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3. Palaeontology (Open Session)

Damien Becker

Swiss Palaeontological Society (SPS)
Kommission des Schweizerischen Paläontologischen Abhandlungen (KSPA)

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3.1

Sedimentology and palaeocology of the Banné Member (Late Jurassic, Kimmeridgian): new data from excavations along the Transjurane highway (Canton Jura, Switzerland)

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The Banné Member defined by Gygi in 2000 was originally called "Marnes à Ptérocères" (Ptérocère=*Harpagodes oceani*), and it was described by Jules Thurmann as "Marnes du Banné" (Thurmann & Etallon 1864). The Banné Member is about a 10 m thick sequence of highly fossiliferous calcareous marls and marly limestones deposited in a shallow, internal lagoon or a shallow, large tidal channel. Most of the levels are so rich in marine invertebrates (mainly Bivalvia, Gastropoda and Brachiopoda) that they are best described as shell beds. Ammonites (*Prorasenia* sp.) date the Banné Member to the late Early Kimmeridgian (Divisum zone, ca. 152 My) and the time interval of its sedimentation, based on sequence stratigraphical and cyclostratigraphical analyses (Colombié 2002, transgressive deposits after Kim 3), corresponds to about 0.2 My.

Between 2001 and 2007, the Palaeontology A16 carried out systematic excavations along the future course of the Transjurane highway (A16) in the Banné Member near Porrentruy (Canton Jura, Switzerland). Based on bulk sampling and detailed documentations of several surfaces of one square meter species richness, abundance and commonness were used to characterize the vertical evolution of the invertebrate assemblages. Larger surfaces were also excavated in order to improve the completeness of the fossil record, including uncommon taxa (echinoids, ammonites, fishes, turtles and crocodiles). A systematic sampling was performed for mineralogical and sedimentological analyses using X-ray diffraction and microfacies descriptions.

The first faunal list of bivalves contains about 100 species (Hicks 2006; Richardt 2006). The surface documentations underline a significant vertical change in the invertebrate assemblages, marked by an increasing diversity. Moreover, clay mineral analysis shows a progressive decrease and then the disappearing of kaolinite in the middle part of the sequence. This study is actually in progress. It seems that we can interpret the preliminary results as a climatic change influencing the weathering regime of the hinterland. The decline in kaolinite abundance, is probably directly controlled by the 'drying-out' of the hinterland (Wignall & Ruffell 1990), but local observations of the Banné Member near Porrentruy may help us even to understand in more detail how climate, sea-level and tectonics interact and influence hydrodynamic changes and the ecological evolution of the depositional environment.

A special effort will be done in statistic analyses to better understand the evolution of the faunal assemblages. Our aim is to characterize the ecological evolution of the fauna of the Banné Member and the associated mineralogical changes in a high resolution stratigraphical frame and to correlate these changes with other regional localities of the same time interval.

REFERENCES

Colombié, C. 2002: Sédimentologie, stratigraphie séquentielle et cyclostratigraphie du Kimméridgien du Jura suisse et du Bassin vocontien (France): relations plate-forme – bassin et facteurs déterminants. GeoFocus 4, 198 pp.

Hicks, S. 2006: Palökologie des Makrobenthos aus dem oberen Jura (Kimmeridge) im Kanton Jura, Nordschweiz. Unpublished master thesis, Institut für Paläontologie, Universität Würzburg, 72 pp.

Richardt, F. 2006: Palökologische Analyse einer oberjurassischen Mergelfolge im Gebiet von Porrentruy, NWSchweiz. Unpublished master thesis, Institut für Paläontologie, Universität Würzburg, 50 pp.

Thurmann J. & Etallon A. 1861-64: Lethea Bruntrutana ou Études paléontologiques et stratigraphiques sur le Jura bernois et en particulier les environs de Porrentruy. Mémoires de la Société hélvétique des Sciences naturelles 18-20, 1-500.

Wignall, P.B. & Ruffell, A.H. 1990: The influence of a sudden climatic change on marine deposition in the Kimmeridgian of north-west Europe. Journal of the Geological Society of London 147, 365-371.

3.2

Palaeocene to Oligocene Foraminifera from the Azuero Peninsula (Panama): The timing of seamount formation, accretion and forearc overlap, along the Mid-American Margin

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Larger benthic and planktonic Foraminifera recovered from limestones and debris flows in the Azuero Peninsula (Panama) allow to date the formation of accreted seamounts, the time of their docking along the Mid-American convergent margin, as well as the diachronous onset of forearc sequences on accreted terranes.

Interflow pelagic to offshore limestones from the Hoya Seamount Unit: Paleocene-early Eocene ages are indicated by *Morozovella*-type planktonic foraminifera and small *Amphistegina* spp. An early Eocene age is indicated by the association of *Discocyclina barkeri, Pseudophragmina* sp., *Euconoloides* sp. cf. E. *wellsi* and *Amphistegina undecima* (Pl.1 Figs.1-4). Calcarenites interbedded with lava flows of the Punta Blanca seamount Unit reveal an early to middle Eocene age by the presence of *Pseudophragmina ancoensis* and *Orthophragmina* sp. (Pl.1 Figs.7-8). These findings document synchronous Late Palaeocene to early-middle Eocene volcanic construction and carbonate sedimentation in at least two pacific seamounts, that outcrop in the SW-corner of the Azuero Peninsula.

Middle to late Eocene ages are indicated by rich assemblages of Larger Benthic Foraminifera both in tectonic mélanges that overly the seamount sequences, as well as at the base of the unconformably overlapping Tonosi forearc-sequence. *Discocyclina* sp. and *Lepidocyclina polylepidina* (Pl.1 Figs. 5-6). suggest a middle Eocene age maximum age for the debris flows found in tectonic mélanges that formed during accretion of the seamounts. *Pseudophragminides* ssp., *Asterocyclina* in the older, paralic facies and abundant *Lepidocyclina* spp., and rare *Operculinoides* sp. (Pl.1 Fig. 9)., in the younger pure carbonate facies suggest a middle to late Eocene age for the unconformable onset of the Tonosi forearc sediments in SW-Azuero.

Oligocene ages are determined from shallow water limestones at the base of Tonosi in central Azuero documenting the progressive onlap of this fore-arc sequence onto the Late Cretaceous plateau and arc “basement”. At least two distinct facies are characterized by: 1. abundant flat *Nummulites* spp. (Pl.1 Figs.10-11) and 2. by dominant large Oligocene *Lepidocyclina* spp. (Pl.1 Figs.12-13).

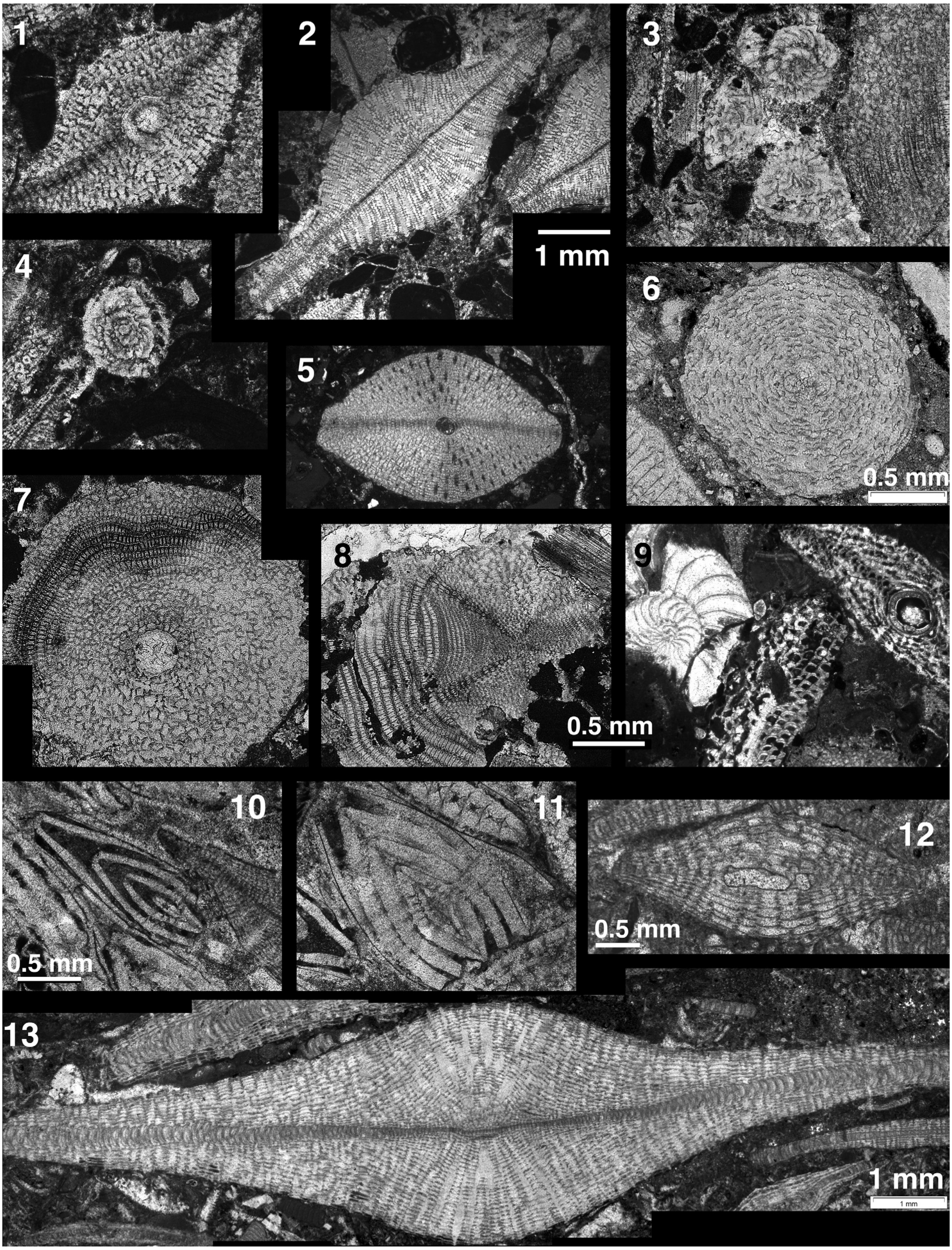

Plate 1. 1-4, lower Eocene larger benthic Foraminifera, inland outcrop (DB07-010b, Rio Pavo) Hoya Seamount Unit, Azuero, Panama.Scale bar = 1 mm.1. *Discocyclina barkeri*, 2. *Pseudophragmina* sp., 3. *Euconoloides* sp. cf. *E. wellsi* and *Amphistegina undecima*., 4. *Amphistegina undecima*. 5-6, middle Eocene, debris flow matrix, Covachon beach (POB06-20). 5. *Discocyclina* sp., scale as for 1-4, 6. *Lepidocyclina polylepidina*. 7-8, lower-middle Eocene forms from calcarenite (DB07-037b, Rio Horcones) interlava, Punta Blanca Seamount, S-Azuero. 7. *Pseudophragmina ancoensis*, 8. *Orthophragmina* sp. 9. *Lepidocyclina* sp. and *Operculinoides* sp. (POB06-022 W of Punta Blanca). Middle-Upper Eocene shallow water limestone at base of Tonosi overlap sequence. 10-13, Oligocene, shallow water lmestones associated with the base of Tonosi forearc sequence, central Azuero. 10. *Nummulites panamensis* and *Discocyclina* sp. (AL026, Rio Guerita), 11. *Nummulites dia* (AL026, Rio Guerita), 12. *Lepidocyclina tournoueri* and 13. *Lepidocyclina undosa* (both AL031, Rio Guerra).

3.3

The Late Pleistocene mammalian fauna from Ajoie (Northwestern Switzerland): stratigraphy, taphonomy, palaeoecology

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The karstic relief of the Ajoie Plateau is formed by many dolines. These dolines functioned as natural traps for skeletal remains of mammoth, woolly rhinoceros and other large terrestrial mammal during the last glaciation. Often the dolines yield a fossil assemblage of the latest Middle Pleniglacial (ca. 30 to 40–45 ka BP) embedded in a loessic matrix (see fig. 1).

Most of the fossil remains have been transported by biological (predation, scavenging) and/or physical (solifluction, geliflucttion, withdrawing) processes resulting in sorting, abrasion, weathering and concentration of the bones and teeth. The fossil mammal assemblages are dominated by grazing mega- (>1000 kg) and large herbivores (>100 kg) as well as fossorial rodents. In contrast, forest-dwelling species are only a minor component and intermediate-sized mammals seem to lack in these faunal assemblages. Rare lithic artefacts associated with the mammal fossils support at least an occasional presence of humans, but no long time settlements or hunting.

Based essentially on palaeoecological analyses of the mammal community (e.g., biodiversity, cenograms, ecological histograms) the palaeoenvironmental reconstruction of the Ajoie during the time interval 30 to 40–45 ka BP should correspond to a humid relatively open landscape partially covered by a bush, shrub and forest vegetation. The preliminary results of phosphate oxygen isotope analyses of mammoth tooth enamel (mean $\delta^{18}O_{PO4}$=14.1±1.5‰, n = 14) about 2.5‰ higher than those of mammoth teeth from the 45 ka BP old Niederwenigen site, near Zurich (Tütken et al., 2007) and indicate the ingestion of drinking water with similar $\delta^{18}O$ values as for modern precipitation in Swiss lowland areas. Thus the mammoths probably lived in the Ajoie during an interstadial phase of the latest Middle Pleniglacial (either the Hengelo, Huneborg or Denekamp).

REFERENCES

Aubry, D., Guélat, M., Detrey, J. & Othenin-Girard, B. 2000: Dernier cycle glaciaire et occupations paléolithiques à Alle, Noir Bois (Jura, Suisse). Cahier d'archéologie jurassienne, 10, Office de la culture et Société jurassienne d'Émulation, Porrentruy, 175 pp.

Braillard, L. 2006: Morphogenèse des vallées sèches du Jura tabulaire d'Ajoie (Suisse) : rôle de la fracturation et étude des remplissages quaternaires. PhD Thesis, University of Fribourg, Geofocus, 14, 224 pp.

Guélat, M. 2006: Le Quaternaire dans le canton du Jura. Actes de la Société jurassienne d'Emulation 2005, 9-31.

Tütken, T., Furrer, H. & Vennemann, T.W. 2007: Stable isotope compositions of mammoth teeth from Niederweningen, Switzerland: Implications for the Late Pleistocene climate, environment and diet.Quaternary International 164-165, 139-150.

Vliet-Lanoë van, B. & Guillocheau, F. 1995: Évolution de l'enregistrement pédosédimentaire depuis 150 ka en France du NO et en Belgique: biorhexistasie et bilans sédimentaires. Comptes Rendus de l'Académie des Sciences, 320, 419-426.

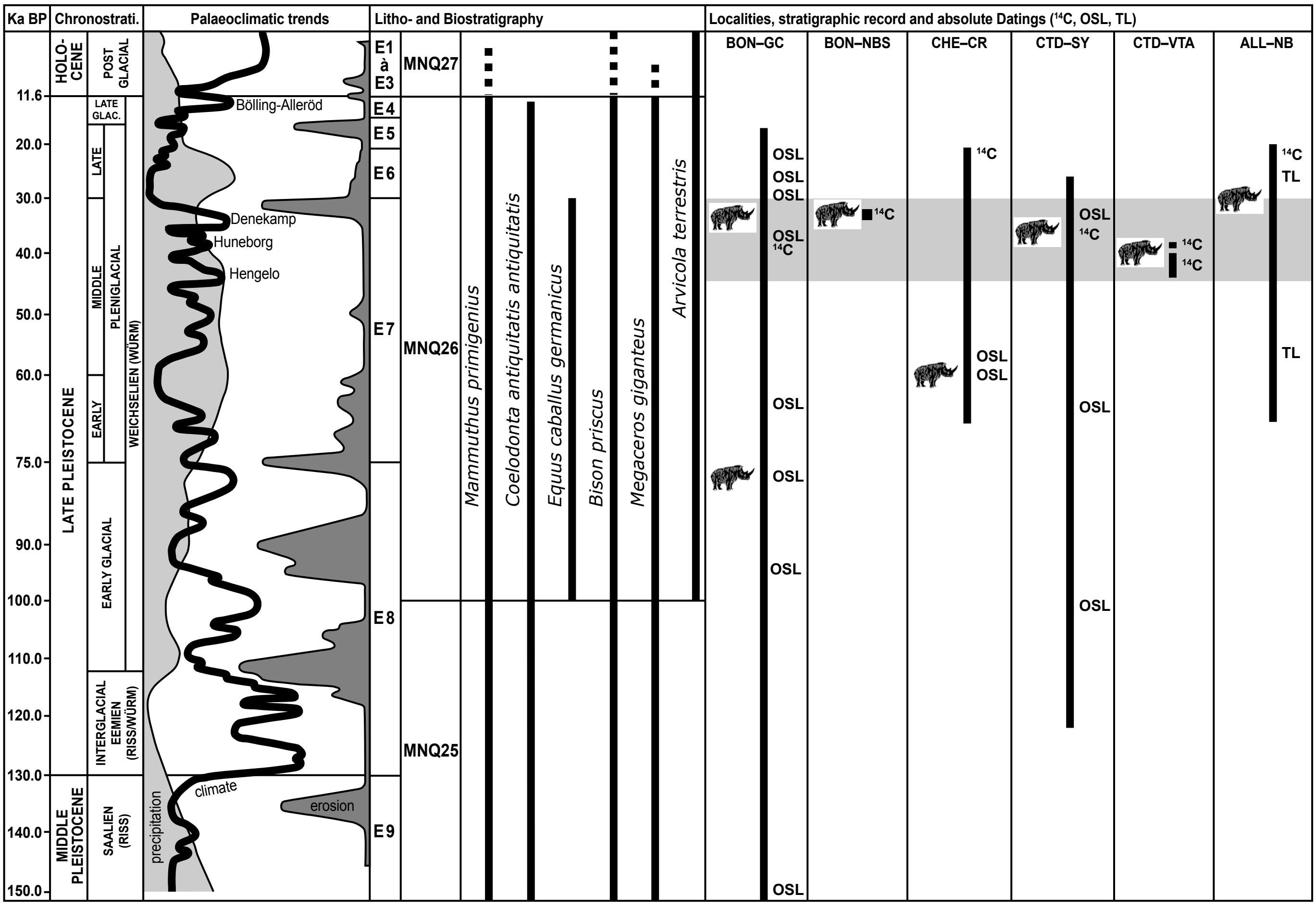

Figure 1. Chronostratigraphy of the large mammal remains of the doline fillings of Ajoie (Late Pleistocene, north-western Switzerland), modified from Van Vliet-Lanoë & Guillocheau (1995), Aubry et al. (2000), Braillard (2006) and Guélat (2006). The grey area underlines the time interval 30 to 40–45 ka BP associated to the most part of mammal remains. TL: Thermoluminescence dating; OSL: Optically Stimulated Luminescence dating; ^{14}C: Radiocarbon dating.

3.4

Inventory of geotopes of national significance : the paleontological record

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Starting in 2006, the revision of the inventory of Geotopes of national significance is in progress (see Berger et al. 2008, Reynard et al 2008). We publish here a complete list of the geotopes presenting a paleontological value. A part of this list has been already accepted by the assembly of the Working group, the other part will be probably accepted in february 2009. The publication of the full inventory is planned for 2010.

AG
01. GIN330 Echinodermensteinbruch Schinznach
02. GIN619 Fossilfundstelle Tongrube Frick
03. GIN981 Molasse Steinbruch Eckwil, Mägenwil
04. GIN627 Herznach
05. GIN738 Schümel
06. GIN221 Aargauer FaltenJura im Staffeleggebiet
Appenzell AI
07. GIN558 Felskuppe Flammeneggzug Rüte
08. GIN902 Flyschgebirge Fäneren, Rüte
Appenzell AR
09. GIN678 Molassekar Rossmoos Urnäsch
10. GIN679 Sturzenegg
11. GIN554 Urnäschtobel, Urnäsch
BE
12. GIN205 Austernriff Scherpfenrain, Häutligen
13. GIN906 Fallantiklinal bei Plaffeien (Fallvorsessli)
14. GIN113 Chaîne des Gastlosen (Jaun, BE/FR)
15. GIN905 Carrière Reuchenette
16. GIN621 Moutier (Cluse + Combe du Pont)
17. GIN431 Cluse de la Birse/Moutier.
18. GIN415 Gorges Pichoux, Undervelier
19. .... Wischberg, Bumbach, Marbach :
BL
20. GIN10 Ziegelei, Allschwil
21. GIN12 Trias Neue Welt, Münchenstein
22. GIN13 Molasse/Jura Kontakt Schlossgarten
23. GIN14 Huppergruben Lausen
24. GIN15 Fossilfundstelle Rain, Zunzgen
25. GIN16 Molasse Steinbruch Steinholden
26. GIN17 Trias Steingraben Hemmiken
27. GIN19 Tongruben Liesberg-Dorf, Andil
28. GIN20 Tongrube Laufen Uf Saal
29. GIN311 Molasse Tennikerfluh
30. .... Brochene Fluh bei Waldenburg
BS
——
FR
31. GIN349 Fossiles du Creux de l'Ours
32. GIN393 Molasse de Heitenried
33. GIN620 Crétacé-Tertiaire de Roter Sattel (Jaun)
34. GIN440 Mt. Vully
35. GIN650 Veveyse Fégyre
36. GIN023 Gorges de la Sarine
37. .... Schiffenen
GE
38. GIN123 Molasse oligocène de la Roulavaz
GL
39. GIN633 Fossillokalität Landesplattenberg, Engi
GR
40. GIN47 Ruchberg-Sandstein (Maienfeld)
41. GIN507 Kesch-Ducan Gebiet mit Prosanto-Fm.
42. GIN964 Dinosaurierfährten am Piz dal Diavel
JU
43. GIN656 Grès vosgiens des Etangs de Bonfol
44. GIN623 Paléokarst de Petite Morée (Glovelier)
45. GIN639 Récifs coralliens de St-Ursanne
46. GIN1035 Traces de dinosaures de Courtedoux
47. .... Chevenez
48. .... La Caquerelle
49. .... Châtillon
50. .... Soulce
LU
51. GIN130 Molasse (OMM) Ränggloch
52. GIN133 Molasse (OMM) Luzern
53. GIN 479 Hagleren - Schlieren Flysch (LU, OW)
NE
54. GIN743 Localité type du Valanginien (Valangin)
NW
55. GIN372 Bärenhöhle S-4 am Schwalmis
56. ....Risteten-Beckenried Steinbruch
OW
——
SG
57. GIN203 Ries-Impakt Sittertobel, Waldkirch
58. GIN461 Lignit Böllenbergtobel, Uznach
59. GIN532 Molasse Goldach Martinstobel
60. GIN534 Molasse Schrönteller, Thal
61. GIN540 Saugetierlokalität Martinsbrünneli, Jona
62. GIN538 Gufler, Weesen + GIN559 Mättler Höchi
+ GIN560 Brunegg Amden
63. GIN550 Krummenau
SH
64. GIN79 Randen-Biberthal Verwerfung, Biberegg
65. GIN80 Seebi Trias-Steinbruch, Schleitheim
SO
66. GIN338 Liasische Stromatolithe, Passwang
67. GIN345 Sauropodenfährten Oberdorf/Lommiswil
68. GIN347 Typuslok. Solothurner-Schildkrötenkalke St Niklaus
69. GIN618 Liasgrube Unterer Hauenstein
70. .... Egerkingen
71. .... Rickenbach Huppergrube

SZ
72. GIN478 Bergsturzgebiet Goldau (SZ/ZG)
73. GIN645 Flysch und Klippendecke, Mythen
74. GIN990 Steinbach, Einsiedlen
TG
75. GIN86 Felsenholz Deckenschotter, Sitterdorf
76. GIN91 Molasse (OSM) Mammern
77. GIN521 Molasse Tongrube Altegg, Mettlen
78. GIN524 Glimmersandgrube Helsighausen
79. GIN526 Deckenschotter Grosswies
80. GIN528 Molasse Sandgrube Schlatt-Paradies
81. GIN90 Bischofszell Bentonite (TG, SG)
TI
82. GIN157 Serie Triassico-Giurassica Lucomagno
83. GIN164 "Bündnerschiefer" 'Alta Valle Bedretto
84. GIN165 Palude della Bedrina (Dalpe)
85. GIN175 Carbonifero di Manno
86. GIN176 Serie stratigrafica del Monte Caslano
87. GIN177 Sito paleontologico Monte San Giorgio
88. GIN178 Gole della Breggia
89. GIN179 Argille di Castel di Sotto (Novazzano)
90. GIN180 Gonfolite Lombarda della Collina Penz
91. GIN185 Conglomerato di Pontegana (Morbio)
92. GIN917 Torbiera al Paü Coldrerio
UR
——
VD
93. GIN624 Gisement fossilifère Rivaz-Monod
94. GIN625 Carrière de St-Triphon
95. GIN685 Crét./Molasse La Chaux-La Vraconne
96. GIN425 La Sarraz-Gorges du Nozon
+ Carrières du Mormont-Eclépens

97. GIN10106 Goufre du Narcoleptique
VS
98. GIN615 Glaciokarst de Tsanfleuron (Savièse)
99. GIN111 Traces dinosaures la Golette
100. GIN153 Empreintes de dinosaures d'Emosson
101. GIN684 Carrière de Miéville
ZG
102. ....Schieferkohlenkomplex Greit (BLN 1307)
ZH
103. GIN458 Deckenschotter Irchel
104. GIN740 Benken
105. GIN600 Käpfnach, Horgen
106. GIN596 Küsnachter Tobel
107. GIN601Tüfels, Chilen
108. GIN121 Lägern- Dielsdorf (= GIN223)

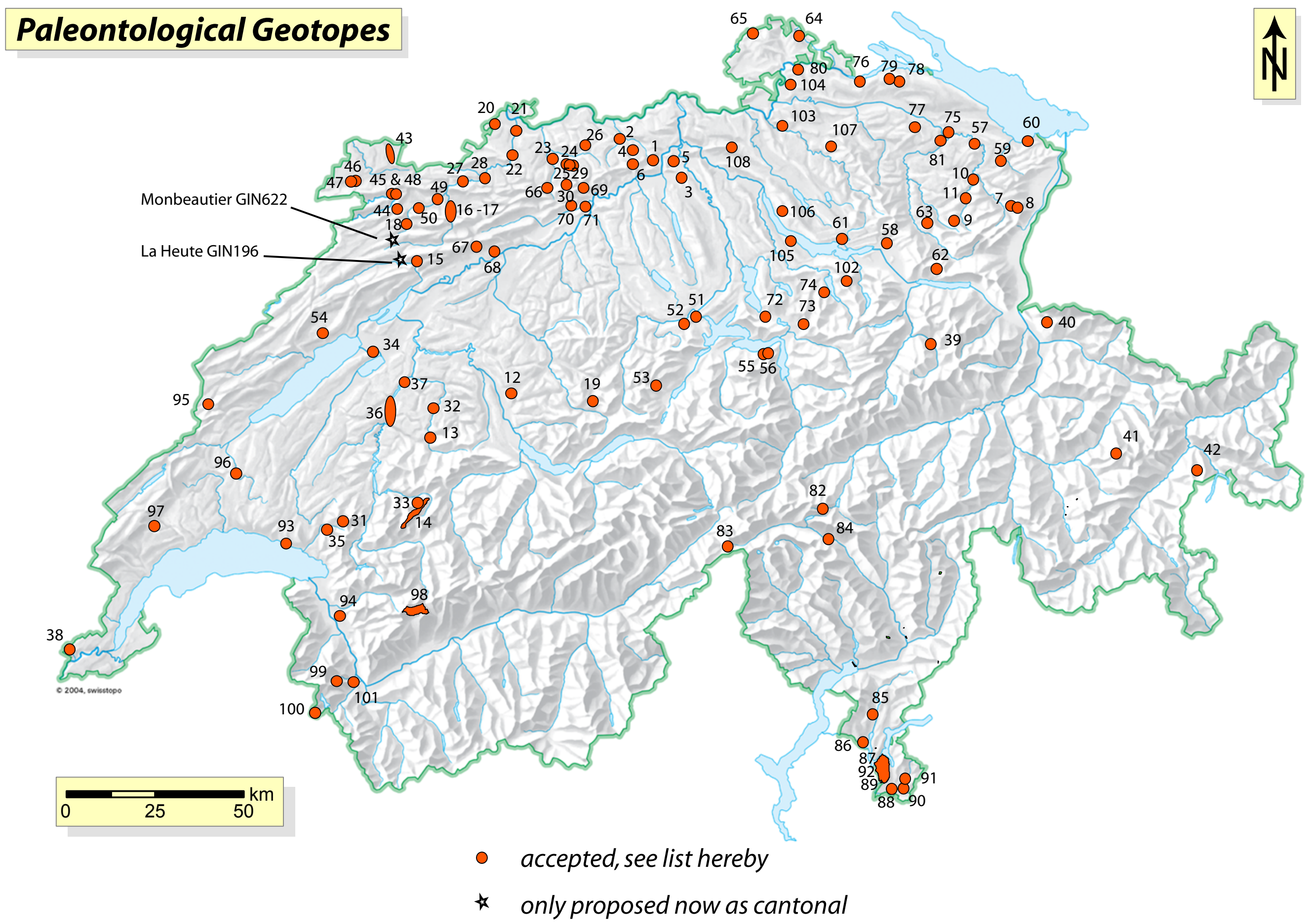

Figure 1. Map of paleontological geotopes of national significance

REFERENCES

Berger J.-P., Reynard E., Bissig G., Constandache M., Dumas J., Felber M., Häuselmann P., Jeannin P.Y., Schneider H. : Révision de la liste des géotopes d'importance nationale : rapport du groupe de travail 2006-2007. – Groupe de Travail pour les Géotopes en Suisse, 22 p.

Reynard E, Berger JP, Constandache M, Dumas J, Felber M, Häuselmann P, Jeannin PY, Martin S, Regolini G, Scapozza C, Schneider H : The revision of the inventory of geotopes of national significance. SGM Lugano, this volume

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3.5

Fossil assemblages from the early Late Cretaceous of southeast Morocco

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The Cretaceous deposits surrounding the northern, eastern and southern borders of the Palaeozoic Tafilalt and Mader basins have yielded numerous fossils for more than fifty years. First surveys by French geologists recorded Cenomano-Turonian ammonite assemblages (Basse & Choubert 1959), fish fragments in Turonian of the High Atlas and Midelt area (Dubar 1949), continental reptiles remains in the 'Grès Infra-cénomaniens', or 'Continental Intercalaire' of the Kem Kem region (Lavocat 1948, 1949).
During the following decades, only few palaeontological data about the 'mid-Cretaceous' of that area have been published. During the last thirty years, however, local people have engaged very active excavation works for collecting Cretaceous fossils for commercial purpose. Beautifully preserved specimens have been discovered by this way, but little information about sedimentological, startigraphic and geographical contexts is usually associated with this material.

Here we present preliminary results of fieldworks conducted by the authors in 2008. The goal of this study is to better understand the palaeoenvironmental and startigraphic contexts of the 'mid-Cretaceous' transgression in North-west Africa. In this study, we focused on microfossils, ammonites and fishes as indicators of age and environment changes.
We sampled in eight main localities along a north-south transect within the basin in order to detect lateral variations. The series started with continental and deltaic deposits (fig. 1), regarded as Albian-Cenomanian in age, which are topped by coastal then open marine deposits (fig. 2) corresponding to the Cenomanian-Turonian major transgression.

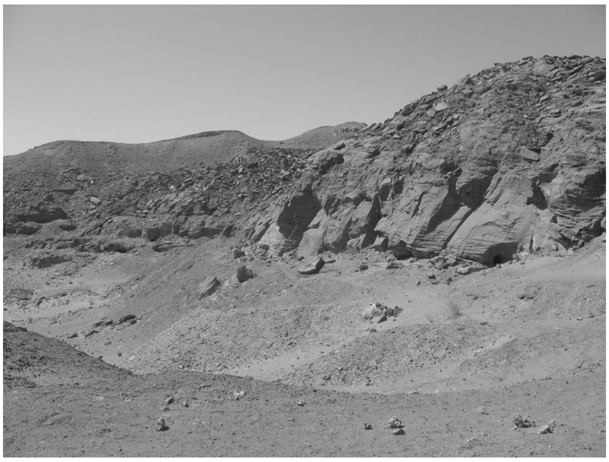

Figure 1. Albian-Cenomanian continental and deltaic deposits at the base of the series, Taouz (photo Cavin, L.).

Figure 2. Cenomanian-Turonian marine deposits at the top of the series, Belkassem (photo Piuz, A.).

REFERENCES
Basse, E., & Choubert, G. 1959: Les faunes d'ammonites du "Cénomano-Turonien" de la partie orientale du domaine atlasique marocain et de ses annexes sahariennes, C. R. 20th International Geological Congress. In L. B. Kellum (ed.) El Sistema Cretacico, 2, 59-81.
Dubar, G. 1949: Carte géologique provisoire du Haut-Atlas de Midelt, notice explicative. In: Notes et Mémoires du Service géologique du Maroc, 1–56.
Lavocat, R., 1948. Découverte de Crétacé à vertébrés dans le soubassement de l'Hammada du Guir (Sud marocain), C. R. Académie des Sciences, Paris 226, 1291–1292.
Lavocat R., 1949. Les gisements de vertébrés crétacés du Sud marocain, C. R. sommaires de la Société Géologique de France, 19, 125–126.

3.6

Correlation between morphology, behaviour and habitat – bivalve burrowing in simulation and robotics

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Bivalves show a large diversity of shell shapes and sculptures during their long history of evolutionary adaptations to different modes of life. The comparatively dense fossil record of bivalves, the well-defined morphological space and the quite complete picture of bivalvian phylogeny offer basis for an analysis of general evolutionary processes. However, while the fossil record conveys information about the shape and the habitat of bivalves, the interpretation of the functional morphology, locomotion and changes in shell shape is generally vague, as fossils represent only discrete states in the morphological space and suffer from the preservational bias. Thus, the purpose of this project is to extend the knowledge about the evolution of bivalves and their adaptations to burrowing using both a computer simulation and a burrowing robot. The simulation will cover the dynamics of burrowing as well as the evolution in morphology and behaviour, reconstructing a trajectory in the morphological space and analysing the processes inducing these state-shifts.

There already exist mathematical models of sea shells (e.g. Raup & Michelson 1965), models of granular media (e.g. van Wachem & Almstedt 2003), burrowing robots and simulations of artificial evolution, but they have never been combined. Our simulation consists of (i) models of recent, fossil and artificial bivalve morphospecies, (ii) a model of a granular medium including the physical interactions with the shell, (iii) an implementation of the burrowing sequence (cf. Trueman 1966) and (iv) an artificial evolutionary system. The artificial evolution may change parameters controlling the behaviour or the morphology of the bivalves. Using a computer simulation allows an efficient and systematic analysis of the burrowing efficiency by changing just a single parameter at a time.

The virtual shell models are converted into physical objects using a 3D-printer (Fig. 1). As a starting point for the physical experiments, finally leading to a self-sufficient burrowing robot, we will attach the shell to two rods simulating the rocking locomotion of the bivalve during the burrowing process (cf. Stanley 1975). In further steps, the opening and closing of the valves and finally an artificial foot probing into the sediment will be added to complete the robot. The data provided by the robot is used to calibrate the simulation and to assess the coherence of the model and the physical reality. After testing the biological significance of the simulation, we will explore the functional correlations between the shell shapes and sculptures, the burrowing behaviour and the sediment type.

As shown in earlier examples (Hadorn et al. 2004), a close collaboration between palaeontology and evolutionary computation/robotics can return profit for both scientific fields. A possible application of this research may be a tool for palaeontologists to link shell forms and the mode of life of fossil bivalves in a more sophisticated way. The simulation can be used to perform experiments with evolution, to identify functional constraints, to find explanations for aberrant and extinct shell forms and even to create and test shell forms that have never existed. By investigating the functionality not only of recent but also of fossil shells, the field of bionics could be remarkably extended. In industry, the robot might serve as a prototype for autonomous burrowing robots or removable and fixed anchorage of man-made structures in soft sediments.

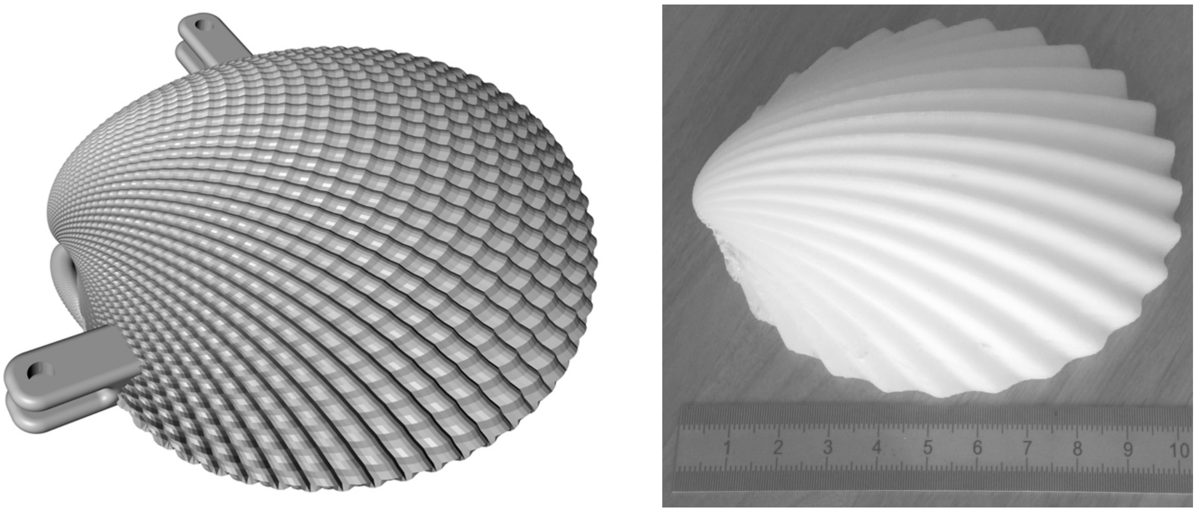

Figure 1. Left: An artificial shell generated by the simulation software with added sockets for the rods. Right: Photo of a valve printed by the 3D-printer (scale in centimetres).

This work is part of the Swiss National Foundation project no. 113934.

REFERENCES

Hadorn, M., Schatz, W. & Eggenberger Hotz, P. 2004: Were Adam and Eve Ediacarans? – A possible sexual dimorphism in Dickinsonia costata, Abstracts of the 2nd Swiss Geoscience Meeting.

Raup, D. & Michelson, A. 1965: Theoretical morphology of the coiled shell, Science, 147, 1294-1295.

Stanley, S. 1975: Why clams have the shape they have; an experimental analysis of burrowing, Paleobiology, 1, 48-58.

Trueman, E. 1966: Bivalve mollusks: Fluid dynamics of burrowing, Science, 152, 523-525.

van Wachem, B. & Almstedt A. 2003: Methods for multiphase computational fluid dynamics, Chemical Engineering Journal, 96, 81-98.

3.7

Smithian-Spathian boundary: the biggest crisis in Triassic conodont history

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Ongoing work in California, S-China, Tibet, Pakistan and Oman has led to a refined biochronologic subdivision of the late Early Triassic and allows reconstructing a high resolution diversity time series, partly constrained by new U-Pb ages from S-China (Galfetti et al. 2007a).

Conodonts crossed the PTB without major changes (Orchard 2007). In the Early Triassic the first major conodont faunal turnover occurred during the late Griesbachian - early Dienerian, with the disappearance of Anchignathodontids (*Hindeodus-Isarcicella* group), which were replaced by the emergent *Neospathodus* and *Borinella*? species.

In the earliest Smithian, conodonts experienced a dramatic radiation, which ended in a major extinction during the late Smithian. This extinction was the most severe of the entire Triassic in terms of generic diversity and multi-element apparatuses. In the early Spathian conodonts radiated again explosively and gradually declined during late Spathian times.

These global diversity patterns coincide with large perturbations of the global carbon cycle (Brühwiler et al. 2007; Galfetti et al. 2007b, Payne et al. 2004). As indicated by changes in the latitudinal gradient of generic richness of ammonoids, the boreal palynological record, and a prominent positive $\delta^{13}C$-isotope shift, the late Smithian - early Spathian boundary interval is marked by a severe climatic change.

REFERENCES
Brühwiler T., Goudemand N., Galfetti T. & Bucher H. 2007: Early Triassic ammonoid biostratigraphy and a new high-resolution carbon isotope record from Tulong area, South Tibet. 5th Swiss Geoscience Meeting, Geneva.
Galfetti T., Bucher H., Ovtcharova, M., Schaltegger U., Brayard A., Brühwiler T., Goudemand N., Weissert H., Hochuli P. A., Cordey F. & Guodun K., 2007a: Timing of the Early Triassic carbon cycle perturbations inferred from new U-Pb ages and ammonoid biochronozones. Earth and Planetary Science Letters, 258, 593-604.
Galfetti T., Hochuli P.A., Brayard A., Bucher H., Weissert H. & Vigran O.V. 2007b: Smithian-Spathian boundary event: Evidence for global climatic change in the wake of the end-Permian biotic crisis. Geology 35:291-294.
Orchard M.J., 2007: Conodont diversity and evolution through the latest Permian and Early Triassic upheavals, Palaeogeography Palaeoclimatology Palaeoecology **252** (2007), 93-117.
Payne J.L., Lehrmann D.J., Wei J., Orchard M.J., Schrag D.P. & Knoll A.H., 2004: Large perturbations of the carbon cycle during recovery from the end-Permian extinction, Science **305 (2004)**, 506–509.

3.8

New data on the Bouwxiller Formation (Eocene, Lutetian)

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The old quarry in Bouxwiller is a historical outcrop studied since the beginning of the XIXe century (Cuvier 1812). It is located in the village of Bouxwiller, in the western part of the North Middle Upper Rhine Graben in Alsace, France (Fig. 1). Previous studies from the marls situated below and above the Bouxwiller limestone dated the deposit to the mammal zone MP 13 (Jaeger 1971). This author postulates that the fauna of the two levels can be considered as homogeneous.

The outcroup consists of fossiliferous limestones and clays with a very small proportion of detrital elements.
All samples come from the "Ensemble supérieur" of the Bouxwiller formation, of the marly levels directly over- (coll. Lavoyer 2006-2007) and underlying (Collected by R. Isenmann during the eighties) the Bouxwiller limestone s.s. (Fig 2).

It has provided new fossils of several species, notably otoliths, mammal and reptilian teeth (crocodiles (with some serrated teeth (pristichampsids)) and lizard), fragments of turtle shells, osteoderms, charophytes (with *Maedleriella embergeri*), gastropods (*Planorbis* sp., *Hydrobia* sp., *Melanopsis* ?) and ostracods.

R. Isenmann has also provided access to his private collection, composed of reptilian and mammal teeth and bones. They originate from the green marls, in the upper part of the limestone/clay alternation just under the Bouxwiller limestone s.s.

The purpose of this work is to compare the various levels of the Bouxwiller Formation (biostratigraphy, paleoecology, taphonomy) and to confront these new data with the existing literature to confirm (or not) the homogeneity of the Bouxwiller fauna.

This study is a part of the PhD of T. Lavoyer and is financed by the SNF Project 200020-109457 and 200020-118025 "Paleontology and Stratigraphy of the South Rhine graben during the Paleogene".

We thank Mr Rodolphe Isenmann for providing access to his personnal collection.

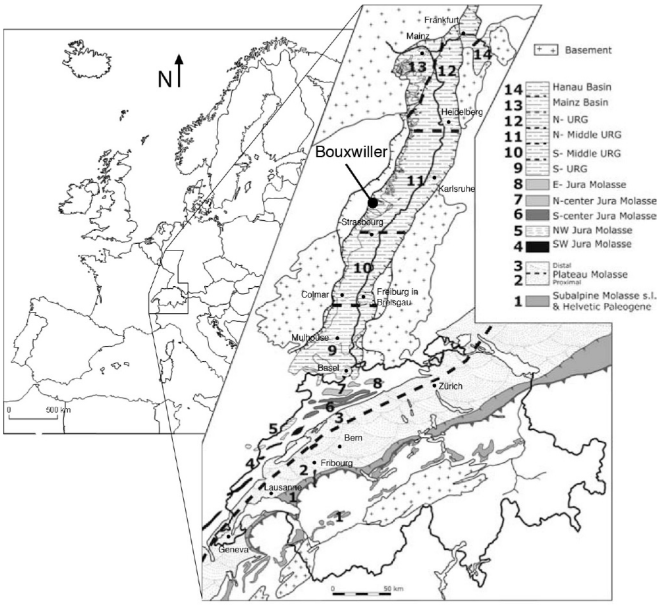

Figure 1. Location of the outcrop (modified from Berger et al. 2005)

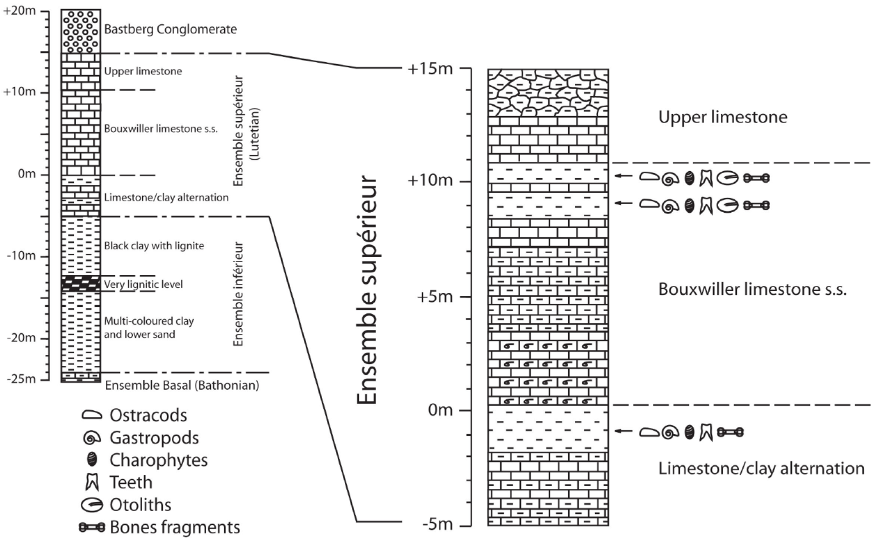

Figure 2. Lithology (modfied from Trauth et al. 1977)

REFERENCES

Berger J.-P. Reichenbacher B., Becker D., Grimm M., Grimm K., Picot L., Storni A., Pirkenseer C., Derer C., Schaefer A., 2005b. Eocene-Pliocene time scale and stratigraphy of the Upper Rhine Graben (URG) and the Swiss Molasse Basin (SMB). International Journal of Earth Sciences, 94(4): 711-731.

Cuvier G. 1812. Recherches sur les ossemens fossiles où l'on rétablit les caractères de plusieurs animaux dont les révolutions du globe ont détruit les espèces. E. d'Ocagne, Paris 3 : 1-436.

Jaeger J.-J.,1971. La faune des mammifères du Lutétien de Bouxwiller (Bas-Rhin) et sa contribution à l'élaboration de l'échelle des zones biochronologiques de l'Eocène européen. Bull Sci géol Alsace Lorraine 24(2-3):93-107

Trauth N., Cavelier C., Sommer F., Tourencq J., Pomerol C., Thiry M., 1977. Aperçu sur la sédimentation paléogène du synclinal de Bouxwiller, comprise entre les Marnes à Rynchonnelles (Bathonien) et le conglomérat du Bastberg (Oligocène). Sci. Géol. Bull, 30, 2, p. 91-100.

3.9

Methodology of systematic excavation and documentation of dinosaur tracksites along the Transjurane highway (Canton Jura, NW Switzerland)

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Since 2002, the Palaeontology A16 excavates dinosaur tracksites near Porrentruy along the future course of the Transjurane highway A16 (Marty et al., 2007). This resulted in the development of a complex excavation-, documentation-, and protection-methodology of dinosaur tracks and tracksites.

First, tracksites are located by geological surveying followed by palaeontological prospecting with shovel excavators. Large-scale excavations are then planned and scheduled in agreement with the civil engineering office over one to several years prior to the construction of the highway. The tracks are found on multiple superimposed palaeosurfaces within horizontally-bedded biolaminites of Late Kimmeridgian age, which accordingly have to be excavated level-by-level. At the beginning of an excavation as much overburden as possible is removed with the help of shovel excavators. Within the biolaminites, the track-bearing levels are then excavated and cleaned with hand tools. This is often a time-consuming and difficult affair, because of normal faults displacing levels or because levels are amalgamated and cannot be followed laterally.

Tracks are then searched for, identified, and wherever possible attributed to trackways. This includes analyses at night with oblique lighting, indispensable to find and study small tracks and track details. Simultaneously, all tracks are outlined with black chalk and labelled on the surface itself using specified acronyms. Subsequently, the tracks and trackways are analyzed and described, and their parameters are measured in a consistent fashion and gathered in a database. They are also photographed including stereoscopic photographs of selected tracks. Further, macrosedimentary features (e.g., desiccation cracks, ripple marks) are analyzed and the encasing sediment is logged and sampled.

Afterwards, a georeferenced 2x2 meter grid is installed on the surface and tracks and normal faults are drawn at a scale of 1:10 or 1:20. These drawings are vectorized in the office and assembled in a map. Because outline drawings represent one person's simplified interpretation of a complex three-dimensional object, the most important palaeosurfaces are likewise documented with 3D imaging techniques using high-resolution (in the order of 1-2 mm) laser scanning and extreme close-range (2-10 m from camera to object) photogrammetry. These are merged in a virtual 3D model, on the basis of which tracks and trackways can easily be vectorized and their parameters measured in CAD software, if previously they were labelled and outlined with chalk. Similarly assembled data can later also be integrated into a GIS database.

If a surface is going to be destroyed or exposed to weathering after excavation the 3D documentation is the most accurate way to document its original state, especially if applied together with complementary, classical illustrative and descriptive techniques as well as replicas (see also Lockley & Matthews, 2007). Consequently, future generations of researchers will have access to virtually the same database. Nonetheless, judging by our own experience, the 3D methods cannot fully replace careful observations and descriptions of the actual tracks in the field because the interpretation of small tracks or track details (e.g., digital pads, claws, skin impressions), poorly-preserved tracks, and/or crossing trackways (track interferences) is a difficult and subjective task made at best on the original specimens. Also, 3D methods are expensive and cannot always be applied. Another drawback is that adequate safeguarding of the imaging data for posterity may be difficult to guarantee.

After their documentation, the most important tracks and trackways are either recovered as slabs or replicated, and then the underlying level is excavated. Such level-by-level excavation and documentation offer important insight into the formation, taphonomy, and preservation of tracks. Notably the identification of undertracks, true tracks, and overtracks, which is important for the correct ichnological and palaeoecological interpretation of the tracks (Marty, 2008).

At the end of an excavation recovered slabs, samples, and replicas are archived, and the documentation (e.g., photographs, track parameters, etc.) is assembled in a database (collection and documentation management). The main track level of the Transjurane tracksites is commonly located at the top of massive limestone and at the base of biolaminites. Consequently, it cannot be removed and will be either covered or (partially) destroyed by the construction of the highway. The importance of a tracksite has to be evaluated "in context" based on abundance, quality, and uniqueness of the tracks. Whenever possible it has to be preserved as a geotope *in situ*. Actually, at least two tracksites can be preserved for posterity by the construction of additional highway bridges. These outstanding results of cooperation between engineers and palaeontologists are the basic conditions for a public accessibility of the tracksites, managed and financed by the Canton Jura, once the highway will be finished.

REFERENCES

Lockley, M.G. & Matthews, N.A. 2007: Observations on scientific documentation and preservation strategies employed at hominid and other vertebrate tracksites in America and elsewhere. In: Kim, J.Y., Kim, K.S. (eds.), Proceedings of 2007 International symposium on the conservation and application of hominid footprints, 7th-9th December 2007, Jeju Island, Japan, 13-43.

Marty, D. 2008: Sedimentology, taphonomy, and ichnology of Late Jurassic dinosaur tracks from the Jura carbonate platform (Chevenez—Combe Ronde tracksite, NW Switzerland): Insight into the tidal-flat palaeoenvironment and dinosaur diversity, locomotion, and palaeoecology. GeoFocus, 21, 278 pp.

Marty, D., Ayer, J., Becker, D., Berger, J.-P., Billon-Bruyat, J.-P., Braillard, L., Hug, W.A. & Meyer, C.A. 2007: Late Jurassic dinosaur tracksites of the Transjurane highway (Canton Jura, NW Switzerland): overview and measures for their protection and valorization. Bulletin for Applied Geology, 12, 75-89.

3.10

A new Aquitanian fauna in the Jura Molasse (Sur le Mont, Tavannes, Northwestern Switzerland)

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The construction of the Transjurane Highway (A16) in the Jura Mountains gave the opportunity to observe new outcrops in the Tavannes area (Canton Bern). The new vertebrate locality of Sur le Mont, located in the eastern part of the future tunnel of Tavannes, corresponds to three different fossiliferous levels of a fluvial sandy conglomeratic complex rich in mud pebbles. This series of around ten meters of thickness is stratigraphically situated just above the last freshwater deposits of the *Calcaires delémontiens* Formation. The microfossil assemblage essentially contains essentially charophytes. The vertebrate assemblage is composed by turtles, crocodiles, eggshells probably of birds, small carnivores, lagomorphs, and small and large ungulates. The presence of the taxa *Diaceratherium asphaltense* (Rhinocerotidae) and *Dremotherium feignouxi* (Ruminantia) allows to assign this fauna with confidence to the Aquitanian.

The *Calcaires delémontiens* were long time considered by numerous authors as exclusively Oligocene. These last ten years, Picot et al. (1999) and Becker (2003) showed that the top of this formation could correspond to the basal Aquitanian in some rare outcrops. However, this dating is most of time based on charophyte assemblages. Only the locality of SE Pré Godat (Canton Jura) and Waldenburg-Humbel (Canton Basel Land) were ascribed to the biozones MP30-MN1 on the basis of small mammal remains (see Theiler 1998 and Engesser & Mödden 1997). Additionally, Mojon et al. (1985) and Engesser & Mödden (1997) mentioned the well-known Aquitanian localities of Boudry (MN1) and La Chaux 7 (MN2). These localities belong respectively to the *Grès et Marnes grises à Gypse* and the *Calcaires de La Chaux* Formations and are located at the southern boundary of the Western Jura Mountains. Thus the top of the Sur le Mont section could be the youngest record of USM deposits within the Jura Molasse. It should allow to reconsider the classical "Aquitanian" gap within this structural unit and to give some light to the geodynamic evolution of the Jura Mountains (see Berger et al. 2005).

This study is supported by the Swiss National Foundation project (n°115995) on the large mammal evolution in the Swiss Molasse Basin during the Oligocene and early Miocene. More investigations will be made in the taxonomy of the fossil remains and biogeochemical analyses will complete this work. The aim is to better understand the palaeobiogeography and the palaeoenvironmental conditions during the early Miocene in Switzerland.

REFERENCES

Becker, D. 2003: Évolution paléoécologique et paléoclimatologique de la Molasse du Jura et sud-rhénane: utilisation des Périssodactyles (Mammalia) et des Minéraux argileux. PhD Thesis, University of Fribourg, Geofocus 9, 327 pp.

Berger, J.-P., Reichenbacher, B., Becker, D., Grimm, M., Grimm, K., Picot, L., Storni, A., Pirkenseer, C. & Schaefer, A. 2005: Eocene-Pliocene time scale and stratigraphy of the Upper Rhine Graben (URG) and the Swiss Molasse Basin (SMB). International Journal of Earth Sciences 94, 711-731.

Engesser, B. & Mödden, C. 1997: A new version of the biozonation of the Lower Freshwater Molasse (Oligocene and Agenian) of Switzerland and Savoy on the basis of fossil Mammals. In Aguilar, J.-P. et al. (Eds.): Actes du Congrès BiochroM'97.

Mémoires et Travaux de l'Ecole pratique des Hautes Études, Institut de Montpellier 21, 475-499.
Mojon, P.O., Engesser, B., Berger, J.P., Bucher, H. & Weidmann, M. 1985: Sur l'âge de la Molasse d'eau douce inférieure de Boudry, Neuchâtel. Eclogae geologicae. Helvetiae 78, 631-667.
Picot, L., Becker, D. & Berger, J.-P. 1999: Nouvelles données paléoécologiques et biostratigraphiques sur la formation des Calcaires delémontiens (« Delsberger Kalke », Oligocène terminal, Jura Suisse). Neues Jahrbuch für Geologie und Paläontologie Abhandlungen 214, 433-462.
Theiler, E. 1998: Geologie im Gebiet der Tiergartenantiklinale (JU) mit besonderer Berücksichtigung der Molasseeinheiten. Unpublished Master Thesis, University of Fribourg, 93 pp.

3.11

New excavations in the Cassina levels (Monte San Giorgio, Middle Triassic) preliminary reports

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Among the calcilutite sequence of the Early Ladinian Lower Meride Limestone of Monte San Giorgio (Unesco WHL, Switzerland) three fossiliferous beds are known: the Cava inferiore, Cava superiore and Cassina beds. These latter were originally investigated in 1933 by the University of Zürich which carried out further excavations in 1937 and in the period 1971-1975. Along with different reptile taxa (e. g. *Ceresiosaurus lanzi, Neusticosaurus edwardsii, Macrocnemus bassanii* and *Tanystropheus meridensis*) a large fish fauna was collected then, dominated by well preserved *Saurichthys* (S. *curionii* and S. *macrocephalus)*, along with smaller actinopterygians referred to three different species: *Peltopleurus* sp. (one specimen, Bürgin 1992), *Archaeosemionotus* sp. nov. and *Macrosemiidae* gen. et sp. nov. (both listed in Bürgin 1999, but not described so far).

In 2006 the Museo cantonale di storia naturale (Lugano) undertook a new excavation in the Cassina beds at the type locality, to investigate bed by bed on a surface of about 40 m^2 the whole fossiliferous succession. In the new site the fossiliferous beds represent an almost 3m thick interval of mainly interbedded finely laminated, organic-rich shales and limestones with intercalated thicker bituminous micritic and marly limestones. Normal graded calcarenites, showing erosional surfaces and bearing scattered clearly reworked fossil fragments, suggest the instability of the basin margins and the occasional influence of turbidity currents. Volcaniclastic layers (tuffs and bentonites) are frequent throughout the section.

The new excavations revealed profitable, yielding an interesting vertebrate fauna. Besides isolated bones and teeth of sauropterygian reptiles, interesting and well-preserved fossil fishes have been found, providing further information about the extraordinary ichthyofauna from the Monte San Giorgio area.

In the Cassina beds both neopterygians, as *Archaeosemionotus* and *Eosemionotus*, and paleopterygians, as *Saurichthys* and *Peltopleurus*, are represented. The medium-sized *Archaeosemionotus* is characterized by the mosaic-like covering of the cheek and the well-developed dentition, probably adapted to an hemi-durophagous diet; this genus has been found in other levels from Monte San Giorgio, with at least three different species (Bürgin 1999). On the contrary, the smaller *Eosemionotus*, with its typical thin and elongate teeth on premaxillary and dentary bones and the small fins with large fulcra, is reported for the first time in these levels. *Peltopleurus*, is widely represented throughout the different levels of Monte San Giorgio, with a surprising intra- and interspecific variability (Bürgin 1992; Lombardo 1999).

The most abundant findings, however, belong to the large predator actinopterygian fish *Saurichthys*, with many complete and well preserved specimens (mainly S. *curionii*, but S. *macrocephalus* is also present). Among yet prepared material, four *Saurichthys* specimens contained several skulls of small specimens that can be identified as embryos. In one of these specimens, the embryos are very small and each skull is associated to a tiny, narrow and white cylinder (Fig. 1) that is either curled or comma shaped. Chemical investigation revealed that these structures are made of phosphate. The chemical compostion, size and structure of these cylinders compared to the associated skulls, suggests that they may well represent the fossilized musculature of the embryos and each segment corresponding to a somite. This finding is of great scientific relevance because it represents the first case of preservation of soft tissues and even of postcranial structures in embryos of *Saurichthys*.

REFERENCES

Bürgin, T. 1992: Basal Ray-finned fishes (Osteichthyes, Actinopterygii) from the Kalkschieferzone (Uppermost Ladinian) near Meride (Canton Ticino, Southern Switzerland). Eclogae geol. Helv. 88/3, 803-826.

Bürgin, T. 1999: Middle Triassic marine fish faunas from Switzerland. In Arratia G. & Schultze H.-P. (eds.): Mesozoic Fishes 2 – Systematics and Fossil Record. Pfeil, München, 481-494.

Lombardo, C. 1999: Sexual dimorphism in a new species of the Actinopterygian *Peltopleurus* from the Triassic of Northern Italy. Palaeontology, 42/4, 741-760.

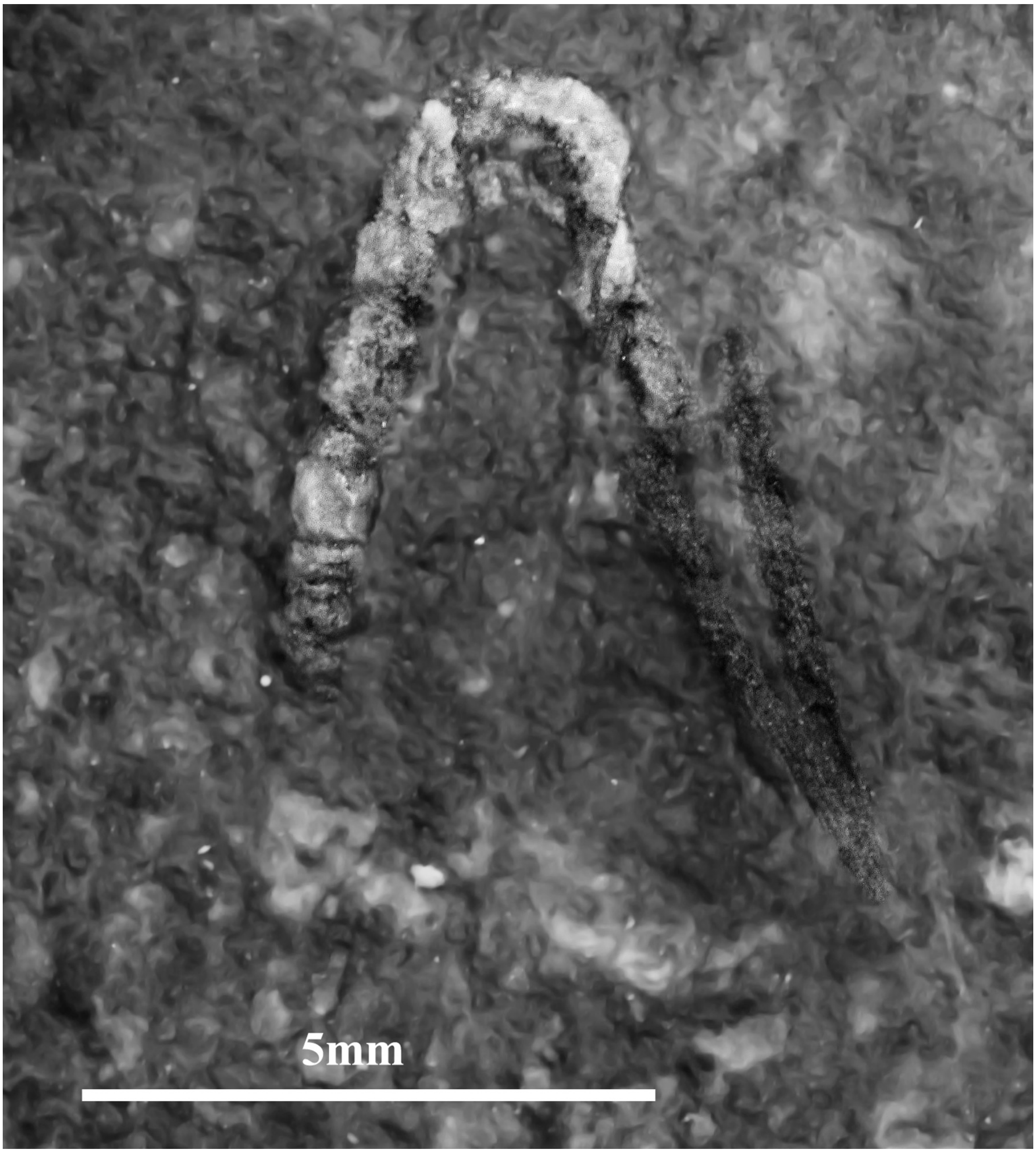

Figure 1. A small *Saurichthys* embryo with axial musculature preserved.

3.12

The revision of the inventory of geotopes of national significance

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In the early 1990s, a group of Earth scientists created the *Working Group for the protection of geotopes in Switzerland* (Strasser et al., 1995) and organised a first inventory of geotopes of national significance, published in 1999 (Swiss Academy of Sciences, Working Group for the protection of geotopes, 1999). A call for proposals was sent to Earth scientists, regional services, museums, universities and other interested institutions. From a preliminary list of more than 800 sites, 401 geotopes were selected and partly described and the list was published with a small abstract for each site. A map presenting the location of each geotope was also published but no legal status was given to the inventory. In 2006, a revision of the inventory was launched. The objectives were to re-evaluate each site, to complete the information available and to create a digital database for managing the data. This paper presents the methodology that was used, the different steps of the revision and the problems that the authors faced.

A database was created and each site was described and assessed. The evaluation was carried out by three disciplinary groups of scientists: geology, geomorphology and speleology. The criteria used for assessing the quality of sites are those developed by V. Grandgirard (1999). The scientific quality of the sites was evaluated, based on criteria such as rarity, representativeness and integrity, and information on other interests – educational value, ecological interest, archaeological interest, etc. – were also taken into account. Information on the integration of sites in other federal and cantonal inventories (e.g. mire landscapes, alluvial zones, landscapes of national significance, cantonal inventories of geotopes, etc.) was also collected. For each site, one or more photographies were collected, and a map showing the indicative perimeter and location was created in a GIS environment. For speleological sites, topographic sketches were also integrated in the database.

At the moment, 248 sites have been accepted as geotopes of national significance by the assembly of the working group (fig. 1), about 100 sites necessitate more information and need a new evaluation, and 50 sites were rejected. About 80 supplementary potential geotopes have been proposed by members of the working group and by some cantonal administrations. A second phase of assessment has therefore begun in 2008 and will be completed at the end of 2009. The publication of the full inventory is planned for 2010.

We faced several problems. Because experts based the inventory carried out in the 1990s on proposals, the spatial and thematic representativeness of the current list is not sufficient. Some geological objects (e.g. erratic boulders, morainic systems) are over-represented, whereas others (e.g. rock glaciers, structural or hydrological sites) are not sufficiently taken into account. Thematic and geographical gaps were therefore discussed during a forum organised in June 2008 in Fribourg, where specialists of various Earth science fields could propose new sites. A second important issue is the uniformity and quality of the inventory. Because the assessment was not carried out in a systematic manner, the content of the assessment cards is variable. A quality assessment will therefore be carried out in 2009. The third phase of the project will be to promote the inventory both in the political circles and in the tourist domain, especially by promoting the creation of geoparks in areas where the geological heritage is particularly rich. Data will also be sent to the Cantons, asking them to protect legally the most vulnerable sites.

REFERENCES

Berger, J.-P., Reynard, E., Bissig, G., Constandache, M., Dumas, J., Felber, M., Häuselmann, P., Jeannin, P.-Y. 2008: Révision de la liste des géotopes d'importance nationale: rapport du groupe de travail 2006-2007. Fribourg, Groupe de travail pour les géotopes en Suisse, 17 p.

Grandgirard, V. 1999: L'inventaire des géotopes. Geol. Insubr. 4, 59-66.

Strasser, A., Heitzmann, P., Jordan, P., Stapfer, A., Stürm, B., Vogel, A., Weidmann, M. 1995: Géotopes et la protection des objets géologiques en Suisse. Fribourg, Groupe Suisse pour la protection des géotopes.

Swiss Academy of Sciences, Working group for the protection of geotopes. 1999: Inventory of geotopes of national significance. Geol. Insubr. 4, 25-46.

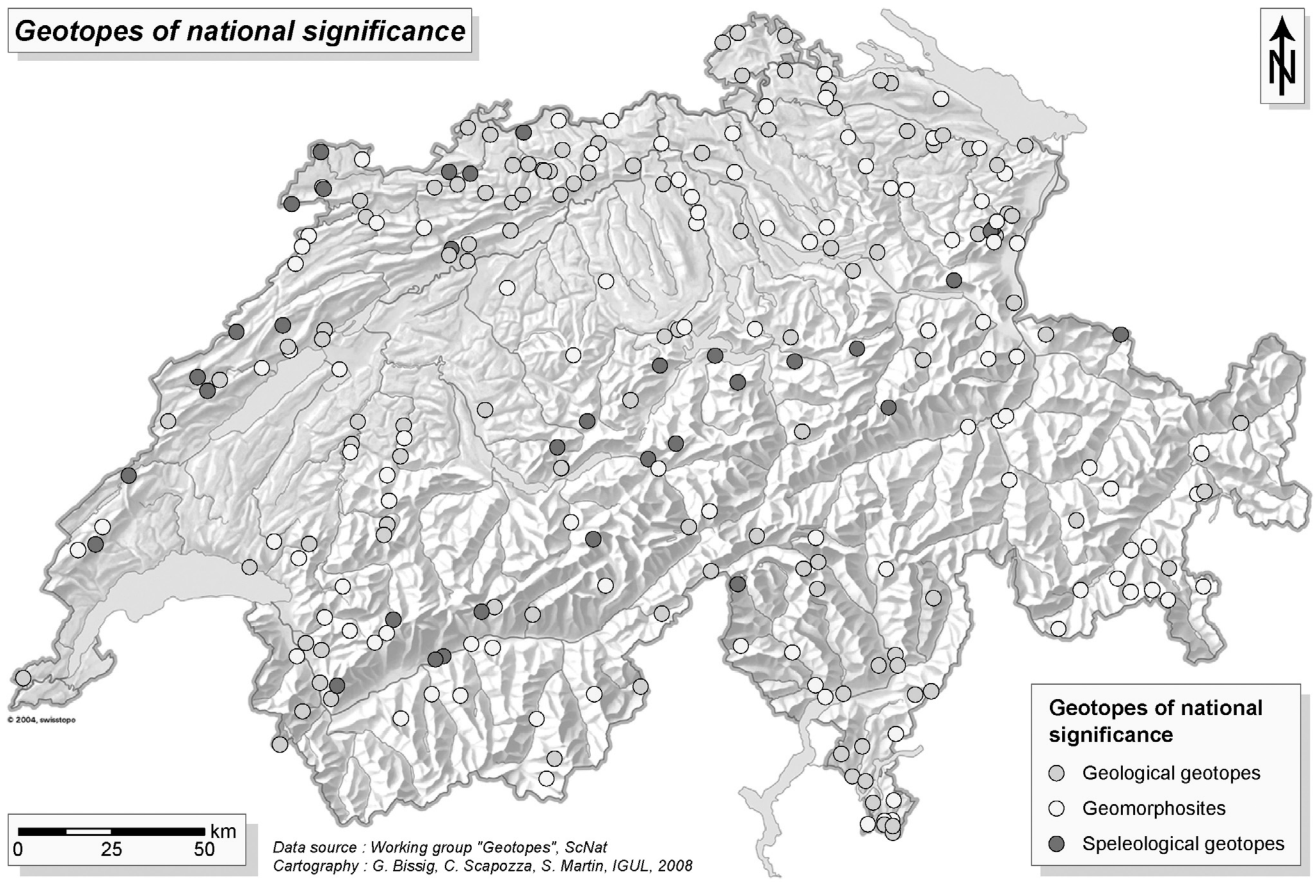

Figure 1. The preliminary map of geotopes of national significance (248 sites). The map will be completed in 2009 with a second round of evaluation.

3.13

Tapiridae (Perissodactyla, Mammalia) of the Swiss Molasse Basin during the Oligo-Miocene transition: taxonomical study and preliminary results.

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The systematics of the European tapirids has been prone to a major revision in the last few years (Cerdeño & Ginsburg 1988; Heissig 1999). Four genera are present in Europe from the Oligocene to the Pleistocene, where they disappear: *Protapirus, Paratapirus, Eotapirus* and *Tapirus*.

During the Oligo-Miocene transition several localities of the Swiss Molasse Basin record fossils of Tapiridae, such as Aarwangen (MP27), Ebnat-Kappel (MP28), Rüfi bei Schänis (MP29), Haslen (MP30? or MN3?), Wischberg (MN1), Höhronen (MN1-2?) and Brüttelen (MN3a). Their biostratigraphical record ranges from MP27 to MN3, highlighting the Oligo-Miocene transition (see fig. 1).

The tapirid remains are relatively scarce at the end of the Oligocene, represented for example by a mandible of *Tapirus* sp. in Ebnat-Kappel and a fragmented maxilla in Rüfi bei Schänis, or a skull and a mandible of *Paratapirus helvetius* in Haslen. The remains are more abundant in the Early Miocene, with a skull and a mandible of *Eotapirus broennimanni* in Wischberg and some mandibles and maxillas of *Tapirus intermedius* and *T. helveticus* in Höhronen. These determinations must be clarified —

only remains of Haslen and Wischberg have been reviewed — as *Tapirus* is a genus coming in Europe only in the Middle Miocene.

During this time interval, changes in the large mammal faunal record can be observed:

- in the anthracotheriid community with the extinction in MP29 of *Anthracotherium* and *Microbunodon* (N'Guyen 2008, Scherler in progress);
- in the suid community with the appearance in the Early Miocene of *Hyotherium, Aureliachoerus* and *Bunolistriodon* (Scherler in progress);
- and also in the rhinocerotid (Becker 2003) and ruminant (Mennecart in progress) comunities.

The Swiss tapirids are then expected to bring some precisions upon these environmental changes.

As part of a Swiss National Foundation project (n°115995) started in January 2007, the large mammal evolution studies in the Swiss Molasse Basin during the Oligocene and Early Miocene are aiming for a better understanding of the palaeobiogeography and the palaeoenvironmental conditions. These reconstructions will be obtained through taxonomical determinations and different proxies such as biogeochemical or palaeoecological analyses.

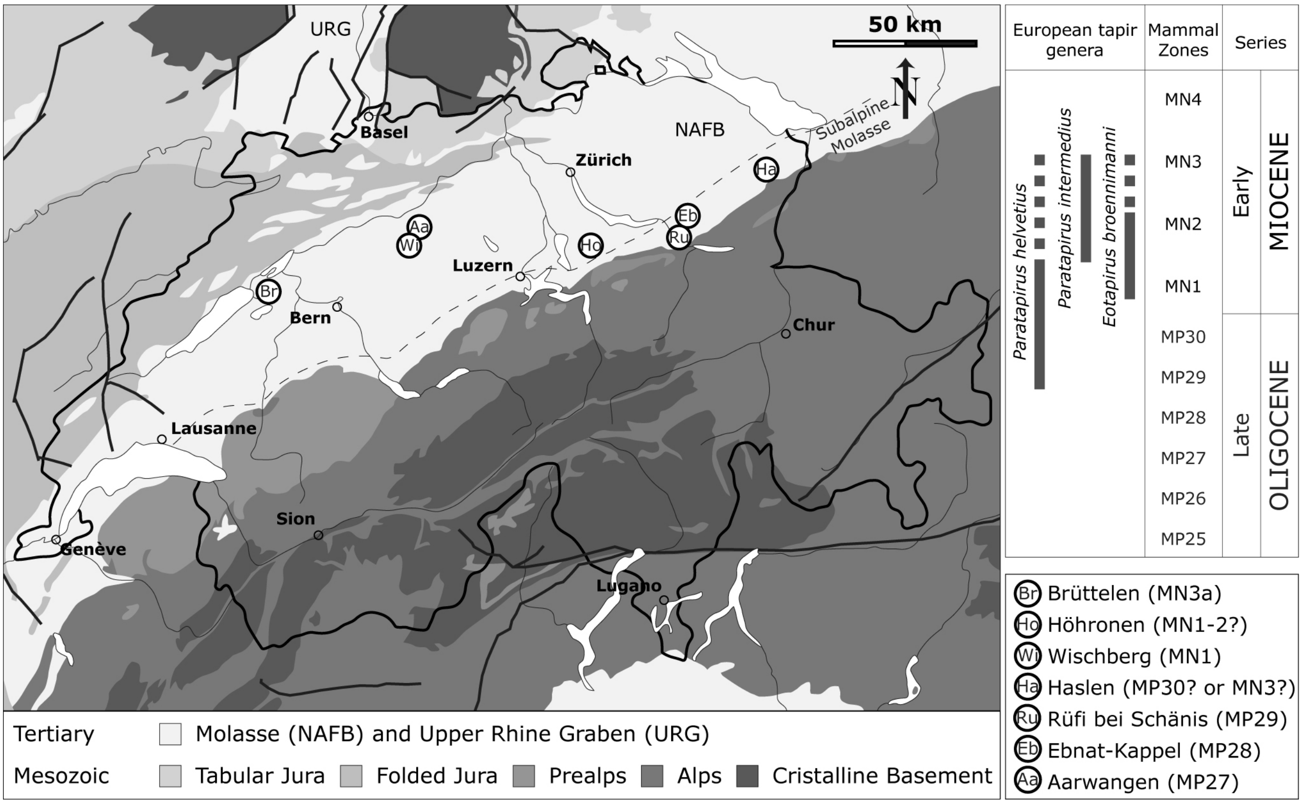

Figure 1. Geographical and geological setting of the Swiss localities recording tapirid remains, with the biostratigraphical extensions of the swiss species.

REFERENCES

Becker, D. 2003: Paléoécologie et paléoclimats de la Molasse du Jura (Oligo-Miocène): apport des Rhinocerotoidea (Mammalia) et des minéraux argileux. GeoFocus, 9, 328 pp.

N'Guyen, T.B. 2008: Die Anthracotherium des Oligozäns der Schweizer Molasse: Stratigraphie, Paläoökologie und Paläoklima. Unpublished Diploma Thesis, University of Fribourg, 138 pp.

Cerdeño, E. & Ginsburg, L. 1988: Les Tapiridae (Perissodactyla, Mammalia) de l'Oligocène et du Miocène inférieur européens. Annales de Paléontologie, 74, 71-96.

Heissig, K. 1999: Family Tapiridae. In: Rössner, G. & Heissig, K. (Eds.): Land Mammals of Europe. Verlag Dr. Friedrich Pfeil, München, 171-174.

Mennecart, B. in progress: The Ruminantia and Cainotheriidae (Mammalia, Artiodactyla) from Oligocene to Early Miocene of Switzerland, reassessment and new data on their phylogeny, palaeoecology and palaeoenvironment. PhD Thesis, University of Fribourg.

Scherler, L. in progress: Large mammal evolution (Anthracotheriidae, Suidae, Tapiridae) from the Swiss Molasse during the Oligo-Miocene: biostratigraphy, biogeochemistry, palaeobiogeography and palaeoecology. PhD Thesis, University of Fribourg.

3.14

How similar are morphological and genetic diversities recognizable on a typical plankton filter?

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Coccolithophore sequences currently available from GenBank concern almost exclusively cultured strains. Recently, it has been shown that it is possible to retrieve DNA from dried filters (Scherrer et al., oral contribution). This opens new perspectives for research on environmental coccolithophore samples collected by filtration.

Here we evaluate how easy it is to link SEM observations of coccolithophores and other organisms with DNA sequences obtained from a single filter piece. For that purpose, we cut small filter fragments containing low numbers of planktic organisms collected in the Arabian Sea. The filter fragments were coated and scanned in a SEM to document all the recognizable organisms on them; DNA was then extracted from each filter piece. The DNA extractions were amplified with universal and specific primers for SSU rDNA and the positive amplifications were cloned. About 60 different clones were sequenced.
None of the coccolith bearing taxa recognizable with the SEM was identified in the DNA sequences. The majority of the sequences belong to Prymnesiophyceae that bear no hard parts and were therefore not identified in the SEM. New primers are currently being developed to specifically amplify coccolith bearing taxa that may have been out-competed by naked ones during amplification.

3.15

Two late Triassic biostroms levels as key beds for controlling sea level changes in central Iran

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This research focused on a pair of biostrom levels in age of Late Triassic in Central Iran (North of Isfahan, Bagher Abad Area). For the first time the appearance and extinction of Genus Heterastridium traced within these biostrom levels. The increasing depth of water from Bidestan Member to Howz- e- Khan Member prepared a good and nutrial paleoenvironment for near shore biota such as: gastropods, bivalves, corals, sponges and crinoids. The changing of silica clastic continental sediments (Middle Triassic) to carbonate component confirmed the deepening phenomena in Late Triassic as well. A regression or decreasing the depth of water happened after end of Howz- e- Khan member (Rheatian). As a result of regression, a mass extinction had happened (wipe out all biota group) in the end of Rheatian to Liassic. Several researchers reported the presence of Late Triassic biota from Iran such as Hautmann, M.,(2001), Kluyver, H. M., Griffis, R. J., Tirrul, R., Chance, P. N and Meixner, H. M., (1983). *Heterastridium* spp. Can be seen in Bagher Abad, Delijan, Soh, Abyaneh, Kalahroud Ferdus, Tabas, Parvadeh, Kerman, Lakar Kuh and Dige rostam. Some of these localities such as Soh, Abyabeh, Kalahroud, Bagher Abad areas (North of Isfahan) *Heterastridium* spp. (marine environment) can be seen as paralic sea within continental coal bearing environment. Finally we proposed that these biostrumal levels (Bagher Abad Area) can be used as Key beds for correlating Late Triassic deposits in Iran and neighboring countries as well as Alpine Region.

REFERENCES

Hautmann, M. 2001: Die Muschelfauna der Nayband – formation (obertrias, Nor- Rhät) des östlichen Zentraliran: Beringeria, 29: 1- 181.

Kluyver, H. M., Griffis, R. J., Tirrul, R., Chance, P. N & Meixner, H. M. 1983: Explanatory text of the Lakar Kuh Quadrangle Map 1: 250,000: Geological Survey of Iran, J9: 1- 175.

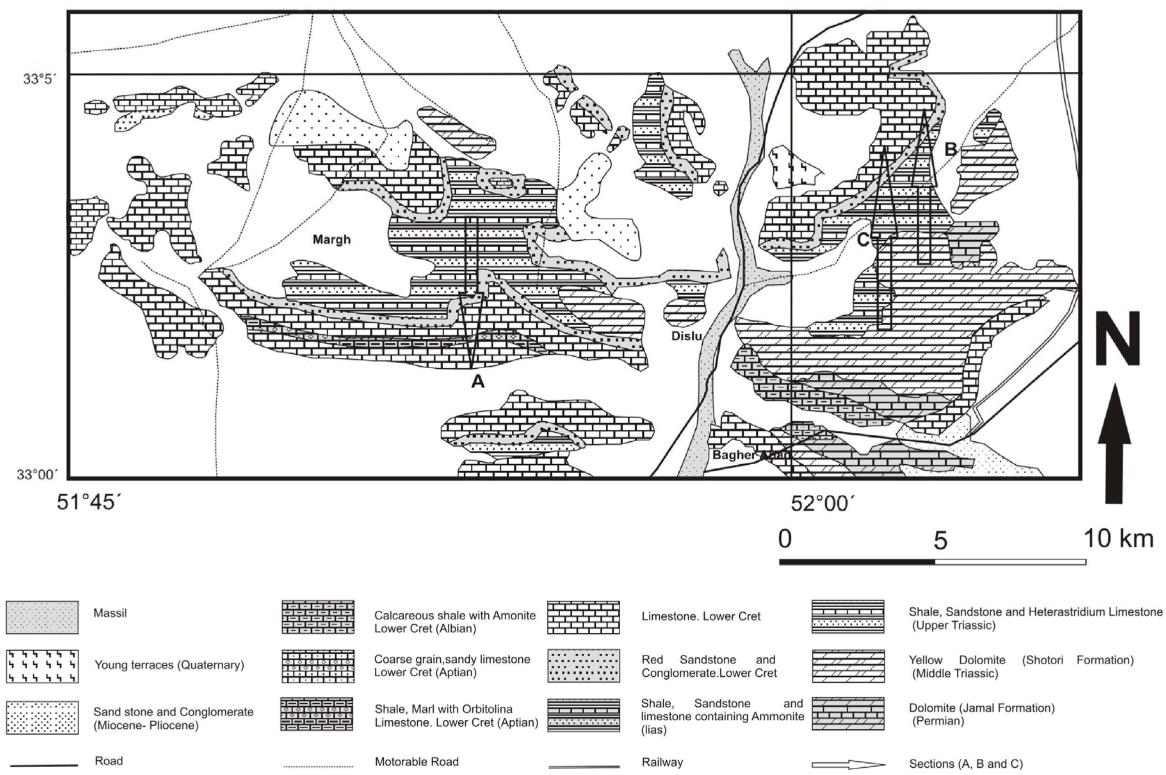

Fig.1 Geological map of north of Isfahan (Central Iran)