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## Scientific research in the Geopark Carnic Alps – a never ending story

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Active scientific research, as exemplified in the Geopark Carnic Alps, is a backbone of every Geopark. Management and administration are important activities, the role that geologists and other Earth scientist play are however much more important assets of a Geopark. Thus, it seems rather logical that every Geopark employs at least one geoscientist as member of its staff; otherwise geoscientists from outside have to be encouraged to undertake Earth science-related studies. Fortunately, the majority of EGN Geoparks has recruited at least one Earth scientist as permanent staff member.

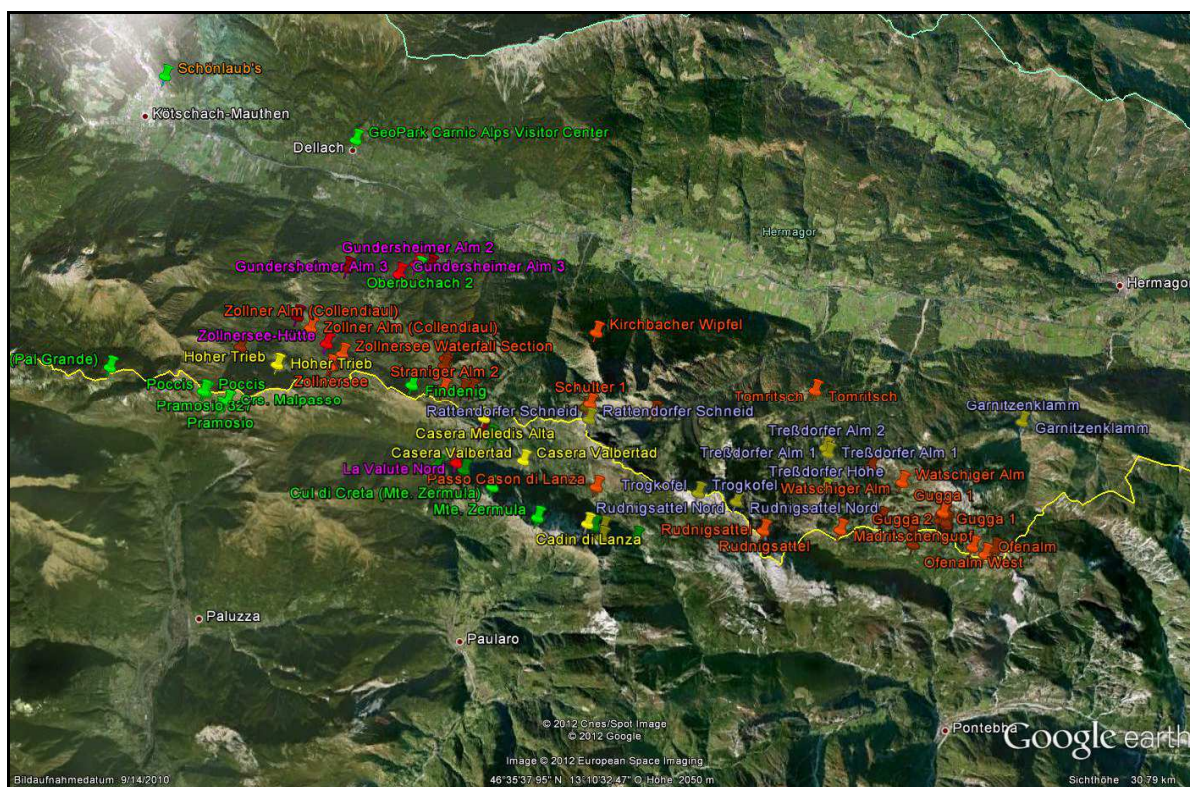


Fig. 1: Example of different fossil localities in the central part of the Carnic Alps (yellow names-Ordovician, pink-Silurian, green-Devonian, brown-Carboniferous, light blue-Permian).

The Carnic Alps are widely regarded as being among the most attractive mountain ranges in Austria and beyond. Their intrinsic beauty originates from the interplay of spectacular limestone mountains with gentle mountain pastures and foothills. A great diversity of colors is derived from the contrasts between the pink to pale-colored limestone massifs and the intervening green forests and flower-covered mountain meadows.

The mountains rise either as isolated peaks or ranges with intersecting ravines, in places forming spectacular arena-like sceneries. Some limestone sections extend vertically over more than 1,500 m and thus rank among the highest limestone cliffs found in the Alps.

Pioneering geologists were among the first who were excited by the beauty of the mountains, and their writing and subsequent publications attracted generations of scholars and visitors alike to become acquainted with the extraordinary aesthetic and scientific appeal of the area.

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Soon after the visit of Leopold von Buch, the famous German geologist, paleontologist and geographer in the Carnic Alps in 1824 systematic study of rocks and fossils of the Palaeozoic sequences started in the area of the Geopark. During the first field campaign carried out by the Geological Survey of Austria shortly after the middle of the 19<sup>th</sup> century the equivalents of the Ordovician, Silurian, Devonian, Carboniferous and Permian were recognized which stimulated the first palaeontological studies. Until today generations of Earth scientists have worked in the Carnic Alps which during these times have become one of the best and most intensively studied mountain range. The current knowledge is based on more than 1500 scientific publications covering geology, structural geology, palaeontology, sedimentology, geochemistry, and Quaternary research.

The Carnic Alps of southern Austria and northern Italy provide an almost continuous sequence of sedimentary rocks from the Ordovician to the Triassic, or almost 250 million years of Earth's history. They are characterized by highly diverse marine fossil assemblages ranging from shallow water lagoonal deposits to coral-stromatoporoid reefal buildups, slope and open and deep sea environments.

The record of life of both faunas and floras in the Carnic Alps has been documented in numerous palaeontological descriptions dealing with almost all fossil groups ranging from eye-catching macroscopic creatures to micro- and nannofossils. The rich faunal spectrum covers planctonic, nectonic and benthonic animal groups.

Following the Variscan Orogeny, the late Upper Carboniferous and Lower Permian shallow-water deposits range from coastal swamps to those of an intertidal shelf embayment of the expanding Tethys Sea. They are characterized by exceptionally rich faunal and floral remains. During the late Lower Permian shelf-edge reefal deposits accumulated which were terminated due to an uplift event resulting in a short gap in sedimentation and subsequent karstification. In the Middle and Upper Permian this episode was succeeded by the red clastics of the Gröden Formation and the locally evaporitic Bellerophon Formation.



Fig. 2: The new generation (right to left): Hans Peter Schönlaub, Maria Cristina Perri, Rosy Piller, Werner E. Piller, Enzo Farabegoli, Luca Simonetto, Carlo Corradini, Maria G. Corrigan, Monica Pondrelli, Claudia Spalletta, Dodo Dojen, Damien Pas, Erika Kido, Thomas Suttner.

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In a global comparative analysis there is no other property in the world which comprises such a continuous succession of rocks ranging from the late Ordovician to the lower Triassic Periods with evidences of rich fossil occurrences, shifting palaeoclimates, plate drifting, and mountain building processes. They suggest a steady northward drift of one of the Peri-Gondwanide terranes from high southern and cool-tempered latitudes in the Ordovician to the moderate and tropical belt in the Silurian, Devonian and Carboniferous followed by an equatorial position with desert conditions in the Permian; ongoing drifting during the remaining 250 m.y. moved the continental plates to its present position. The fully marine succession spanning some 250 m.y. of Earth's history has opened a window to many groups of organism in a true oceanic setting – where evolution primarily takes place. This case strongly differs from other world famous fossil sites listed in various compilations (e.g., "Evolution" eds. D. Palmer & P. Barrett, 2009) which have almost nothing in common with the Carnic Alps since they mainly comprise freshwater and shallow marine faunas (tetrapods, arthropods, fishes).

To date, more than 100 fossil sites across the state border between southern Austria and northern Italy are shown in a specially designed Google Earth map (Fig. 1). This list is based on more than 160 scientific papers published in renowned journals in different countries. It includes the name of the locality, its coordinates, elevation, lithostratigraphic assignment, main fossil groups and the bibliographic references. In addition, photo images of both the outcrop and fossils can be downloaded. This new service of the GeoPark Carnic Alps is the result of a close cooperation of an international team of young scientists (Fig. 2) who, with the same spirit as the pioneers from the 19<sup>th</sup> and 20<sup>th</sup> centuries, continue cross-border research in the area of the EGN Geopark Carnic Alps and beyond.

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