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Autor: Gygi, Reinhart A. / Marchand, Didier

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An Early Oxfordian ammonite bed in the Terrain à Chailles Member of northern Switzerland and its sequence stratigraphical interpretation

By Reinhart A. Gygi [1]) and Didier Marchand [2])

ABSTRACT

A distinct, thin bed enriched in macrofossils has been found in the Terrain à Chailles Member at several localities in northern Switzerland. Between 76% and 90% of the macrofossils in the beds are ammonites. Between 58% and 90% of the ammonites are cardioceratids that make a precise biochronologic dating of the beds possible. According to the ammonites, the beds are at all the localities of the same age: the Cordatum Subchron of the Cordatum Chron in the latest part of the Early Oxfordian. The ammonite beds were deposited in a time of reduced sedimentation rate, but they are not condensed in the strict sense, because the range of the ammonite ages is only within the Cordatum Subchron. The beds are the effect of a stratigraphic event and probably mark a transgressive surface.

RÉSUMÉ

De minces couches enrichies de macrofossiles ont été trouvées dans le Terrain à Chailles de plusieurs localités de Suisse septentrionale. Entre 76% et 90% des macrofossiles récoltés sont des ammonites. Entre 58% et 90% des ammonites sont des cardioceratidés qui permettent une datation biochronologique précise de ces couches. D'après ces ammonites, les couches fossilifères sont toutes du même âge: sous-zone à Cordatum, zone à Cordatum, dernière sous-zone de l'Oxfordien inférieur. Les couches fossilifères ont été déposées avec un taux de sédimentation réduit, mais elles ne sont pas condensées au sens strict parce que les ammonites caractérisent seulement la sous-zone à Cordatum. Les couches sont l'effet d'un évènement stratigraphique et marquent probablement une surface de transgression dans le contexte de la stratigraphie séquentielle.

ZUSAMMENFASSUNG

Je eine bestimmte, dünne Schicht mit einer angereicherten Makrofauna wurde im Terrain à Chailles an mehreren Orten in der Nordschweiz gefunden. Zwischen 76% und 90% der Makrofossilien in diesen Schichten sind Ammoniten. Zwischen 58% und 90% der Ammoniten sind Cardioceratiden, welche eine genaue biochronologische Datierung der Fundschichten ermöglichen. Auf Grund der Ammoniten haben die Fundschichten an allen Orten dasselbe Alter: sie fallen in das Cordatum-Subchron des Cordatum-Chrons im spätesten Teil des Frühen Oxfordian. Die Fossilschichten wurden bei einer reduzierten Sedimentationsgeschwindigkeit abgelagert, doch sind sie nicht kondensiert im strengen Sinn, weil die vertikale Verbreitung aller vertretenen Ammonitenarten allein in das Cordatum-Subchron fällt. Die Schichten sind die Wirkung eines stratigraphischen Ereignisses und dokumentieren wahrscheinlich eine Transgressionsfläche im Sinne der Sequenz-Stratigraphie.

[1]) Naturhistorisches Museum, Augustinergasse 2, CH - 4001 Basel, Switzerland.

[2]) Université de Bourgogne, Centre des Sciences de la Terre, URA 157, 6, Boulevard Gabriel, F - 21100 Dijon, France.

1. Introduction (R. G.)

This paper is a contribution to the discipline of sequence stratigraphy. The 66 ammonites in the collection of the Museum of Natural History in Basel from the "fossil bed" in the Terrain à Chailles Member as indicated in Gygi & Persoz (1986, Table 2) make it now possible to fix the biochronologic position of the bed exactly. We consider this to be the principal aim of this paper.

The lithostratigraphic framework of the Oxfordian of northern Switzerland was worked out by Gygi & Persoz (1986). A detailed ammonite biostratigraphy of the Terrain à Chailles Member has never been established because of the few ammonites found in situ at levels other than the one fossil bed. But the existence and the age of the fossil bed described here was known to Gygi & Persoz (1986, Table 2 and Pl. 1). These authors presumed that the bed was the time equivalent of the limonitic crust above the Schellenbrücke Bed or of the oxidized marl above the Glaukonitsandmergel Bed that occur in numerous sections elsewhere. The biochronologic age of these two beds was established to be of the Cordatum Subchron by Gygi & Marchand (1982) who figured a large number of ammonites. Only one ammonite from the Terrain à Chailles Member was included in that paper.

A radiometric age of the Glaukonitsandmergel Bed that is slightly older than our ammonite bed was first measured by Gygi & McDowell (1970) to be 146 Ma, then revised by Fischer & Gygi (1989) to be 149.2 Ma. The existence of a maximum flooding surface just above the Cordatum/Vertebrale subzonal boundary was documented by Rioult et al. (1991, Figs. 15 and 17) from the Anglo-Paris Basin. Coe (1992a, p. 45; 1992b) recognized a transgressive surface at the Cordatum/Vertebrale subzonal boundary in southern England. The fossil bed in the Terrain à Chailles Member is slightly older.

2. Geographic and stratigraphic setting (R. G.)

Beds with an abundant macrofauna have been found in the Terrain à Chailles Member near Vellerat BE, Bärschwil SO, Sornetan BE (Fig. 1) and Fournet-Blancheroche in France, near the Swiss border north of La Chaux-de-Fonds, 33 km west of Sornetan. The fossil beds occur only in the marginal part of the submarine mud bank of the Renggeri and Terrain à Chailles Members (Gygi & Persoz 1986, Table 2 and Pl. 1), but they probably represent an uninterrupted layer that might be present all along the margin of the submarine bank (see Contini 1976, Fig. 3). The fossil bed near Bärschwil is in about the middle of the Terrain à Chailles Member, which crops out nearly in its total thickness at that locality. Short logs with the positions of the fossil beds and figured ammonites within the Terrain à Chailles Member are given in Fig. 2.

3. Litho- and sequence stratigraphy (R. G.)

The Terrain à Chailles is the middle member of the Bärschwil Formation that has three members: the Renggeri Member at the base, the Terrain à Chailles Member in the middle and the Liesberg Member above. The Terrain à Chailles Member is a succession of marl-clay with intercalations of bands of calcareous concretions and continuous beds of argillaceous limestone. The thickness of the Member is around 45 m. There are generally few ammonites in the Terrain à Chailles Member. The fossil bed is about in the middle of the member. It is characterized by a high content of ammonites. This is unusual for the Terrain à Chailles Member. The lateral extention of the bed is at least 53 km. The bed consists of a single band of calcareous concretions within marl-clay. The thickness of the lenticular concretions is 10 to 20 cm. The conretions consist of microsparite which is indicative of diagenetic recrystallization. The macrofossils are found only in the concretions. The ammonites are ill-preserved casts without traces of the shell. The concretions contain no authigenic minerals like glauconite or iron sulfide. They are neither corroded nor encrusted. Up to three ammonites were found per concretion. This is an uncommonly high concentration of macrofossils. The ammonites represent a single paleopopulation (see below). This is indicative of a short time of deposition, but there are no signs of condensation in the strict sence. We use this term s. str. as defined by Arnold Heim (1934, p. 376; see also Marchand & Tarkowski 1992). Condensation s. str. implies that fossils from two or several subzones or zones occur together in one and the same bed. This is not the case in the ammonite bed of the Terrain à Chailles Member.

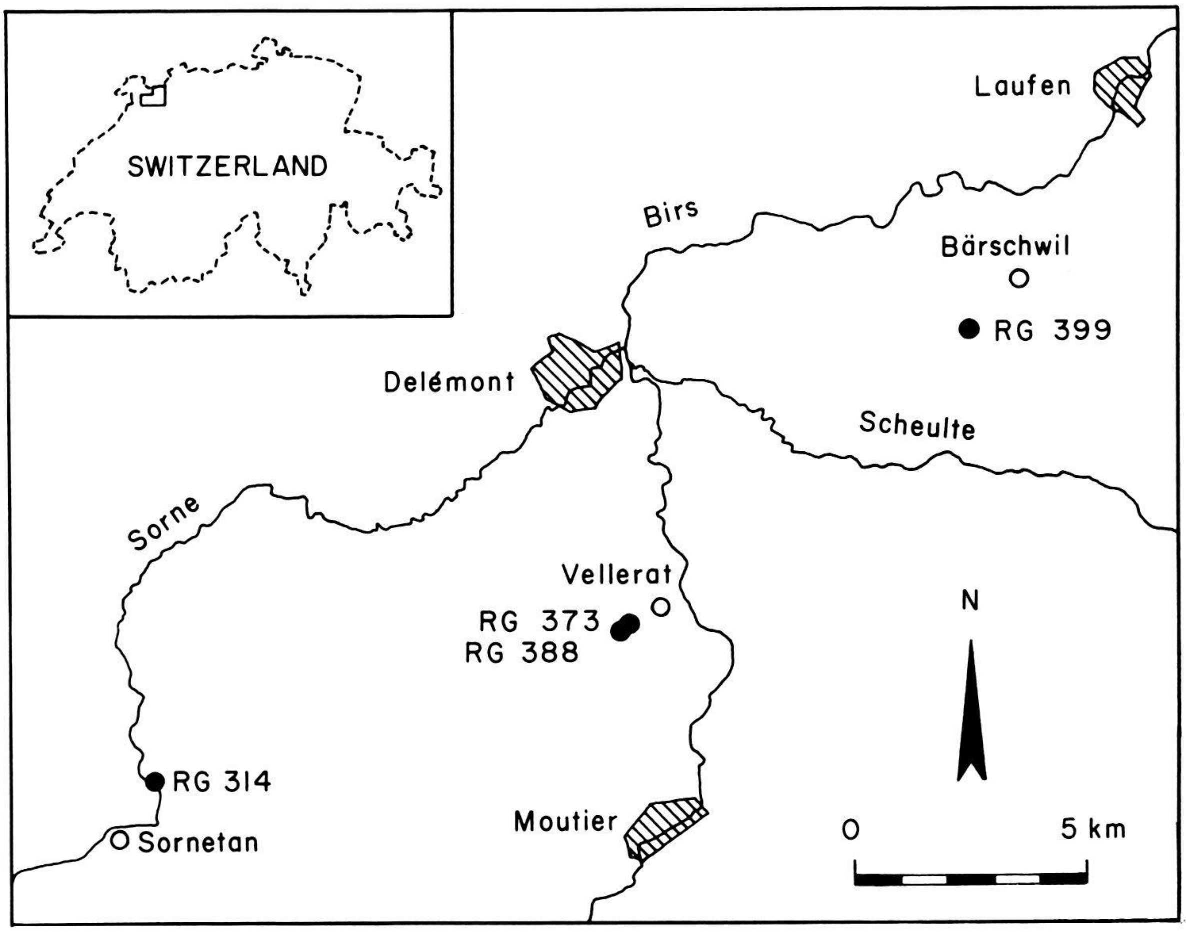

Fig. 1. Map of localities with figured ammonites from the Terrain à Chailles Member.
Coordinates: RG 314: 584'150/237'230/620
RG 388: 593'850/240'340/910
RG 373: 594'200/240'600/810
RG 399: 601'510/246'780/870

Gygi et al., (in prep.) recognize a sequence boundary at the base of the Terrain à Chailles Member which appears to correspond to the Costicardia/Cordatum Subchron boundary. This is equivalent to the sequence boundary O 2 of Coe (1992 a) in southern England. Sequence statigraphy documents within a sequence from base to top the following systems tracts: the lowstand, shelf margin, transgressive and the highstand systems tracts (van Wagoner et al. 1988). Within a sequence, fossils are often concentrated in the proximal shallow marine sediments of the transgressive systems tract, because the rate of sedimentation is low in parts of this systems tract (Loutit et al. 1988, p. 186). Sedimentological evidence of condensation, e.g. concentration of authigenic minerals like glauconite and iron sulfide is also common in such sediments (Vail et al. 1991, p. 653). The concentration of fossils characterized by a great diversity and abundance may be enhanced above the transgressive surface at the base of the transgressive systems tract and tends to be at a maximum at the top of the transgressive systems tract, because the parasequences that make up the transgressive systems tract generally become thinner upwards as a consequence of sediment starvation during backstepping (Vail 1987, p. 3). The top of the transgressive systems tract is the maximum flooding surface (Vail 1987, p. 4). Gygi et al. (in prep.) interpret the fossil bed described in this paper as representing the transgressive surface above the sequence boundary O 2.

4. Remarks on some cardioceratid ammonites (D. M.)

The following cardioceratid taxa are represented:

Cardioceras (*Cardioceras*) *cordatum* (J. Sowerby) var. *costicordatum* Arkell

J 31 523, RG 314/1, Gorges du Pichoux, Sornetan BE
J 31 530, RG 373/2, Sous la Peute Roche, Vellerat BE
J 31 533, RG 373/2, ibidem
J 31 515, RG 388/2, Sous la Peute Roche, Vellerat BE
J 31 518, RG 388/2, ibidem
J 31 449, RG 388/2, ibidem
J 31 434, RG 399/46, landslide west of Vögeli farm, Bärschwil SO
J 31 435, RG 399/46, ibidem

Cardioceras (*Cardioceras*) *cordatum* (J. Sowerby) var. *angusticordatum* Arkell

J 31 432, RG 399/46, landslide west of Vögeli farm, Bärschwil SO
J 31 445, RG 399/46, ibidem
J 31 528, RG 373/2, Sous la Peute Roche, Vellerat BE

Cardioceras (*Cardioceras*) *cordatum* (J. Sowerby) in Siegfried 1952

J 31 516, RG 388/2, Sous la Peute Roche, Vellerat BE

Cardioceras (*Cardioceras*) *persecans* (S. S. Buckmann)

J 31 441, RG 399/46, landslide west of Vögeli farm, Bärschwil SO
J 31 446, RG 399/46, ibidem
J 31 447, RG 399/46, ibidem
J 31 513, RG 388/2, Sous la Peute Roche, Vellerat BE
J 31 521, RG 388/2, ibidem
J 31 527, RG 373/2, Sous la Peute Roche, Vellerat BE

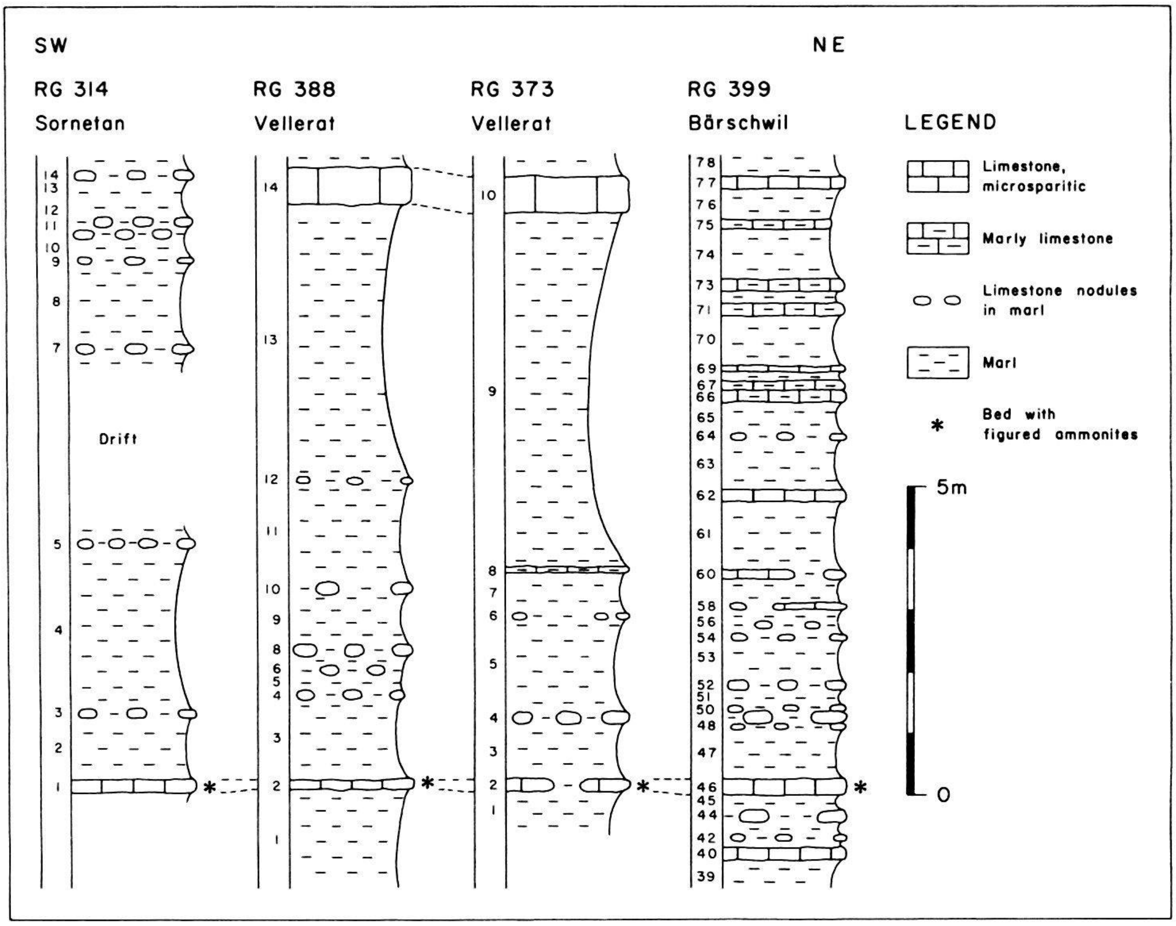

Fig. 2. Detailed sections of localities where figured ammonites were found in the Terrain à Chailles Member.

Cardioceras (*Cardioceras*) *ashtonense* ARKELL

J 31451, RG 388/2, Sous la Peute Roche, Vellerat BE
J 31511, RG 388/2, ibidem
J 31514, RG 388/2, ibidem
J 31526, RG 388/2, ibidem
J 31534, RG 373/2, Sous la Peute Roche, Vellerat BE

Cardioceras (*Cardioceras*) aff. *roemeri* SIEGFRIED 1952

J 31519, RG 388/2, Sous la Peute Roche, Vellerat BE

Cardioceras (*Cardioceras*) *excavatum* (J. SOWERBY) in Kniazev 1975

J 31439, RG 399/46, landslide west of Vögeli farm, Bärschwil SO

Cardioceras (*Plasmatoceras*) *plasticum* ARKELL

J 31431, RG 399/46, landslide west of Vögeli farm, Bärschwil SO

Numbers preceded by J are the individual numbers of specimens deposited in the Museum of Natural History, Basel. Numbers preceded by RG refer to localities and bed numbers of detailed sections.

The Cardioceratinae are characterized throughout their range from the Upper Callovian to the Middle Oxfordian by a great intra-specific variability that is the result of three causes, namely ontogeny, sexual dimorphism and non-sexual polymorphism.

During the ontogeny some changes in morphology appear: the inner whorls are statistically more evolved than the outer whorls as a result of a paedomorphic evolution (neoteny or retardation). The sexual dimorphs – microconch and macroconch – are morphologically close together but only at the innermost whorls to a diameter of 3 or 4 cm. At greater diameters, morphological differences appear and increase so much that adults are easy to recognize. As a result of paedomorphic evolution, the microconchs look more evolved. The polymorphism of the whorl thickness, so conspicuous among the early representatives of this sub-family (Late Callovian to Early Oxfordian), declines in the Middle Oxfordian but persists in the northern part of the northwest-European epicontinental sea; in Switzerland, as in the south-eastern part of France, this polymorphism is rare or absent.

The above-mentioned three causes of morphological variability induced, when a population is abundant (more than one hundred specimens), numerous morphologies; commonly, this phenomenon is interpreted as the result of a sedimentological condensation and as the telescoping – in one level – of numerous paleo-populations of different stratigraphical units.

The Cardioceratinae studied in this paper have a lot of pecularities. They are all characterized by a subplatycone or platycone morphology, a prominent keel on a shouldered venter and a typical ornamentation:

- the primary ribs are normally stronger than the secondaries, with more or less prominent tubercles,
- the secondary ribs separate from the primary ribs at the external part of the side. There is often a quite smooth band that is not depressed,
- the secondary ribs are sometimes strongly sweeping forward and, on the venter, always very much inclined foreward, and
- tertiary ribs are not uncommon.

The occurrence of all these peculiar elements in ornamentation indicates, without doubt, that these specimens must be considered as a single paleo-population which characterizes a short time of deposition. This conclusion is corroborated by a typological analysis. If we try to identify all the specimens, only very few typological species names are necessary (see above).

In conclusion, the Cardioceratidae and associated ammonites, collected in three neighbouring outcrops in the northwestern part of Switzerland, may be from a single population, homogenous from a biological and a stratigraphical point of view. These faunas are the result of a concentration (only one biostratigraphical subzone recognized) and not a condensation (more than one biostratigraphical subzone recognized). From a geological point of view, this population may be considered as being isochronous.

5. Biochronologic position of the ammonite beds (D. M.)

All the typological names used to describe this fauna are characteristic of the Cordatum Subchron (later part of the Cordatum Chron). If we compare this population with

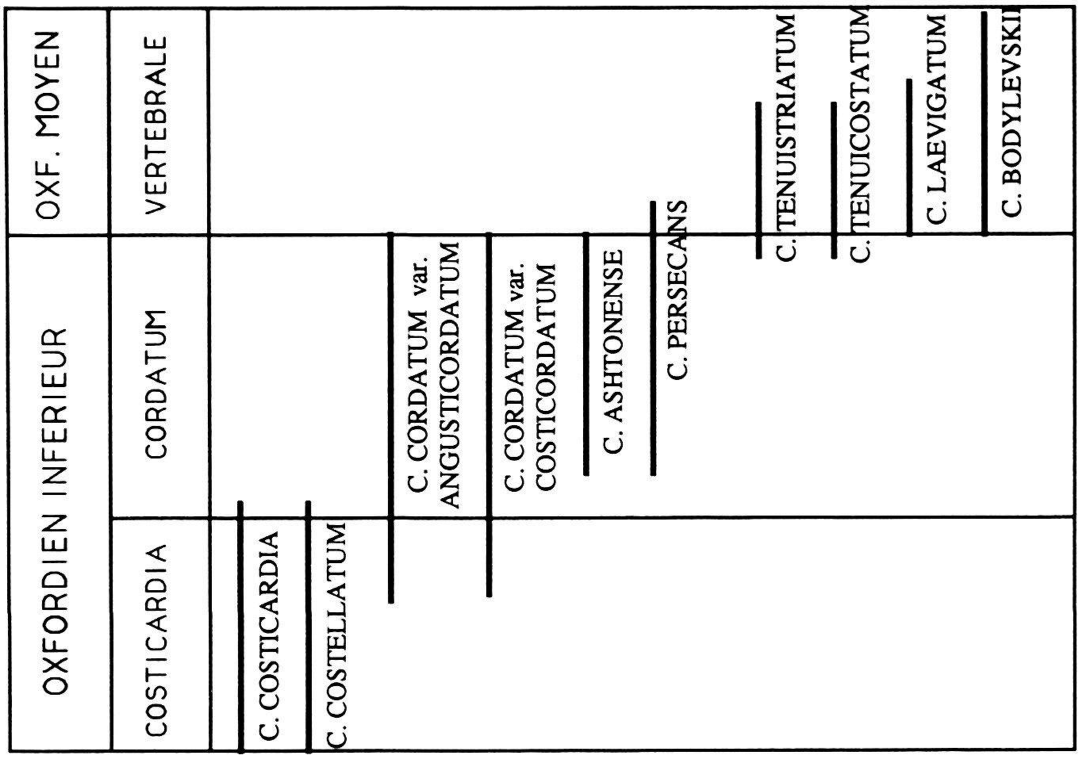

Fig. 3. The vertical range of the principal Cardioceratinae morphospecies.

older ones (of the Costicardia Subchron) or younger ones (of the Vertebrale Subchron) we can observe that:

- species as *Cardioceras costicardia* BUCKMAN or *Cardioceras costellatum* BUCKMAN of the Costicardia Subchron are absent,
- species described by Siegfried (1952) as *Cardioceras tenuicostatum* NIKITIN or *Cardioceras tenuistriatum* BORISSJAK, typical of the Early/Middle Oxfordian boundary, are also absent (Fig. 3). If we further compare with other populations of *Cardioceras cordatum* (SOWERBY) collected in Europe (England, Scotland, France, Poland), it appears that our population probably represents only the Cordatum Subchron and probably no more than one horizon.

Gygi & Persoz (1986) assumed a slight age difference between the fossil bed in the Terrain à Chailles Member and the Schellenbrücke Bed at Herznach that was dated with the ammonites figured by Gygi & Marchand (1982). Gygi & Persoz (1986, Table 2) indicated that in spite of the small difference in age between the two beds, both were of the Cordatum Subchron. This is now confirmed by the ammonites figured in this paper.

6. Paleoecology of the ammonite beds (D. M.)

All the invertebrates come from the same fossil bed. Of 81 specimens collected in three outcrops, 66 are ammonites (82%), 14 are bivalves (17%) and one is a brachiopod (1%). In the ammonite assemblage (N = 66), only 4 families are present. The Cardioceratidae are the most abundant with 51 specimens (77%; then come the Perisphinctidae

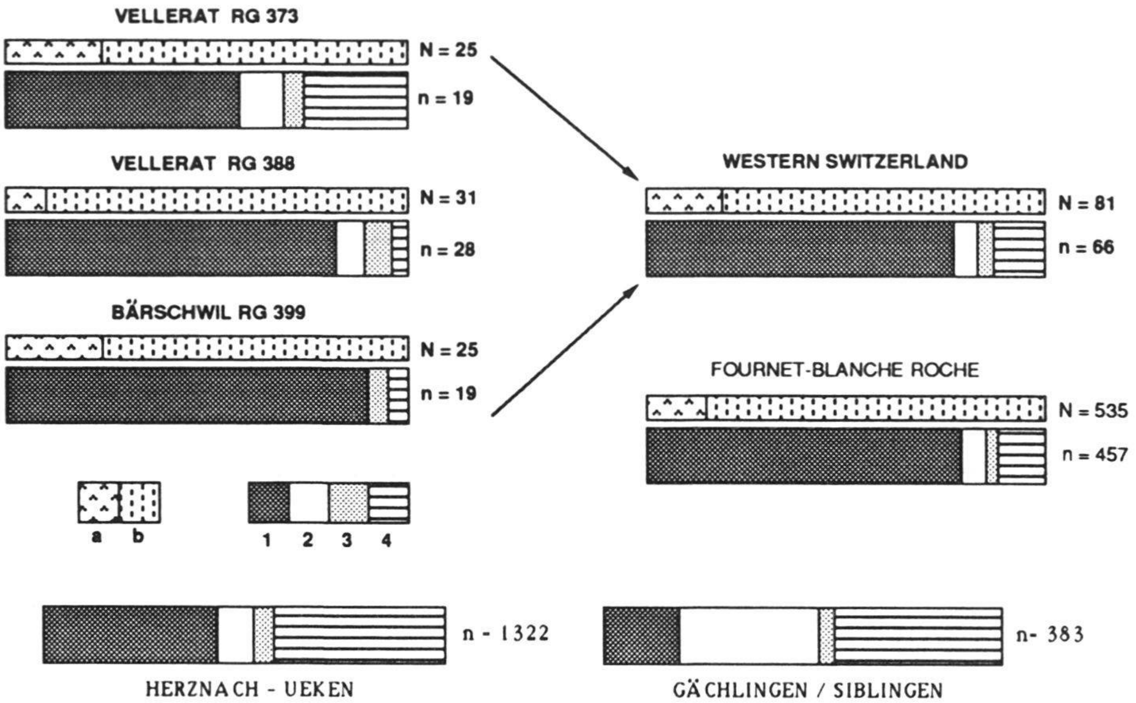

Fig. 4. Faunal spectra of the ammonite beds from the Terrain à Chailles Member: a: bivalves and brachiopods, b: ammonites, 1: Cardioceratidae, 2: Oppeliidae, 3: Aspidoceratidae, 4: Perisphinctidae.

(N = 8, 12%), the Oppeliidae (N = 4, 6%) and the Aspidoceratinae (N = 3, 5%). These percentages are graphically represented in Fig. 4.

Another assemblage of the same age is known from further west. At Fournet-Blancheroche (France) north of la Chaux-de-Fonds (Switzerland), the ammonite assemblage (N = 457) is almost identical with our new one: the Cardioceratidae are the most abundant (79%); then come the Perisphinctidae (11%), the Oppeliidae (Ochetoceratinae: 6%, Taramelliceratinae: less than 1%) and the Aspidoceratinae (3%). The benthic fauna is also present (15%), and is represented only by bivalves (13%) and brachiopods (2%).

The two faunal spectra, obtained in the same lithological and in the same paleogeographical environment, are very close together and indicate similar ecological and bathymetric conditions (Fig. 4).

When we compare these faunal spectra with those of the same subzone obtained in the Herznach/Üken area or in the Gächlingen/Siblingen sections (close to Schaffhausen, see Gygi & Marchand 1982, Fig. 1), a lot of similarities appear:

- the same four families are present and dominant;
- the same sub-families, Ochetoceratinae versus Taramelliceratinae and Euaspidoceratinae versus Peltoceratinae, are best represented.

But there are also differences. The most important concerns the Perisphinctidae which are more abundant in the two eastern assemblages: 43% at Herznach/Üken and 42% at Gächlingen/Siblingen against 12% in the new western assemblages. The second difference concerns the couple Cardioceratidae/Oppeliidae: at Herznach/Üken, the Cardioceratidae (42%) dominate the Oppeliidae (9%), but in the Gächlingen/Siblingen assemblages, Oppeliidae with 35% dominate the Cardioceratidae (19%).

In 1982 (Gygi & Marchand, p. 531), we proposed that the Couche de Schellenbrücke in the Herznach/Üken area and the Glaukonitsandmergel close to Schaffhausen were deposited, according to sedimentological data, at a depth of between 80 and 100 m in the first and between 100 and 150 m in the second case. These results agree with what is known of the ecological requirements of the four families present in these two assemblages. The new faunal spectrum that is largely dominated by the Cardioceratidae presented in this paper is therefore also compatible with a shallower environment. Such a conclusion is strengthened by the discovery of bivalves and brachiopods that are more numerous than in the eastern sections. The conclusion corroborates what Gygi & Persoz (1986, Plate 1) assumed.

7. Discussion (R. G., D. M.)

The lithostratigraphy published by Gygi & Persoz (1986) may be regarded as being well established. The biostratigraphy of the ammonite beds in the Terrain à Chailles Member has now also been adequately documented, even though the state of preservation of the ammonites is not good. Even so, a sufficient number of species could be identified with certainty. The biochronologic age determinations of the fossil beds near Sornetan, Vellerat and Bärschwil gave concordant ages within the resolving power of paleontologic methods. Biochronologic age determination with ammonites is still the most precise available method of measuring relative ages in Jurassic stratigraphy. The age difference between the ammonite bed in the Terrain à Chailles Member and the Schellenbrücke Bed in Canton Aargau is less than a subchron and cannot be determined more closely. Both ammonite beds are of the Cordatum Subchron. The apparently greater variability of the Cardioceratidae in the Schellenbrücke Bed at Herznach is probably merely a reflection of the much greater number of ammonites collected near Herznach and, possibly, also by a little longer time of sedimentation of the Schellenbrücke Bed.

The macrofossils are concentrated in the ammonite bed of the Terrain à Chailles Member to the extent that up to three ammonites may be found in a single limestone nodule. Such beds are called condensed in the literature on sequence stratigraphy (see mainly Loutit et al. 1988). This condensation s. l. documents a low rate of sedimentation and must be distinguished from the condensation s. str. as mentioned before. The concretions are neither corroded nor incrusted in the ammonite bed of the Terrain à Chailles Member. Nor are they mineralized with glauconite or iron sulfide. The macrofossils are abundant, but the ammonites represent only one paleopopulation. This is indicative of a short time of deposition, but not of condensation.

Rioult et al. (1991) recognized the sequence boundary of 150.2 Ma near the base of the Cordatum Subzone (Figs. 17, 25), but they assumed the transgressive surface and the maximum flooding surface of the corresponding sequence to be in the lowermost Vertebrale Subzone. We prefer not to use numeric ages to calibrate sequence boundaries because of the great discrepancies of different numeric time scales (see Fischer & Gygi 1989). Gygi et al. (in prep.) place the sequence boundary O2 that corresponds to the 150.2 Ma boundary of Ponsot & Vail (1991) at the base of the Terrain à Chailles Member.

They interpret the ammonite bed of the Terrain à Chailles Member to be a transgressive surface. Evidence for this is the high fossil content within a thin bed and the wide geographic range of this bed (see above).

8. Conclusions

The ammonite beds in the Terrain à Chailles Member near Sornetan, Vellerat and Bärschwil owe their enhanced fossil content to a low rate of sedimentation, but they are not condensed in the strict sense. The biochronologic age determinations by means of ammonite taxonomy indicate that the beds are time-equivalent. Therefore, the beds must be the effect of a stratigraphic event. They are interpreted to mark a transgressive surface. The ammonite beds are biochronologically dated as late Cordatum Subchron and radiometrically as somewhat less than 149.2 Ma according to Fischer & Gygi (1989), or about 149.8 Ma according to the time scale as adopted by Haq et al. (1987).

Acknowledgments

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Plate 1

Fig. 1. *Cardioceras (Cardioceras) cordatum* (J. SOWERBY) var. *costicordatum* ARKELL m. RG 314, Gorges du Pichoux, bank of Sorne river, bed 1, Sornetan BE, J 31 523.
Fig. 2. *Cardioceras (Cardioceras) cordatum* (J. SOWERBY) var. *costicordatum* ARKELL m. RG 373, eastern landslide Sous la Peute Roche, bed 2, Vellerat BE, J 31 530.
Fig. 3. *Cardioceras (Cardioceras) cordatum* (J. SOWERBY) var. *costicordatum* ARKELL m. RG 388, western landslide Sous la Peute Roche, bed 2, Vellerat BE, J 31 518.
Fig. 4. *Cardioceras (Cardioceras) cordatum* (J. SOWERBY) var. *costicordatum* ARKELL m. RG 388, western landslide Sous la Peute Roche, bed 2, Vellerat BE, J 31 449.
Fig. 5. *Cardioceras (Cardioceras) cordatum* (J. SOWERBY) var. *angusticordatum* ARKELL M. RG 373, eastern landslide Sous la Peute Roche, bed 2, Vellerat BE, J 31 528.
Fig. 6. *Cardioceras (Cardioceras) cordatum* (J. Sowery) var. *angusticordatum* ARKELL m. RG 399, landslide west of Vögeli farm, bed 46, Bärschwil SO, J 31 432.

All the specimens are from the Cordatum Zone, Cordatum Subzone of the Early Oxfordian, in the middle part of the Terrain à Chailles Member. Leg. R. Gygi. Scale ×1. M: macroconch, m: microconch.

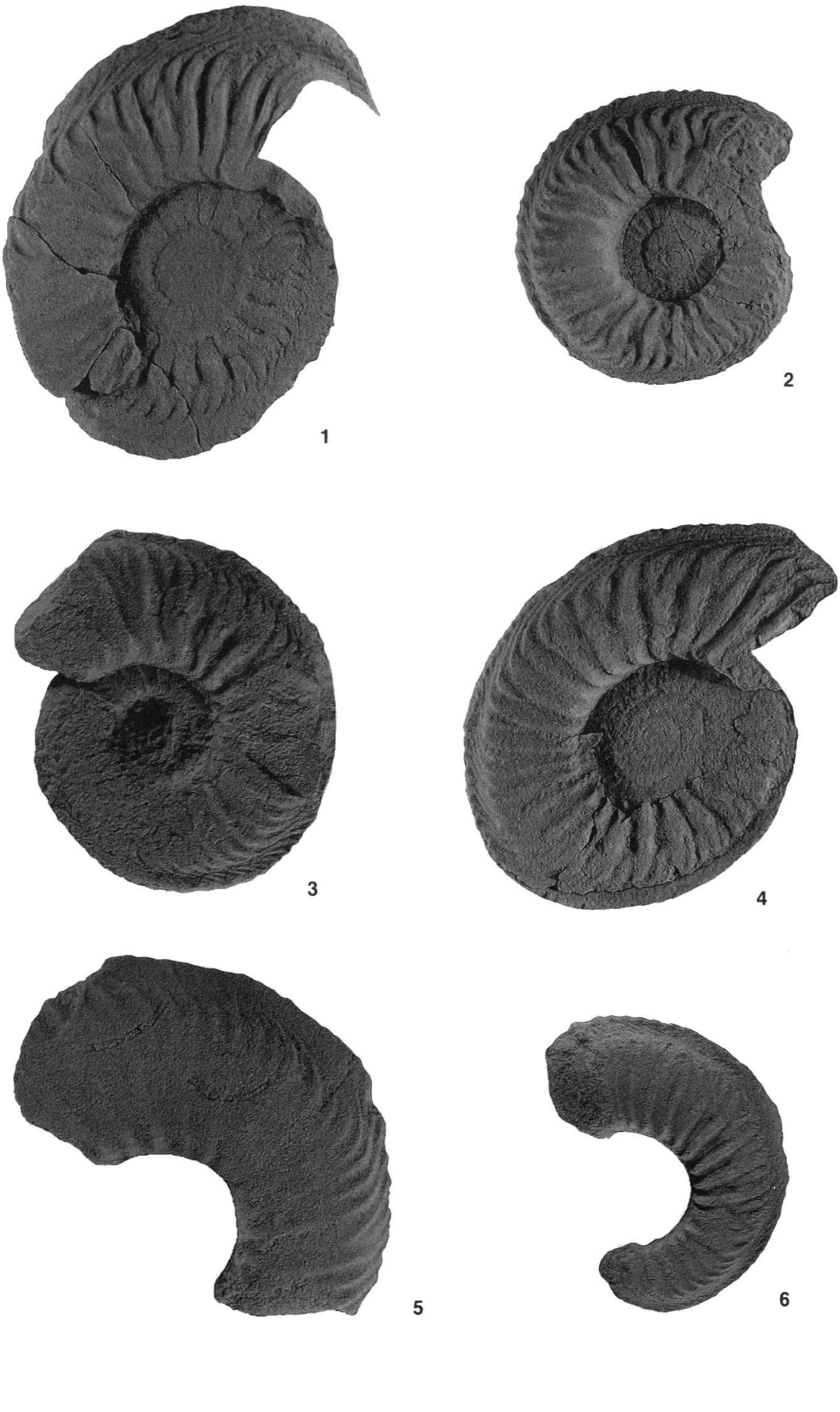
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Plate 2

Fig. 1. *Cardioceras* (*Cardioceras*) *cordatum* (J. SOWERBY) in Siegfried m? RG 388, western landslide Sous la Peute Roche, bed 2, Vellerat BE, J 31 516.
Fig. 2. *Cardioceras* (*Cardioceras*) *persecans* (S. S. BUCKMAN) M. RG 399, landslide west of Vögeli farm, bed 46, Bärschwil SO, J 31 447.
Fig. 3. *Cardioceras* (*Cardioceras*) *persecans* (S. S. BUCKMAN) m. RG 388, western landslide Sous la Peute Roche, bed 2, Vellerat BE, J 31 521.
Fig. 4. *Cardioceras* (*Cardioceras*) *persecans* (S. S. BUCKMAN) M? RG 373, eastern landslide Sous la Peute Roche, bed 2, Vellerat BE, J 31 527.
Fig. 5. *Cardioceras* (*Cardioceras*) *ashtonense* ARKELL m. RG 388, western landslide Sous la Peute Roche, bed 2, Vellerat BE, J 31 451.
Fig. 6. *Cardioceras* (*Cardioceras*) *ashtonense* ARKELL m. RG 388, western landslide Sous la Peute Roche, bed 2, Vellerat BE, J 31 511.

All the specimens are from the Cordatum Zone, Cordatum Subzone, of the Early Oxfordian, in the middle part of the Terrain à Chailles Member.Leg. R. Gygi. Scale $\times 1$. M: macroconch, m: microconch.

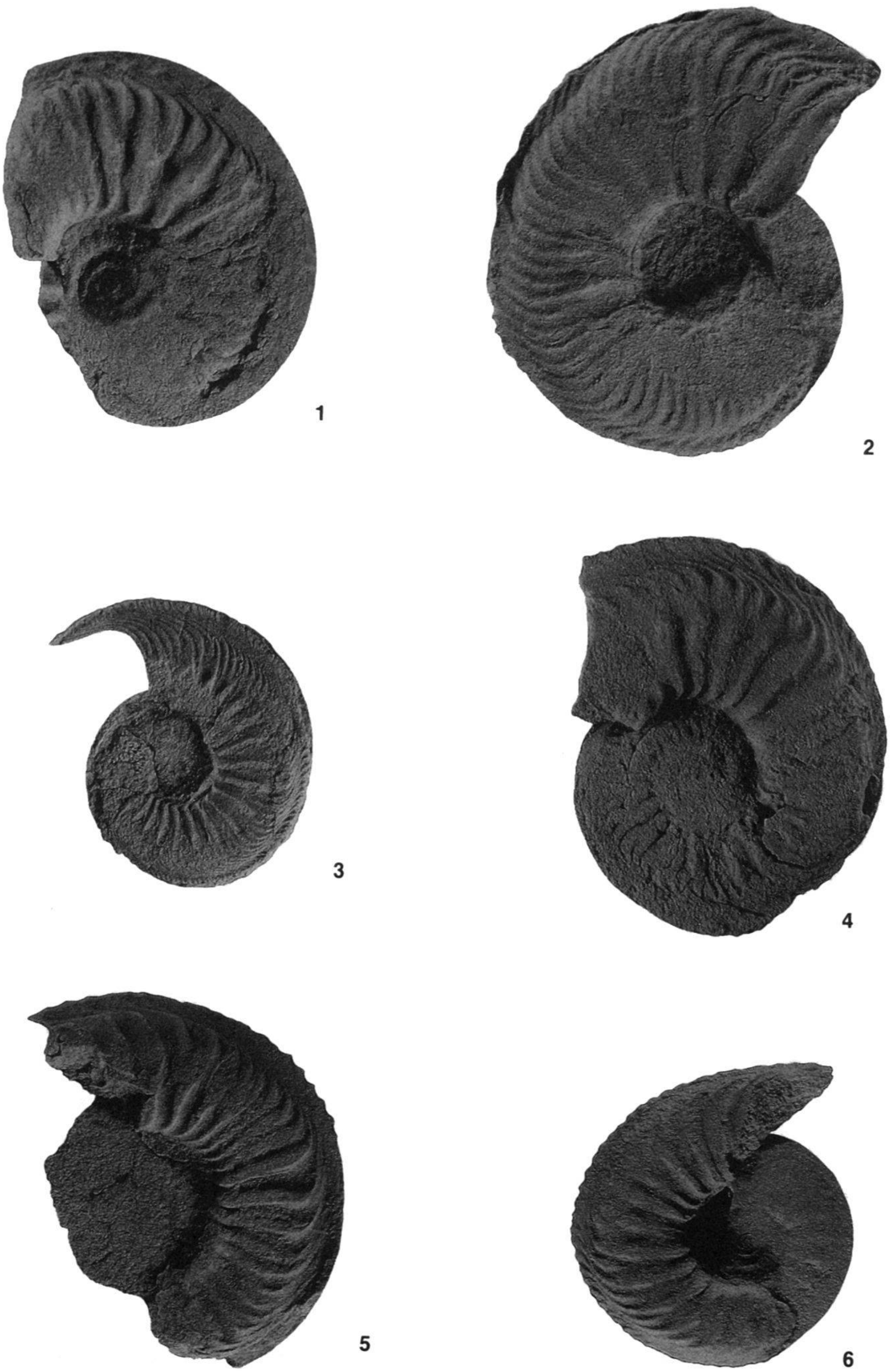
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Plate 3

Fig. 1. *Cardioceras (Cardioceras)* aff. *ashtonense* ARKELL m. RG 373, eastern landslide Sous la Peute Roche, bed 2, Vellerat BE, J 31 531.
Fig. 2. *Cardioceras (Cardioceras)* cf. *ashtonense* ARKELL m? RG 373, eastern landslide Sous la Peute Roche, bed 2, Vellerat BE, J 31 535.
Fig. 3. *Cardioceras (Cardioceras)* aff. *roemeri* SIEGFRIED M. RG 388, western landslide Sous la Peute Roche, bed 2, Vellerat BE, J 31 519.
Fig. 4. *Cardioceras (Cardioceras)* aff. *excavatum* (J. SOWERBY) in Kniazev M? RG 373, eastern landslide Sous la Peute Roche, bed 2, Vellerat BE, J 31 532.
Fig. 5. *Cardioceras (Plasmatoceras) plasticum* ARKELL M? RG 399, landslide west of Vögeli farm, bed 46, Bärschwil SO, J 31 431.
Fig. 6. *Perisphinctes (Otosphinctes) paturattensis* DE LORIOL m. RG 373, eastern landslide Sous la Peute Roche, bed 2, Vellerat BE, J 31 536.

All the specimens are from the Cordatum Zone, Cordatum Subzone, of the Early Oxfordian, in the middle of the Terrain à Chailles Member. Leg. R. Gygi. Scale ×1. M: macroconch, m: microconch.

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