

Miocene Mud and more

A background photograph showing a construction site. In the foreground, a large excavator with a dark grey arm and a red bucket is positioned in a deep, muddy trench. The excavator's arm has a yellow warning label. In the background, a person wearing a red long-sleeved shirt and grey trousers is standing in the mud, using a long-handled tool. The ground is a mix of dark brown mud and patches of green grass. The sky is overcast.

Miste 2013

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Fig. 1: Overview of the Miste dig, with many enthusiastic collectors (photo by Ronald Pouwer). Inset: map of The Netherlands (drawing by Jerry Streutker) showing the location of Miste (red dot).



Fig. 2: The excavation of the pit of the Miste dig. The Miste Bed consists of black sediment, while the overlying Pleistocene glacial deposits are brownish to greyish in colour.



Fig. 3: Finally, the participants at the Miste dig hurry to start collecting.

'Miste'... This word has an almost magical meaning for many fossil collectors in The Netherlands and neighbouring countries. That is because the extremely fossiliferous Miste Bed lies close to the surface around the municipality of Winterswijk-Miste, which, in turn, lies close to the Dutch-German border in the Eastern Netherlands (Fig. 1). The Miste Bed (Aalten Member, part of the Breda Formation) was deposited about 15mya (during the Middle Miocene), in a shallow subtropical sea. The fossils preserved in the sandy sediments are extremely diverse: over 600 species of molluscs (Janssen, 1984; Parren, 2005) and dozens of species of sharks, rays (Bor et al., 2012) and bony fish (Hoedemakers & Van Hinsbergh, 2013) have been found, but also marine mammals (Schneider & Hessig, 2005), sea stars (Jagt, 1991), sea urchins, bryozoans and corals.

However, this fossil wealth is not easily accessible. To be able to assemble a decent collection, you need to dig a rather large exposure. Establishing a large hole reaching into the Miste Bed is a lot of work, because you need to excavate approximately 4m on private property. A number of digs have previously been organised at Miste, of which at least three were by the Dutch 'Werkgroep voor Tertiaire en Kwartaire Geologie' (WTKG; see box, The WTKG).

Organising a dig at Miste is also a huge task and finding the right spot is quite hard. For this reason, it seemed likely that the Miste dig carried out in 2003 (celebrating 40 years of WTKG; Mermuys, 2004) was to be the last one. If you missed that one, or the earlier ones, you had simply missed Miste. However, last year, the WTKG celebrated its fiftieth anniversary and that, of course, had to be celebrated in style. Therefore, the WTKG organised a new, large Miste dig in September 2013. A staggering 750m³ of sediment from the Miste Bed was excavated, of which no less than 150m³ was from the very rich basal layer. This sediment was processed by some 140 participants (most of them members of the WTKG): it was wet sieved in different fractions (from 1cm down to <1mm mesh size) and the residues were taken home to be picked over. In this article, we will describe the preparations and provide a report of the Miste dig itself. We will also

show some finds uncovered during the processing of the sediment.

Location and manual drilling

Most previous Miste digs were organised on a field owned by the Berenschot family. It is located a couple of hundred meters to the northeast of the 2013 dig site described here. In 2004, the Berenschot property was changed into a lovely park. Therefore, it was impossible to organise any more digs on that terrain. For the 2013 dig, we had to look at other possible locations. From the literature (Janssen, 1984), we knew that the Miste Bed was accessible in a field owned by the Brethouwer family. Thanks to their participation, we were able to manually drill a test borehole on their field into the Miste Bed. That showed us that the fossils preserved in the Brethouwer field were of high quality. Therefore, we decided to organise the 2013 dig in that field.

Digging

After much preparation, the entire exposure was dug out on 2 September 2013. Two excavators and two dumper trucks were used to excavate and move the sediment, creating a large pit (12m by 25m). The pit was excavated all the way down to the Oligocene clay (Winterswijk Formation) underlying the Miocene Miste Bed, resulting in a depth of about 4.25m (Fig. 2). The upper 1.75m of sediment (disturbed soil, Pleistocene glacial deposits from the Drente Formation and the unfossiliferous part of the Miste Bed) were moved away from the pit and stored in a long, low mound. The fossiliferous sediments were deposited in a horseshoe-shaped mound around the pit. After the excavation, two edges of the pit were made less steep with unfossiliferous sediment. Finally, water was pumped into the pit and a neighbouring ditch, to facilitate the washing of the sediment using sieves. During the excavation, a description of the exposed geological section was made and the exact location of the pit (officially named Miste-3) was determined. The section was sampled (at each 25cm interval) by a number of private collectors and researchers from the Naturalis Biodiversity Centre (Leiden, The Netherlands) to see whether the Miste Bed can be further subdivided on the basis of the fossils present in it (that is, using biostratigraphy).

The excursion

The excursion started on Saturday, 7 September and lasted till Sunday, 15 September 2013. During this time, the participants were free to wash the sediment and collect fossils and residues from about 9am to 6pm every day. On the first day, it was very crowded: some 120 participants, as well as a crew from the Dutch TV program 'Vroege Vogels' (a program focusing on Dutch nature), were present on this 'misty' Saturday morning (Fig. 3).

All participants were provided with a wristband, which indicated that they had paid the entrance fee. After getting their shovels, sieves, crates, buckets and so on, all participants lined up at the ribbon at the edge of the pit. There, they listened to the opening announcements concerning collecting and safety. The crowd got really enthusiastic when these were over and the ribbon separating them from the rich Miocene sediments was cut (Fig. 3). Within minutes, everyone had found a spot and was busy digging and washing the sediments. Soon, the first good fossils were found (see box, Species found during the Miste dig). Most of the fossils were rather small, but the many gastropods, bivalves, corals and sharks' teeth were excellently preserved and therefore are real Miocene treasures.

Nice finds despite bad weather

The next day was just as nice as the first one. The weather was rather good and the fossils that were lying literally everywhere kept spirits high. However, during Tuesday night, the weather took a turn for the worse. A large amount of rain (the equivalent of expected rainfall for the entire month) fell in just that one night. On

Wednesday, it was also very rainy and the pit was abandoned entirely for some time during that day. However, the bad weather did not mean that any fewer fossils were collected.

A nice example of a spectacular fossil that was found is a tooth of the famous shark, *Otodus megalodon*, which occurs very rarely in the Miste Bed (Fig. 4). Most known specimens are just fragments. However, this tooth is in mint condition. The awareness that each and every shovel-full of sediment may contain such a magnificent fossil, kept everyone really enthusiastic. No matter how much rain fell.

The end

On the final day of the excursion, all the equipment was retrieved and loaded into the cars and trailers of the participants. When the final bags, buckets and containers holding residues and larger finds were prepared for the travel back home, the question arose: "what to do now?" The answer is rather obvious - all the residues had to be rewashed at home to get rid of excess sand and clay, and to sort the fossils into different fractions (down to 0.5mm or even less). Then, these fractions had to be dried. In the meantime, there were many boxes containing larger finds to clean and dry. Another important issue was finding a place to store the many fossils. But the most important and fun part was still to come - picking through the (sometimes, very tiny) fossils from the residues, to identify finds and of course to learn more about them.

Miste on the Internet

Quickly after the end of the excursion, one of the participants created a Facebook group (named Miste) about

The WTKG



The Dutch "Werkgroep voor Tertiaire en Kwartaire Geologie" (WTKG) is an active association open to anyone with an interest in fossils and/or the geology of Tertiary and Quaternary deposits (that is, the entire Cainozoic). The WTKG organises three to four meetings a year, allowing its members to consult each other and discuss finds, identifications and localities, as well as to listen to the (often professional) lectures held for the association. The WTKG publishes two periodicals: *Afzettingen* is its popular periodical and, together with the Tertiary Research Group, it also publishes the international scientific journal *Cainozoic Research*. The WTKG also regularly organises geological excursions in The Netherlands and neighbouring countries, such as the Miste dig. More information can be found at: www.wtkg.org.

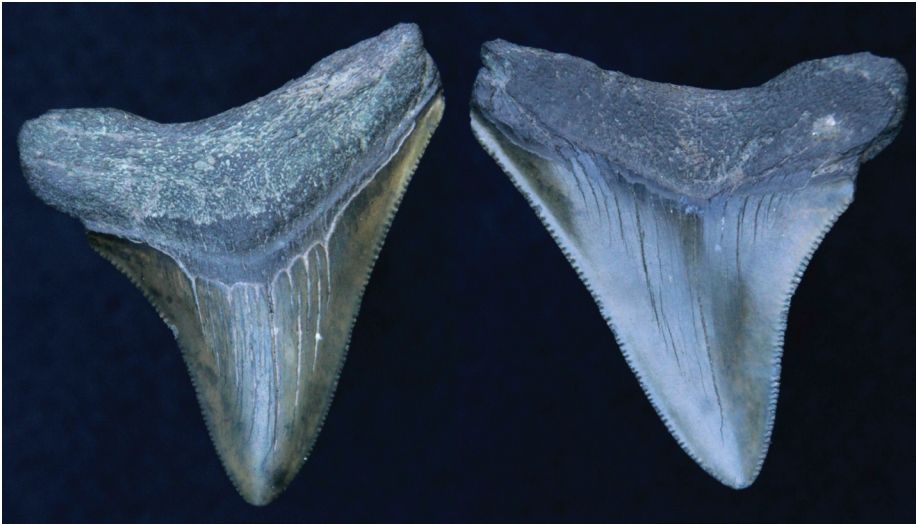


Fig. 4: Two views of a magnificent tooth of *Otodus megalodon* (Agassiz, 1837) from the Miste dig. It measures 56mm by 54mm. Collection and photos by Henri Jansen (The Netherlands).



Fig. 5: This *Trigonostoma (Misteia) mistense* A.W. Janssen, 1984 was found and photographed by Frans Frenken (The Netherlands). It is an extremely rare species, of which only a couple of specimens are known from all of the Miste digs.



Fig. 7: A number of these beautiful teeth of *Notorynchus primigenius* (Agassiz, 1835) were recovered during the dig.



Fig. 6: Ferry Albrecht (Germany) found and photographed this *Aphanitoma fransi* Janssen, 1972. A remarkable, but also rather unknown species, from Miste, because it is not mentioned in the standard reference work on the Miste Bed molluscs (Janssen, 1984).



Fig. 8: By washing away the sand, intense rain revealed the true wealth of the excavated sediment from the Miste Bed.

the excursion. Here, the many finds from the excursion, but also the many fossils picked from the collected residues, are actively discussed. This has resulted in the quick discovery of some important specimens, like for example those in Figs. 5 and 6.

Milestone

A fiftieth anniversary is a rather large milestone and the fact that it was celebrated in Miste was a logical choice: the Miste Bed and its fossils played an important role in the formation of the WTKG during the early 1960s (Van den Bosch & Janssen, 2013). The great interest and the enthusiasm of the participants showed that the WTKG, as well as the Miste Bed, are still very much alive and kicking today. As well as the TV crew mentioned above, Dutch radio, a couple of Dutch websites and a Dutch newspaper paid attention to the Miste dig.

Onsite, a large amount of excellent finds were made, including some important specimens, such as the *megalodon* tooth. As well as that, literally thousands of kilograms of residues were washed from the sediment and taken home by the collectors. As a result, our knowledge of the Miste fauna, which contains the richest fossil mollusc fauna, as well as the richest fossil shark fauna, in The Netherlands (Bor *et al.*, 2012), will undoubtedly increase thanks to these collected residues. Species lists will become more complete; and more and better preserved specimens of rare species will become available. So the sheer number of people working actively and seriously on such an important fossil locality shows that our hobby is not just for fun. It is also scientifically relevant and can help us better understand the geological history of The Netherlands (and of life on earth in general).

Many 'veterans', but also many young enthusiasts, collected during the Miste dig and they all experienced the wealth and diversity of the Miste Bed. Especially for those who had not collected from this Bed before, the experience was a real sensation. Therefore, we can safely conclude that the Miste dig was an enormous success.

Acknowledgements

We would like to thank all the participants, and also the board and

organisation of the WTKG for this great experience. But, most of all, we would like to thank the Brethouwer family for allowing us to dig the exposure on their land. For more information about the Miste dig(s) and the WTKG, go to: www.wtkg.org.

About the authors

The authors are all (board) members of the WTKG. Bram Langeveld handles the public relations of the WTKG. Colin van Elderen specialises in the molluscs of the Miste Bed. Stef Mermuys handles the WTKG's geological excursions and is the main organiser of the Miste dig. They can be contacted at: Bramlangeveld@hetnet.nl, C.vanelderen@aragemstones.nl and Stefmermuys@live.nl respectively.

Further reading

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Fig. 9. A handful of Miocene fossils, just washed from the sediment.

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Fig. 10. The fossils are washed from the sediment using sieves.

Species found during the Miste dig

Found by Ariën van Oord:

- *Xenophora burdigalensis* (Grateloup, 1847)

Found by Ton van Eijden:

- *Apiocypraea (Apiocypraea) subphysis septemtrionalis* (Schilder, 1929)

Found by Hans Wijnstekers

- *Conus (Chelyconus) clavatus* d'Orbigny, 1852

Found by Eddy Spijkerman:

- *Isurus retroflexus* (Agassiz, 1843)

Found by Marleen Schouten:

- *Cirsotrema (Cirsotrema) crassicoatum* (Deshayes, 1839)

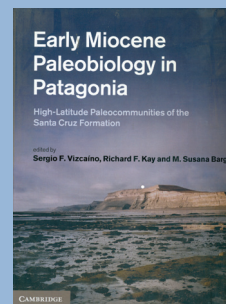
Found by Martin Cadée:

- *Trigonostoma (Trigonostoma) barnardi* A.W. Janssen, 1984

Book review

Jon Trevelyan (UK)

Early Miocene Paleobiology in Patagonia: High-Latitude Paleocommunities of the Santa Cruz Formation by Sergio F Vizcaino, Richard F Kay and M Susan Bargo



Patagonia has not always been the cold, arid and dry place it is today. About 17mya - because the Andes were much lower allowing humid winds from the west to reach the area - it consisted of substantial forests and grasslands. It

was also inhabited by strange and wonderful animals, many of which are now extinct, such as glyptodonts, huge snakes and the giant, tapir-like astrapotheres.

Their remains and others of a more familiar nature are found in the sedimentary rocks of the Santa Cruz Formation, the best examples of which can be seen along the southern Atlantic coastline. It has been from these sites that specimens have been collected for more than 150 years, after the first extraordinary remains were sent to Charles Darwin in the 1840s, who forwarded them to Richard Owen for study.

This excellent book sets out to discuss the biology of all of these different species and interpret their ecological interaction and the environment in which they lived. Using the latest methodology, the chapters are written by a large number of different specialists. They include discussions on biostratigraphy, ichnology, marsupials (both carnivores and non-carnivores), the so-called "terror beds" and their relatives, South American ungulates, and also excellent chapters introducing the subject matter of the book and summarising the findings of the authors of the chapters. Differing viewpoints are discussed without prejudice and readers are often left to make up their own minds. In addition, the whole volume effectively represents a huge and extremely useful and important resource of references to the work on the palaeontology and palaeoecology of Patagonia.

However, it is clear to me that the real interest of the authors is fossil mammals. And who can blame the, given the fascinating specimens that have turned up in this part of the world? Despite this (and its expensive price tag), this well-written and well-illustrated book will be fascinating and useful for postgraduates and established academics, undergraduates studying vertebrate palaeontology and evolution, and amateurs with an eclectic taste in fossils and fossil ecosystems.

Early Miocene Paleobiology in Patagonia: High-Latitude Paleocommunities of the Santa Cruz Formation by Sergio F Vizcaino, Richard F Kay and M Susan Bargo, Cambridge University Press, New York (2012). 370 pp., £99 (US\$155) hardback, ISBN: 978-0-521-19461-7