal setting with lagoons and swamps contaminated by terrigenous input. In addition to the dominant *Rhynchosauroides tirolicus* imprints, other archosaurs like *Isochirotherium delicatum* (Courel & Demathieu 1976), *Chirotherium barthiii* (Kaup, 1845), and *Brachychirotherium aff. B. parvum* (Hitchcock 1858) are typical. Also a new and interesting ichnospecies was found there by Michael Wachtler and described as *Sphingopus ladinicus* (Avanzini & Wachtler, 2012).

Another relatively rich and new ichnosite was discovered also by Wachtler in 2007, near Pozates (Val Duron, Fassa-Valley). A fair amount of *Rhyncosauroides tirolicus* imprints together with *Chirotherium barthiii, Isochirotherium delicatum* and *Brachychirotherium* was recovered (Todesco et al., 2008). The trampled layers occur in the Illyrian Morbiac Formation consisting of decimetric-thick grey silty and silty-limestone layers becoming towards the top wack- and packstones. Isolated plant remains were common. For all the layers, the depositional environment is referable to a marine marginal setting as a terrigenous tidal flat (Todesco et al., 2008b). In the Triassic of the Dolomites, the tracks of *Rhynchosauroides* are the most abundant ichnogenus.

Larger imprints, like *Chirotherium, Isochirotherium, Sphingopus,* or *Brachychirotherium* are probably due to their greater size making it more difficult to recover entirely. Other Anisian tracks are recorded from the Early Triassic of the Gampenpass, the Richthofen Conglomerate of Val di Creme (Recoaro), Val Fiorentina (Belluno), and Val di Non over the Morbiac Limestone from Bad Gfrill near Tisens. Similar sites are distributed also in other parts of Europe.

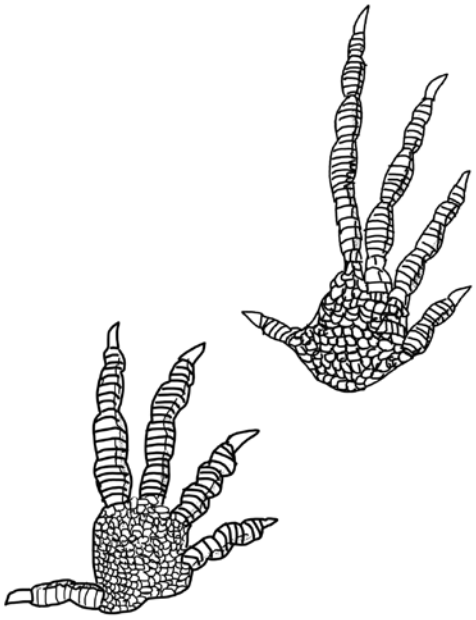
Imprints of jelly-fishes, Furkel-Pass-Piz da Peres, Coll. Michael Wachtler



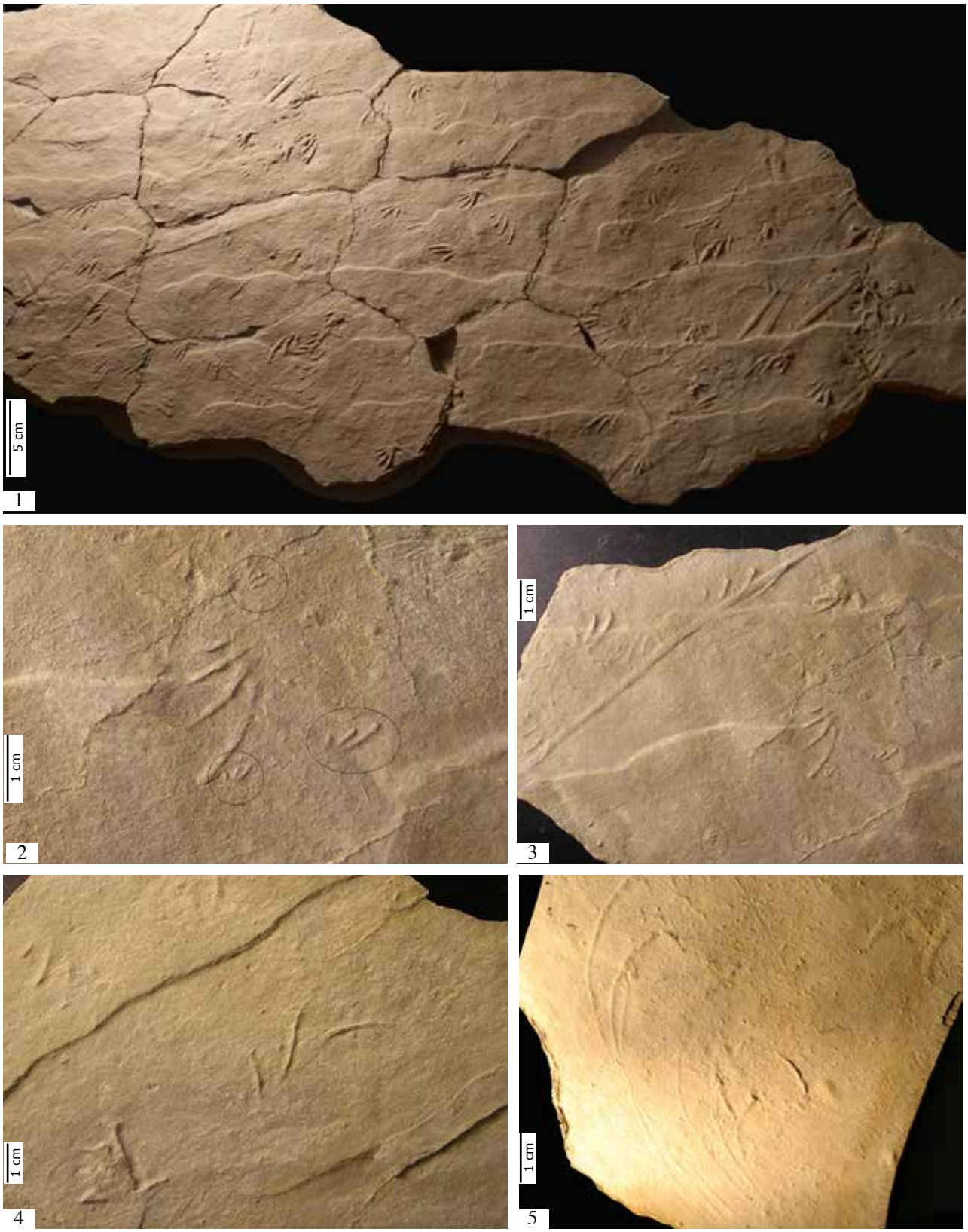
1. R*hyncosauroides tirolicus:* Two imprints, Val Duron, Coll. Michael Wachtler; 2. Detail of a manus showing well the skin-ripples (Piz da Peres, Coll. Michael Wachtler)

Rhynchosauroides tirolicus Abel 1926

The ichnogenus *Rhynchosauroides (rectipes)* was instituted by Maidwell (1911) on the basis of imprints found in association with skeletal remains of rhynchosaurs (Avanzini & Renesto, 2002). But contrary to the name given by Maidwell, *Rynchosauroides* can not be attributed to rhyncosaurs. Instead, it can be treated as the footprints of some lepidosauromorph or archosauromorph trackmakers. The long stratigraphic range from Early Permian of the Dolomites till the Late Jurassic (Spain) suggests that probably different ichnospecies attributed to *Rhynchosauroides* could have been made by different animals. They are characterized by relatively broad trackways of a small quadruped animal with low pace angulation. In most cases, the pes oversteps the manus laterally. The pentadactyl pes imprints are digitigrade and show long and slender digits that increase in length from I to IV, with digit IV being the longest. Its length varies from 45 till 60

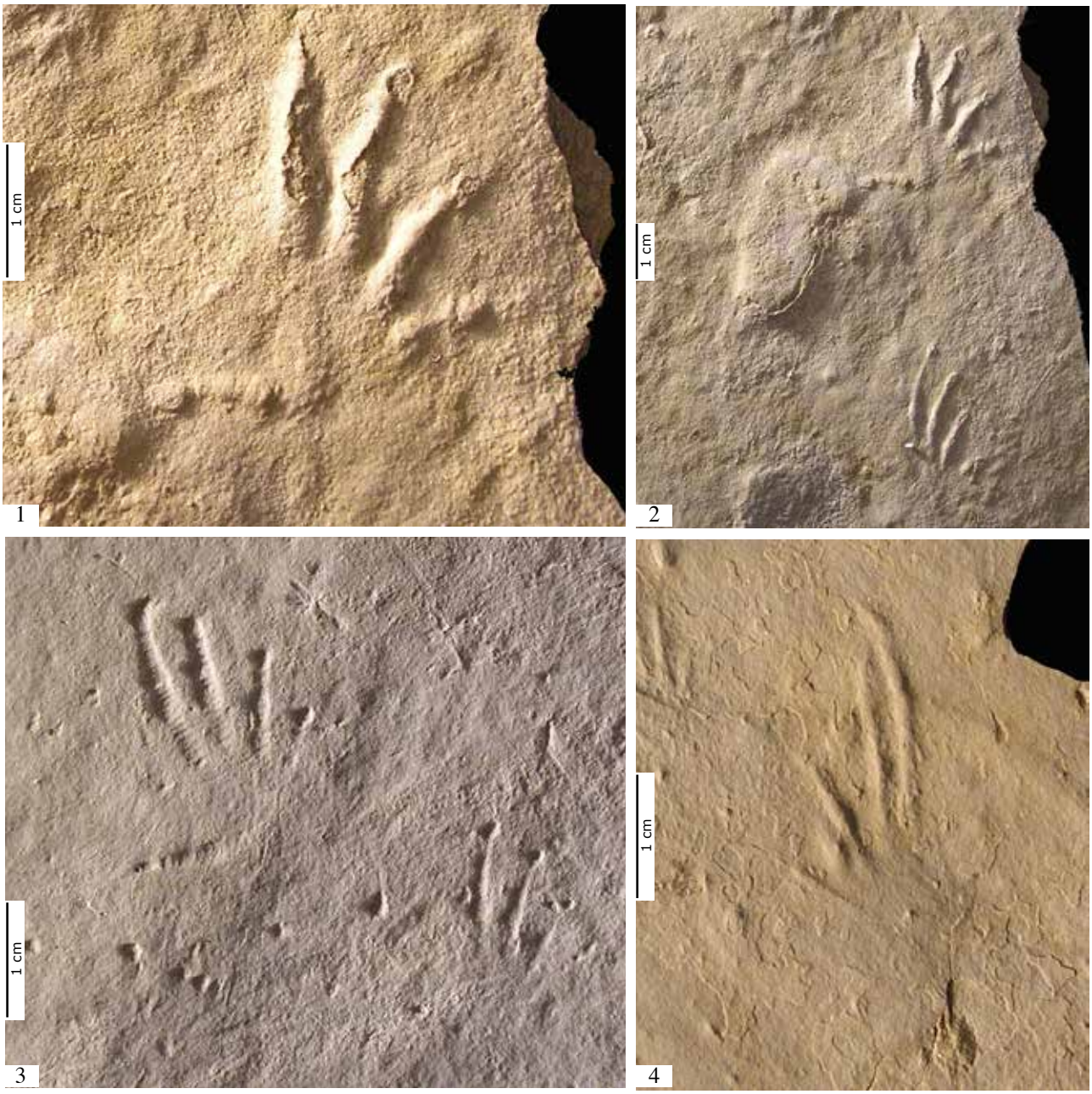


R*hyncosauroides tirolicus:* Manus-pes-sequence. Usually from the pes are preserved only the digits.



Rhyncosauroides tirolicus

1. A big slab with ripple marks, tracks and tail-drags (Coll. Michael Wachtler, Naturmuseum Südtirol, Bozen); 2. Juvenile and adult trackways; 3. Slender tracks with tail-drag; 4. Imprints with a broken digit; 5. Imprint with long slipping-trace (All Coll. Michael Wachtler, Naturmuseum Südtirol, Bozen).



Rhyncosauroides tirolicus

1. Excellent preserved manus; 2. Pes-manus trackway; 3. Pes-manus with skin impression; 4. Well preserved pes (All Coll. Michael Wachtler, Naturmuseum Südtirol, Bozen)

mm. Digit V even is short. Tiny sharp claws are present on all digits. Digit V is not always preserved, but in this case, it is positioned posterolateral to the other digits and is short.

The manus is similar in shape but shorter and rather semi-plantigrade or plantigrade. Well-preserved specimens show rounded pads and impressions of the scales. The manus length varies between 25 and 50 mm and in that it is something smaller than the pes. Occasionally, tail drag marks are preserved.

Rhyncosauroides footprints often occur on trampled surfaces in mass accumulations, together with scratch marks and tail gaits of the same trackmaker. Often, the trackways evidence an overstep of the manus by the pes. Therefore, the trackmaker belongs to a medium-sized lizard-like animal. Sometimes, the footprints, especially the manus, are so well preserved evidencing skin im-

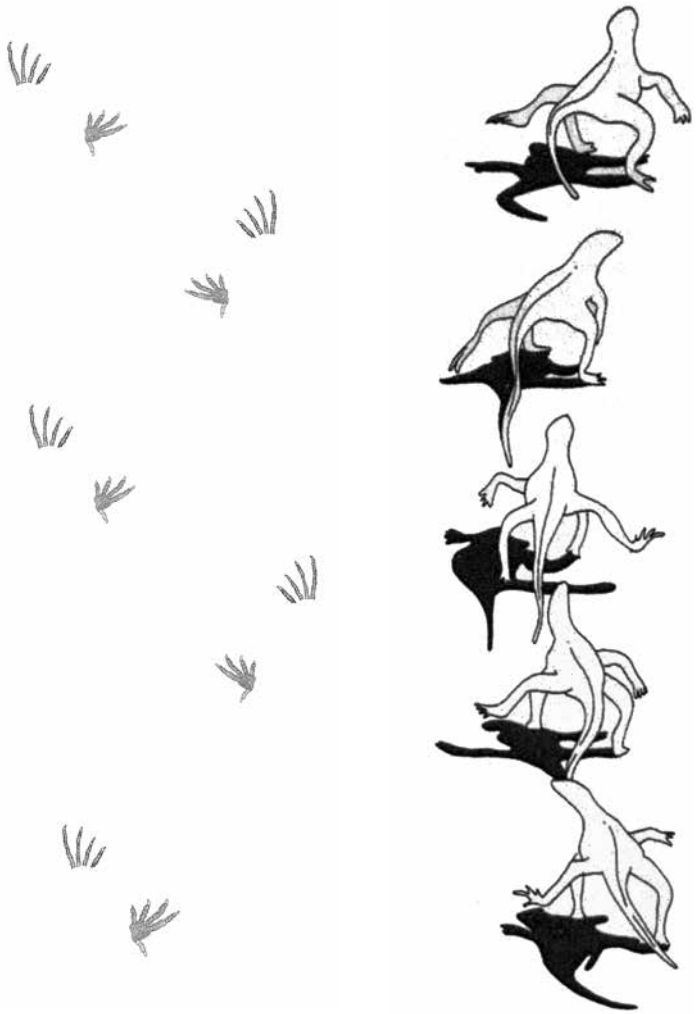
R*hyncosauroides tirolicus.* Well preserved slab with a pes-manus sequence. The pes imprints touch the soil only with the digits, but not with the heel (Coll. Michael Wachtler, Naturmuseum, Südtirol)

pressions with rectangular scales outlined in two parallel lines on the digits and a mosaic of rounded scales close to each other on the palm. Sometimes, especially from the Piz da Peres, the high preservation degree suggests that some of the footprints pertain to separate animals, but it can also be explained by a sexual dimorphism. Occasionally, the digits are thin and strongly arcuate inward. Other shows a pentadactyl pes with long and thin digits.

From all known Alpine skeletons of archosaurs, many can be excluded as trackmaker due to their different morphology. This is valid also for the enigmatic Rhyncosaurs. *Macrocnemus bassanii* (Nopcsa, 1930, 1931), a medium sized prolacertiform reptile recorded from lagoon deposits at the Anisian/Ladinian boundary in the Southern Alps (Avanzini & Renesto, 2002), especially from Monte San Giorgio is probably out of the question, because it seems to be a larger and more powerful terrestrial reptile.

Also, *Megachirella wachtleri* (Renesto & Posenato, 2003) discovered on the nearby Kühwiesenkopf/Pra della Vacca, belonging to the crown-group of squamates evidence different and more climbing-adapted manus digits and claws.

Another partly recovered skeleton from the Piz da Peres Furkel area, *Wachtlerosaurus ladinicus*, suggesting a classification in an early group of avian-line-archosaurs has more possibilities to be inserted as trackmaker from *Rhyncosauroides tirolicus* (Perner, 2018; Wachtler, 2018). The skeleton shows a well-preserved left hind limb and complete metatarsals from 1 till 5. The first metatarsal is stout and much shorter than the others (its length being about one-third of that of the second metatarsal and one-fourth of the third one), with a wide

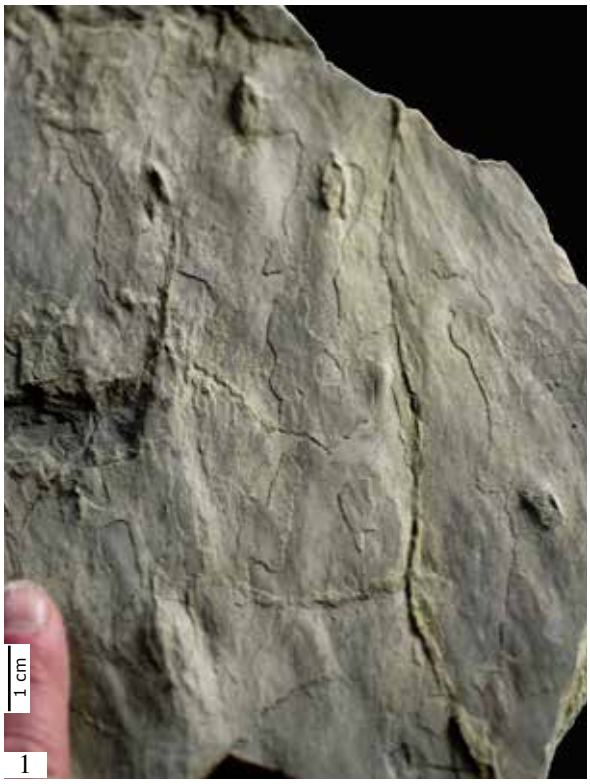


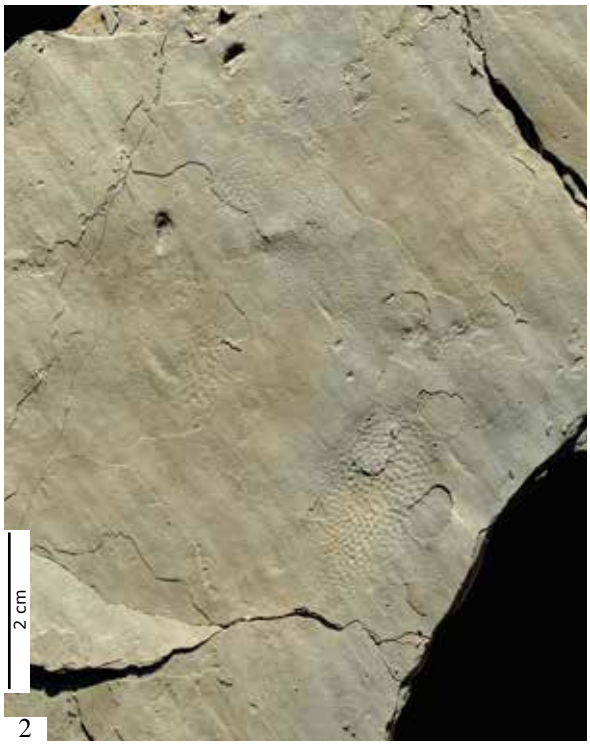
R*hyncosauroides tirolicus.* A detail of the big slab with a manus-pes trackway-sequence (Coll. Michael Wachtler, Dolomythos, Innichen). Movement of the animal after Avanzini & Renesto, 2002.

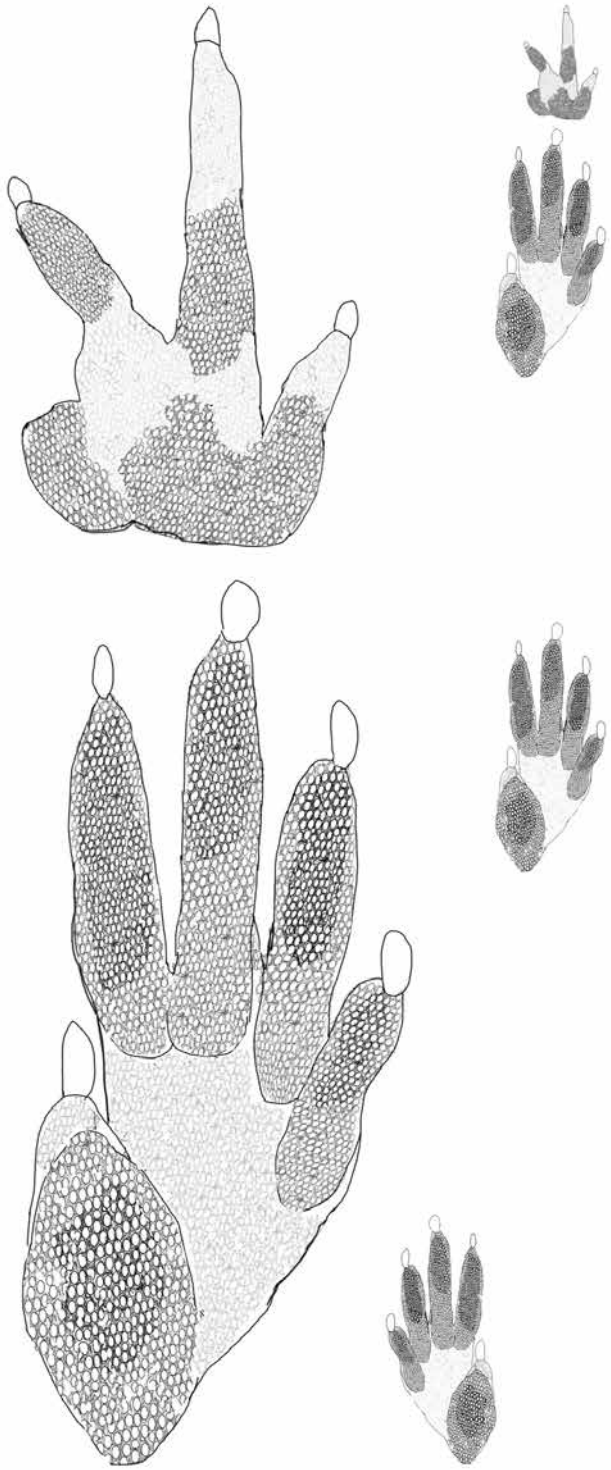
proximal head, the second and third metatarsals show a straight shaft with slightly expanded heads. The proximal articular sur- face is deeply concave as it appears in hatch- lings or very immature specimens of extant reptiles where metatarsals are not yet fully ossified. The fourth metatarsal has approximately the same size or is slightly larger than the proximal head of the third metatarsal, suggesting that it was possibly as long as, or somewhat longer, than the third metarsal; the fifth metatarsal has an expanded proximal head which is medially bent, with an articular
area for the lateral surface of the fourth distal tarsal. The phalanges are short, the ungual phalanges form laterally compressed and dorsoventrally high claws. There are good possibilities that *Rhyncosauroides tirolicus* tracks pertain therefore to some Avemetatarsalian archosaurs.

Sphingopus ladinicus (Avanzini & Wachtler, 2012

Another interesting ichno-species is represented by *Sphingopus ladinicus* (Avanzini & Wachtler, 2012), with almost 30 cm length the biggest tracks recorded in the Triassic Dolomites and having some affinities with the Parachirotheriidae. The Late Anisian (Illyrian) succession, cropping out on the Piz da Peres, shows in the upper layers – in vicinity to the Contrin Formation – a mixed carbonate and terrigenous succession with bigger footprints, although also the characteristic *Rhyncosauroides tirolicus* imprints are common (Avanzini & Wachtler, 2012; Todesco et al., 2008). The mud deposits were made in a marine marginal lagoon, plant debris is common, but entire or bigger plant remains are missing. All specimens from *Sphingopus ladinicus* came from the same

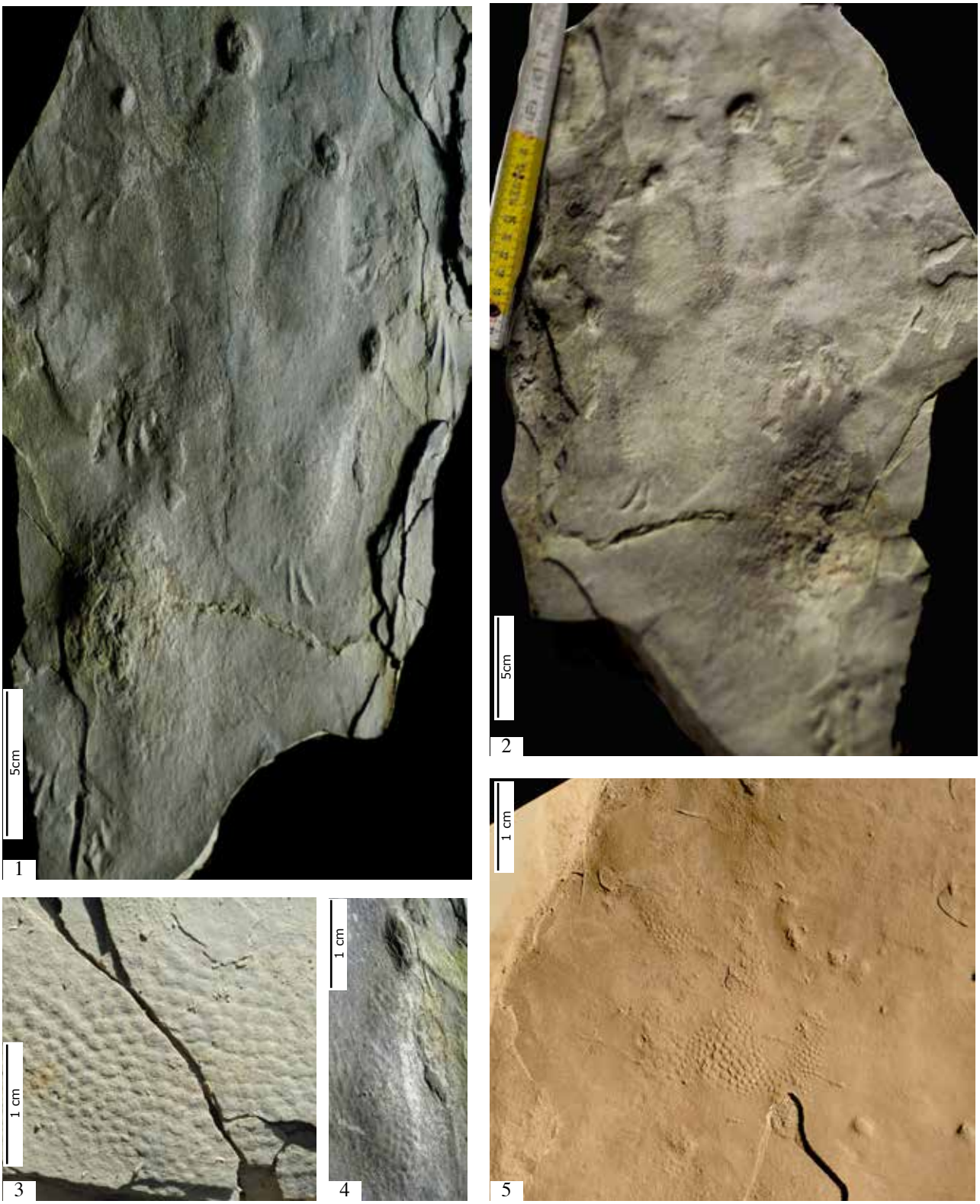






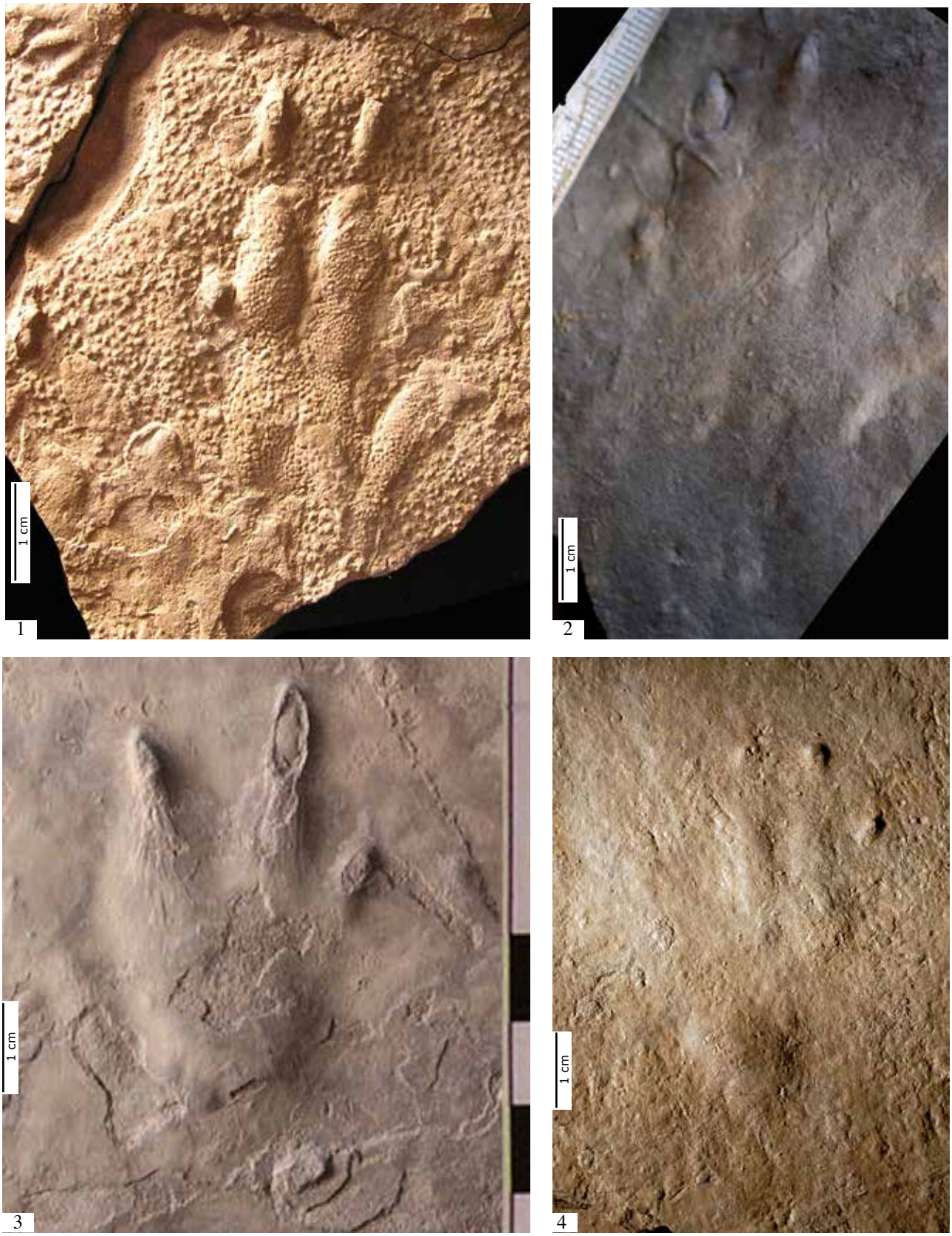
Sphingopus ladinicus (Avanzini & Wachtler, 2012). Manus-pes

The slabs photographed immediately after the recovery. 1. The holotype FP003. Print and counterprint of a manus-pes set. The pes is long and slender, pentadactyl with anteriorly directed, subparallel digits II-IV, a small and proximally positioned digit I and a marked proximal pad V. The manus track is small and tridactyl, rounded with a pronounced heteropody - and placed in front of the hind foot. It is slightly longer than wide (12cm long,9 cm wide. The manus is placed in front of the pes and divergent from the long axis (Coll. Michael Wachtler, Naturmuseum Südtirol)



Sphingopus ladinicus (Avanzini & Wachtler, 2012). Pes

The slabs photographed immediately after the recovery. 1-2. Paratype FP001 - Print and counterprint of a single pes. The pes is (28 cm long and 12 cm wide. All digits are slender, the claws are elliptical. R*hyncosauroides tirolicus* tracks are also visible. 3. Impression of skin traces. 4. Impression of a digit. 5. Isolated Manus. (All Coll. Michael Wachtler, Naturmuseum Südtirol)



***Isochirotherium delicatum*, Courel & Demathieu 1976**

1. Well-preserved pes with phalanges and claw impressions of digits, 2. Pes; 3. Perfect impressed manus with skin traces. 4. Manus (All Piz da Peres, Furkel, Coll. Michael Wachtler, Naturmuseum Südtirol, Bozen)