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PALEOGEOGRAPHIC EVOLUTION OF THE SWISS MOLASSE BASIN: A SHORT REVIEW

(Figs. 3)

Abstract: This article is a short review of the paleogeographic evolution of the Swiss molasse during the Oligo—Miocene. A bibliographic list of the principal studies of the last ten years is given, with brief comments.

Резюме: Предлагаемая статья является коротким обозрением палеогеографического развития Швецарской Молассы в течении олиго—миоцена. В том числе предлагается библиографический список изучений из последних десяти лет с короткими комментариями.

During the last ten years, numerous studies concerning various thema yielded new results for our knowledge of the Swiss Molasse basin and its evolution. The aim of this paper is to provide a short review of these studies and a rapid comment on the paleogeographic evolution of the basin during the Oligo—Miocene.

The Swiss Molasse basin, a classical peripheral foreland basin, is structurally subdivided in two zones:

— The "Molasse du Plateau", relatively autochthonous and slightly deformed, whose N-limit is now trapped in the Jura Mountains synclines, and whose S-limit, masked now by the Alpine front thrust, was probably localized 20—50 km back to the south of its present location.

— The Subalpine Molasse (including the so-called "Subalpine Flysch" and the "North Helvetic Flysch"), allochthonous, and whose origin can be situated probably 50—100 km south.

Lithostratigraphically, the Swiss Molasse is subdivided in four principal units, from top to base:

— OSM	— Obere Süsswassermolasse	= Upper Freshwater Molasse,
— OMM	— Obere Meeresmolasse	= Upper Marine Molasse,
— USM	— Untere Süsswassermolasse	= Lower Freshwater Molasse,
— UMM	— Untere Meeresmolasse	= Lower Marine Molasse.

Lower Marine Molasse (UMM)

The beginning of the story of Molasse is marked by a great acceleration of the subsidence, well observed at the limit Eocene—Oligocene with the "Globigerinenschiefer" which are localized now in the Helvetic Nappes.

During the Lower and Middle Oligocene, the molassic facies were essentially marine, but the N-coast of the sea did not overstep a line Geneva—Lausanne—

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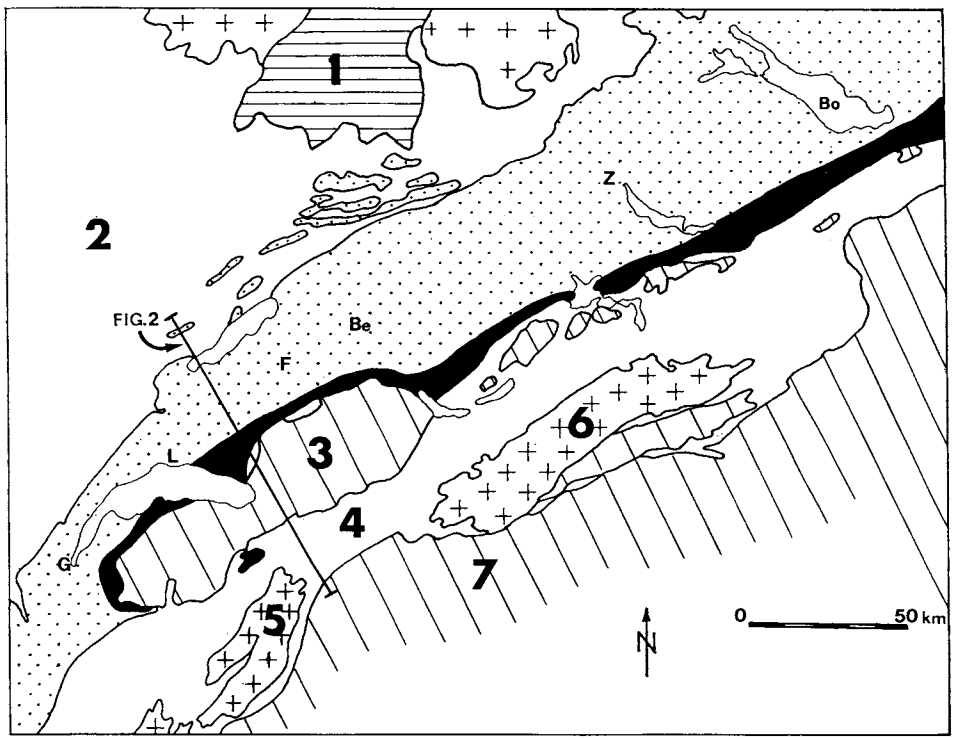

Fig. 1. Major structural division of Switzerland.
Legend: 1 — Rhine Graben; 2 — Jura Mountains; 3 — Prealps; 4 — Helvetic and Ultrahelvetic; 5 — Mt. Blanc/Aiquilles Rouges massives; 6 — Aar/Gothard massives; 7 — Penninic and Austroalpine.
G — Geneva, L — Lausanne, F — Fribourg, Be — Bern, Z — Zürich, Bo — Bodensee. "Plateau Molasse" is indicated with points and "Subalpine Molasse" is indicated in black — including Subalpine Flysch in Figs. 1, 2 and North-helvetic Flysch in Fig. 2.
Common legend also for Fig. 2

Fribourg—Bern—Zürich—Bodensee. Further north, some lacustrine deposits, -dated Miocene deposits are still unknown in the Subalpine Molasse. deposited. However, a connection between the Alpine Sea and Rhine Graben Sea had to exist at one time (perhaps during NP 24?), but its precise location remains hidden.

Lower Freshwater Molasse (USM)

Following the UMM-deposits, the freshwater facies cover all the basin since the Middle Oligocene. Numerous localities with mammals and charophytes yielded good datations to correlate the different lithostratigraphical units of the USM: in the Subalpine Molasse, the oldest levels are dated from Middle Oligocene, while in the "Molasse du Plateau", the oldest ages are Lower Oligocene (see paragraph "UMM").

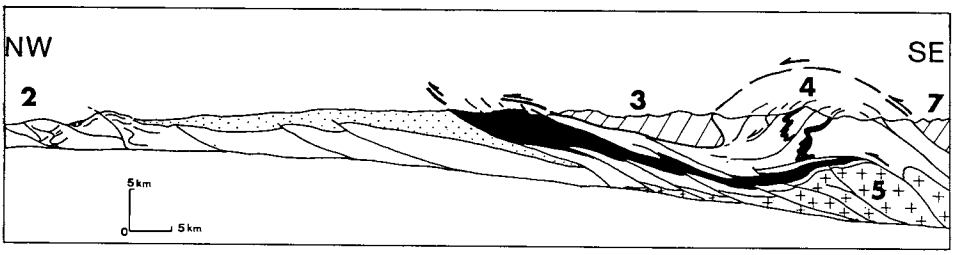

Fig. 2. Simplified structural cross section from the Jura to the Helvetic nappes. *Legend:* see Fig. 1.

In the proximal part, the products of the Alpine erosion were transported by several alluvial fans to the center of the basin and later to the east by the axial drainage of the basin (= "Genfersee-schüttung"). In the distal part, more lacustrine facies were deposited, sometimes with gypsum. At the base of the Miocene ("Aquitanian"), the fluviatile sedimentation follows the same model but the lacustrine facies are rarer. On the other hand, this Miocene USM is only found in the "Molasse du Plateau"; indeed, well-dated Miocene deposits are still unknown in the Subalpine Molasse.

Upper Marine Molasse (OMM)

During the Lower Miocene, a sea coming from the Paratethys and from the Rhone Valley area, invaded the Swiss Molasse basin. The age of this transgression depends on the area (proximal/distal, E-W variations): from NM 2b to NM 3a. The "Burdigalian" facies (= Luzerner Formation) are essentially formed by sandbodies influenced by tides, waves and storms; these are very poor in macrofauna but relatively rich in microfauna (benthic and planktonic foraminifera). The upper part of the OMM ("Helvetian" facies or St. Galler Formation), well known by its rich mollusc fauna, has been recently dated by mammals (NM 3b to NM 4b), nannoplankton (NN3) and foraminifera (N 6-7?).

Upper Freshwater Molasse (OSM)

The marine regression observed at the end of the OMM in the late Lower Miocene led to a fluviatile and lacustrine sedimentation with a reactivation of the alluvial fans, drained towards the West by the "Glimmersandschüttung". The presence of bentonites levels in the OSM-deposits is specially interesting: some of these have been recently dated from 14.4, 15.2 and 15.4 mio years. This confirms that a part of the bentonites is older than the "Nördlinger Ries deposits" and cannot be correlated with this event.

The age of the top of the OSM is not yet clear: in the distal part, the youngest facies are dated from NM 8, while the top of the conglomeratic proximal layers could be attributed to NM 6 or perhaps NM 7.

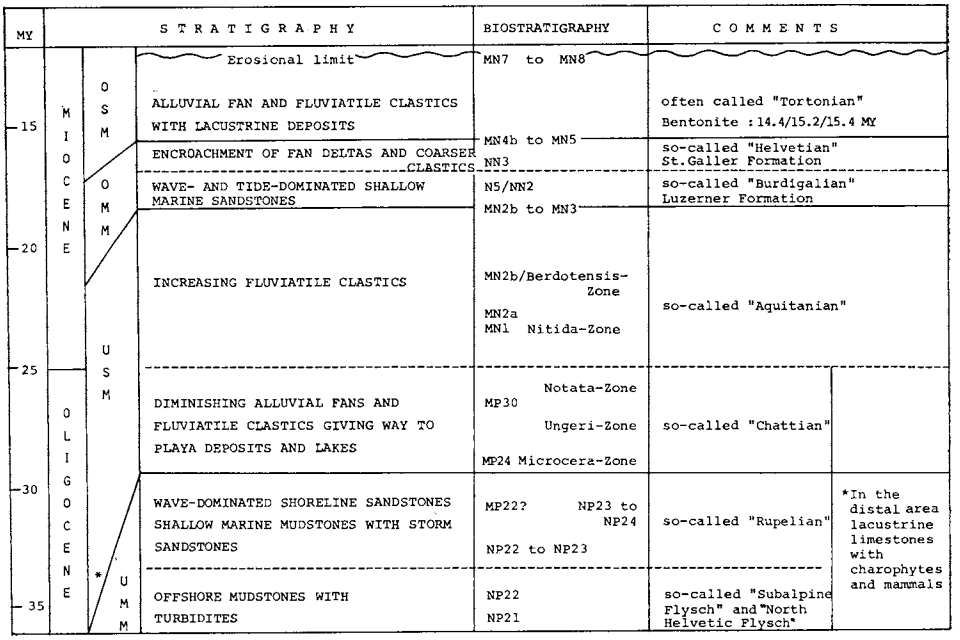

Fig. 3. Stratigraphic table of the Swiss Molasse.
Legend: MN — Mammal Neogene Units, MP — Mammal Paleogene Units, NN — Nannoplankton Zones, N — Planktonic Foraminifera Zones.
Charophytes Zones: *Berdotensis, Nitida, Notata, Ungeri, Microcera.*

After the Middle Miocene

Excepted an isolated episode dated from NM 9, there are no post-Miocene deposits in the basin. This could be due to the tectonic activity in the Mio—Pliocene as to the erosion caused by the Quaternary glaciations.

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BOLLIGER—GATTI—HANTKE, 1988: East-Switzerland, litho- and biostratigraphy, paleoclimate.

BÜCHI—SCHLANKE, 1977: Geodynamics, paleogeography.
CARBONEL—WEIDMANN—BERGER, 1985: West-Switzerland, ostracods.
ESCHER—MASSON—STECK, 1987: Cross-section through the W-Alps, with Molasse.
FREI, 1979: East-Switzerland, litho- and biostratigraphy.
FUCHS, 1976: Geodynamics, tectonics.
HABICHT, 1987: Lithostratigraphy, biostratigraphy.
HANTKE, 1984b: Macroflora, paleoclimate.
HOCHULI, 1978: Palynology.
HOMEWOOD, 1986: Geodynamics, paleogeography.
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MATTER et al., 1980: Flysch and Molasse, with description of sections.
MAURER, 1983: Heavy minerals, paleogeography.
MONNIER, 1979; 1982: Clay minerals, diagenesis.
NAEF—DIEBOLD—SCHLANKE, 1985: Tectonics and sedimentation, N-Switzerland.
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LOWER MARINE MOLASSE (UMM)

DIEM, 1986a, b: Sedimentology, paleogeography, Central and East Switzerland.
LATELTIN, 1988: Sedimentology, paleogeography, geodynamics, W-Switzerland.
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BERGER, 1988: Paleoecology, paleoclimate, macroflora, Subalpine Molasse, W-Switzerland.
ENGESSER, 1987a: Biostratigraphy, mammals.
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ENGESSER—MAYO—WEIDMANN, 1984: Bio- and lithostratigraphy, mammals, Subalpine Molasse, W-Switzerland.
FASEL, 1986: Litho- and biostratigraphy, sedimentology, Subalpine Molasse, W-Switzerland.
KISSLING, 1974: Litho- and Biostratigraphy, "Molasse du Plateau", Oligocene, W-Switzerland.
MAYO, 1987a, b: Biostratigraphy, mammals.
RIGASSI, 1977: Litho- and biostratigraphy, correlations.
WEIDMANN, 1984: Litho- and biostratigraphy, Lower Oligocene, W-Switzerland.

UPPER MARINE MOLASSE (OMM)

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BERGER, 1985: Biostratigraphy, paleocology, paleogeography, W-Switzerland.
ENGESSER, 1987b: Biostratigraphy, mammals.
FISCHER, 1987: Datations with strontium-isotops.
HOMEWOOD—ALLEN, 1981: Sedimentology.
KELLER, 1989: Litho-, bio- and chronostratigraphy, paleoecology. Central-East Switzerland.
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