# A new reptile from the Middle Triassic (Anisian) of Piz da Peres (Dolomites – Northern Italy)

by
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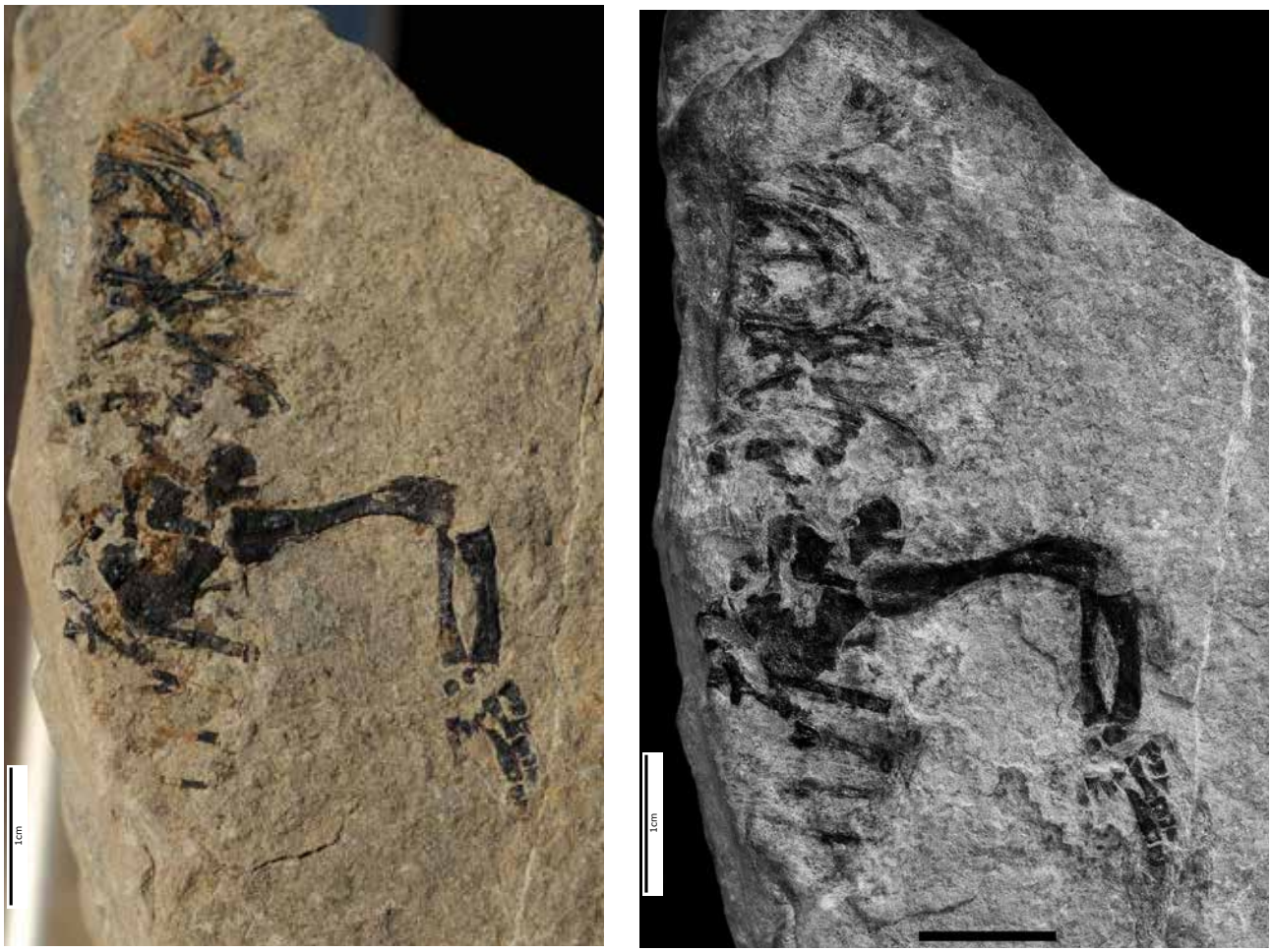
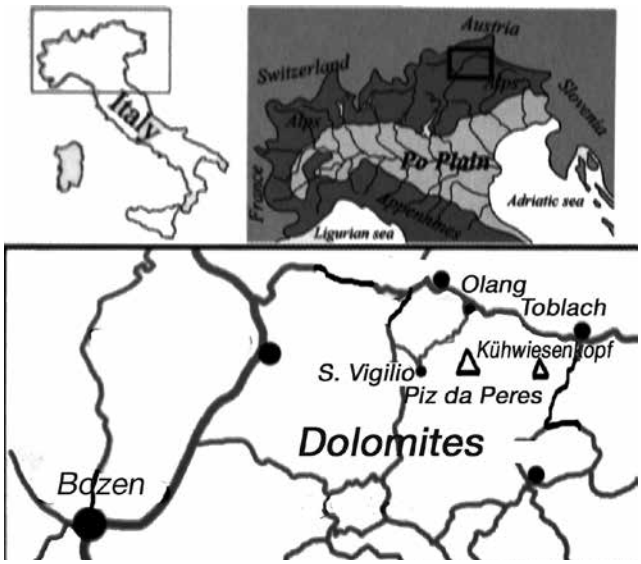
**Abstract**

The partial skeleton of a tetrapod collected in the Middle Triassic (Illyrian, late Anisian) fossiliferous locality of Piz da Peres (Braies Dolomites, Bolzano Italy) is described. The small size and the degree of the ossification suggests that the specimen represents a juvenile exemplar of an early growth stage. Despite the incompleteness of the specimen, some characters are similar to the dinosauromorphs or to an evolving line of the dinosaurs and birds. As a mainly complete skeleton from the Ladinian of the Dolomites with many similar features was described as *Wachtlerosaurus ladinicus*, a classification in this genus could also be plausible. Probably the small-sized *Rhyncosauroides tirolicus* tracks, recovered frequently in these sediments, also belong to this animal.

Online: August 2018
Key words: Rhynchosauria, Illyrian, late Anisian, Middle Triassic, Dolomites, Italy.




1. Specimen PZIF 60/2009, immediately after recovery; 2. After the preparation. Scale bar equals 10mm.

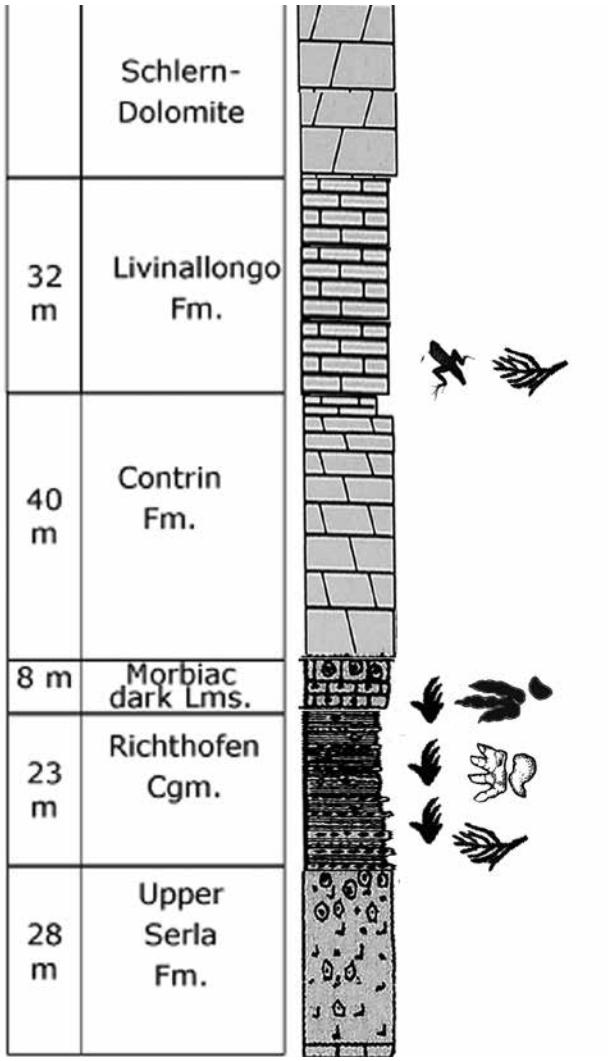



Map of the Piz da Peres locality (S. Vigilio Marebbe) in the Braies Dolomites

**Zusammenfassung:** Ein teilweise erhaltenes Skelett eines Tetrapoden der Mittleren Trias (spätes Anisium – Illyr) aus der Fossillagerstätte Piz da Peres (Pragser Dolomiten, Südtirol, Italien) wird beschrieben. Die Körpergröße und das Maß der Verknöcherung weisen auf ein jugendliches Exemplar in einem frühen Wachstumsstadium hin. Trotz seiner Unvollständigkeit liegen Hinweise vor, um es zur Gruppe der dinosauromorphen Skelette zu stellen, einer frühen Entwicklungslinie in Richtung der Dinosaurier oder der Vögel. Da aus dem Ladin der Dolomiten mittlerweile ein ähnliches, aber vollständiges Skelett vorliegt, das als *Wachtlerosaurus ladinicus* (Perner, 2018) beschrieben wurde, wäre sogar eine genauere Einordnung in diese Gattung plausibel. Zu überprüfen ist auch ob die häufig in diesen Schichten gefundenen *Rhyncosauroides dolomiticus* Trittfährten von diesem Tier hinterlassen wurden.

## Introduction

The geological and paleontological richness of the Braies Dolomites is well known since 1875, when the German geologist Hermann Loretz first described various marine invertebrates (brachiopods, molluscs). After him, Edmund von Mojsisovic (1882) completed a basic work on ammonoids, even if the most widely accepted and long-standing study was published by Julius Pia (1937). Further studies (Bechstädt & Brandner, 1970; De Zanche et al., 1992, 1993) increased the knowledge. In 1999, Wachtler discovered surprisingly rich fossil layers in this extensive area between Kühwiesenkopf (Italian Prà della Vacca) and Piz da Peres (nearly 20 km in length) at mostly Middle Triassic levels that contained abundant Early Mesozoic floras and also a single skeleton of the till now oldest squamata (*Megachirella wachtleri*, Renesto & Posenato, 2003; Renesto & Bernardi, 2014; Simões et al., 2018), additionally to new ichnofaunas, and marine biota (e.g., bivalves, brachiopods, ammonoids, and fish skeletons) as well. The first results were published in 2002 (Broglio Loriga et al.). In 2009, the UNESCO inserted this new 'Fossillagerstätte' in the world heritage list like other parts of the Dolomites for its geological beauty.




Stratigraphic section of Piz da Peres. Modified from De Zanche, 1993

In 2009, Wachtler collected the partial skeleton of a reptile above the Furkel Pass in the direction of Piz da Peres, in the lowest part of the Buchenstein Formation of the Illyrian age, slightly above a site with a rich ichnofauna, which is the subject of the present publication.

## Geological setting

Until now, the richest fossil horizons and especially well-preserved plant remains have been found in the Prags Formation, Anisian in age. Studies on brachiopods (Bechstädt & Brandner, 1970) and foraminifers (Fugagnoli & Posenato, 2004) suggest a Pelsonian age; integrated studies between palynomorphs and ammonoids narrow the time interval for the deposition of the fossiliferous layers down to the boundary between the Middle and Upper Pelsonian (Kustatscher et al., 2006). The slightly younger Richthofen Conglomerate (Avanzini et al., 2007) and Morbiac Dark Limestone (Delfrati & Farabegoli, 2000), both Illyrian in age, include a rich ichnofauna, mainly *Rhyncosauroides* tracks but also archosaur footprints (Isochirotherium, various *Chirotherium* genera (Todesco et al., 2008) and a new species of dinosauromorph

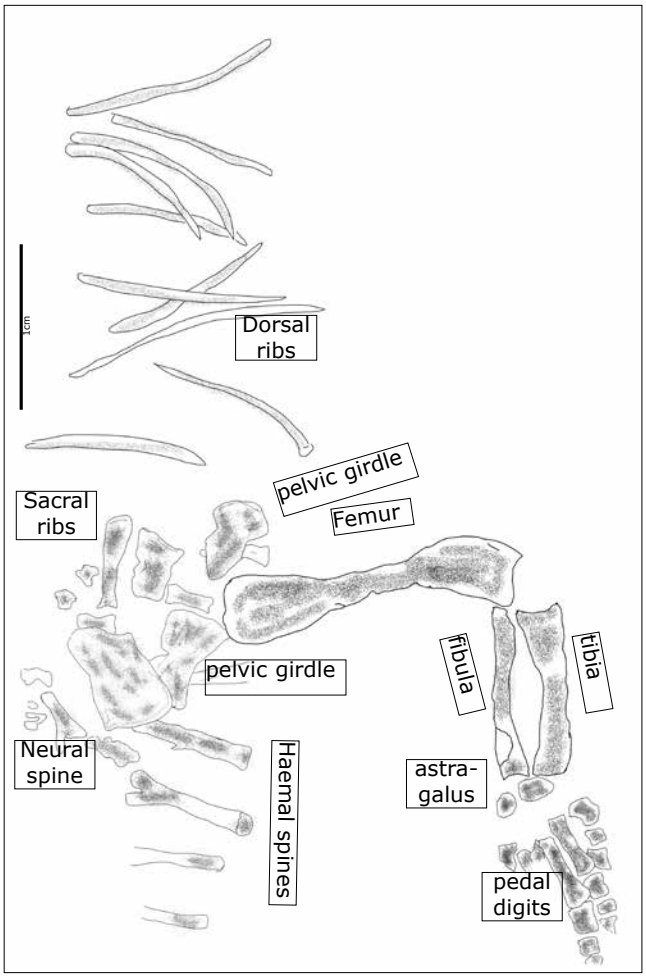


The fossil-bearing horizon on the Northern Piz da Peres slopes with the archosaur-site. (Foto Michael Wachtler)

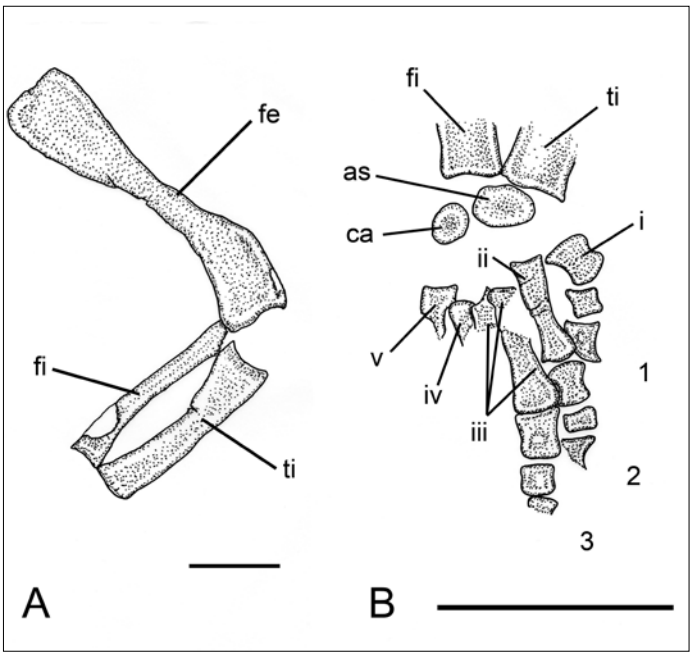
trample layers described as *Sphingopus ladinicus* (Avanzini & Wachtler, 2012). Especially *Rhyncosauroides tirolicus* footprints, first described in 1926 by Othenio Abel after an isolated find on the Piz da Peres made by Julius Pia, are now so common that we receive an extraordinary knowledge of their palaeoecosystem.

In the described area, the ichnofauna horizon of the Richthofen Conglomerate and Morbiac Dark Limestones is capped by a 40 m thick carbonate platform pertaining to the Contrin Formation. The Contrin Formation, first classified in this area as Oberer Sarldolomit (Pia, 1937), now includes both the Upper Sarl Formation and the Contrin Formation and consists of markedly whitish dolomites. It is sharply overlain at its top by dark bituminous pelagic Plattenkalke of the Buchenstein Formation, whose base is believed to belong to the latest Anisian (late Illyrian) or Early Ladinian (Bechstädt & Brandner, 1970, De Zanche et. al., 1992). The Illyrian age is also documented by a rich microfauna consisting of conodonts and ostracods (Kozur et al., 1994).

In the late Illyrian, extensive parts of the Dolomites where submitted to different regional tectonic subsidence rates. Extended areas of the Contrin carbonate platforms were completely drowned or eroded and subjected to anoxic sedimentation (Senowbari-Daryan, 1993). Therefore, the boundary between the Contrin Formation carbonates and the Plattenkalke of the Buchenstein Formation is very distinct and corresponds to a marked increase in subsidence (De




Specimen PZIF 60/2009. Detail of the incomplete skeleton




A-B) Specimen PZIF 60/2009, drawing of the left hind limb (A) and detail of the pes (B). Abbreviations are: as) astragalus; ca) calcaneum; fe) femur, fi) fibula; ti) tibia, i-v) metatarsals 1-5; 1-3) pedal digits 1-3. Scale bars equal 5mm. Courtesy by Silvio Renesto.


Pelvic girdle, femur, fibula, tibia and the pedal digits

Zanche et al., 1993). This Plattenkalke consists of pelagic bituminous dark laminated limestone, calcsiltites, and shales related to an anoxic environment. Bechstädt & Brandner (1970) noted of the Buchensteiner Schichten that '*although of sparsely examined specimens ... is extremely rich in microfossils, and also megafossils could not seldomly be found*'. Typical blue-coloured by Vivianite transformed fish-scales and animal remains could be found everywhere, even though classifiable animals were extremely rare.

With 32 m thickness, the Buchenstein Formation in the area over the Furkel Pass is well-marked but poorly developed. This confirms the results by Bechstädt and Brandner (1970) who found the Buchenstein Formation to be very reduced in the areas of maximum expansion of the Obere Peresschichten (Pia, 1937) Bechstädt & Brandner (1970) or Richthofen Conglomerate (Avanzini et al., 2007a). This can be explained by the continuous siltation of the coastline from wide parts of the Olang-Dolomites and the rapidly subsidence of the landscape. The Buchenstein Formation is covered by a massive pelvic girdle, femur, fibula, tibia and the pedal digits carbonate platform denominated as Schlern Dolomite, recording an evolution from regional muddy banks to isolated high-relief build-ups (Bosellini, 1984).

The beds in which the reptile was found are characterized by a high percentage of bitumen-pearls, an indicator of an oxygen-poor burrow-habitat (Bechstädt & Brandner,

Piz da Peres, Furkel: Ammonite-layers (mostly *Eoprotrachyceras curionii)* from the Buchenstein-Formation, where also the skeleton was recovered.

1970). The deposit is well laminated. In no other part from Kühwiesenkopf to Piz da Peres could this anaerobic milieu be observed as distinctively as here. Further more, the reptile-site lies on the border of a narrow, axial depression 4 m deep engraved in the Contrin-carbonate. Isolated fish remains as well as poorly preserved plant fragments were also found. Especially *Equisetites* sp., but also conifers of *Voltzia*-type, and some semi-destroyed *Neuropteridium* ferns could be classified. Embedded cm-thick yellow ash-layers known as 'Pietra verde' in witness of the distanced volcanic debris of the Buchenstein Formation are typical. The fact that the deposited acid fallout layers and submarine pyroclastic flows in this case does not have the characteristic green colouring of other parts of the Dolomites is probably due to this locally putrid sapropel habitat. Even though vertebrates seem to be not so seldom, the discovery anyway would be hampered by the impossibility to recover bigger (fossil) slabs because of their highly fragmented appearance.

This anaerobic environment is overlain by a rich ammonite-bank (*Eoprotrachyceras* sub-zone) 5 m over the Contrin-border, as a marker horizon. The latest Illyrian covered also the lower Buchenstein Formation (De Zanche et al., 1993). Of special interest is that the lower laying and most rich ichnosite of Piz da Peres is divided here only by a relatively small carbonate bank of the Contrin Formation.
*Rhyncosauroides tirolicus* (Abel, 1926) is the dominant ichnotaxon (Todesco et al., 2008). It is well known from several ichnosites of the Southern Alps, and its stratigraphic distribution is confined to the Ansian with dominance in the Illyrian (Avanzini, 2002). Therefore, it could not be completely devious to assume that mostly the same animals occupied also the living spaces of the Buchenstein Formation.

## Systematic Palaeontology

Reptilia Laurenti, 1768
Diapsida Osborn, 1903
Archosauria, Cope, 1869
Avemetatarsalia, Benton, 1999

## Repository

Dolomythos-Museum (Innichen, Italy)

## Material

Specimen PIZF 60/2009. A partial skeleton consisting of fragments of dorsal and sacral vertebrae and ribs, a complete hind limb and portions of the haemal spines of the first four caudal vertebrae.

## Horizon and locality

Buchenstein-Formation, Late Illyrian.
Furkel Pass, Piz da Peres, Braies Dolomites.

## Description

**Measurements:** Length of the femur: 17 mm; of the tibia: 9 mm; of the fibula 10 mm; of the first metatarsal: 1 mm; of the second metatarsal: 3 mm; of the third metatarsal: 4 mm; of the preserved caudal neural spine: 8.5 mm; of the second preserved haemal spine: 7 mm.
**Skeleton:** Few splints of bone are all what remains of the dorsal vertebrae. An isolated centrum of a sacral vertebra is preserved in lateral view, and on its left side, a prominent

transverse process for the articulation of the sacral rib is visible. A massive disarticulated neural spine lacking its tip can also be identified. Badly preserved fragments of other sacral and caudal centra are visible.
Four long and narrow structures are preserved at the base of the tail. They are mostly incomplete, but the second one reveals a forked extremity allowing to identify the structures as elongate haemal spines. Also, some dorsal ribs are preserved but only a few are nearly complete. They are holocephalous, with a robust, flattened shaft and slightly expanded distal end. Sacral ribs are robust, with a straight shaft and expanded distal end. A few fragments of straight and thin gastralia are interspersed among the dorsal ribs. A couple of sub- rectangular flat bones can be regarded as portions of the pubis and ischium, but overlapping sacral ribs prevent any further classification.
Hind limb. The left hind limb is the best-preserved part of the skeleton. A majority of the bones are in anatomical connection. The small-sized femur (17 mm) evidence cross-sectional shapes and is flattened in an anteroposterior direction. The articular surfaces of the proximal and distal heads are nearly flat or slightly concave; however, they seem to have a rough 'unfinished' structure as if they were capped with cartilage in life.
The tibia is slightly shorter and stouter than the fibula; it also has expanded proximal and distal heads; the proximal articular surface is concave while the distal one is flat. The fibula is narrower than the tibia and shows a slightly convex proximal articular area and a faintly concave distal one. Both the tibia and the fibula have concave medial margins, thus, forming a distinct spatium interosseum.
Only two tarsals are preserved: the medial element is the larger one; it has a sub-elliptical outline with a dorsal emargination and can be identified as astragalus. The smaller one lies distal to the fibula and is subcircular in outline and can probably be classified as calcaneum. The space distal to the tibia and lateral to the astragalus suggests that another proximal tarsal (possibly a centrale) may have been present. In addition, an empty space distal to the astragalus and calcaneum allows the supposition that distal tarsals were also present but either they have not been preserved or they were not yet ossified at the animal death. Metatarsals 1-3 are complete, while only the proximal heads of metatarsal four and five are preserved. 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 proximal head; the second and third metatarsals show a straight shaft with slightly expanded heads; the proximal articular surface is deeply concave as it appears in hatchlings or very immature specimens of extant reptiles where metatarsals are not yet fully ossified (Rieppel, 1992).
The proximal heads of the fourth and fifth metatarsal are preserved; that of 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 metatarsal; 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 phalangeal formula can be reconstructed only for the first three digits: 2, 3, 4. The phalanges are short, squared elements with expanded distal articular areas, and the penultimate phalanges of each pedal digit are wider than long. The ungual phalanges form laterally compressed and dorsoventrally high claws. The ungual phalanx of the first pedal digit is larger than those of the second and third ones.

## Discussion

Unfortunately, the specimen lies on the margin of a slab that was exposed to the ravages of nature; therefore, the specimen was weathered before being collected.
Therefore, the conservation of many parts of the skeleton is poor. In addition, the surface of the slab is irregular, which causes that some bones are flexed or fractured. The cranial part of the skeleton is missing whereas the specimen is exposed on its ventral side. The incompleteness of the skeleton and the poor preservation of many elements render difficult a more exact taxonomic assignment.
The preserved portion of the specimen is approximately 5 cm long, and it corresponds only to less than half of the trunk, plus few caudal vertebrae; thus, it is reasonable to hypothesize a total length of at least 15–20 cm. If the frequent ashfalls have something to do with the death of the reptile is unclear.

It could also be draggled by natural causes in this benthonic burrow-habitat.
The shape of the astragalus and of the calcaneum as well as the lack of other tarsal elements and the incomplete ossification of the heads of the long bones in the hind limb can be attributed to the early growth stage of the specimen. Both in extant and fossil taxa, the ossification of the tarsal elements is completed after hatchling, and the astragalus and calcaneum are the first tarsal bones to ossify, thus it is reasonable that they are the only preserved tarsal elements in a specimen fossilized in its early stage of development (personal notice Renesto, 2010).
The sygmoidal femur is a neodiapsid synapomorphy (Benton, 1985) and the fifth metatarsal hooked in one plane is an archosauromorph synapomorphy (Benton, 1985). Within the Archosauromorpha, a first classification assumed that the short first metatarsal (length ratio between mt1 and mt3 is approximately 0.3), the short pes digit 1, and the phalanges that are shorter than metapodials link PIZF 60/2009 indicate in the direction of the Middle Triassic rhynchosaurs (Evans, 1989; Benton, 1985; Benton, 1990; Hone & Benton, 2008).
*Rhynchosaurus articeps* (name given by Owen, 1842) from the Middle Triassic of Grinshill, northern Shropshire, England, was a small reptile, about 50 cm long. The typical skull was low and broad at the back, and the typical rhynchosaur features of beak-like premaxillae, single median naris, fused parietal, broad maxillary tooth plate and dentary, both with multiple rows of teeth, and a deep lower jaw are present.
Some skulls reach a length from 8 cm to 14 cm, and the compressive body size was 1.3 m long. The skeleton had some adaptations for fast terrestrial locomotion with a semi-erect hindlimb posture (Benton, 1990; Hone & Benton, 2008). *Rhynchosaurus* and the rest of the rhynchosaurs became extinct at the end of the Triassic. Although the Piz da Peres Anisian layers are characterised by their richness in the ichnospecies of *Rhynchosauroides tirolicus* (Abel, 1926), it is not proven that *Rhyncosauroides* tracks and *Rhyncosaurus* skeletons belong to the same animal. Probably this supposition can be excluded due to the fact that *Rhyncosaurus* was a moderately big reptile with its 1–2 m body size, whereas the ichnospecies is characterised by a 20–40 cm small-sized trackmaker. There are some characters that speak against an attribution into an insertion in the family of Rhyncosauria: This is, in particular, the smallish size and the pattern of the tarsus with the rounded astragalus and calcaneum. Apart from these features, the skeleton has no other similar characteristics of the Sauropterygia like Nothosauria like *Neusticosaurus*, semi-aquatic lizard-like animals with long limbs.
Also, *Megachirella wachtleri* (Renesto & Posenato, 2003; Renesto & Bernardi, 2014; Simões et al., 2018), found in the Anisian layers on the nearby Kühwiesenkopf do not fit in the characteristics of this skeleton. It belongs to the squamata.
Another interesting and promising cross-comparison could be made with *Wachtlerosaurus ladinicus* (Perner, 2018) from the slightly younger Wengen Formation (Ladinian: Fassanian-Langobardian) of the Southern Dolomites. This skeleton is mostly entirely preserved. The conserved hind-limb region has striking resemblances with the skeleton from the Piz da Peres-Furkel.
*Wachtlerosaurus* can be regarded as a mostly fully grown or adult archosaur but is also relatively small sized at 25 cm. The ribs are fragile; the femur and humerus length is longer than the tibia or the ulna. The long ischium and pubis is remarkable. It was quadruped but probably just to be able to make some bipedial steps. All the characteristics indicate in the direction of the dinosauromorpha and more restricting to the Avemetatarsalia, being closer parented with the bird-ancestors. Therefore, till now this skeleton was inserted in the genus *Wachtlerosaurus.*
Anyway, the finding is of scientific interest because PZIF 60/2009 represents a young specimen of archosaurs. It increases the knowledge about the paelobiogeography of this animal and gives further information about the diversity of the Middle Triassic terrestrial vertebrates of northern Italy.

## Acknowledgements

I thank Silvio Renesto (Università degli Studi dell'Insubria, Varese) for his help and comments. We agreed to publish this together, but unfortunately, due to bureaucratic cir-

cumstances, this was not possible. Nevertheless, I regard this publication as a joint work.

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