Introduction

Objekttyp: **Chapter**

Zeitschrift: **Eclogae Geologicae Helvetiae**

Band (Jahr): **79 (1986)**

Heft 2

PDF erstellt am: **22.09.2024**

CONTENTS

1. Introduction

1.1 Previous work

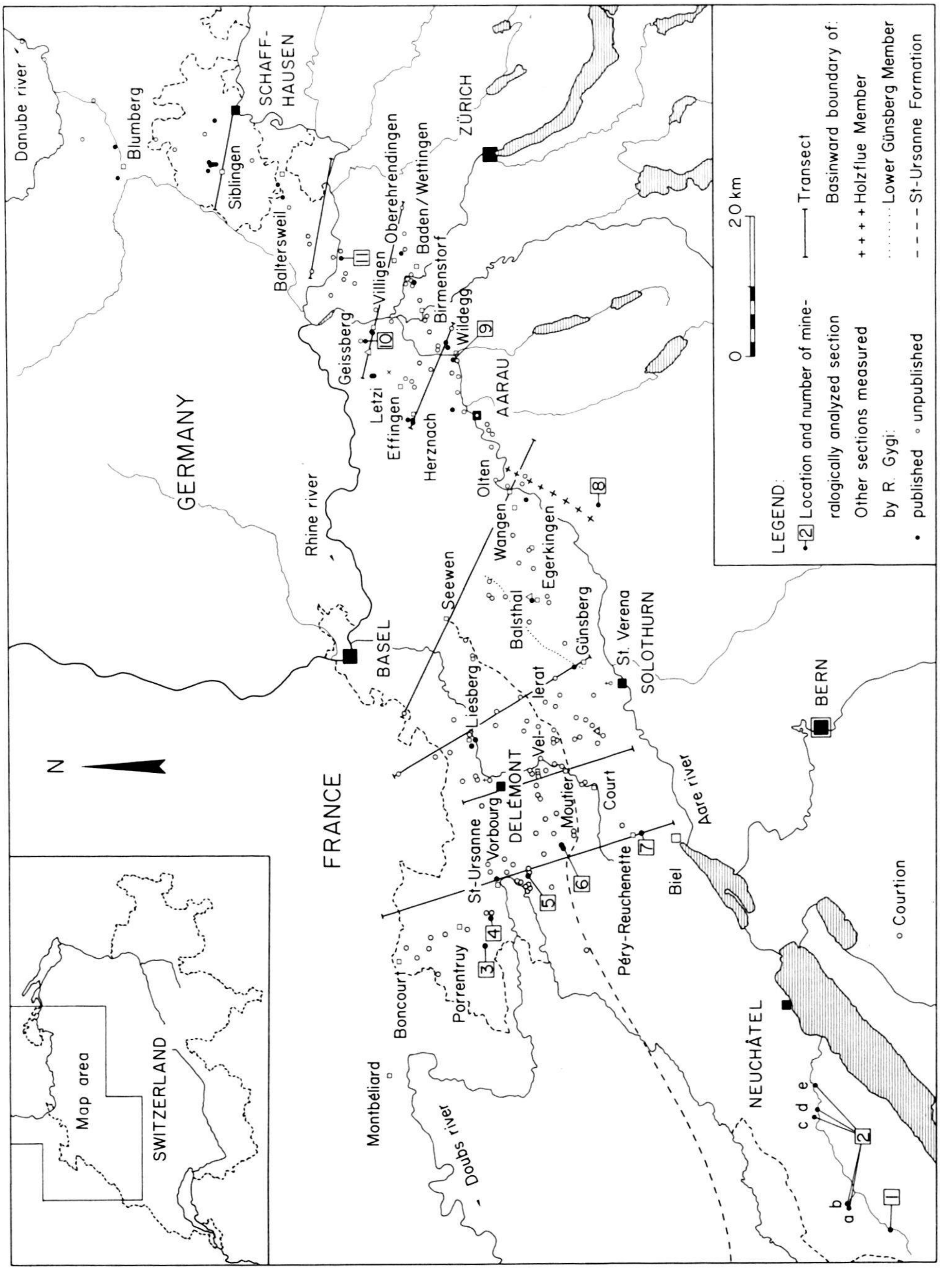
Stratigraphic work in the Swiss Jura range began before 1820. MERIAN (1821) correlated the Early and Middle Oxfordian marl-clays (Renggeri Member and Terrain à Chailles Member) of northwestern Switzerland with the Effingen Member in canton Aargau, and the coral limestones of the St-Ursanne Formation in the "basinal" realm of canton Aargau (see Pl. 1A). GRESSLY (1838–41) carried out extensive geological mapping in canton Solothurn and in adjacent areas. Close observation of the coral bioherms and the coeval fine-grained sediments of the St-Ursanne Formation at La Caquerelle near St-Ursanne inspired this author to introduce the concept of facies into the scientific literature. Ironically, the great effort in mapping, practical use of the new stratigraphic method, and ample fossil collecting did not allow this distinguished geologist to arrive, in his own opinion, at a satisfactory time correlation between the deposits from shallow water and those of deeper marine origin. The progress of paleontology as pioneered by OPPEL (1856–8, 1862–3) in the Oxfordian of this region led to an important revision of Merian's correlation. On the evidence of ammonites, OPPEL (1857, p. 626) recognized that the thick Renggeri Member and part of the Terrain à Chailles Member in the northwest thin out to the southeast and grade into what is now called the Schellenbrücke Bed (Table 2 and Pl. 1A).This is a ferruginous marly limestone with iron ooids. The thickness of the bed is normally less than 10 cm. ROLLIER (1888, p. 87) correlated the Liesberg Member with the Birmenstorf Member, and the St-Ursanne Formation with the Effingen and Geissberg Members. He had no ammonites from the platform deposits to support his assertion. Later, ROLLIER (1911, Fig. 54) reaffirmed his view, and it remained unchallenged until 1967, when BOLLIGER & BURRI proposed another correlation which was based on the distribution of detrital quartz. The significance of the important paleontological work by de Loriol in relation to Rollier's correlation was not appreciated by most stratigraphic workers, perhaps because de Loriol paid so little attention to stratigraphy. In a short review, ARKELL (1956, p. 95–96) threw some light on the stratigraphic implications of the ammonites published by de Loriol from the Oxfordian in northwestern Switzerland.

M. A. ZIEGLER (1962) studied the platform to basin transition of what is now the St-Ursanne Formation (Table 2). He did not question Rollier's correlation of this formation with most of the Wildegg Formation (Table 2). Ziegler presented evidence for the wide areal extent of a supratidal horizon with characeans and limnic ostracods in the Natica Member above the St-Ursanne Formation (see OERTLI & ZIEGLER 1958). Thin coal seams in about this level have been reported before by HEER (1865, p. 125) and by KEMMERLING (1911, p. 22, see also LAUBSCHER & PFIRTER 1984, p. 208). BOLLIGER & BURRI (1970) figured peritidal stromatolites from the Natica Member. ROLLIER (1898, p. 58) reported limestone bands in the Natica Member with sufficient fine-grained detrital quartz that they could be worked to grindstones near Damvant, west of Porrentruy. M. A. ZIEGLER (1962, p. 26, 42) concluded from the good sorting of the quartz that it might be of eolian origin. This view was taken up by BOLLIGER & BURRI (1967). They considered the vertical variation of the quartz content to be a valuable means of correlation between the platform and the "basin". In doing so, they arrived at a correlation of the Natica Member with the Effingen Member, and at a correlation of the St-Ursanne Formation with the Birmenstorf Member alone. The latter correlation has since been corroborated on the strength of ammonites as found in situ by PÜMPIN (1965, Pl. 1A, section 2) in the upper St-Ursanne Formation at St-Ursanne. These ammonites were identified by R. Enay and R. Gygi to be from the late Antecedens Subchron (see BAYER et al. 1983, p. 128).

The correlations by M. A. ZIEGLER (1962) and by BOLLIGER & BURRI (1967, 1970) are conflicting. Moreover, there are some shortcomings in the argumentation by Bolliger and Burri relating to the alleged eolian origin of the detrital quartz and the correlations based on it (see below). The following problems remained unresolved in 1970:

Fig. 1. Location of measured and mineralogically analyzed sections. The township name is followed by the abbreviated name of the canton (NE = Neuchâtel, JU = Jura, BE = Bern, LU = Luzern, AG = Aargau), then by the locality name. Coordinates are after the Swiss National Map. First set of coordinates: starting point of section. Second set: end of section. The number of sections measured by R. Gygi is preceded by RG.

1: La Côte-aux-Fées NE, Noirvaux, 529.450/190.520, 529.525/189.855.
2a: St-Sulpice NE, Haut de Tour II, 532.620/196.160, 532.230/196.060.
2b: St-Sulpice NE, Haut de Tour I, 532.985/196.440, 532.890/196.360.
2c: Noiraigue, NE, well near Clusette, 544.912/200.859.
2d: Noiraigue NE, well near Clusette, 546.779/200.787.
2e: Boudry NE, Combe Garot, 551.240/201.430, 551.960/201.240.
3: Bressaucourt JU, water well, RG 359, 569.980/248.490.
4: Courgenay JU, Chemin paulin, RG 350, 573.850/247.100, 573.950/247.430.
5: Glovelier JU, road near Foradrai, RG 323, 579.760/242.000, 580.090/242.070.
6: Sornetan BE, Gorges du Pichoux, RG 314, 584.150/237.230, 584.170/237.220; RG 315, 584.070/237.170, 584.030/236.720.
7: Péry BE, La Charuque and La Reuchenette quarries, RG 307, 585.600/225.250, 585.850/226.400.
8: Pfaffnau LU, gas well Pfaffnau 1, 632.708/231.789.
9: Auenstein and Veltheim AG, Unteregg and Jakobsberg quarries, RG 226, 653.950/252.800, 654.000/252.420, RG 37, 653.900/252.400, 653.800/252.050.
10: Villigen AG, Gabechopf quarry, RG 294, 656.550/264.900, 656.570/264.850.
11: Mellikon AG, new quarry, RG 70, 668.100/268.650, 668.300/268.600.


Danube river
Blumberg
SCHAFF-HAUSEN
Siblingen
Baltersweil
ZÜRICH
Oberehrendingen
Baden / Wettingen
Villigen
Birmenstorf
Geissberg
Wildegg
Letzi
Effingen
Herznach
AARAU
GERMANY
Rhine river
Olten
Wangen
Egerkingen
Seewen
BASEL
Balsthal
Günsberg
St. Verena
SOLOTHURN
Liesberg
Vellerat
BERN
N
FRANCE
DELÉMONT
Court
Moutier
Aare river
St-Ursanne
Vorbourg
Péry-Reuchenette
Biel
Courtion
Porrentruy
Boncourt
NEUCHÂTEL
Montbéliard
Doubs river
Map area
SWITZERLAND
LEGEND:
2 Location and number of mine-ralogically analyzed section
Other sections measured by R. Gygi:
• published ◦ unpublished
0 20 km
Transect
Basinward boundary of:
+ + + + Holzflue Member
Lower Günsberg Member
- - - St-Ursanne Formation

— What is the time equivalent of the Liesberg Member and of the St-Ursanne Formation in the "basin"?
— Can the Hauptmumienbank marker bed of P. A. Ziegler (1956) be related to any unit in the "basin"?
— How can the boundary between the Court Formation and the Reuchenette Formation be defined, and what is the age of this boundary?

Gygi (1969) worked out Oxfordian and Early Kimmeridgian lithostratigraphy and ammonite biostratigraphy mainly in the "basinal" facies of the cantons Aargau and Schaffhausen. Gygi & Marchand (1982) figured the cardioceratid ammonites which are relevant for biochronology from the end of the Middle Jurassic Epoch to the Middle Oxfordian Age. In these papers and in the one by Bayer et al., the base of the Oxfordian Stage in northern Switzerland was defined lithostratigraphically and biostratigraphically. Major problems of correlation were solved from the base of the Oxfordian upward to the St-Ursanne Formation. The sedimentology and the paleoenvironment of the Early Oxfordian Schellenbrücke Bed was investigated by Gygi (1981). An outline of the depositional history of the Oxfordian in northern Switzerland is to be found in Bayer et al. (1983). The radiometric ages obtained by Gygi & McDowell (1970) of the Glaukonitsandmergel (Early Oxfordian) and of the lower Baden Member (Early Kimmeridgian) were republished, with slight revisions, by Odin (1982): 148 m.y. and 139.5 m.y., respectively.

In 1979, R. Gygi began measuring sections and collecting ammonites in the part of northwestern Switzerland previously worked on by P. A. Ziegler (1956), M. A. Ziegler (1962), and Bolliger & Burri (1967, 1970), in order to re-evaluate the controversial results of these authors. This work is not yet completed: some sections from south of the Laufen Basin to the southern boundary of the Jura range have yet to be measured or supplemented. The aim was to subdivide the successions into sequences, to calibrate the sequences with the previously established ammonite biochronology and with numerical ages, and to use sequence boundaries for correlation in successions without ammonites. It soon became apparent that in some sections, the base of sequence 3 as conceived in Plate 1 of this paper could not be discerned with certainty in the field. The boundary between the Balsthal Formation and the Reuchenette Formation could be well recognized and correlated in the field between Courgenay and Egerkingen (see this paper, Fig. 1 and Pl. 1A), but there were no ammonites to test the correlation in detail.

All fossils, including ammonites, are more or less restricted to certain environments. Ammonites are rare or absent in sediments from very shallow water (B. Ziegler 1971, p. 35). Detrital clay minerals have the advantage that they are ubiquitous. They are present even in winnowed deposits like carbonate oolite. Persoz & Remane (1976, p. 35) and Persoz (1982, p. 15) concluded that the vertical variation in the distribution of clay minerals, and particularly the variation in kaolinite, could be used for stratigraphic correlation from terrestrial to deeper marine environments.

1.2 Purpose of this paper

It is the purpose of this paper to investigate the feasibility of detailed correlations based on clay minerals, and to find what degree of resolution can be obtained by mineralostratigraphic correlations in an area of limited geographic extent. The Oxfordian of the Swiss Jura range was chosen, because on the one hand, these sediments have been investigated at intervals since the beginnings of stratigraphy in this country, and because, on the other hand, no consensus on correlation has been reached to this day in spite of the large amount of work done. We wish to stress that the results presented in this paper are preliminary. Most of the sections measured by R. Gygi are unpublished, and so are most of the ammonites collected by R. and S. Gygi since 1962, on which biostratigraphy and most of the regional correlations of the Oxfordian as presented in this paper are based.

2. Methods

The biochronologic framework for the mineralostratigraphic correlations was provided by sampling three sections for clay mineral analysis in the "basinal" cephalopod facies of canton Aargau (no 9, 10, and 11 in Pl. 1). Ammonite biochronology is well known in the rhodano-swabian "basin" (Enay 1966) which was a shallow sea on the southern continental shelf of Jurassic Europe. The deeper marine Oxfordian and Kimmeridgian sediments discussed in this paper were laid down in part of this epicontinental sea, which was less than 200 m deep. Therefore, the term basin is referred to with quotation marks in this paper. The other sections sampled for clay minerals include paleoenvironments from the slope, the margin, and the inner part of carbonate platforms, as well as environments of the intertidal and the supratidal zones.

2.1 Lithostratigraphy

The palinspastic cross section of Plate 1 is assembled from sections measured by R. Gygi (Fig. 1). The sections are spaced as closely as possible in order to facilitate correlation. They are arranged in transects perpendicular to depositional strike, or lines of equivalent facies, respectively. Thus, the cross section of Plate 1 is drawn along a line of maximum facies change. One difficulty in preparing the plate was that the slope of the Pichoux limestone between the St-Ursanne Formation and the Birmenstorf Member (see Table 2) varies from transect to transect. Another difficulty is the change of thickness within the St-Ursanne Formation which is from 35 m in the platform interior to more than 100 m at the platform margin. Even greater thickness variance over short distances occurs within the Natica Member at the transition to the Günsberg Member. Thicknesses had to be averaged in order to make Plate 1 interpretable.

When measuring the sections, every recognizable horizon down to a thickness of a few centimeters was sampled individually. Thick-bedded or massive limestones were sampled at intervals of 1 m or less. Some of the thick-bedded or massive shallow-water limestones in the sections done by Gygi (1969) were sampled at larger intervals. Only the limestone samples processed to thin sections or polished slabs, or marls to be washed, are kept in the Museum of Natural History, Basel. Plate 1 is based on more than 2150 thin sections and more than 560 polished slabs from 182 measured sections. The sections were subdivided into shallowing-upward sequences. Rock names for primary mixtures of clay and lime mud are from Pettijohn (1957, Fig. 99).