The Maastrichtian type area (Netherlands–Belgium): a synthesis of 250+ years of collecting and ongoing progress in Upper Cretaceous stratigraphy and palaeontology

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Abstract: Cretaceous limestones near Maastricht (SE Netherlands) have been quarried at least since Roman times. In the late eighteenth century, scientific interest developed in their macrofossil content and specimens were illustrated for the first time. Amongst the early discoveries was a partial skull of a large predatory vertebrate that would play an important role in the emergence of modern palaeontology and our understanding of the concept of extinction. After decades of scientific debate, this animal was recognized as a large extinct marine relative of monitor lizards (varanoids) and named *Mosasaurus.* A detailed lithostratigraphy of Upper Cretaceous (Santonian–Maastrichtian) rocks was established in the Maastrichtian type area during the mid-1970s, which resulted in a renewed interest in fossil hunting by professional and amateur palaeontologists alike. During recent decades, both micro- and macrofossils have enabled a refinement of biozonations, correlations within the basin and with sections elsewhere, a greater insight into taphonomic processes and updated taxonomic interpretations. A new age model and chemostratigraphical framework is the most recent addition, permitting the placement of geoheritage in a larger frame and intensifying outreach to the public, including also virtual and augmented reality and hands-on experience to visitors of museum and (disused) quarries alike.

Since the latter half of the eighteenth century, when the first remains of marine reptiles (turtles and mosasaurs) and a range of invertebrates were recognized in the building blocks extracted in subterranean galleries near Maastricht (Fig. 1) and published (Faujas-Saint-Fond 1798–1803), the soft, friable and easily worked limestones in the area have been attracting the attention of scholars and private collectors alike. Taxa illustrated by Faujas-Saint-Fond were given formal Latinized names in the following decades by German, English and French naturalists, including Nathanael Gottfried Leske, Ernst Friedrich von Schlotheim, William Conybeare, August Goldfuss, Gideon Algernon Mantell, Anselme Gaëtan Desmarest and Jean-Baptiste de Lamarck. The coining of the 'système maestrichtien' in the summer of 1849 by André Hubert Dumont, the current Maastrichtian Stage, dated between 71.2 and 66.02 Ma, accelerated studies of fossils, which were carried out near-exclusively by local, non-professional pioneers, 'citizen scientists' *avant la lettre*, who laid the foundation for later work. When they died, their well-stocked collections, inclusive of type material, were sold off and disappeared abroad. For instance, by auction, the Van Breda Collection, which contained the type femur of the theropod dinosaur, *Betasuchus bredai* (Seeley, 1883), as well as a matrix block with a carapace and plastron of the marine turtle, *Allopleuron hofmanni* (Gray, 1831), in anatomical connection, made its way to the Natural History Museum (London, UK). This ushered in a 'quiet period', roughly between 1890 and the early 1960s.

The introduction of a formal lithostratigraphical subdivision for the Upper Cretaceous (Santonian–Maastrichtian) in the mid-1970s (Felder 1975)

From: Clary, R. M., Pyle, E. J. and Andrews, W. M. (eds) *Geology's Significant Sites and their Contributions to Geoheritage*. Geological Society, London, Special Publications, **543**,
https://doi.org/10.1144/SP543-2022-232

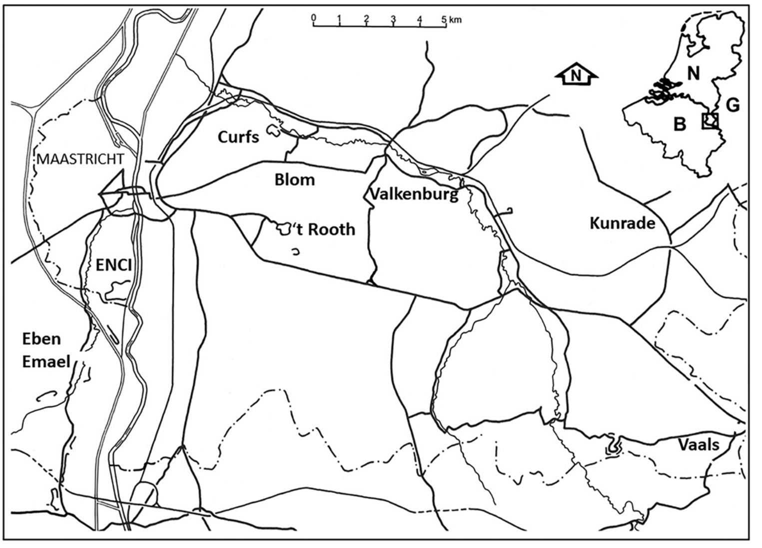

Fig. 1. Map of the extended type area of the Maastrichtian Stage in southern Limburg (the Netherlands; N) and contiguous Belgian (B; provinces of Liège and Limburg) and German (G; Aachen area) territories, with indication of the main fossil-producing localities. The Geulhemmerberg Cretaceous–Paleogene (K/Pg) boundary section is just SE of the former Curfs quarry (Brinkhuis and Smit 1996; Vellekoop *et al.* 2020). ENCI, Eerste Nederlandsche Cement Industrie open pit.

(Fig. 2) brought a new impetus, coupled with extensive collecting by a large group of amateurs at numerous small limestone pits and outcrops that have now all but disappeared or are overgrown. In recent decades, another surge of activity has yielded plenty of new material, including taxa not previously described from the area or new to science. In addition, fossils are being used to 'paint the larger picture', backed up by a new age model and chemostratigraphical framework for the type Maastrichtian (Vellekoop *et al.* 2022) which allow firmer correlations with stratigraphical sections abroad. Museum exhibitions, educational programmes, videos and podcasts can now be better implemented to illustrate the area's geoheritage. All these offer the public a hands-on experience of a long-gone, warm marine setting teeming with life and cruising mosasaurs at the top of the food chain. Although the Maastrichtian rocks are shallow marine in origin, their fossil record also offers glimpses of the terrestrial environments – isolated dinosaur bones, partial bird skeletons, an odd mammal tooth and washed-in conifer twigs and leaves of other plants. A visit to the historical main Maastrichtian type section quarry, the now inactive ENCI (Eerste Nederlandsche Cement Industrie) open pit, with virtual or augmented reality equipment, provides a powerful additional educational element.

Below, a brief overview of the palaeogeographical–stratigraphical setting will be presented, followed by a summary of recent finds, of both invertebrate and vertebrate biota, plus plants and ichnofossil suites. Added to that is a short list of activities developed at our institutions to illustrate the geoheritage of the Maastrichtian type area, and an outline of future plans.

Geographical and stratigraphical setting

The extended type area of the Maastrichtian Stage comprises the area between Maastricht (Netherlands), Liège (Belgium) and Aachen (Germany; Fig. 1), with outliers towards the SE on the Ardennes Plateau (Hautes Fagnes) in NE Belgium (Bless *et al.* 1991). During the Santonian to Maastrichtian, when this area was situated at a palaeolatitude of approximately 40°N (Voigt *et al.* 2008; https://www.paleolatitude.org), both siliciclastic and carbonate strata were laid down. Deposition was periodically influenced by local tectonics (Bless *et al.* 1987; Felder 1996, 2001), which resulted in marked facies changes over short distances of less than 25 km (Felder and Bless 1989; Felder and Jagt 1998). Estimates of palaeowater depth on these generally flat-lying shelves, during the early Campanian to late Maastrichtian, predominantly based on microfaunal assemblages, vary between *c.* 150 to less than 10 m (Sprechmann 1981; Bless 1991; Jagt 1999*a*). There is a clear overall tendency for the depositional setting to become shallower upsection, culminating in hardground

HOUTHEM Fm			
		Vroenhoven Hz	
	MEERSSEN Member, IVf-7		
		Berg en Terblijt Hz	66.02 Ma (**K/Pg**)
	MEERSSEN Member, IVf-1/-6		
		Caster Hz	66.13 Ma
	NEKUM Member, IVe-3/-4		
		Kanne Hz	66.25 Ma
	NEKUM Member, IVe-1/-2		
		Laumont Hz	66.35 Ma
MAASTRICHT Fm	EMAEL Member		
		Romontbos Hz	66.55 Ma
	SCHIEPERSBERG Member		
		Schiepersberg Hz	66.60 Ma
	GRONSVELD Member		
		St. Pieter Hz	66.90 Ma
	VALKENBURG Member		
		Lichtenberg Hz	67.00 Ma
	LANAYE Member		
		Nivelle Hz	67.80 Ma
	LIXHE 3 Member		
		Boirs Hz	68.60 Ma
	LIXHE 2 Member		
		Halembaye 1 Hz	69.20 Ma
	LIXHE 1 Member		
		Wahlwiller Hz	69.70 Ma
GULPEN Fm	VIJLEN Member, interval 6		
		Zonneberg Hz	
	VIJLEN Member, interval 5		
		Böckler Hz	70.40 Ma
	VIJLEN Member, intervals 0-4		
		Bovenste Bos Hz	(**Camp/Mstr**)
	BEUTENAKEN Member		
		Froidmont Hz	72.60 Ma
	ZEVEN WEGEN Member		
		Zeven Wegen Hz	
VAALS Fm			

Fig. 2. Local stratigraphy of the Vaals, Gulpen, Maastricht and Houthem formations (Fm), with all members and horizons (Hz) separating the latter. The Aachen Formation, of middle to late Santonian age, as well as the Kunrade Formation, which is the equivalent of the middle Lanaye to basal Emael members, are not shown here. The numerical ages in the right-hand column are taken from Vellekoop *et al.* (2022). Abbreviations: K/Pg, Cretaceous–Paleogene boundary; Camp/Mstr, Campanian–Maastrichtian boundary.

development and bryozoan-, scleractinian- and rudist-rich levels within the upper part of the Maastricht Formation (Meerssen Member), except for the highest portion of the Meerssen Member (Vonhof and Smit 1996) which reflects basin subsidence. Spot occurrences in Germany (see e.g. Voigt 1951) prove that this biocalcarenitic, fossil-rich facies formerly had a much wider distribution, being a marginal facies coeval to the white chalk sea of northern Europe.

A formal lithostratigraphical subdivision of strata outcropping in the area, or penetrated in boreholes, was proposed by Felder (1975) and updated twenty-five years later (Felder and Bosch 2000) (Fig. 2). The sedimentology, flint genesis and ichnofossil assemblages of a part of the sequence were analysed by Zijlstra (1994), while biozonations have relied mostly on calcareous nannoplankton, palynomorphs (including dinoflagellates), benthic foraminifera, ostracods, coleoid cephalopods and inoceramid bivalves (see e.g. Deroo 1966; Sprechmann 1981; Schiøler *et al.* 1997; Walaszczyk *et al.* 2010; Keutgen 2011; Slimani *et al.* 2011; Keutgen *et al.* 2017; Jagt and Jagt-Yazykova 2018; Vancoppenolle *et al.* 2022).

The discovery of Cretaceous–Paleogene boundary (K/Pg) strata in the underground galleries of the Geulhemmerberg, close to the former Curfs quarry (Fig. 1), has allowed a better constraint of the type section of the Maastrichtian Stage and a more reliable correlation of overlying lower Danian carbonates with the type area of that stage in Denmark (Brinkhuis and Smit 1996). In addition, the first strontium isotope curve for the type Maastrichtian was published (Vonhof and Smit 1996), followed by a strontium, carbon and oxygen isotope stratigraphy for the area based on belemnites (Vonhof *et al.* 2011). In recent years, a sequence-stratigraphical interpretation of bioclast ecozonations (Keutgen 2018) and a new age model and chemostratigraphical account (Vellekoop *et al.* 2022) have been published. In the latter paper, the mid-Maastrichtian events, as recognized elsewhere in Europe (Denmark, Italy), were recorded for the first time from the Maastricht area (see also Vancoppenolle *et al.* 2022).

A brief synopsis of earlier studies

The discovery of the mosasaur skull in the Sint-Pietersberg underground galleries in October 1778 caused quite a stir (Homburg 2015) and the subsequent debate regarding its nature and affinity inspired people like Jean-Leonhard Hoffmann, Petrus Camper and his son Adriaan Gilles, and Georges Cuvier, who, as pioneers of vertebrate palaeontology, helped lay the foundation for the field (Mulder 2004). Of specimens illustrated in the monograph on the fossil fauna from Sint-Pietersberg area in Maastricht by Faujas-Saint-Fond (1798–1803), many survive in the Paris collections, including scleractinian corals, echinoderms, bivalve and gastropod molluscs, brachiopods, ichnofossils, fish and shark teeth (Brignon 2015), as well as turtle and mosasaur remains.

Between 1850 and 1880, there was a surge of new studies by three amateur collectors, early ‘citizen scientists’: Johan Theodorus Binkhorst van den Binkhorst (1810–76), Joseph Bosquet (1814–80) and Casimir Ubaghs (1829–94). Bosquet even corresponded with Charles Darwin on the subject of extinct barnacles (Jagt 2020). However, in those days, the city of Maastricht had no natural history museum, nor a university, and collections left the area for Brussels, London and Berlin, ushering in a relatively ‘quiet period’ with little scientific progress.

Around the mid-1960s, the Felder brothers started their careers as local specialists in the fields of lithostratigraphy (Felder 1975) and ecostratigraphy or bioclast zonations (Felder and Bless 1989; Felder 2001), allowing correlation within the basin, but also extending towards the south and west to boreholes in NW Belgium and the Ardennes (Hautes Fagnes), where residual Upper Cretaceous strata had been found. Interestingly, the established ecozones can also be used in archaeology, for instance to determine the provenance of building stone (‘Maastricht Stone’) used in Roman villas and medieval churches (Lahaye *et al.* 2022). Active quarrying for the production of Portland cement and fertilizer at numerous limestone pits across southern Limburg (Netherlands) in the 1970–90s, coupled with a growing number of amateur collectors, have resulted in the current availability of large palaeontological and geological collections, both institutional and private.

Recent advances

In recent decades, revisions of existing museum collections have been complemented with records of newly recovered material. A brief overview of biotic groups dealt with in those studies is presented here.

Plants

In addition to pollen and spores (Kedves and Herngreen 1980), sea grass and other marine plants have been recorded, as well as terrestrial taxa of various kinds (van der Ham *et al.* 2001, 2003, 2007, 2010, 2017). At some stratigraphical levels within the Gronsveld and Emael members (Maastricht Formation; Fig. 2), there are storm-generated accumulations of sea grass stems and leaves that have smothered (endo)benthic life, including bivalves and starfish (Jagt *et al.* 2019*b*).

Invertebrates

Amongst molluscs, ammonites have received ample attention (Kennedy 1987; Jagt and Jagt-Yazykova 2019), inspiring discussions of the survival of some groups (e.g. Baculitidae, Scaphitidae) across the Cretaceous–Paleogene (K/Pg) boundary (Landman *et al.* 2015). The first sepiid (Hewitt and Jagt 1999), bioimmured gastropod egg capsules (Zatoń *et al.* 2013), a new type of nautiloid jaw element (Mironenko *et al.* 2022) and the youngest late Maastrichtian trigoniid bivalves (Jagt *et al.* 2022) have been recorded as well. An analysis of gastropod diversity across the K/Pg boundary (Vellekoop *et al.* 2020) has illustrated a rapid recovery phase during the earliest Danian in the area.

Amongst crustaceans, new anomuran and brachyuran taxa have been recorded and the stratigraphical ranges of other species documented in more detail (Collins *et al.* 1995; Fraaije 2003; Jagt *et al.* 2010, 2014; Van Bakel *et al.* 2012; Fraaije *et al.* 2017). In addition, the youngest cycloid crustacean on record to date has been described from the uppermost Maastricht Formation (Fraaije *et al.* 2003) and there are new records of another important element of crustacean faunas – cirripedes (Jagt and Collins 1999; Gale 2014; Jagt 2020).

An echinoderm Fossil-Lagerstätte, discovered in the mid-1990s, has provided a glimpse of a population of stalked crinoids, ophiuroids, asteroids and echinoids that was smothered by obrution (Jagt *et al.* 1998). Subsequent records include new species of sea lily, brittle star, starfish and sea urchin of latest Cretaceous and earliest Paleogene age (Jagt 1999*b*, 2000*a*, *b*, *c*; Blake and Jagt 2005; Gale and Jagt 2021; Jagt *et al.* 2021), as well as examples of predation, scavenging and attachments of stalked crinoids to secondary hardgrounds (Jagt *et al.* 2018).

The calcitic tubes of serpulid worms have also been systematically assessed and their stratigraphical ranges been determined in greater detail, from both biotic and abiotic substrates (Jäger 2005). Brachiopod faunas, including micromorphs, have also been revised and a number of new species been added (Simon 2007*a*, *b*, 2011).

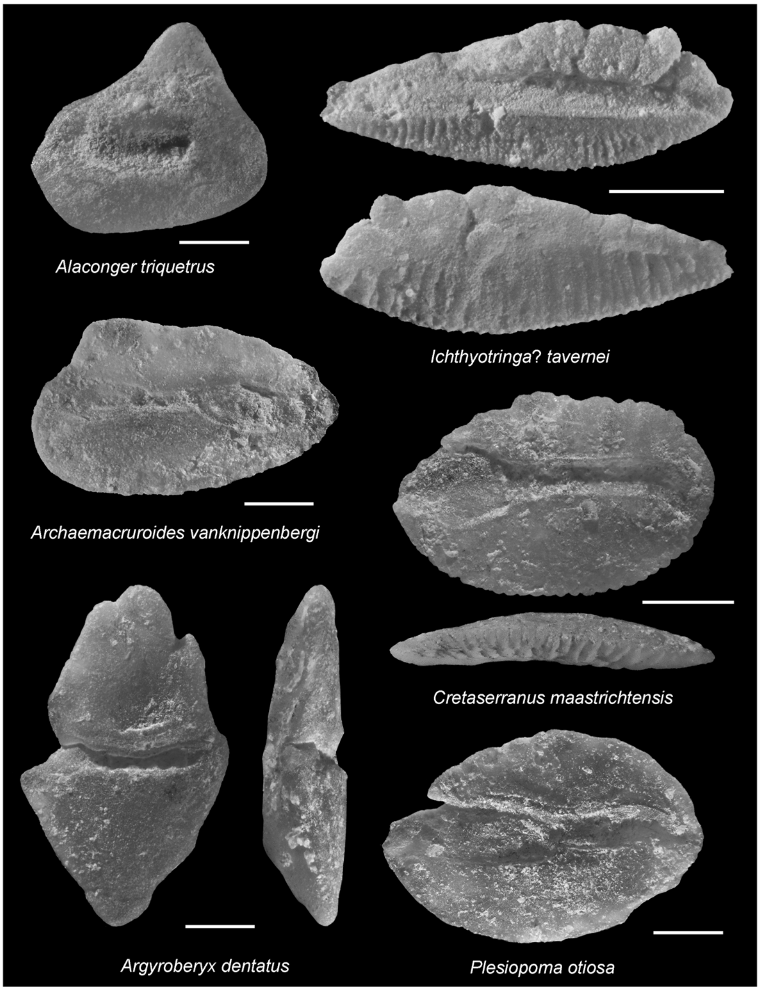

Fig. 3. Silicified teleost otoliths (NHMM collections) from the lower Maastricht Formation, including newly described cod and bass taxa. Source: copied with permission from Jagt and Schwarzhans (2022); see also Schwarzhans and Jagt (2021).

Ichnofossils

In recent years, ichnofossil suites of a wide range of morphologies, illustrating both bioerosion and burrowing, have received ample attention (Donovan and Jagt 2004, 2013, 2020; Wisshak *et al.* 2015, 2019; Donovan *et al.* 2019). For the first ever record of echinoid-produced burrows from the Maastricht Formation, reference is made to Jagt *et al.* (2018).

Vertebrates

Interesting additions to the bony fish assemblages of the type Maastrichtian comprise new dercetids (Taverne and Goolaerts 2015; Wallaard *et al.* 2019), as well as silicified otoliths (Fig. 3) of a range of families of which no skeletal material has yet been recognized, thus providing data on an otherwise unknown assemblage (Schwarzhans and Jagt 2021). Recent work on marine turtles includes a revision of the large, paedomorphic ('superbaby') *Allopleuron hofmanni* and an inventory of other marine turtle species (Mulder 2003; Nolis *et al.* 2018*a*, *b*). Isolated teeth and vertebrae of elasmosaurid plesiosaurs (Mulder *et al.* 2000; Miedema *et al.* 2019) are the only remains of these reptiles found in the Maastrichtian type area. The paucity of elasmosaurs (Schulp *et al.* 2017) may reflect an absence of these sauropterygians in the shallow-marine platform setting of the Late Cretaceous Maastricht ecosystem and be linked to incidental floating-in of decomposing carcasses.

The record of neosuchian crocodiles, inclusive of thoracosaurines (Mulder 1997; Mulder *et al.* 2016), is meagre, comprising only dissociated vertebrae, limb bones, scutes and teeth. Possibly, competition with larger shark and smaller mosasaur species was too fierce for them to become firmly established at the top of the food chain; this is in need of further study.

As apex predators, mosasaurs invariably attract a lot of attention, and every find of associated remains of individuals generates a lot of publicity, not only on a regional, but also on a national level. To commemorate the discovery in August 1998 of the type specimen of *Prognathodon saturator*, nicknamed 'Bèr' (Dortangs *et al.* 2002; Fig. 4), even a special beer was brewed. In addition to the discovery and reports of new specimens, the fossils recovered have also yielded palaeobiological insights. For instance, palaeopathologies such as the infected quadrate (Schulp *et al.* 2006) of the 'Bemelse' mosasaur, discovered in the mid-1950s, the bitten snout of 'Carlo' (Bastiaans *et al.* 2020) and the rib fracture in 'Bèr' (Schulp *et al.* 2004), have provided good stories to captivate museum visitors. The same can be applied to experiments in feeding 'the mechanical mosasaur' (Schulp 2005), or, how did the durophagous species, *Carinodens belgicus* (Woodward, 1891), grab and process its prey items? Scratch marks on the enamel of teeth of this particular species illustrate its preference for hard-shelled food (Holwerda *et al.* 2013). Diving and resource partitioning amongst mosasaurs, reflected in tooth enamel isotopes, have also been documented (Schulp *et al.* 2013), as have differences in oxygen and carbon isotopes in marine vertebrates such as turtles, mosasaurs and sharks (Van Baal *et al.* 2013).

Non-avian dinosaurs are rare (Jagt *et al.* 2003; Buffetaut 2009; Madzia *et al.* 2020), considering that the Maastrichtian type section constitutes a fully marine setting. However, they are not entirely absent, with remains likely introduced through *post-mortem* transport from shorelines, or via rivers. Remains include more than one species of hadrosaur, as well as a carnivorous form, *Betasuchus bredai* (Fig. 5). Skeletal remains of avian dinosaurs are even rarer and comprise a new, tooth-bearing *Ichthyornis*-like taxon and the earliest modern bird known to date, *Asteriornis maastrichtensis*, which is considered to have been a common ancestor of modern chicken- and duck-like birds, or Galleroanserae (Dyke *et al.* 2002, 2008; Field *et al.* 2020; Benito *et al.* 2022).

A single mammal tooth from the type Maastrichtian, the type specimen of *Maastrichtidelphys meurismeti*, is featured in the exhibit 'Meeting your true ancestor' at the Natuurhistorisch Museum Maastricht. This diminutive tooth had far-reaching implications for palaeobiogeography in suggesting the possibility of a land bridge between North America

Fig. 4. The holotype of the mosasaur *Prognathodon saturator* Dortangs *et al.*, 2002, residing in a specially designed 'Mosaleum' on the inner square of the Natural History Museum of Maastricht. Source: photograph NHMM/Stefan Graatsma.

Fig. 5. Reconstruction of the skeleton of the sole carnivorous dinosaur known from the Maastrichtian type area, *Betasuchus bredai*, by Aart Walen. Source: collections of Oertijdmuseum Boxtel; photograph by Jonathan Wallaard.

and NW Europe during the latest Maastrichtian (Martin *et al.* 2005).

Conclusions and future outlook

Although more than two and a half centuries of research have elapsed, new taxa and novel data are still being extracted from the (few) remaining outcrops, quarries and existing collections alike. Not only do we now have a better idea of which animal and plant taxa are represented, silicification of aragonitic molluscs and teleost otoliths offers a previously unnoted glimpse of trophic structures and taphonomic pathways (Hewitt and Jagt 1999; Schwarzhans and Jagt 2021). Correlations with stratigraphical sections elsewhere in Europe (Denmark, northern Germany, Poland, England and France) and North America are also becoming more detailed, both on chemostratigraphical evidence and key index taxa

Fig. 6. Jubilee exhibitions in 2012, celebrating the 100th anniversary of the Natural History Museum of Maastricht: (**a**) on the uppermost Maastrichtian in the Geulhem area; (**b**) on the temporary loan of fossil material collected in the Maastricht area and now held in natural history collections abroad. Source: graphic design NHMM/Arthur Marks, Maastricht.

Fig. 7. Poster of the 'Rock Fossils on Tour' exhibition (http://www.rock-fossils.com), which suffered from COVID-19-related measures and was open to the public for several months only, between February 2020 and January 2021.

amongst foraminifera, dinoflagellates and various groups of macrofossils.

It is fortuitous that Maastricht's geoheritage values are now being considered in earnest by local societies and museums that organize thematic temporary exhibitions (Fig. 6), as well as by universities. Maastricht University, one of the global top universities under 50 years of age, has incorporated earth science and palaeontology research and education in the Maastricht Science Programme of its recently established Faculty of Science and Engineering (Jagt *et al.* 2019*a*), providing another limb to the centuries-old scholarly pursuits in the Upper Cretaceous of Maastricht. The Natural History Museum of Maastricht, the Maastricht Science Programme of Maastricht University, and Natuurmonumenten, the Dutch nature conservancy that has taken on the stewardship of the former ENCI quarry, collaborate through a convenant to ensure proper management, continued research and ongoing public education at the original type section of the 'système maestrichtien' of Dumont (1849). The type section of the Maastrichtian Stage (Felder and Bosch 1998), underneath the Lichtenberg farmstead and behind the former main office of the ENCI-Heidelberg Cement Group has the status of a geological monument and is protected. Geological and palaeontological field work will remain possible in the adjacent quarry, but prior permission must be sought via Natuurmonumenten. Its staff members, in collaboration with Maastricht University and the Natural History Museum of Maastricht, will decide in such matters. For now, visitors can use the staircase on the northern quarry face and follow the path parallel to the former cement plant which leads to chalet d'n Observant where refreshments may be purchased. At a later date, the deeper-lying part of the quarry will also become accessible, depending on safety measures and mating and breeding seasons of local fauna.

Fig. 8. The Science Lab at the Natural History Museum of Maastricht, allowing museum visitors to approach preparators and learn more about their activities. Source: photograph NHMM/Johan Strijckers).

Fig. 9. Panorama photograph (looking SW) of the former Eerste Nederlandsche Cement Industrie (ENCI) quarry (Sint-Pietersberg, Maastricht). Source: photograph by Elena A. Jagt-Yazykova.

In September 2024, the 175th anniversary of the introduction of the Maastrichtian will be celebrated, to be followed by the 'Mosasaur Meeting', the first edition of which was staged at Maastricht in 2003.

Thanks to continued public outreach of the Natural History Museum of Maastricht, new target groups come into contact with palaeontology and palaeontologists, including when the 'Rock Fossils on Tour' (http://www.rock-fossils.com) (Fig. 7) exhibit was put up in Maastricht (Thuy *et al.* 2020). Educational programmes ('mergellessen', analysing the fossil content of limestones) at the museums cater for local and/or regional schools, preparation sessions by volunteers and museum staff at the Science Lab (Fig. 8). The so-called Museum Jeugd Universiteit ('Museum Junior University'), for children aged 8–12, allows subject matters to be covered by professionals in the fields of biology and palaeontology. In addition, recent nationally produced, popular Dinosaur Podcasts by Gijs Rademaker and Maarten van Rossum and thematic issues of the programme 'Vroege Vogels' on national television (BNNVARA) help highlight the educational value of geoheritage to a wider audience.

There are more chances to bring geology and palaeontology to the public at large, by organizing city 'stone walks', covering themes such as sea level, climate change, extinction, geomorphology, the River Maas as landscape architect and builder and recognition of stone types and their use through the ages (Dusar *et al.* 2011; Lahaye *et al.* 2022). Added to that, walks at the now abandoned ENCI quarry (Fig. 9), which is currently managed by Natuurmonumenten, a Dutch nature conservancy, enables the public to experience the quarry in person with a knowledgeable guide, or with virtual/augmented reality equipment. Thus, geoheritage in the type area of the Maastrichtian Stage is very much alive and kicking, and the Natural History Museum of Maastricht, Maastricht University, Natuurmonumenten, local societies and many future generations of citizen scientists can be counted on for an ever-growing understanding of the deep geological history of the Maastrichtian of Dumont, the mosasaur, and so much more.

Acknowledgements We thank the numerous private collectors from all walks of life and active members of the Dutch Geological Society (Limburg branch), for sharing their views and finds with us over the last four decades, and Natuurmonumenten for fruitful co-operation during recent years. We are also grateful to Stefan Graatsma, Arthur Marks, Wilfried Miseur, Werner Schwarzhans and John W. Stroucken for providing photographs, and co-ordinating editor Renee M. Clary and journal reviewers Andy S. Gale and Michael J. Polcyn for pertinent comments on an earlier version of the typescript.

Competing interests The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author contributions **JWMJ**: conceptualization (equal), writing – original draft (equal), writing – review & editing (equal); **LPAMC**: conceptualization (equal), writing – original draft (equal), writing – review & editing (equal); **RHBF**: conceptualization (equal), writing – original draft (equal), writing – review & editing (equal); **EAJ-Y**: conceptualization (equal), writing – original draft (equal), writing – review & editing (equal); **EWAM**: conceptualization (equal), writing – original draft (equal), writing – review & editing (equal); **ASS**: conceptualization (equal), writing – original draft (equal), writing – review & editing (equal); **JJWW**: conceptualization (equal), writing – original draft (equal), writing – review & editing (equal).

Funding This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Data availability All data generated or analysed during this study are included in this published article.

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