Update of ichnofaunal units and link with footprint biochrons in the late Palaeozoic to early Mesozoic of the Southern Alps: towards a better correlation with the marine realm

Lorenzo Marchetti[1] *, Ausonio Ronchi[2], Nereo Preto[3], Piero Gianolla[4], Paolo Mietto[3], Giuseppe Santi[2], Marco Avanzini[5]

1 Urweltmuseum Geoskop, Burgstraße 19, 66871 Thallichtenberg, Germany

2 Dipartimento di Scienze della Terra e dell´Ambiente, Università degli Studi di Pavia, Via Ferrata 1, 27100 Pavia, Italy

3 Dipartimento di Geoscienze, Università degli Studi di Padova, Via Gradenigo 6, I-35131 Padova, Italy

4 Dipartimento di Fisica e Scienze della Terra, Università di Ferrara, Via Saragat 1, I-44122 Ferrara, Italy

5 Museo delle Scienze, Corso del Lavoro e della Scienza 3, I-38122 Trento, Italy

* presenting author, lorenzo.marchetti85@gmail.com

Abstract:

Tetrapod footprints have recently proven to be a valid and useful stratigraphic tool in the late Palaeozoic-early Mesozoic continental stratigraphy. The Southern Alps of Italy (SA) show a number of very thick and well-exposed successions and preserve one of the best tetrapod footprint records of this time interval, either for the abundance, quality and diversity of the ichnoassociations. Furthermore, the stratigraphy of this area is well-constrained by radiometric datings, microfloras from both continental and marine units, invertebrate fossils and microfossils, sequence stratigraphy, carbon stable isotopic stratigraphy and magnetostratigraphy from interspaced marine units (Fig. 1).

We revised the stratigraphic record of tetrapod footprints of this area, updating existing ichnofaunal units (IFUs) and describing ichnoassociations that may represent IFUs. IFUs are informal ichnoassemblages of possible biostratigraphic value (Conti et al., 1997; Avanzini et al., 2001a). IFUs and ichnoassociations have been correlated with tetrapod footprint biochrons as listed in the following.

A) The oldest tetrapod footprint record in the SA occurs in the latest Carboniferous (Ghzelian) continental Corona Formation (Carnic Alps), which yielded probable anamniote tracks (Mietto et al., 1986). This record is considered too small to represent a proper IFU.

B) The first extensive ichnoassociation is from the Lower Permian (Kungurian) continental Collio, Dosso dei Galli, Pizzo del Diavolo, Monte Luco and Tregiovo formations, all well-constrained by radioisotopic methods (e.g., Schaltegger & Brack, 2007; Marocchi et al., 2008). It is characterized by common non-archosauromorph eureptile and parareptile tracks, anamniote tracks and rare synapsid tracks (e.g., Ceoloni et al., 1987; Santi & Krieger, 2001; Marchetti et al., 2015a, b, c; Marchetti, 2016). It constitutes the Collio IFU (Conti et al., 1997), characterized by the lowest occurrence (LO) of *Erpetopus* and the highest occurrence (HO) of *Amphisauropus* (Fig. 1). The Collio IFU is the reference for the *Erpetopus* footprint biochron in the Kungurian (Voigt & Lucas, 2018) and represents the reptile radiation started by the mid Cisuralian (Marchetti et al., 2019a).

C) The subsequent tetrapod ichnoassociation follows a hiatus of at least 15 Ma marked by a regional unconformity, and occurs in the continental marginal marine Val Gardena Formation, dated through sporomorphs as late Permian (late Wuchiapingian/Changhsingian; e.g., Pittau, 2001). This ichnoassociation is characterized by common diapsid and parareptile tracks, synapsid tracks and rare anamniote tracks (e.g., Conti et al., 1977; Ceoloni et al., 1988; Valentini et al., 2007, 2009; Marchetti et al., 2017). It constitutes the Bletterbach IFU (Conti et al., 1997), characterized by the *Rynchosauroides* LO and the *Pachypes* last appearance datum (LAD) (Fig. 1). It is the reference for the *Paradoxichnium* footprint biochron (Voigt & Lucas, 2018). However, the lack of *Erpetopus* and *Hyloidichnus* and the possible first appearance datum (FAD) of *Protochirotherium* (e.g., Bernardi et al., 2015; Petti et al., 2015) differ from other Late Permian assemblages.

D) The Lower Triassic is characterized by scattered neodiapsid footprints found in the continental

to shallow marine Werfen Formation (almost entirely Lower Triassic according to the conodont and bivalve biozones; e.g., Posenato, 2019), in the Campil and Cencenighe members (e.g., Avanzini & Mietto, 2008), but findings are too scarce to build a valid IFU. This ichnoassociation coincides with the *Rhynchosauroides schochardti* Assemblage of Avanzini & Mietto (2008).

E) Middle Triassic ichnoassociations are found in the continental-to-marginal marine Lower Serla, Gracilis, Voltago, Giovo, Richthofen and Morbiac formations. All these units are well dated through biostratigraphy (ammonoids, conodonts), macro and microfloras, magnetostratigraphy, sequence stratigraphy and stable isotopic chemostratigraphy from intercalated/correlated marine units in the Dolomites area, all considered to be of Anisian age (e.g., De Zanche et al., 1993; Mietto & Manfrin, 1995; Gianolla et al., 1998).

The Anisian ichnoassociations coincide with the *Rhynchosauroides tirolicus* Assemblage of Avanzini & Mietto (2008).

The lower Anisian Lower Serla and Gracilis ichnoassociation includes few neodiapsid and synapsid tracks (e.g., Avanzini & Mietto, 2008; Petti et al., 2013), therefore it is not informative enough to build a valid IFU.

The mid-upper Anisian ichnoassociation from the Voltago, Giovo, Richthofen and Morbiac formations is characterized by abundant archosauromorph tracks, non-archosauromorph eureptile and synapsid tracks and rare dinosauromorph tracks (e.g., Avanzini & Lockley, 2002; Avanzini & Renesto, 2002; Avanzini & Mietto, 2008; Todesco et al., 2008; Todesco & Bernardi, 2011). It is characterized by the LOs and HOs of *Chirotherium* and *Isochirotherium* (Fig. 1). This ichnoassemblage, here named *Chirotherium-Isochirotherium* Ichnoassociation, has the potential to become a valid IFU. The most significant localities are the Gampenpass/Passo Palade site (Voltago-Giovo formations) and the Piz da Peres site (Richthofen Formation). This is largely coincident with the *Chirotherium barthii* footprint biochron, although the upper part may be transitional with the *Atreipus-Grallator* biochron (Klein & Lucas, 2010) because of the LO of *Sphingopus* (Avanzini & Wachtler, 2012).

The Ladinian units are devoid of tetrapod footprints.

F) The Upper Triassic tetrapod ichnoassemblage is preserved in the Carnian continental marginal marine Val Sabbia, Travenanzes and Monticello formations, dated with sporomorphs in these units and ammonoids and conodonts in intercalated marine units (e.g., Assereto & Casati, 1965; Preto et al., 2005; Roghi et al., 2010), and in the late Carnian-Rhaetian Dolomia Principale Formation, dated with brachiopods, conodonts and sequence stratigraphy (e.g., Mietto, 1977; Gianolla et al., 1998; Belvedere et al., 2008).

The lower Carnian ichnoassociation, preserved in the Val Sabbia Formation (Zone locality, near the lake of Iseo; Petti et al., 2009), includes only non-dinosauromorph archosauromorph tracks, and coincides with the Assemblage 1 of Bernardi et al. (2018). It is characterized by the FO of *Brachychirotherium*, here named *Brachychirotherium* ichnoassociation, and may become a valid IFU after further findings. More track occurrences are reported from the lower Carnian Dolomia Cassiana Formation (Mietto et al., 2012), but they are unfortunately poorly-preserved.

The upper Carnian ichnoassociation comes from the Travenanzes, Monticello and Dolomia Principale formations and is characterized by abundant dinosaur tracks, archosauromorph tracks and rarer dinosauromorph tracks (e.g., Mietto, 1988; Dalla Vecchia, 1996; Dalla Vecchia & Mietto, 1998; D´Orazi Porchetti et al., 2008; Avanzini et al., 2010; Bernardi et al., 2013). It coincides with the Assemblages 2 and 3 of Bernardi et al. (2018) and probably represents the first dinosaur radiation with a contemporary reduction of the non-dinosauromorph archosauromorphs. It is characterized by the FAD of *Eubrontes* and *Evazoum*, the first occurrence (FO) of *Grallator* and the LO of *Brachychirotherium* (Fig. 1). This ichnoassemblage, here named *Eubrontes-Grallator* ichnoassociation, has the potential to become a valid IFU. The most representative locality is San Gottardo near Mezzocorona (Travenanzes Formation).

The Late Triassic ichnoassociations coincide with the *Brachychirotherium* footprint biochron (Klein & Lucas, 2010).

G) The Lower Jurassic ichnoassociation comes from the tidal Hettangian-Sinemurian Monte Zugna

Formation and from the Pliensbachian Rotzo Formation (both pertaining to the Calcari Grigi Group), dated with marine fossils (e.g., Avanzini et al., 2007). It is characterized by diverse dinosaur tracks (e.g., Leonardi & Mietto, 2000; Mietto et al., 2000, Avanzini et al., 2001b, 2003; Avanzini & Petti, 2008), with the LO of *Kayentapus*, *Anomoepus* and *Parabrontopodus*, and the HOs of *Grallator* and *Eubrontes* (Fig. 1). This ichnoassemblage, here named *Kayentapus-Parabrontopodus* ichnoassociation, has the potential to become a valid IFU. The most representative locality is the famous megatracksite of the Lavini di Marco near Rovereto (Monte Zugna Formation). This is coincident with the Lower Jurassic footprint biochron (*Eubrontes* acme) (Lucas, 2007).

In conclusion, two IFUs based on tetrapod footprints have been revised and four ichnoassociations that may become IFUs have been described for the late Palaeozoic-early Mesozoic continental-marginal marine ichnoassociations from the Southern Alps. In our view, because of the quality of the ichnofossil record and the high-resolution stratigraphic record in the marine units, this area constitutes an ideal reference for the continental-marine stratigraphic correlations and the combined study of the continental-marine biota during climatic crises.

Keywords: tetrapod footprints, biostratigraphy, ichnofaunal units, Palaeozoic-Mesozoic, Southern Alps

References

Assereto, R. & Casati, P. (1965): Revisione della stratigrafia permo-triassica della Val Camonica meridionale (Lombardia). Rivista Italiana di Paleontologia e Stratigrafia, 71: 999-1097.

Avanzini, M. & Lockley, M.G. (2002): Middle Triassic archosaur ontogeny and population structure: interpretation based on *Isochirotherium delicatum* fossil footprints (Southern Alps - Italy). Palaeogeography, Palaeoecology, Palaeoclimatology, 185: 391-402.

Avanzini, M. & Mietto, P. (2008): Lower and Middle Triassic footprint based biochronology in the Italian Southern Alps. Oryctos, 8: 3-13.

Avanzini, M. & Petti, F.M. (2008): Updating the dinosaur tracksites from the Lower Jurassic Calcari Grigi Group (Southern Alps, Northern Italy). Studi Trentini di Scienze Naturali, Acta Geologica, 83: 289-301.

Avanzini, M. & Renesto, S. (2002): review of *Rhynchosauroides tyrolicus* Abel, 1926 ichnospecies and some inferences on Middle Triassic (Anisian-Ladinian) *Rhynchosauroides* ichnogenus trackmaker. Rivista Italiana di Paleontologia e Stratigrafia, 108: 51-66.

Avanzini M. & Wachtler, M. (2012): *Sphingopus ladinicus* isp. Nov. From the Anisian of the Braies Dolomites (Southern Alps, Italy). Bollettino della Società Paleontologica Italiana 51: 63-70.

Avanzini, M., Ceoloni P., Conti, M.A., Leonardi, G., Manni, R., Mariotti, N., Mietto, P., Muraro, C., Nicosia, U., Sacchi, E., Santi, G., Spezzamonte, M. 2001a. Permian and Triassic tetrapod ichnofaunal units of Northern Italy: their potential contribution to continental biochronology. In: Cassinis, G. (ed.), Permian continental deposits of Europe and other areas. Regional reports and correlations. Natura Bresciana, Annali del Museo Civico di Scienze Naturali, Monografia, 25: 89-107.

Avanzini, M., Gierliński, G., Leonardi, G. (2001b): First report of sitting *Anomoepus* tracks in European Lower Jurassic (Lavini di Marco site - northern Italy). Rivista Italiana di Paleontologia e Stratigrafia, 107: 131-136.

Avanzini M., Leonardi, G., Mietto, P. (2003): *Lavinipes cheminii* ichnogen., ichnosp. Nov., a possible sauropodomorph track from the Lower Jurassic of the Italian Alps. Ichnos, 10: 179-193.

Avanzini M., Masetti, D., Romano, R., Podda, F., Ponton, M. (2007): Calcari Grigi. In: Cita Sironi, M.B., Abbate, E., Balini, M., Conti, M.A., Falorni, P., Germani, D., Groppelli, G., Manetti, P. & Petti, F.M. (eds.), Carta Geologica d'Italia: 1:50.000, Catalogo delle Formazioni, Unita` tradizionali: APAT, Dipartimento Difesa del Suolo, Servizio Geologico d'Italia: Quaderni serie III, volume 7, numero VII: 125–135.

Avanzini, M., Bernardi, M., Petti, F.M., Tomasoni, R. (2010): Crocodyle-like footprints from the Upper Triassic (Carnian) of the Italian Southern Alps. New Mexico Museum of Natural History and Science Bulletin, 51: 51-64.

Belvedere M., Avanzini M., Mietto P., Rigo, M. (2008): Norian dinosaur footprints from the "Strada delle Gallerie" (Monte Pasubio, NE Italy). Studi Trentini di Scienze Naturali, Acta Geologica, 83: 267-275.

Bernardi, M., Petti, F.M., D'Orazi Porchetti, S., Avanzini, M. (2013): Large tridactyl footprints associated with a diverse ichnofauna from the Carnian of the Southern Alps. New Mexico Museum of Natural History and Science Bulletin, 61: 48-54.

Bernardi M., Klein, H., Petti, F.M., Ezcurra, M.D. (2015): The origin and early radiation of Archosauriforms: integrating the skeletal and footprint record. Plos One 10 (6), e0128449.

Bernardi M., Gianolla, P., Petti, F.M., Mietto, P., Benton, M.J. (2018): Dinosaur diversification linked with the Carnian Pluvial Episode. Nature Communications, 9, 1499.

Ceoloni, P., Conti, M.A., Mariotti, N., Mietto, P., Nicosia, U. (1987): Tetrapod footprints from Collio Fm. (Lombardy, Northern Italy). Memorie di Scienze Geologiche, 39: 213-233.

Ceoloni, P., Conti, M.A., Mariotti, N., Nicosia, U. (1988): New Late Permian Tetrapod Footprints from the Southern Alps. Memorie di Scienze Geologiche, 34: 45-65.

Conti, M.A., Leonardi, G., Mariotti, N., Nicosia, U. (1977): Tetrapod footprints of the "Val Gardena Sandstone" (North Italy). Their paleontological, stratigraphic and paleoenvironmental meaning. Palaeontologia Italica, 70: 1-91.

Conti, M.A., Mariotti, N., Nicosia, U., Pittau, P. (1997): Selected bioevents succession in the continental Permian of the Southern Alps (Italy): improvements of intrabasinal and interregional correlations. In: Dickins, J.M., Zunyi, Y., Yhongfu, Y., Lucas, S.G. & Acharyya, S.J. (eds), Late Palaeozoic and Early Mesozoic Circum-Pacific Events and Their Global Correlation. Cambridge University Press, Cambridge, New York, Melbourne: 51-65.

Dalla Vecchia, F.M. (1996): Archosaurian trackways in the Upper Carnian of Dogna valley (Udine, Friuli, NE Italy). Natura Nascosta, 12: 5-17.

Dalla Vecchia, F.M. & Mietto, P. (1998): Impronte di rettili terrestri nella Dolomia Principale (Triassico superiore) delle Prealpi carniche (Pordenone, Friuli). Atti Ticinensi di Scienze della Terra, 7: 87-107.

De Zanche, V., Gianolla, P., Mietto, P., Siorpaes, C., Vail, P.R. (1993): Triassic Sequence Stratigraphy in the Dolomites (Italy). Memorie di Scienze Geologiche, 45: 1-27.

D´Orazi Porchetti, S., Nicosia, U., Mietto, P., Petti, F.M., Avanzini, M. (2008): *Atreipus*-like footprints and their co-occurrence with *Evazoum* from the upper Carnian (Tuvalian) of Trentino Alto-Adige. Studi Trentini di Scienze Naturali, Acta Geologica, 83: 277-287.

Gianolla, P., De Zanche, V., Mietto, P. (1998): Triassic Sequence Stratigraphy in the Southern Alps (Northern Italy): definition of sequences and basin evolution. In: de Gracianski, P.C., Jacquin, T. & Vail, P.R. (eds.), Mesozoic and Cenozoic Sequence Stratigraphy of European Basins. SEPM special publications, 60: 721-747.

Klein, H. & Lucas, S.G. (2010): Tetrapod footprints – Their use in biostratigraphy and biochronology of the Triassic. Geological Society, London, Special Publication, 334: 419-446.

Leonardi, G. & Mietto, P. (2000): Dinosauri in Italia: le orme giurassiche dei Lavini di Marco (Trentino) e gli altri resti fossili italiani. 494 pp. Accademia Editoriale, Pisa – Roma.

Lucas, S. G. (2007): Tetrapod footprint biostratigraphy and biochronology. Ichnos, 14: 5-38.

Marchetti, L. (2016): New occurrences of tetrapod ichnotaxa from the Permian Orobic Basin (Northern Italy) and critical discussion of the age of the ichnoassociation. Papers in Palaeontology, 2: 363-386.

Marchetti L., Ronchi, A., Santi, G. & Voigt, S. (2015a): The Gerola Valley site (Orobic Basin, Northern Italy): a key for understanding late early Permian tetrapod ichnofaunas. Palaeogeography, Palaeoclimatology, Palaeoecology, 439: 97-116.

Marchetti L., Ronchi, A., Santi, G., Schirolli, P. & Conti, M. A. (2015b): Revision of a classic site for Permian tetrapod ichnology (Collio Formation, Trompia and Caffaro valleys, N. Italy), new evidences for the radiation of captorhinomorph footprints. Palaeogeography, Palaeoclimatology, Palaeoecology, 433: 140-155.

Marchetti L., Forte, G., Bernardi, M., Wappler, T., Hartkopf-Fröder, C., Krainer, K., Kustatscher, E. (2015c): Reconstruction of a late Cisuralian (Early Permian) floodplain lake environment: palaeontology and sedimentology of the Tregiovo Basin (Trentino-Alto Adige, Northern Italy). Palaeogeography, Palaeoclimatology, Palaeoecology, 440: 180-200.

Marchetti L., Voigt, S., Klein, H. (2017): Revision of Late Permian tetrapod tracks from the Dolomites (Trentino-Alto Adige, Italy). Historical Biology, 1-36. DOI: 10.1080/08912963.2017.1391806

Marchetti, L., Voigt, S., Lucas, S.G., Francischini, H., Dentzien-Dias, P., Sacchi, R., Mangiacotti, M., Scali S., Gazzola, A., Millhouse, A. (2019a): Tetrapod ichnotaxonomy in eolian paleoenvironments (Coconino and De Chelly formations, Arizona) and late Cisuralian (Permian) sauropsid radiation. Earth-Science Reviews, 190: 148-170.

Marchetti, L., Voigt, S., Lucas, S. G. (2019b): An anatomy-based study of the Lopingian eolian tracks of Germany and Scotland reveals the first evidence of the end-Guadalupian mass extinction at low paleolatitudes of Pangea. Gondwana Research, 73: 32-53.

Marocchi, M., Morelli, C., Mair, V., Klötzli, U., Bargossi, G.M. (2008): Evolution of large silicic magma systems: new U-Pb zircon data on the NW Permian Athesian Volcanic Group (Southern Alps, Italy). The Journal of Geology, 116: 480-498.

Mietto, P. (1977): Considerazioni stratigrafiche e paleontologiche sulla Dolomia Principale nell'area di Recoaro (Vicenza). Rivista Italiana di Paleontologia e Stratigrafia, 83: 687-696.

Mietto, P. (1988): Piste di dinosauri nella Dolomia Principale (Triassico Superiore) Del Monte Pelmetto (Cadore). Memorie della Società Geologica Italiana, 30: 307-310.

Mietto, P. & Manfrin, S. (1995): A high resolution Middle Triassic ammonoid standard scale in the Tethys Realm. A preliminary report. Bulletin de la Societé Géologique de France, 166: 539-563.

Mietto, P., Muscio, G., Venturini, C. (1986): Impronte di Tetrapodi nei terreni Carboniferi delle Alpi Carniche. Gortania, Atti del Museo Friulano di Storia Naturale, 7: 59-74.

Mietto, P., Belvedere, M., Barbuni, M. (2012): Recenti scoperte sulle impronte di dinosauro nelle Dolomiti. 109pp. Sileagrafiche, Treviso.

Mietto, P., Roghi, G., Zorzin, M. (2000): Le impronte di dinosauri liassici dei Monti Lessini Veronesi. Bollettino del Museo Civico di Storia Naturale di Verona, 24 (Geologia, Paleontologia, Preistoria): 55-72.

Petti, F.M., Avanzini, M., Nicosia, U., Girardi, S., Bernardi, M., Ferreti, P., Schirolli, P., Dal Sasso, C. (2009): Late Triassic (Early-Middle Carnian) chirotherian tracks from the Val Sabbia Sandstone (Eastern Lombardy, Brescian Prealps, Northern Italy). Rivista Italiana di Paleontologia e Stratigrafia, 115: 277-290.

Petti, F.M., Bernardi, M., Kustatscher, E., Renesto, S., Avanzini, M. (2013): Diversity of continental tetrapods and plants in the Triassic of the Southern Alps: Ichnological, paleozoological and paleobotanical evidence. New Mexico Museum of Natural History and Science Bulletin, 61: 458-484.

Petti, F.M., Bernardi, M., Klein, H. (2015): Towards a redefinition of the lower boundary of the Protochirotherium biochron. Permophiles, 61:22–24.

Pittau, P. (2001): Correlation of the Upper Permian sporomorph complexes of the Southern Italian Alps with the Tatarian complexes of the stratotype region. Natura Bresciana, 25: 109-116.

Posenato, R. (2019): The end-Permian mass extinction (EPME) and the Early Triassic biotic recovery in the western Dolomites (Italy): state of the art. Bollettino della Società Paleontologica Italiana, 58: 11-34.

Preto, N., Roghi, G., Gianolla, P. (2005): Carnian stratigraphy of the Dogna area (Julian Alps, northern Italy): tessera of a complex palaeogeography. Bollettino della Società Geologica Italiana, 124: 269-279.

Roghi, G., Gianolla, P., Minarelli, L., Pilati, C., Preto, N. (2010): Palynological correlation of Carnian humid pulses throughout western Tethys. Palaeogeography, Palaeoclimatology, Palaeoecology, 290: 89–106.

Santi, G. & Krieger, C. (2001): Lower Permian tetrapod footprints from Brembana Valley – Orobic Basin (Lombardy, Northern Italy). Revue de Paléobiologie, 20: 45-68.

Schaltegger, U. & Brack, P. (2007): Crustal-scale magmatic systems during intracontinental strike-slip tectonics: U, Pb and Hf isotopic constraints from Permian magmatic rocks of the Southern Alps. International Journal of Earth Sciences, 96: 1131-1151.

Todesco, R., & Bernardi, M. (2011): Una nuova icnoassociazione a vertebrati nel Triassico medio (Anisico) del Trentino meridionale (Val Gerlano, Vallarsa). Studi Trentini di Scienze Naturali, 88: 203-218.

Todesco, R., Wachtler, M., Dellantonio, E., Avanzini, M.A. (2008): First report on a new late Anisian (Illyrian) vertebrate tracksite from the Dolomites (Northern Italy). Studi Trentini di Scienze Naturali, Acta Geologica, 83: 247-252.

Valentini, M., Conti, M.A., Mariotti, N. (2007): Lacertoid footprints of the Upper Permian Arenaria di Val Gardena formation (Northern Italy). Ichnos, 14: 193-218.

Valentini, M., Nicosia, U., Conti, M.A. (2009): A re-evalution of *Pachypes*, a pareiasaurian track from the Late Permian. Neues Jahrbuch für Geologie und Paläontologie Abhandlungen, 251: 71-94.

Voigt, S. & Lucas, S.G. (2018): Outline of a Permian tetrapod footprint ichnostratigraphy. Geological Society, London, Special Publications, 450: 387-404.

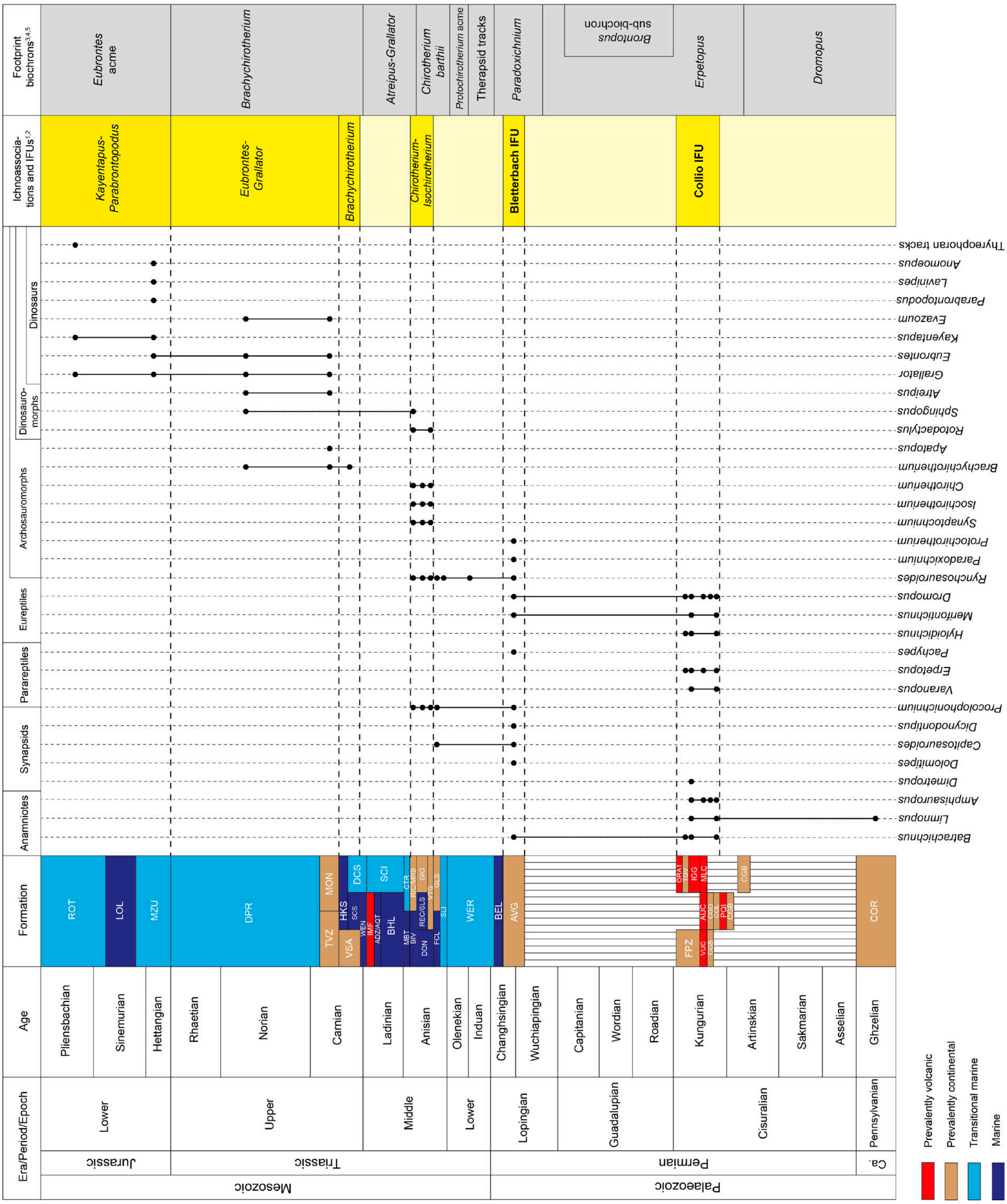

Fig. 1: Chronostratigraphic scheme of the Southern Alps with the Palaeozoic-Mesozoic continental and marginal marine units containing tetrapod footprints, and intercalated or correlated marine units; ichnotaxa ranges (occurrences centered in the middle of the formations); supposed trackmaker groups; ichnoassociations/ichnofaunal units (IFUs) and footprint biochrons. Note that pre-Late Triassic *Brachychirotherium* and *Parasynaptichnium* are not represented because probably assignable to different ichnogenera (e.g., Petti et al., 2013). The tracks from the Corona Formation (Mietto et al., 1986) are assigned to *Limnopus*, and the crocrodilomorph tracks from the Monticello Formation (Dalla Vecchia, 1996) are assigned to *Apatopus*. The Palaeozoic units are dated with radiometric ages and palynology, the Mesozoic units mostly with marine macro- and microfossils from intercalated or coeval marine formations. Formation acronyms: COR=Corona, CGB=Basal Conglomerate, VUC=Auccia Volcanite, FPZ=Pizzo del Diavolo, PQI=Lower Porphyries, COL=Collio, CGD=Dosso dei Galli, AUC=Auccia, MLC=Monte Luco, IGG=Gargazzone, TGV=Tregiovo, ORA1=Ora Formation, Predonico Member, AVG=Val Gardena, BEL=Bellerophon, WER=Werfen, SLI=Lower Serla, FCL=Coll´Alto Limestone, GLS=Gracilis, DON=Dont, VTG=Voltago, REC=Recoaro Limestone, SLS=Upper Serla, GIO=Giovo, BIV=Bivera, RIC=Richthofen, MRB=Morbiac, MBT=Ambata, CTR=Contrin, BHL=Livinallongo/Buchenstein, ADZ=Zoppè Sandstone, AQT=Acquatona, IMF=Fernazza Volcanite, SCI=Sciliar, WEN=Wengen, SCS=San Cassiano, DCS=Cassian Dolomite, HKS=Heiligkreuz, TVZ=Travenanzes, VSA=Val Sabbia, MON=Monticello, DPR=Dolomia Principale, MZU=Monte Zugna, LOL=Loppio Oolitic Limestone, ROT=Rotzo. 1=this work, 2=Conti et al., 1997, 3=Klein & Lucas, 2010, 4=Voigt & Lucas, 2018, 5=Marchetti et al., 2019b.