First report on a new late Anisian (Illyrian) vertebrate tracksite from the Dolomites (Northern Italy)

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SUMMARY - First report on a new late Anisian (Illyrian) vertebrate tracksite from the Dolomites (Northern Italy) - A new Middle Triassic ichnosite from the central Dolomites is described. The tracks occur in mixed carbonate siliciclastic basal levels of the Illyrian Calcare di Morbiac Fm. The tracks represent a typical Anisian Alpine ichnoassociation in which have been identified Rhynchosauroides tirolicus, Chirotherium barthii, Isochirotherium delicatum, Brachychirotherium isp.

Key words: Illyrian, Dolomites, ichnosite, Rhynchosauroides

Parole chiave: Illirico, Dolomiti, ichnosito, Rhynchosauroides, Chirotheriidae

1. INTRODUCTION

In the Southern Italian Alps, Early and Middle Triassic tetrapod footprints are known since the first decade of the '900 (Abel 1926), but extensive researches were lead only in the last 30 years with the discovery of vertebrate tracks at many sites of the Dolomite region and surrounding areas of Northern Italy (Avanzini et al. 2001). The main ichnoassociations are preserved in terrigenous and carbonate sediments of Anisian age, deposited in marine marginal environments. They consist of complex Lepidosauria - Archosauria associations. In the Southern Alps, continental layers rich of vertebrate traces are interbedded with marine and volcanic levels, both datable; this mixed succession has allowed the dating and the correlation of the levels containing ichnoassociations (Avanzini et al. 2001).

The tetrapod ichnofauna of the Southern Alps is important for paleoenvironmental and paleogeographic reconstructions and for paleobiological considerations as well.

2. GEOLOGICAL SETTING

The new ichnosite occurs in the Calcare di Morbiac Formation (Illyrian) (Delfrati & Farabegoli 2000) in Val Duron near Campitello (Passa Valley, Trento) (Fig. 1). Here, the formation prevalently consists of decimetric-thick grey silty and silty-limestone layers becoming towards the top wackestones and packstones with foraminifers and ostracods (Fig. 2). Several stromatolite bindstones and thin grey or green siltstones layers are present. Plant debris is common.

In the lower portion of the unit, three main layers of laminated silty-limestones are trampled by vertebrates. In the lowermost and uppermost layers small tracks, mainly pertaining to lizard-like reptiles are largely represented, whereas larger reptile footprints are found in the middle layer.

For all the three layers, the depositional environment is referable to a marine marginal setting as a terrigenous tidal flat.

3. SYSTEMATIC ICHNOLOGY

Twelve silty-limestone slabs with one or more preserved footprints were recovered from the studied section. Most of the tracks belong to the ichnogenus Rhynchosauroides, the remaining pertain to probable chirotheriids. The slabs are currently stored at the Museo Tridentino di Scienze Naturali, Trento and at the Museo di Geologia di Predazzo (provisory catalogue marks progressive number from VD1 to VD12).
Ichnogenus *Rhynchosauroides* Maidwell 1911

*Rhynchosauroides tirolicus* Abel 1926

**Material**

Many footprints on 4 slabs; not all well preserved. Slab VD12 shows the best manus-pes set. Referred material VD 8, VD 9, VD 11, VD 12.

**Description**

**Manus.** Pentadactyl, semiplantigrade and asymmetric. Digit IV is the longest but III is nearly as long as it. Digit V is placed behind digit IV and rotated outward with respect to the digits I-IV.

**Pes.** Similar to the manus, but rather larger and digitigrade. Lenght varies between 30 to 50 mm. Digits II, III and IV are the better impressed. Digit is V never impressed. The angle of divergence between digits I-IV varies from 21° to 70°.

**Manus-pes set.** Pedal print overlaps the manual print. Pes rotation is of 16° with respect to the manus. Manus-pes distance is about 41 mm.

**Discussion**

The form here described belongs to a medium-sized lizard-like trackmaker, and correspond to the well known ichnospecies *Rhynchosauroides tirolicus* Abel 1926, the most common track of the Anisian of Southern Alps (Abel 1926; Brandner 1973; Avanzini 1999; Avanzini & Renesto 2002).

**Rhynchosauroides isp**

**Material**

The best specimen is shown in slab VD 10 (Fig. 3) with manus-pes set. Other are poorly preserved. Referred material VD 8, VD 9, VD 10, VD 11.

**Description**

**Manus.** Pentadactyl, semiplantigrade and asymmetric, smaller than the pes. Digit lengths increase from I to IV. Digit V is placed in a rear position, and rotated outwards with re-
pect to the digit IV (IV-V=46°). The digits are nearly straight. The manus is 36 mm long and the 16 mm wide. The low angle value I-IV (between 9° and 15°) denotes a narrow shape. Pes. It is almost always represented by the distal ends of the digits I, II, III, IV only.

Discussion

The general pattern of characters exhibited by these footprints is comparable to that of the ichnogenus *Rhynchosauroides* Maidwell 1911. The most similar ichnotaxa to these are *R. tirolicus* Abel 1926. The manus of *R. tirolicus* displays some differences allowing for excluding the described specimen from it, namely, less length-width ratio (about 1,3), more spread digits I-IV (21° to 70°), digits III and IV of the same length; digits I and V outwardly aligned.

An intraspecific (i.e. sexual dimorphism) or a preservational variant of *R. tirolicus* seems very probable.

*Ichnogenus Chirotherium* Kaup 1835

*Chirotherium barthii* Kaup 1835

**Material**

A manus-pes set on slab VD 7, fairly well preserved (Fig. 4).

**Description**

*Manus*. Digits I-IV are well impressed digit V slightly impressed. The manus is 112 mm long and 97 mm wide. Digit I is the shortest (32 mm), digits II and III are nearly equal 42-44 mm. Digits I-IV angulation is of 72°.

*Pes*. Much more complete and clearly impressed than the manus. Size: length 230 mm, width 196 mm. The length to width ratio is about 1.18 and indicates an enlarged print. Digits about 43 mm wide. Digit III is the longest (110 mm), I, II and IV are rather equal (90, 92, 86 mm). Digit V is placed behind digits I-IV. It displays a large sub-ovoidal impression of the metatarsal pad; 54 mm in width, and an elongate impression of the distal portion of the digit, rotated outwards and relatively perpendicular to the digit-axis. Its total length is 120 mm, and it is rotated of 16° with respect to digit IV. Divergence between digits I-IV is 72°. Cross axis is 84°. Claws are well impressed and are about 15 mm in length.

*Manus-pes set*. The manus-pes distance is 204 mm. The manus is placed in front of the pes, and rotated 5° with respect to it.

**Discussion**

These footprints based on their general morphology: for instance the longest digit III and divergence of digit V are referable to the ichnogenus *Chirotherium* Kaup 1835. The Chirotheriidae are well known in Lower-Middle Triassic layers all over Europe, featuring numerous ichnospecies. The most representative ichnotaxon is *C. barthii* Kaup 1835 (Haubold 1971a, 1971b, 1984; Demathieu 1970; Gand 1978) which shows similarities with the described specimen.

The specimen here described has to be compared with other *C. barthii* from Pelsonian strata of the Southern Alps in which two complex ichnofaunae were found (Valdiserri & Avanzini 2007; Todesco 2007).
Description

Manus. \( L = 22 \) mm (about 1/4 of the pes print length), of a sub-circular shape with digit prints lightly evidenced.

Pes. Digit I thin and lightly impressed. Digits II and III are nearly equal, IV is the shortest and separated from the digits I-III. Digit V is placed behind IV and is commonly represented by the sub-circular metatarsal pad imprints. Digits I-III are subparallel. The length varies from 86-92 mm, the width from 51 to 47 mm.

Two pes preserved on slab VD1 exhibit a more robust morphology (L/W = 1.7) compared to the more slender pes on slab VD2 (L/W = 1.95). They also differ in the angulation between digits III-IV (41° in VD1 and 17° in VD2) and in
the digit V shape, which is sub-circular in VD 1 and in VD 2 it show a long metatarsal pad with the digit distal end rotated outwards.

Manus-pes set. One set on VD 2. The manus-pes distance is about 75 mm (measured from each central prints projecting the segment on pes axis). The manus is placed in front of the pes and more internally with respect to the midline.

Discussion

Characters displayed by these traces, namely the length ratio of digits II and III, the digit IV separated from groups I-III, the metatarsal pad shape and position of digit V, the light impression of digit I, and the much smaller manus, belong to ichnospecie Isochirotherium delicatum Courel & Demathieu 1976.

The specimens studied in this paper correspond to the greatest specimens of I. delicatum found in Pelsonian strata of Voltago Conglomerate Fm. at Gampenpass (Bozen) and described by Avanzini & Lockley (2002).

Isochirotherium delicatum is a characteristic ichnospecies of the French Central Massif, identified by Courel & Demathieu 1976 at the Anisian-Ladinian boundary in the area of Largentière (Ardèche, France). It is reported here for the first time from Illyrian strata of the Southern Alps.

Ichnogenus Brachychirotherium Beurlen 1950

Brachychirotherium isp.

Material

A manus-pes set on slab VD 6. It is slightly impressed and shows well preserved skin impressions on all digits and on the metatarsal pad of pes digit V (Fig. 6).

Description

Manus. It is smaller than the pes (M:P=1:2.2) and exhibit rounded digits splayed like a fan and rotated outwards. Digit V is placed behind IV and nearly parallel to it.

Pes. It is about 112 mm in length and 89 in width. Digit I is the shortest and is placed behind the digits group II-IV. The longest digit is III, 39 mm, but it is quite equal with IV, that is 35 mm long. Digits group I-IV are well impressed (especially II and III), while the V is represented only by a small (27 x 18 mm) elliptic metatarsal pad, placed behind along the IV digit axis, with angulation of 70° to IV. A relatively large gap (about 5-7 mm) separates digits II from III. Digits are short and blunt with robust, rounded pads.

Digits I-IV are sub-parallel, angulation I-IV= 11° and digit group I-IV is slightly wider than longer (L/W= 0,98). Cross-axis is about 65°.

Set. Manus-pes distance is about 86 mm (measured from the base of the manus and pes digit III). The manus is placed in front of the pes and more internally with respect to the trackway axis.

Skin impression are recognizable on pedal and manual prints with small rounded scales of different size on different areas of the tracks.

Discussion

The stout shape and rounded digits moderately spread are typical features of the ichnogenus Brachychirotherium (Beurlen 1950). Brachychirotherium is widely distributed in Middle Triassic deposits of Central Europe with several ichnospecies.

The specimen described here is compared with some material of the B. parvum (Hitchcock 1889) "group". The features of the studied specimen suggests attribution to B. aff.
Ichnoassociation described here represents a typical Anisian ichnofauna of the Southern Alps. The former, B. aff. parvum, is nearly equal in size but more slender (L/W group I-IV = 1.2) and exhibits the same manus-pes ratio (M:P= 1:2). Digit III is the longest, 65 mm, digits II and IV are equal in length, 55 mm. Divergence I-IV is 20°. B. paraparvum is greater in size (L pes= 120 mm), but with the same digits I-IV L/W ratio (0.98). Digits III and IV are the longest and quite equal.

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