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Editor in chief's Note

European UNESCO Geoparks: Introduction to Part II

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Abstract

The concept of the volume is to survey all the key geoparks throughout Europe in terms of their palaeontological significance. The second set of 36 articles in this Part cover the long span of geological time from the Triassic to the Quaternary, arranged in chronostratigraphic order. These document some of the most important stages in the history of life, especially focusing on life after the end-Permian mass extinction, as marine and terrestrial ecosystems rebuilt, and the 'modern-style' faunas and floras emerged.

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Introduction

This is the second part of the special volume on the 'European UNESCO Geoparks,' covering fossils from the Mesozoic and Cenozoic, from dinosaurs to humans. In the first part of the volume, we included 25 sites that showed key steps in the evolution of life from the Precambrian and Paleozoic, essentially from the origin of life, through the Cambrian Explosion, colonization of the seas, and terrestrialization of plants, arthropods and vertebrates.

Here, we take the history of life forward, using accounts of 36 Geoparks, to explore the time of recovery of life on land and in the sea from the end-Permian mass extinction. In the sea, this is the Mesozoic Marine Revolution, the time during which faunas show enhancement of adaptations for predation and protection, and similarly on land the Triassic, Jurassic and Cretaceous were times of expansion and speeding-up of energy flow through ecosystems. There is a focus on ammonites and dinosaurs in the Mesozoic, and then coral reefs, plants, and mammals in the Cenozoic. We finish with five Quaternary sites, four of them showing interplay of mammals and other faunas with early humans. These Mesozoic and Cenozoic Geoparks document some of the extinction events through this time, especially the Eocene-Oligocene extinction, and generally some of the important responses of life to climate change through the Cenozoic.

Here, as in the first part, we are grateful to Professor Dan Grigorescu of the University of Bucharest in Romania for his leadership over decades in encouraging and establishing geoparks throughout Europe, through his position as UNESCO lead. As with the first part of the volume, Professor Grigorescu and I have worked together to request papers from people based in and around each of the key geoparks, sometimes researchers who have worked on the fossils, and sometimes the park staff engaged in geoconservation and education initiatives. As with the Precambrian and Paleozoic chapters, we were keen to encourage authors to present the scientific background and justification of their Geopark, but also to talk about the history of establishment as a Geopark, as well as practical and educational aspects of the Geopark in terms of its development, its current state, and future plans.

In this Introduction, I review the key geological time divisions and the European Geoparks that can illustrate aspects of the paleontology of each.

Triassic

The Triassic was named for its three-part (tripartite) division in Germany, comprising the Bunter, Muschelkalk and Keuper, in traditional terminology. During the Triassic, the supercontinent Pangaea persisted from the Permian, although initial rifting of the North Atlantic and Tethys oceans began towards the end. The climate was mostly hot and dry. The main paleontological aspects relate to the recovery of life after the devastating end-Permian mass extinction. Indeed, there were many environmental perturbations during the Early Triassic that delayed the full recovery of life, but when ecosystems began to rebuild, the bases were established for modern ecosystems in the sea and on land. On land, arboreal lycophytes, horsetails and seed-ferns survived from the Permian, but new gymnosperm groups emerged. New tetrapod groups appeared, mainly ancestors of birds and mammals and their relatives, most of them warm-blooded to some extent. These included dicynodonts and rhynchosaurs as major herbivores, to be replaced by dinosaurs after the Carnian Pluvial Event, 233–232 Ma. In marine environments, new invertebrate faunas developed gradually, replacing the groups which disappeared at the end of Permian: modern types of corals, ammonites, which diversified from the few survivors of the great extinction, numerous new groups of bivalves and echinoderms. Bony fishes and new groups of marine reptiles (placodonts, nothosaurs, plesiosaurs, ichthyosaurs) helped form new kinds of food webs.

Triassic paleontological themes in the European

geoparks include examples both marine and terrestrial life. One of the oldest marine locations is in the Idrija UNECO Global Geopark in Slovenia, from which Mojca Gorjup Kavčič and Matija Križnar describe the unique ammonite *Tirolites idrianus*. This used to be a mercury mining area, and that theme is represented in the Geopark, but several fossiliferous sites around the town of Idrija show the limited fauna of bivalves (including *Claraia*), gastropods, ammonites (species of *Tirolites* and *Dinarites*) and trace fossils. Educational and geotourism activities focus around explaining the importance of zonal fossils in global biostratigraphy, as well as the recovery of life from the end-Permian mass extinction.

Among sites that document the rich terrestrial fossil record of the Triassic in Europe is first the UNESCO Global Geopark Vulkaneifel, which documents Devonian and Triassic sediments perturbed in the Cenozoic by volcanic eruptions. Jens Koppka describes a particular fossil from the Buntsandstein there (Early Triassic), the enigmatic small reptile *Eifelosaurus*, remarkable as one of the first rhynchosaurs, a group that were to become dominant herbivores worldwide in the Middle and early Late Triassic. Different evidence of terrestrial tetrapods is seen in the Monts d'Ardèche UNESCO Global Geopark in south-eastern France, as described by Emmanuel Fara and colleagues. So far, 15 tracksites and nearly a thousand individual tracks have been identified in Middle and Late Triassic rocks, and public works following scientific study include the opening of 'Le Sartre' site where the public can see the tracks in situ. These show a mix of tracks made by small bipedal dinosaur-like animals as well as larger, quadrupedal predators.

Jurassic

The Jurassic, named after the Jura Mountains on the borders of France, Switzerland and Germany, was a time of luxuriant tropical forests and the largest animals that ever lived on land. There were great paleogeographical changes during the Jurassic, with Pangaea beginning to split into two landmasses, Laurasia to the north, and Gondwana to the south. Correspondingly, the climate changed from dry to humid, the arid deserts of the Triassic being replaced by rainforests. Tropical and subtropical conifers, bennettitaleans and cycads were the most common plants. The terrestrial fauna was dominated by dinosaurs which included in the Late Jurassic the largest dinosaurs ever, the sauropods. The birds appeared, having evolved from a branch of theropod dinosaurs, but the dominant flying vertebrates were the pterosaurs. The seas and oceans were inhabited by marine reptiles such as ichthyosaurs and plesiosaurs. In the invertebrate world, ammonites continued their diversification, the belemnites appeared, also the rudists, reef-forming bivalves, and brachiopods, and the crinoids were common.

The oldest Jurassic site is the Sinemurian-aged Les Isnards Ammonite Slab Geoheritage Site in south-eastern France. This remarkable accumulation of thousands of beautiful ammonites is presented by Didier Bert and Jan-Simon Pagès, who describe the international importance of the site and show the practical challenges of presenting a near-vertical seabed slab measuring 320 m^2 in a busy roadside site.

The Swabian Alb Geopark (Geopark Schwäbische Alb) in the far south of Germany is famous for its Jurassic fossil sites, including some in the Early Jurassic and others in the Late Jurassic. Annette Schmid-Röhl describes the Lower Jurassic Posidonia Shale, a remarkable series of Toarcian-aged deposits that have yielded world-famous faunas of marine reptiles, notably ichthyosaurs, crocodilians, and pterosaurs, as well as fishes, crinoids, ammonites and belemnites, all of them with soft tissues preserved, including skin outlines, internal organs, and ink sacs in the cephalopods. The Holzmaden and Dotternhausen localities are conserved as sites where visitors can see former commercial stone and cement works, as well as collect small fossils, and see spectacular specimens. Also in the Swabian Alb Geopark is the Late Jurassic Nusplin-

gen geosite, described by Günter Schweigert and Siegried Roth. The fossils occur in plattenkalks in two neighboring quarries, Nusplingen and Egeshiem, and include remarkable fossil sharks with soft tissues, as well as marine crocodilians, bony fishes, ammonites, belemnites, squid, as well as terrestrially derived organisms such as insects and an isolated feather – evidence of a bird or theropod dinosaur.

The Lower-Middle Jurassic boundary is documented by another GSSP site, marking the base of the Aalenian Stage in the UNESCO Global Geopark Molina & Alto Tajo, in central Spain. Here, Antonio Goy and colleagues describe the long history of research at the site, showing its extensive exposure, the detailed stratigraphic work there, and abundant fossils, including biostratigraphically important ammonites in marine carbonate deposits.

Middle and Late Jurassic crocodilians are known from excellent specimens from the Monts d'Ardèche UNESCO Geopark, as reported by Bernard Riou and colleagues. These long-snouted marine thalattosuchians were top predators, particular to the Jurassic, and great examples to engage the public in thinking about how landscapes change through time.

Late Jurassic dinosaur tracks are well documented from the UNESCO Global Geopark TERRA.vita at Bad Essen-Barkhausen in north-west Germany, as described by Tobias Fischer and colleagues. The tracks document the migration of a herd of sauropods and theropods, and they were first identified in 1921. Conservation efforts over the years have been problematic, and they are now made available for visitors under a protective glass roof.

The Las Loras UNESCO Global Geopark in Spain, described by Sánchez Fabián and colleagues, documents a long stratigraphic sequence, beginning in the Permian and spanning through the Cenozoic, but with especially important deposits in the marine-to-terrestrial transition seen through the Late Jurassic and Early Cretaceous in many parts of Europe. In this case, the authors focus on social participation and educational initiatives in the Geopark. The Sierras Subbéticas UNESCO Global Geopark in southern Spain also spans through the Late Jurassic and Early Cretaceous and shows excellent examples of the Ammonitico Rosso marine sedimentary facies. Alicia Serna Barquero and colleagues describe this highly attractive, red-coloured, ammonite-rich rock that has been widely used in decorative building, but also draws attention of the public because of its appearance. The Geopark can then engage geotourists to learn about the ancient sea beds and their important fossils. The authors show how agriculture can be sustained together with effective demonstration of the geology, but that certain illegal actions can destroy outcrops and have been policed effectively.

Cretaceous

The Cretaceous is named after the chalk (*creta*, Latin) that characterizes at least the upper parts in Europe, a calcareous marine rock made by the accumulation of the skeletons of planktonic microscopic organisms, mainly foraminifera and coccolithophores. World paleogeography changed substantially in the Cretaceous, beginning with the two supercontinents, Laurasia in the north and Gondwana in the south, separated by the equatorial Tethys Sea, and changing to a much more modern-style geography at the end, with the opening of the Atlantic and break-up of Gondwana. The climate was warm and humid and polar regions were ice-free. On land, dinosaurs continued to be important, especially the hadrosaurs and ceratopsians as Late Cretaceous herbivores. Birds diversified as small flyers, and pterosaurs became ever larger. The flowering plants (angiosperms) appeared in the Early Cretaceous and transformed ecosystems on land. In the seas and oceans most common were the ammonites, belemnites, rudist bivalves, and giant reptiles, among which mosasaurs appeared in the Late Cretaceous. One of the greatest mass extinctions took place at the end of

the period, during which about 80% of animal species disappeared after the impact of a huge meteorite in Mexico.

Among the oldest Cretaceous sites are the dinosaur tracksites in the Maestrazgo UNESCO Global Geopark in south-east Spain, described by Luis Alcalá and Alberto Cobos. The oldest tracks are dated as Tithonian to Berriasian, straddling the Jurassic-Cretaceous boundary, showing ornithopod and theropod tracks. Younger track sites date from the Barremian. Details of the scientific study of each of the sites are given, together with conservation measures and the in situ public exhibits at three of the sites. These sites also yielded important skeletal fossils of dinosaurs, as Luis Alcalá and Rafael Royo-Torres describe in another article. These include six new species of theropods, sauropods and ornithischians, subjects of current research, and so of great interest to the public who can see specimens at the Dinopólis Museum in the regional capital, Teruel, and in satellite museums in Galve and Castellote.

Two sites show aspects of the Early Cretaceous marine fossil record. First, the Leše geosite in the Karawanken/Karavanke UNESCO Global Geopark, on the border of Austria and Slovenia, is famed for its heteromorphic ('uncoiling') ammonites, of Valanginian–Hauterivian age. As Matija Križnar and colleagues describe, these fossils were first found by amateur collectors, who then worked with research paleontologists to publish the materials, and then develop the geoheritage as a collaboration between amateurs and professionals for the benefit of science and local economic development. Further, as one of several cross-border Geoparks, legal, political and language issues had to be considered in developing the geoconservation and education programmes.

One of the Early Cretaceous geosites, the Aptian Marls of La Tuilière in the Luberon UNESCO Global Geopark in south-eastern France, represent the global stratotype for the base of the Aptian Stage. The importance of the site was recognized in the 19th century, as described by Stéphane Legal and Pauline Coster,. The geology comprises thick successions with abundant fossils, including 30 species of ammonites, as well as belemnites, solitary corals, echinoderms, brachiopods, and 14 species of sharks represented by teeth. As a GSSP, the local authorities are obliged to conserve this site, and the authors discuss ways of informing the public about the importance of such locations as benchmarks for geological time, as well as for showing ancient ecosystems. Slightly younger is the Albian 'giant ammonites' site in the Basque Coast UNESCO Geopark in north-eastern Spain, described by Asier Hilario and colleagues. This site at the west end of the Geopark is based largely on the work of a single fossil collector who has made a collection of over 150 excellent specimens since 1975, now housed in the Nautilus Center in Mutriku, and the series of negotiations to bring the materials into public ownership for research and educational purposes are described.

Two of the locations show Late Cretaceous dinosaurs. First is Iharkút in the Bakony-Balaton Geopark of Hungary, where dinosaur bones were found in commercial bauxite mines. As Gábor Botfalvai and colleagues show, these bones include remains of terrestrial and freshwater animals, including fishes, amphibians, turtles, lizards, a freshwater mosasaur, pterosaurs, crocodilians, dinosaurs, and birds. The site is internationally important because it represents an age (Santonian) when such fossils are rare worldwide, and documents life on the northern shore of Tethys. Some of the most famous European dinosaur localities are found in the Hațeg Country UNESCO Global Geopark in Romania, as described by Zoltán Csiki-Sava and Alexandru Andrășanu. At several localities, and spanning several million years of the Maastrichtian, abundant faunas of dinosaurs, pterosaurs, crocodilians, lizards, frogs, and mammals have been found. The dinosaurs in particular have been interpreted as 'island dwarfs', animals that are one-quarter to one-tenth the size of the

nearest relatives. The idea is that they had become isolated on islands that made up much of eastern and southern Europe at this time of very high sea levels. Over time, they become smaller to suit the ecologies of the islands, and even show primitive characteristics because of their isolation. Both sites have been important for student education and citizen science approaches, where large numbers of volunteers assist in excavations. Dan Grigorescu gives further, detailed information about the dinosaur eggs and babies from the Hațeg Country UNESCO Global Geopark, fossils that hugely enhance the global importance of this Geopark. This account is especially important because Professor Grigorescu has been instrumental throughout the thirty years of study of these eggs and nests, and because he can document changing engagement by local and governmental authorities in caring for the sites, and some current problems.

In western Europe, the Origens UNESCO Global Geopark in south-eastern Spain shows 15 palaeontological sites of Late Cretaceous age with dinosaur fossils. Here, Isabel Blasi and colleagues show their careful conservation measures based on a formal questionnaire that identifies risks, pressures and geotouristic interests and points to appropriate geoconservation measures for each site.

Eocene

The Eocene (56–34 million years ago) is the second epoch of the Paleogene Period in the Cenozoic Era, following the Paleocene and being followed by the Oligocene. The continents continued to drift toward their present positions; at the beginning Australia and Antarctica remained connected, and they split around 45 Ma. The climate was generally warm in the first part of the Eocene, followed by a pronounced global cooling when Antarctica began to freeze. The floral assemblages reflect the climate variation: dense jungles and rainforests were widely developed in the first part of Eocene, being replaced by deciduous forests in the second part, when the earliest grasses started to evolve. In the terrestrial faunas, early forms of most modern mammalian orders appeared, together with primitive forms that died out by the end of the Eocene. Many modern bird orders appeared. Marine invertebrate faunas became quite modern, and teleost fishes, sharks and the first whales were the most characteristic marine vertebrates.

One of the most famous Eocene fossil Lagerstätten is the Messel Pit, a UNESCO World Heritage Site since 1995, located near Frankfurt, Germany. We present two papers on this site, a general introduction by Marie-Louise Frey and colleagues, and a review of the major fossil groups by Krister Smith. The Messel Pit probably offers the most detailed insight into an Eocene terrestrial ecosystem anywhere in the world. The unique oil shale deposits preserve a rich flora and fauna, including details of soft tissues such as internal organs and hair on the mammals. Climates were warm and subtropical, and fossils include green algae, angiosperms (laurel, moon seed, walnut, grapevine families), snails, spiders, freshwater shrimps, insects (mayflies, dragonflies, earwigs, grasshoppers, termites, flies, butterflies, ants, bees, beetles), fishes (gars, bowfins), frogs, salamanders, lizards, snakes, turtles, crocodilians, birds (nightjars, swifts, hummingbirds, parrots, passerines, trogons, hoopoes, rollers, kingfishers, mousebirds), and mammals (horses, insectivores, artiodactyls, rodents, pangolins, bats, primates). This astonishing site is one of the gems of European paleontology and provides endless information about the life of Europe during an early hothouse climatic optimum.

Of similar age, a small deposit in the UNESCO Global Geopark Vulkaneifel has yielded an important middle Eocene fossil louse. Martin Koziol and Torsten Wappler use this extraordinary fossil to characterize the Eckfelder Maar, a filled volcanic crater that has yielded 25,000 fossils, ranging from algae and pollen grains to complete mammal skeletons, some with soft tissue preservation and stomach contents. The louse has modern relatives and probably infested some Eocene shorebirds or

ducklings.

Further insights into Eocene life can be seen in the Sobrarbe-Pirineos UNESCO Global Geopark in the Central Pyrenees, Spain, as described by José Ignacio Canudo and colleagues. Fossils from marine and continental sedimentary environments are unusually diverse and abundant, including the "Crocodile of Ordesa-Vio" and the sirenian *Sobrarbesiren*. The middle Eocene marine beds include horizons rich in the large nummulite formainifers, as well as gastropods, echinoderms and crabs, as well as diverse marine turtles, crocodilians, and the dugong *Sobrarbesiren*, an unusual aquatic mammal.

Oligocene

The Oligocene is the third and final epoch of the Paleogene period. The Eocene/Oligocene boundary, 34 Ma, is marked by a major extinction, known as the Grande Coupure (Big Break) corresponding to replacements of European faunas with Asian ones. During this epoch, the continents continued to drift toward their present positions. Antarctica became more isolated and finally developed an ice cap. A land bridge functioned in the Early Oligocene between North America and Europe which allowed interchanges of terrestrial faunas. Among plants, temperate deciduous forests and savanna grasses expanded, and these more open landscapes allowed mammals to grow to larger sizes in comparison with the Eocene forms. Many groups, such as horses, rhinos, bovids, camelids became adapted to the spreading savannas. Marine faunas became more modern, and bivalves and foraminifera provide the main index-fossils.

The Grande Coupure is beautifully documented in the phosphatières du Quercy, karstic fillings in the Causses du Quercy Geopark in southern France, described by Thierry Pelissié and colleagues. These phosphate deposits have yielded thousands of continental fossils spanning through some 30 Myr, from late early Eocene to early Miocene. The fossils include natural mummies and 3D vertebrate fossils, including amphibians (frogs and newts), squamates (lizards and snakes), turtles, crocodilians, birds (e.g., parrots and birds of prey), and mammals (marsupials, pangolins, carnivores, insectivores, odd and even-toed ungulates, bats, rodents, and primates), as well as remains of arthropods and plants.

The marine and coastal Oligocene is documented in the Beiguia Geopark of northern Italy, described by Maria Bonci and colleagues. Different locations show a variety of sedimentary settings, including marine shelf habitats with coral reefs, and continental river and lake deposits with abundant ferns and angiosperms, as well as turtles, crocodilians and mammals. This mix of deposits provides rich opportunities for education and geotourism.

The Luberon UNESCO Global Geopark in southern-eastern France is described in two papers by Pauline Coster and Stéphane Legal. The first paper presents the lagerstätte, concentrating on body fossils, including plants, insects, amphibians, reptiles, birds and mammals from an early Oligocene lacustrine-terrestrial ecosystem. This was a time of warm conditions across Europe and other continents, and its early Oligocene date makes the site particularly important as many such sites elsewhere are late Oligocene in age. In the second paper, the rich trace fossil assemblage of mammal tracks is documented, especially at the Saignon tracksite. At one level, the abundant tracks include traces of perissodactyls and artiodactyls, and above these a level richly covered with bird tracks. As with other track sites such as this, the authors discuss varied conservation methods essential to preserve the scientific integrity of the sites, as well as to engage children and geotourists in understanding their unique information.

Miocene

The Miocene is the first geological epoch of the Neogene Period, followed by Pliocene. Conti-

nents continued to drift toward their present positions, with South America and North America still not connected, and India continuing to collide with Asia, creating the Himalaya Mountains. The western Mediterranean temporarily dried out near the end of the Miocene, during a time called the Messinian salinity crisis. Global climates were becoming increasingly arid and slowly cooling as grasslands continued to expand and forests to dwindle. The plants and animals of the Miocene were recognizably modern. Mammals and birds were well-established. Whales, pinnipeds, and kelp spread. By the end of the epoch, the ancestors of humans had split away from the ancestors of the chimpanzees and the other great apes to follow their own evolutionary path.

There are three Miocene palaeontological sites, the first being the so-called 'Prehistoric Pompeii', Ipolytarnóc in the Novohrad–Nógrád UNESCO Global Geopark in northern Hungary and southern Slovakia, described by László Kordos and colleagues. The site shows a mix of Miocene-aged terrestrial sandstones and rhyolite tuffs containing a petrified forest and leaves and abundant animal tracks in a relatively small area, together with a rich shark-tooth-bearing intertidal sandstone. These authors have identified several thousand footprints and body impressions, including new fish, amphibian, reptile, bird, and mammal ichnotaxa. Re-interpretation of the paleohabitats identifies interfingering terrestrial (Rhinoland) and intertidal pool (Crocodilia) landscapes. These connect with evidence for active tectonic uplift in the Neogene and equatorial floras and faunas in eastern Europe.

Early Miocene forests are also shown in the second locality, the petrified forests in the Lesvos Island UNESCO Global Geopark, Greece. Nickolas Zouros describes the diversity of geological phenomena in the Geopark, including evidence of ancient volcanoes and substantial geomorphological change, as well as ancient forests that were overwhelmed by the lava and ash in several locations. Large tree trunks and complex root systems, as well as leaf fossils, show the diversity of plants, and encourage visitors to think about how the climate and landscapes have changed.

The third Miocene site shows Late Miocene coral reefs in the Cabo de Gata-Níjar UNESCO Global Geopark in south-eastern Spain, as described by Juan Braga and colleagues. Here, the sections document three successive Messinian coral reef units, two of them pre-dating the drying out of the Messinian salinity crisis. These were exposed and eroded as sea levels fell, and later, as sea levels recovered, a third reef built up on top of the eroded surface. All reefs show similarities with Indian Ocean reefs, because of open connections to the Mediterranean, but these connections closed and such reefs did not return to the Mediterranean. The public may visit extensive locations by geotrails, and vulnerable locations are protected by fences.

Quaternary

The Quaternary, originally named as the 'fourth' division of geological time after the Paleozoic, Mesozoic, and Tertiary (now subdivided into Paleogene and Neogene), includes the Pleistocene, the time of ice ages, and the Holocene (after 11,700 years ago) and even the Anthropocene (perhaps the last 250 years of industrialization). In the Pleistocene, large parts of Europe were covered with huge ice sheets. Today we are in an interglacial period—the Holocene. The severe climatic changes during the ice age had major impacts on the fauna and flora. Typical examples of the ice age megafauna were the woolly mammoth, steppe mammoth, aurochs, steppe bison, cave lion, cave bear, cave hyena, Irish elk and woolly rhinoceros. At the end of the Pleistocene Epoch there was a major extinction of large mammals in northern areas. Evolution of the hominids continued, and the appearance of the genus *Homo* marks the beginning of Quaternary.

The European Quaternary fossil record is represented in five Geoparks. In stratigraphic order, the

first is the Granada UNESCO Geopark in Spain, the source of rich remains of Pliocene to middle Quaternary mammal fossils from numerous localities, as presented by Alfonso Arribas Herrera and colleagues. The successive faunas have yielded thousands of specimens of hundreds of species, from mice to elephants, and tortoises to horses, showing the impacts of glacials and interglacials on the prevalent mammals, and with human remains associated with the younger assemblages.

The second site is unusual, the Hondsrug UNESCO Global Geopark in the northeast of the Netherlands, described by Harry Huisman and Margaretha Roelfs. This site shows a range of low till ridges produced by moving land ice and melt water, associated with strong cultural history, in which neanderthals encamped about 50,000 years ago. The fossils here are unusual, however, being contained in erratic blocks of Paleozoic rock moved by the ice from thousands of miles north in the Baltic Sea.

The remaining three sites show animal and human remains in association. One is the Middle Paleolithic site of Foz do Enxarrique in the Naturtejo UNESCO Global Geopark in central Portugal, described by Silverio Domingues Figuerido and colleagues. This open-air archeological site has yielded animal fossils and Mousterian stone tools, indicative of a population of Neanderthal humans. There is a single archeological horizon that accumulated in low energy conditions on a river terrace, including abundant fragmentary bones, many of them rhinoceros and elephant bones showing with cut marks as evidence they were hunted. The next site also shows human and animal fossils, dating from the Middle and Upper Paleolithic of the Hohle Fels Cave in the Swabian Alb UNESCO Geopark in southern Germany, described by Conny Meister and colleagues. The cave is open to the public, showing the archeological digs for artefacts and cave art, including carved mammoth tusks, as well as perforated mammal teeth and scallops. The final site is a remarkable Cave bear cave in the Sobrarbe-Pirineos UNESCO Global Geopark in northernmost Spain, described here by Raquel Rabal-Garcés and colleagues. Caves are widespread in these limestones on the southern side of the Pyrenees Mountains, and the Coro Tracito Cave at Tella has yielded a fossil collection that consists entirely of bones of the cave bear *Ursus spelaeus* of late Pleistocene age, accumulated over several thousand years. This site poses interesting geoconservation and geotourism issues and is open to visitors but in limited numbers.