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Fifty Years of Geological Cooperation between Austria, the Czech Republic and the Slovak Republic

First Results on Stratigraphy and Faunal Content of the Jurassic between Bad Mitterndorf and Toplitzsee (Salzkammergut, Austria)

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4 Text-Figures, 17 Plates

Österreichische Karte 1:50.000
Blatt 97 Bad Mitterndorf

Northern Calcareous Alps
Jurassic
Olistolith
Ammonoidea
Brachiopoda
Gastropoda
Bivalvia

Contents

Erste Ergebnisse zu Stratigraphie und Faunen-Inhalt der Jura-Gesteine zwischen Bad Mitterndorf und Toplitzsee (Salzkammergut, Österreich)

Zusammenfassung

Die südwestlichen Ausläufer des Toten Gebirges zeigen eine Schichtfolge aus rhätischem Dachsteinkalk und jurassischen Beckensedimenten, die bis in das Kimmeridgium reichen. Wahrscheinlich existieren hier im Unter- bis (?)Mitteljura zwei unterschiedliche Schichtfolgen nebeneinander: Im Zwicker-Wolfskogel-Gebiet wird der Dachsteinkalk von Allgäu-Schichten überlagert, die Oberes Hettangium bis Unteres Pliensbachium umfassen dürften. Darüber folgt im Oberen Pliensbachium Hierlatzkalk. Rote Crinoidenkalke mit „Bositra“-Mikrolumachellen könnten den Mitteljura vertreten. Im Flodring-Klaushöfl-Gebiet fehlen hingegen die Allgäu-Schichten völlig, die Schichtlücke dürfte hier das gesamte Hettangium umfassen. Der Hierlatzkalk repräsentiert hier im Wesentlichen das Sinemurium. Einige wenige Ammonitenfaunen belegen Unteres Pliensbachium, von zwei Stellen stammen Faunen des Toarcium. Der Oberjura folgt diskordant über dem älteren Untergrund. Er wird hauptsächlich von detritischem Tressensteinkalk vertreten, der Bioklasten von der Plassenkalk-Plattform und deren Hang beinhaltet. Eng verknüpft damit sind Hornsteinkalke der Oberalmer Schichten. Der Tressensteinkalk beinhaltet auch große Olistholithe aus unterjurassischem Hierlatzkalk, sowie zentimetergroße Bruchstücke von untertriassischen Werfener Schichten. Das Gebiet dürfte von den Auswirkungen der jurassischen (Gleit-)Tektonik betroffen sein, die Zwicker-Wolfskogel-Schollen könnten Teile einer jurassischen Gleitmasse darstellen.

Eine bemerkenswert reiche und diverse Fauna von Ammoniten, Brachiopoden, Schnecken und Muscheln aus einem großen Olistholithen bestehend aus Hierlatzkalk des Sinemurium wird genauer beschrieben. Daneben wird der Fauneninhalt einer ganzen Reihe kurzlebiger Aufschlüsse dokumentiert, die unter zahllosen entwurzelten Bäumen während der starken Winterstürme von 2005 bis 2007 entstanden waren und durch die Wiederaufforstung in Kürze wieder unzugänglich werden.

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Abstract

The southwestern foothills of the Totes Gebirge expose a sedimentary succession from uppermost Triassic Dachstein Limestone to Jurassic basinal sediments, persisting until Kimmeridgian. There probably exist two different Lower to (?)Middle Jurassic successions: In the Zwicker-Wolfskogel area the Dachstein Limestone is covered by Upper Hettangian to Lower Pliensbachian Allgäu Beds, followed by Upper Pliensbachian Hierlatz Limestone and red crinoidal limestones with "Bositra" microlumachelles of (?) Middle Jurassic age. In the Flodring-Klaushöfl area the sedimentary gap between Dachstein Limestone and Hierlatz Limestone cover the entire Hettangian. No Allgäu Beds are present here. Hierlatz Limestone has yielded mainly Sinemurian, a few Lower Pliensbachian and two Toarcian ammonite associations. The Upper Jurassic rests discordantly on older rocks and is mainly represented by the detritic Tressenstein Limestone (bioclasts from coeval Plassen carbonate platform and slope) in close connection with basinal Oberalm Limestone. The former contains large olistoliths of Lower Jurassic Hierlatz Limestone as well as centimeter-sized clasts of Lower Triassic Werfen Beds. The area is probably affected by intra-Jurassic (gravitational) tectonic, the Zwicker-Wolfskogel succession might be part of a large gliding mass.

A remarkable rich and diverse fauna of ammonites, brachiopods, gastropods and bivalves is described in detail from a large olistolith of Sinemurian Hierlatz Limestone. Additionally the faunal content of a great number of short living outcrops is documented – outcrops beneath uprooted trees created during strong winter storms 2005–2007.

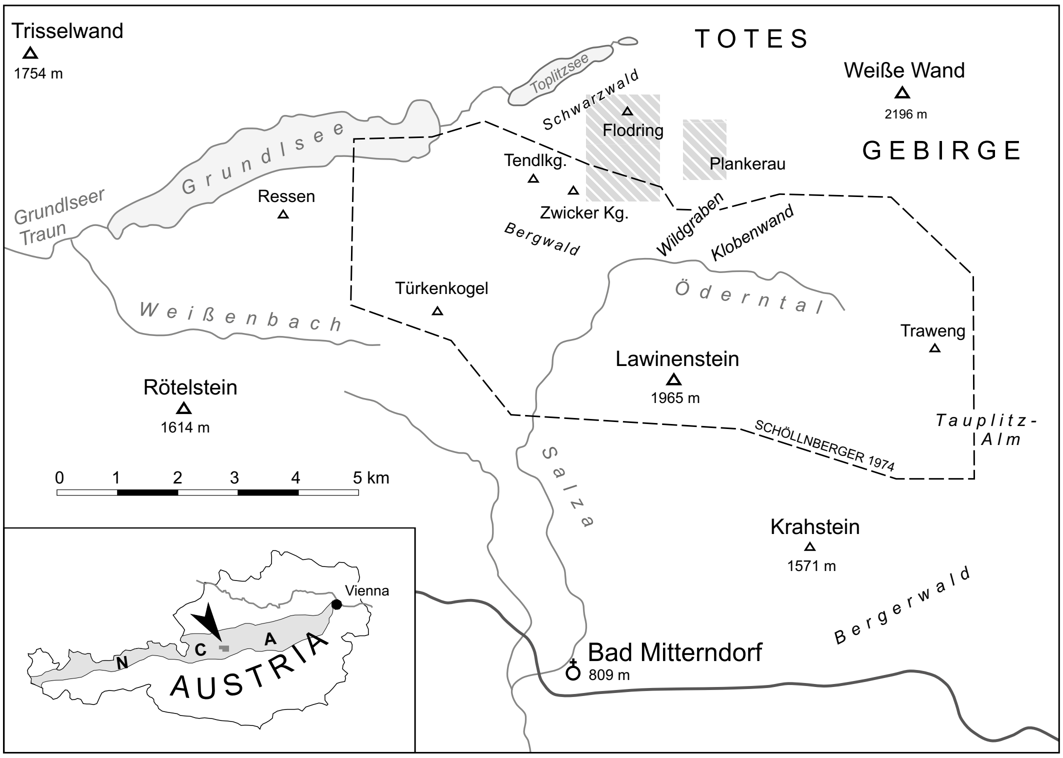
Introduction

Early investigations have reported on rich invertebrate faunas from several localities in the south-western Totes Gebirge, e.g. GEYER (1884, 1916). In recent times W. Kerndler, the custodian of the paleontological collections of the Kammerhof-Museum at Bad Aussee discovered a locality of Lower Jurassic fossiliferous limestones, which raised the hope to find a transition from Upper Triassic to Lower Jurassic. We started a first collecting campaign in 2005 in the framework of bilateral exchange between the Austrian Geological Survey and the Surveys of the neighbouring countries. During this fieldwork we became aware of the olistolithic nature of this Lower Jurassic limestone, resting within Upper Jurassic carbonate sediments. A rich fauna from the olistolith as well as diagnostic ammonites from the surrounding sediments have been obtained.

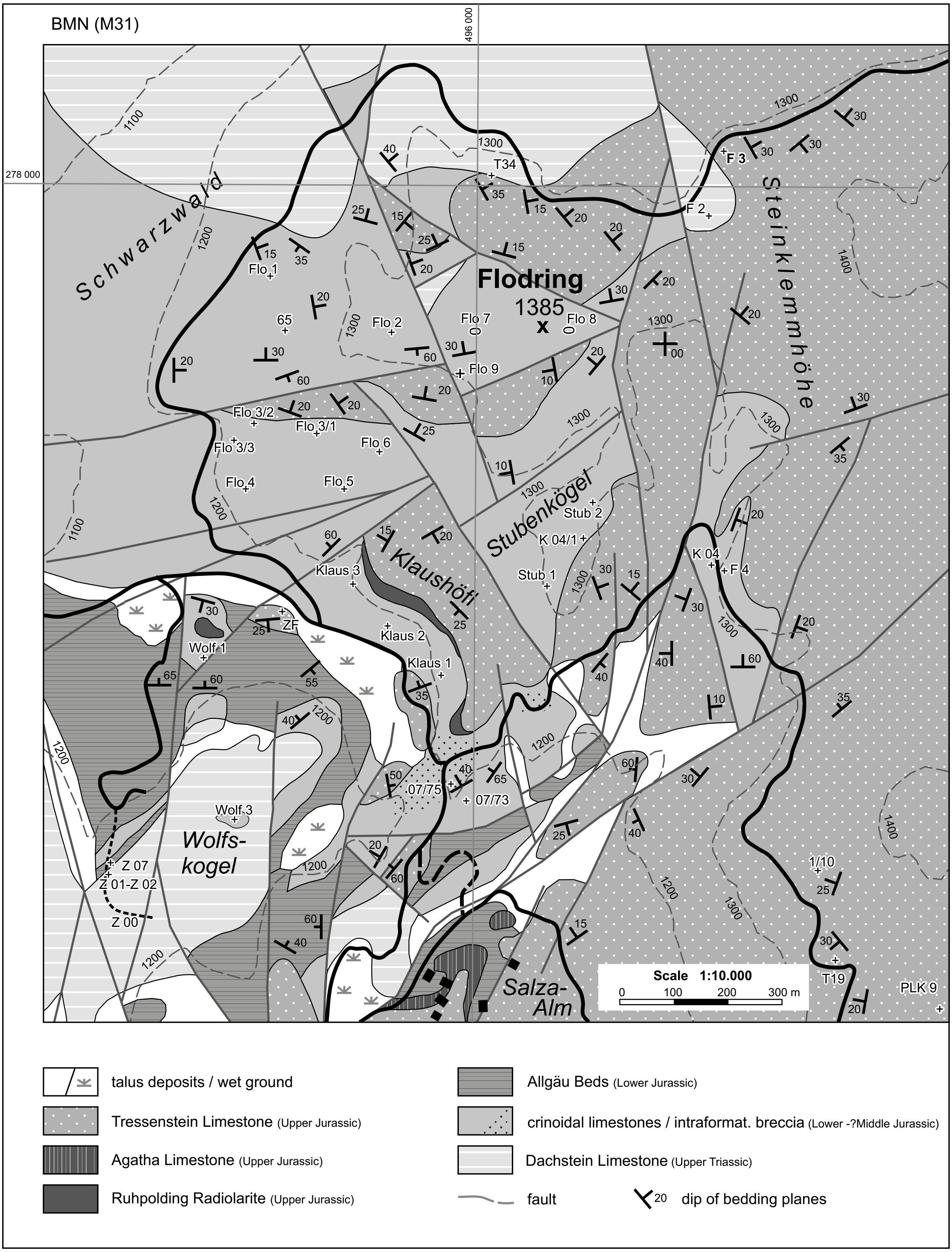
In the following winter 2005/2006 and 2006/2007 enormous winter storms destroyed large areas of forest and created countless small and discontinuous outcrops beneath uprooted trees. Due to this special situation the scope of our further fieldwork has changed into a documentation of the faunal content of these short living outcrops. Removing the wind-blown timber and reforestation will close these windows into the underground in the course of the next years.

Geological Setting

The area around Bad Mitterndorf belongs to those areas within the Northern Calcareous Alps (NCA), which are crucial points in revealing the complex geological history of the NCA. Still under discussion are the details of the palaeogeographic relationship between Triassic carbonate platforms and contemporary basinal sediments (Pötschen and Hallstatt facies), as well as Jurassic gravitational tectonics and sedimentation, Cretaceous to Palaeogene nappe tectonics and Miocene strike slip faults. For comparison of different viewpoints in this topic see e.g. TOLLMANN (1981), MANDL (2000), FRISCH & GAWLICK (2003) and GAWLICK & FRISCH (2003).



Text-Fig. 1.
Geographic sketch of the working areas and mentioned localities in the surroundings of Bad Mitterndorf.
Shaded areas (Flodring, Plankerau) indicate position of geological maps shown in Text-Figs. 2 and 3.



Text-Fig. 2.
Preliminary geological map of the southwestern foothills of Totes Gebirge between Salza-Alm and Flodring.

The most recent geological map by SCHÖLLNBERGER (1974, scale 1:25.000) covers the southern part of the area discussed here – see Text-Fig. 1. For large areas only the geological map of GEYER (1918) at a scale 1:75.000 is available. During our field work just limited time could be used for mapping the surroundings of our fossil collecting sites. Text-Figs. 2 and 3 are showing two preliminary sketch maps, which try to give an impression of the complex small scale fault tectonics and the spatial relation between the Triassic to Jurassic rocks. Further detailed mapping would be necessary – especially the areas indicated as Tressenstein Limestone may contain additional large olistoliths as well as extended occurrences of lower parts of the Jurassic stratigraphic column.

In general the extended karstified mountain plateau of Totes Gebirge is built by Middle to Upper Triassic shallow water carbonates of Wetterstein Dolomite below, and Hauptdolomit and Dachstein Limestone above a thin and discontinuous layer of Lower Carnian "Cardita Beds" (Northern Alpine Raibl Group).

Dachstein Limestone originates mainly from a shallow water lagoonal environment and exhibits the typical cyclic bedding of Lofer cyclothems. Only in the surrounding of Lake Grundlsee and in the Tauplitz area reef limestones are known. It is still unproven biostratigraphically, if these reefs are remnants of a Norian to Rhaetian platform margin or patch reefs within the subsiding lagoon only during the Rhaetian. SCHÖLLNBERGER (1974) has favoured the platform margin hypothesis, especially when he found a transition between the reef limestone and Zlambach Marls in the area southeast of Zwicker Kogel. Zlambach Marls are also the uppermost part of the stratigraphic column of the "Grey Hallstatt Facies" = Pötschen Facies. This transition became a connecting link between the Triassic carbonate platform of Totes Gebirge and contemporary basinal sediments south of Lake Grundlsee – the so called "Hallstätter Nordkanal" (= Northern Hallstatt channel) in terms of TOLLMANN (1981). As already shown in TOLLMANN (1981) extensive gravitational tectonics has changed the palaeogeographic situation during Jurassic times. If this fact is taken into consideration, it seems possible, that also the Dachstein reef limestone of Zwicker and the connected Zlambach Marls belong to the gravitationally transported masses of meter to kilometer-size. Our fieldwork has given no clear proof for this hypothesis so far, but some indications – see below.

The Dachstein Limestone is covered by Lower Jurassic crinoidal-brachiopodal facies of Hierlatz Limestone sensu lato, showing a wide range of lithologies. So far we did not see fissure fillings like at the Hierlatz type locality or as reported from the plateau mountains of Totes Gebirge. Due to our biostratigraphic data there exists a sedimentary gap between Dachstein Limestone and Hierlatz Limestone, embracing Upper Rhaetian and at least Lower Hettangian. The bulk of fossil samples indicate Sinemurian age, only very rare Pliensbachian and Toarcian have been proven. Beside the variegated limestones of Hierlatz facies grey marly limestones of Allgäu Beds have been found around Zwicker Kogel. Between Zwicker Kogel and Wolfskogel marly spiculitic limestones have yielded *Schlotheimia* sp. the only one of Late Hettangian age. In the Bad Mitterndorf area Allgäu Beds are more widespread; e.g. at Bergerwald ammonoids indicate an Early Pliensbachian age.

We have no proof of Middle Jurassic Klaus Limestone and also the earliest Upper Jurassic Ruhpolding Radiolarite was found only at a few places at Klaushöfl area. Toward south the "chert bearing Allgäu Beds" of SCHÖLLNBERGER's map (1974) may also belong to the radiolarite (SCHÖLLNBERGER, pers. comm. 2010).

Upper Jurassic (Kimmeridgian) sediments comprise Agatha Limestone (a few meters thick and discontinuous layer of nodular red limestone), Oberalm Limestone (micritic limestones with chert nodules) and Tressenstein Limestone (detritic limestones with detritus from the Upper Jurassic Plassen carbonate platform, as well as extraclasts and olistoliths). The Upper Jurassic rocks are following immediately above Upper Triassic and/or Lower Jurassic ones; a considerable part of the Jurassic succession is missing. This discordance is seen as an indication for intra-Jurassic tectonics, as well as the extraclasts of Lower Triassic siliciclastic Werfen Beds (from the Hallstatt realm) and the large olistoliths of Lower Jurassic limestone, probably coming from Jurassic scarp faults.

Stratigraphy

Upper Triassic

The oldest rocks of the succession of Totes Gebirge in the investigated area are represented by **Dachstein Limestone** in a near-reef facies. The most characteristic macroscopic feature of this light grey, massive limestone is the abundance of reef building organisms like colonies of branched corals as well as solitary corals and calcareous sponges. Fossils are often broken, covered by encrusting organisms and reworked again. The matrix is mostly fine grained reef debris, occasionally micritic limestone; remaining cavities are filled with sparry calcite.

Additional biotas are crinoids, gastropods, bivalves and brachiopods, for example forming a lumachelle east of Zwicker Kogel (brachiopod fauna see locality Z 00). The microfacies has not been studied.

Concerning the age we have conodont data only from the top of Dachstein Limestone (Zwicker locality Z 01 and Z 02). A greenish grey micritic limestone of about 20 cm thickness is directly covering the Dachstein Limestone. The conodont fauna – *Norigondolella steinbergensis* together with *Parvigondolella andrusovi* – indicates Rhaetian 1 *(Paracochloceras suessi* Zone) in the sense of the newly proposed Rhaetian Stage (KRYSTYN et al., 2007, 2009). According to the fauna we may compare this stratigraphic level to the pelagic interval PI 4 at the Gosaukamm-reef – see KRYSTYN et al. (2009, Fig. 3). That's an argument for a platform-margin origin of the Zwicker Dachstein Limestone, which fits very well the transition to basin sediments (Zlambach Beds) towards southeast, as supposed by SCHÖLLNBERGER (1974).

The Upper Rhaetian (level of Zlambach beds) is missing here between Zwicker and Wolfskogel; the badly exposed succession of dark grey marls and crinoidal limestones following above is already of Late Hettangian age – see below.

Lower Jurassic

Zwicker-Wolfskogel Area

Along a tractor path between Zwicker and Wolfskogel the Dachstein Limestone is followed by grey micritic limestones, crinoidal limestones and shales. The first approx. 13 meters are not exposed, only debris of grey spotted limestones and dark, laminated, locally spotted or silicified shales are visible. In the following outcrop silicified crinoidal limestones, grey spotted limestones and chert layers are alternating. Several specimens of *Schlotheimia* sp. were found here in the debris and in situ as well, indicating Upper Hettangian *(S. angulata* Zone) – location Z 07. The microfacies is dominated by micrites with abundant sponge spicules (monaxon and triaxon forms) and crinoidal wacke- to packstones with echinoid spines, rare tiny gastropods, nodosariid foraminifers and fragments of thin (?)bivalve shells. The crinoidal layers contain intraclasts of spiculitic micrites. Spicules seem to be the source of partly strong silicification and of distinct chert layers.

The next approx. 3.5 meters show massive to bedded light grey crinoidal pack- to grainstone with a few intercalations of partly red or violet spiculitic micrites. Some dark shale layers and thin bedded crinoidal limestone lead over to dark shales with some chert layers at the northern end of the outcrop.

All dark grey marls and limestones of this section are attributed to **Allgäu Beds** in Text-Fig. 2. The area between this outcrop and the next outcrop toward the north at location Wolf 1 is covered with debris of this lithology. Thin-sections are showing mud- to wackestones with some sponge spicules, crinoids and rare radiolarians. Signs of bioturbation are common.

At locality Wolf 1 about 10 meters of **Hierlatz Limestone** follow above the Allgäu Beds; ammonites indicate a Late Pliensbachian age. It is a pinkish and red massive crinoidal wacke- to packstone, with ammonites, brachiopods, bivalves, and is showing "stromatactis" polarity structures. It is covered by a hardground with borings perpendicular to the surface, overlain by a red crinoidal packstone with clasts of the underlying Hierlatz Limestone. After 4–4.5 meters the lithology changes into a bedded, red, fine grained and well sorted crinoidal packstone, with some belemnites and occasionally centimetre thin layers or lenses of *"Bositra"* lumachelles. On top of this Jurassic succession probably **Ruhpolding Radiolarite** was following, here only represented by debris of bleached greenish to reddish chert.

This Jurassic succession, including Allgäu Beds of at least Late Hettangian to Early Pliensbachian age, seems to belong only to the Dachstein Limestone of Zwicker and Wolfskogel. It is quite different to the Flodring-Klaushöfl area.

Flodring-Klaushöfl Area

In contrast to the before described succession the time span from Sinemurian to Early Pliensbachian is represented in this area by **Hierlatz Limestone**. No fauna has been found close to the underlying reefoidal **Dachstein Limestone**, the Hettangian seems to be missing completely. The bulk of fossil associations indicates Early Sinemurian (e.g. locality Flo 1) to Early Pliensbachian age (locality Flo 3). Proof is scarce for Toarcian (localities Klaus 1, 2), probably reaching Aalenian.

The lithological variability is rather wide. The colour ranges from white to beige, pale pink and red. Greenish and violet shades are rare. Bedding planes are seldom visible, therefore the spatial orientation remains often unclear. Geopetal fillings in fossil shells must be proven carefully, because redeposition is common. Microfacies range from micritic limestones with scarce dispersed faunal elements to crinoidal pack- and grainstones and to float- and rudstones with large crinoid fragments, more or less frequent belemnites and ammonites. Brachiopods occasionally accumulate to dense packed lumachelles. Ferromanganese crusts on bedding planes, around fossils or around intraclasts are generally rare, more frequent in the Toarcian limestone. Within the microfauna *Involutina liassica* is a common foraminifer, frequent in the Hettangian and Sinemurian in the Alpine Jurassic. It is a useful tool to recognize small olistoliths without macrofauna (see Pl. 15, Fig. 6; Pl. 17, Fig. 4).

Redeposition affects not only fossils but also the sediment itself. Under good conditions as in location Flo 2 it was possible to get ammonite faunas of different age from different clasts. Breccia matrix is a micritic crinoidal limestone.

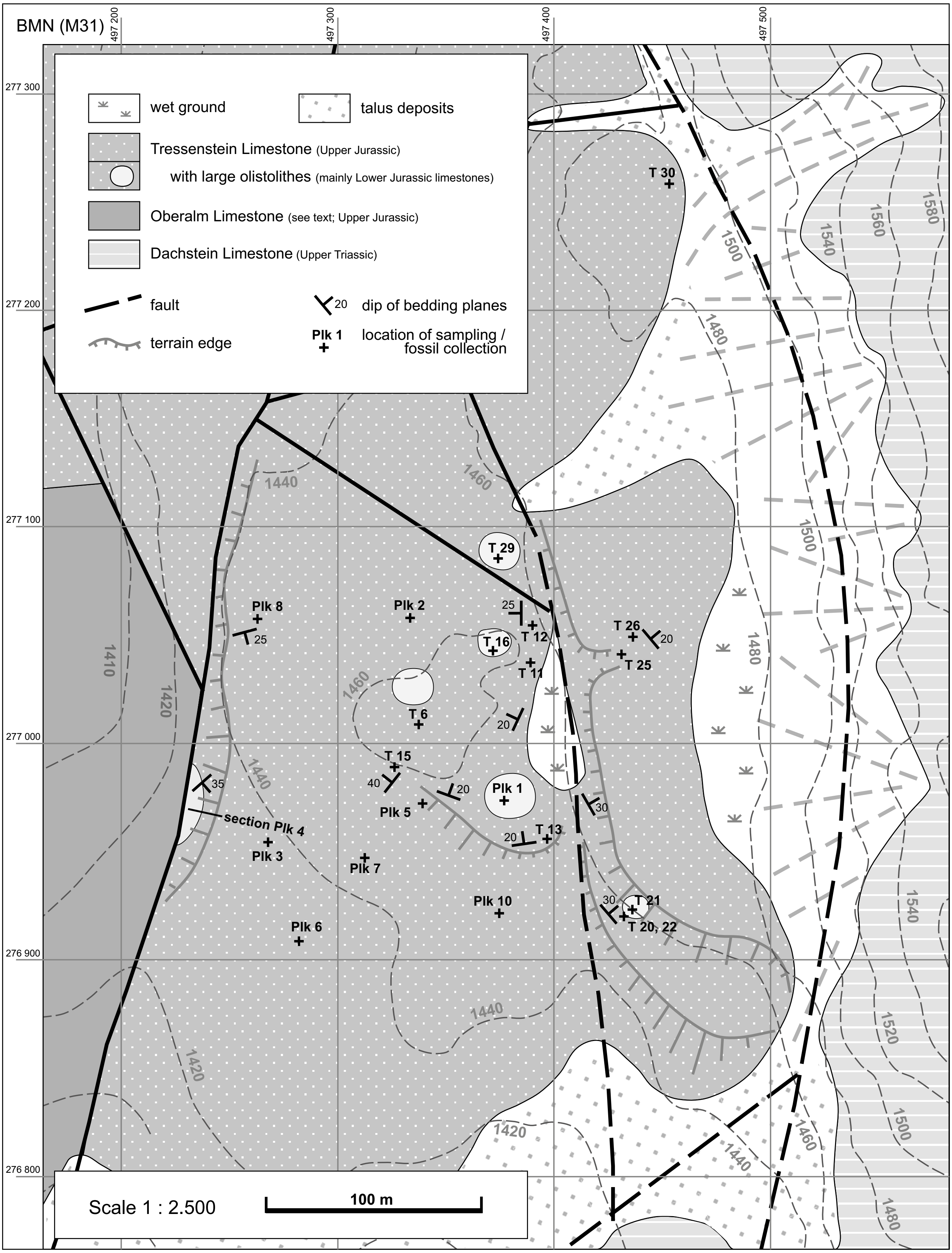
Another breccia is widespread enough, to indicate it on the map (Text-Fig. 2). The most interesting components consist of layers of dense packed, parallel or chaotic orientated thin shells of *"Bositra"*, alternating with crinoidal debris – see Pl. 15, Figs. 1–3. This biofacies has its first occurrence in the Alpine Jurassic in the Toarcian and becomes frequent in the Middle Jurassic. The other components can be assigned to several types of Hierlatz limestone. Unfortunately we have no fauna from the red limestone matrix. Probably this breccia is of Middle Jurassic age. Radiolarite or immediately Tressenstein Limestone follows above it.

Upper Jurassic

Around the beginning of Upper Jurassic, the greatest depth within the NCA depositional realm has been reached, characterized by wide spread sedimentation of radiolarites and by the onset of extensive gravitational processes, creating gliding nappes, olistoliths, breccias and turbidites – see Tollmann (1981), Mandl (2000), Frisch & Gawlick (2003) and Gawlick & Frisch (2003).

Within the area investigated we found only very locally (Klaushöfl area) a thin sequence of red **Ruhpolding Radiolarite**; biostratigraphic data have not been obtained. More widespread is the bedded to nodular red **Agatha Limestone**, e.g. south of Salza-Alm and Zwicker Kogel at the base of Tressenstein Limestone. A similar facies has been found at Plankerau area (e.g. locations Plk 4, Plk 6, T 6, T 25). At least parts of it seem to form local recurrences of this facies within the Tressenstein Limestone. Ammonites indicate Early as well as Late Kimmeridgian ages. Within the microfauna protoglobigerinids are very abundant, at Plk 4 also *Saccocoma* has been found – see Pl. 16, Fig. 9; Pl. 17, Figs. 9–10.

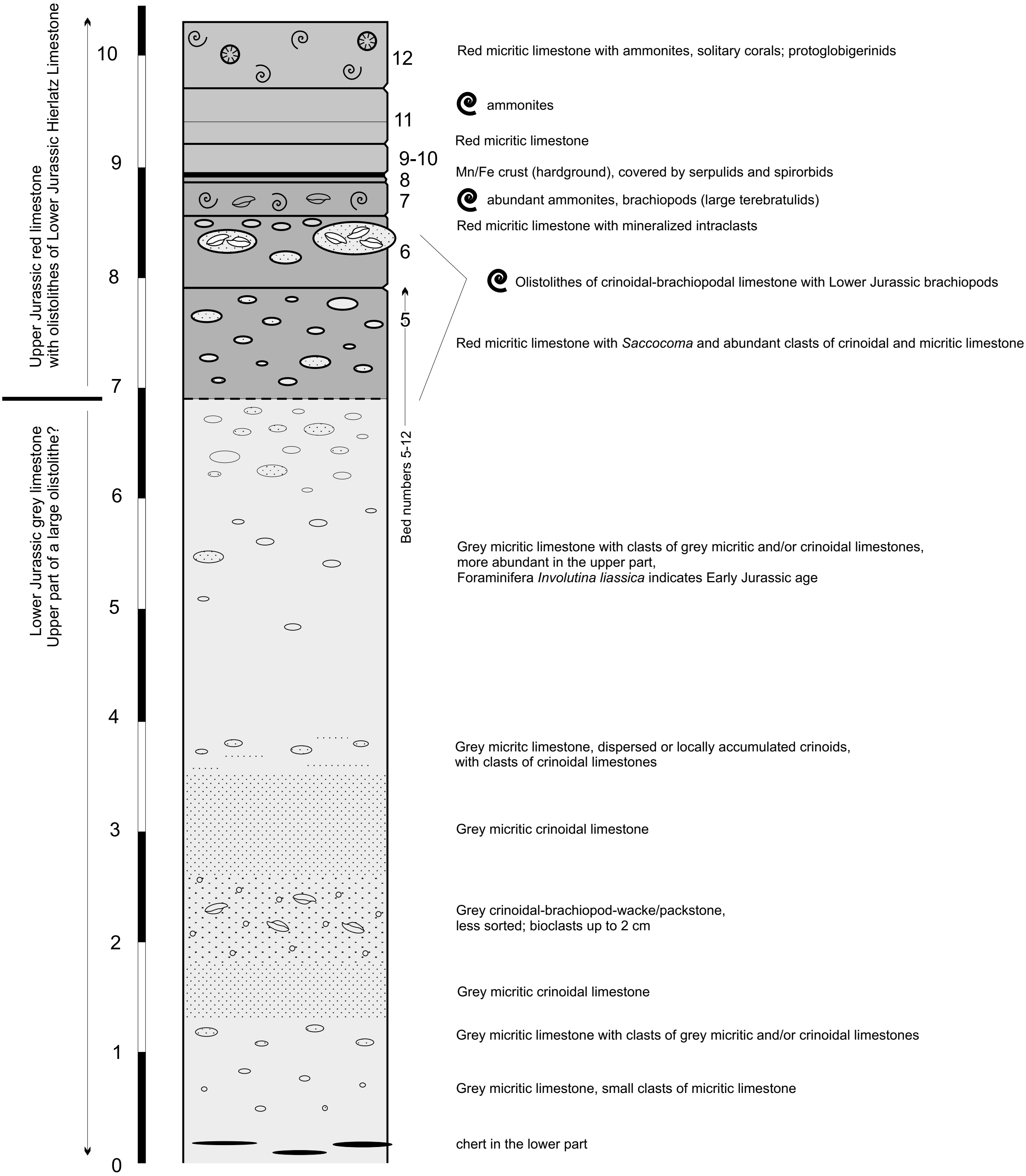
According to Schöllnberger (1974) **Oberalm Limestone** occurs between "cherty Allgäu Beds" (= Ruhpolding Radiolarite?) and Tressenstein Limestone in the Wildgraben area south of Plankerau. In contrast to the detritic Tressenstein Limestone it consists of well bedded, grey micritic limestones, with chert nodules or layers, locally bioturbated and with dispersed bioclasts of crinoids and ammonites. Blocks from the upper part of the slope yielded ammonites (Wild 1) indicating an age around the boundary between Early and Late Kimmeridgian. The wet meadows



Text-Fig. 3.
Geological map of the Plankerau area in the southwestern foothills of Totes Gebirge.

of Plankeraumoos and their continuation towards north (see Text-Fig. 3) probably also cover Oberalm Limestone, because chert fragments are very frequent there in the loamy soil.

Micritic limestones with and without chert also occur along the forest road northeast of Steinklemme (Pl. 16, Fig. 6), together with detritic **Tressenstein Limestone**. This leads to the problem of defining distinct formations. Recently Gawlick & Schlagintweit (2009) have discussed the term Tressenstein Limestone after a reinvestigation of sections at Mount Tressenstein. Due to the co-occurrence of calciturbidites (rich in echinoderms and bioclasts from the slope and fore-reef of the Plassen carbonate platform) with a biomicritic background sedimentation (= Oberalm Limestone with radiolarians, spicules and calpionellids) the detritic carbonates at Mount Tressenstein belong to



Text-Fig. 4.
Detailed stratigraphic section at the locality Plk 4 (scale in meters).

basinal deposits and cannot be interpreted as slope of the Plassen carbonate platform. The term Tressenstein Limestone shouldn't be used any longer to characterize the Upper Jurassic slope deposits. Despite this discussion we still have used this term as a preliminary one, to separate those areas in the map, where carbonate detritic limestones prevail against the micritic Oberalm Limestone. The lithology is similar as described for Mount Tressenstein: crinoidal calciturbidites are very common (see Pl. 17, Fig. 5), coarse grained detritus from the Plassen reef has occasionally been found (Pl. 17, Figs. 7–8). In contrast to Mt. Tressenstein and according to the Kimmeridgian age in our area we did not find calpionellids but abundant protoglobigerinids (Pl. 17, Fig. 6) in the intercalated biomicritic layers, similar to the Agatha Limestone.

In some cases the calciturbidites of Tressenstein Limestone change into micritic limestones with layers of crinoidal fragments and become macroscopically very similar to grey Hierlatz Limestone. Therefore the boundary between these two limestones in the map may not be accurate in some places (e.g. area around Stubenkögel). A useful distinctive mark is the occurrence of coral fragments, which are not rare in the Tressenstein Limestone as well as in the Agatha Limestone (!) but never have been found here in Hierlatz Limestone.

The (Early) Kimmeridgian age is proven by ammonites from several localities in the Plankerau area (Plk 6–7, T 12, T 26, T 30).

The Tressenstein Limestone rests in most cases discordantly on Upper Triassic and Lower Jurassic rocks. North and northeast of Flodring (localities F 2 and T 34) the basal Tressenstein Limestone contains clasts of Dachstein and Hierlatz Limestones – see Pl. 16, Figs. 1–2.

A remarkable feature of the Tressenstein Limestone in our area is the occurrence of extraclasts and large olistoliths from centimetre-size up to more than 10 meters – e.g. Pl. 17 and Text-Fig. 4. The fossil site at Plk 1, where we started our investigations in 2005, is one of these large bodies. Most of them consist of white to beige Hierlatz Limestone with abundant brachiopods. Also ammonites are not rare. The fauna of Plk 1 will be treated in detail below.

The embedding of a several meters large body of Lower Jurassic limestone within Upper Jurassic ones is very well visible at the Plankerau locality T 21 – see Pl. 17: Patches of micritic sediment between the sparitic lumachelles are rich in *Involutina liassica* (Fig. 2) indicating the Early Jurassic age of the olistolith. The surrounding Upper Jurassic sediment consists of carbonate detritic layers rich in echinoderms (Fig. 5), alternating with grey micritic beds with abundant protoglobigerinids (Fig. 6).

Also clasts of Lower Triassic Werfen Beds are remarkable – sandstones and red or greenish shales. Millimeter-sized fragments of this type can be found in the Tressenstein Limestone of Klaushöfl, larger ones up to a few centimetres at Pyrmoos-Brandalm, south of Salza-Alm (see Pl. 16, Figs. 3–4). The Late Jurassic age of the matrix is proven here by *Saccocoma* (Pl. 16, Fig. 5).

Clasts of greenish and red brown shale have also been observed in brecciated Agatha Limestone south of Zwicker Kogel.

Remarks on the Fauna of the Olistolith Plk 1

Ammonoidea

(Jan Schlögl)

On the type locality of Hierlatz limestone the fauna has been collected from dyke infillings. The observations made by Rakús (1999) in the type locality as well as his revision of the preserved part of original material of Geyer (1886) show a rather large stratigraphic range of the ammonite associations, thus a diachronic filling of the fissures. The earliest ammonite association indicates the *A. adnethicum* horizon of the *A. semicostatum* Zone, the latest is already of the Early Pliensbachian age, more precisely *P. taylori* / *Pl. brevispina* horizon of the *U. jamesoni* Zone.

The new locality Plk 1 has yielded a rich macro-invertebrate association. The majority of ammonite fauna seems to be represented by the taxa of Early Sinemurian age. But it is to note, that it contains several specimen not consistent with the age of the assemblage. Several specimens probably representing the inner whorls of the serpenticone, densely ribbed and keeled venter have also been collected. These are well comparable to *Plesechioceras*, but this taxon is already of Late Sinemurian age. Although there are no differences in the mode of preservation, body chamber infilling versus surrounding sediment etc., it can not be excluded that the fauna is more the effect of taphonomic condensation. Additional sampling is the only way to solve the problem.

Phylloceratids are dominated by constricted and moderately evolute *Togaticeras stella. Geyeroceras cylindricum* is also abundant but *Zetoceras* is rare.

The Lytoceratids are composed of rare *Lytoconites hierlatzicus* and several very small juveniles which remind of the internal whorls of *Bouhamidoceras* (Rakús, 1991). The genus *Bouhamidoceras* is a rather rare taxon in the Sinemurian of the NCA. His presence in the Sinemurian was supposed, but the majority of specimens come either from the condensed Adnet Formation or from old collections without a more precise stratigraphic position. It is completely absent in the type locality of Hierlatz.

The *Arnioceras* dominate the association (almost 60 %), unfortunately only juvenile specimens were found. This is related to an apparent sorting of bioclasts. The majority of specimens (or bioclasts) fall within an interval lying between 0.5 cm and 4 cm, exactly as in the locality Hierlatz (Rakús, 1999). If we take into account the division recently made by Corna et al. (1997) thus the majority of the studied *Arnioceras* fall within the morphological variability of the *Arnioceras* sp. gr. B (sensu Corna et al., 1997), indicative of the *A. semicostatum* Zone.

Relative abundance of the higher ammonite taxa:

Phylloceratina 46 sp. (24.35 %)
Lytoceratina 11 sp. (including ?*Bouhamidoceras*) (5.8 %)
Ammonitina 127 sp. (67.2 %)
  Schlotheimiidae 11 sp. (5.8 %)
  Arietitidae 112 sp. (59.3 %)
  Cymbitidae 4 sp. (2.1 %)
Indet. 5 sp. (2.65 %)

Brachiopoda

(Alfréd Dulai)

The Sinemurian Hierlatz Limestone is very common in the studied area and contains a very diverse brachiopod fauna. The preservation of brachiopods is good, and the outer morphological characters are well visible. However, their interior is recrystallized, cavernous or infilled with sparitic calcite. Therefore, the brachiopods from Totes Gebirge were identified at species level on the basis of external characters, but the internal character was not studied by serial sections. The generic attributions are based on recently published other faunas, containing more or less the same species (e.g. SIBLÍK, 2002; DULAI, 2003; VÖRÖS, 2009).

The main collecting point (Plk 1) has yielded 201 specimens, which represent 27 species of 14 genera. Concerning the taxonomic composition of the fauna, phosphatic-shelled Linguliformea and Craniiformea brachiopods are missing, and all studied specimens belong to the Rhynchonelliformea subphylum. Within the Rhynchonelliformea, the order Terebratulida is dominant with 51.7 % of the specimens (including unidentifiable fragments), however, they are represented by only three genera. *Lobothyris* (2 species) and *Linguithyris* (1 species) are relatively rare, but *Zeilleria* with 5 species is the most common genus (38.7 %) within the brachiopods. The order Spiriferinida (28.8 %) contains only 2 genera: *Cisnerospira* (2 species) is rare, however *Liospiriferina* is the second most common genus with 4 species (28.6 %). The order Rhynchonellida is less numerous than terebratulides and spiriferinides (19.5 %), however this is the most diverse brachiopod group with 13 species of 9 genera. None of them is really common, but *Pisirhynchia* and *Salgirella* is relatively more numerous (3.5 % and 2.5 %, respectively) than the other rhynchonellides (*Apringia*, *Jakubirhynchia*, *Prionorhynchia*, *Cirpa*, *Piarorhynchia*, *Cuneirhynchia*, *Gibbirhynchia*; all of them 0.5–1 %). At species level *Zeilleria alpina* (GEYER) (29.8 %) and *Liospiriferina alpina* (OPPEL) (17.9 %) are prominently exceeding all the other brachiopods.

Some other collecting points at Plankerau yielded even more diverse brachiopod faunas (e.g. Plk 3 and Plk 4) and their taxonomic composition was a little different (e.g. more diverse spiriferinides and terebratulides, or the presence of the order Athyridida by *Koninckodonta)*.

Gastropoda

(János Szabó)

In the studied area, the Hierlatz Limestone olistolith of the locality Plk 1 is the only collecting site, which has yielded a rather diverse and abundant but poorly preserved gastropod fauna. Because of the physical characters of this limestone, the specimens are fragile, thus their preparation is a long process. In the present stage of the studies, thirty-one gastropod species have been distinguished on about two hundred more or less isolated specimens (see faunal list location Plk 1 and examples on Pl. 13). Some further species are also indicated by poorly preserved fragments and inner moulds.

The preservation of the gastropod fauna is rather different here from that of the formerly studied Hierlatz Limestone associations. In the "usual cases", the shells are present but their original structure was lost, recrystallized or substituted as a mosaic of calcite. Their interior is fully or partially filled by sediment and/or sparry calcite. In Plk 1, the originally nacreous shells are most frequently dissolved. These specimens are usually preserved as inner moulds that consist of a little sediment near the aperture, and calcite of geopetal structure with the central hole in the remaining inner space of the shells. The imprint of the outer shell surface (ornament) is mostly preserved around the steinkerns and the space of the former shell walls remained usually empty with few calcite crystals. The most common trochoidean species belong to this group and their outer morphology seems evident almost from their imprints only (Pl. 13: Fig. 1 C–E). Those nacreous shells in which a thin outer calcite layer may appear as a protective mantle, like in the pleurotomariids, are more frequently preserved (Pl. 13: Fig. 9). The gastropods of the originally crossed-lamellar aragonite main layer, the neritaemorphs (having also a calcite outer layer) and the caenogastropods, are usually preserved as shelly specimens (Pl. 13: Fig. 1 A, 6, 7). The frequent slitless limpets (Patellogastropoda) have never been found without shell in this locality (Pl. 13: Fig. 4–5). The shelly preservation is more frequent also in *Discohelix*, having unknown original shell-structure (Pl. 13: Fig. 8). Their preservation suggests a more resistant shell-structure than simply nacreous.

Taxonomic Notes

Patellogastropoda

Pseudorhytidopilus COX in KNIGHT et al., 1960 was established after HABER's (1932) nomen nudum for simple, smooth shells of Mesozoic limpets; similar gastropods are usually named *"Scurria"* in the classical literature. COX regarded his new genus as a member of Patelloidea but doubtfully. Lack of knowledge about the shell structure and form of the muscle scar in the shell interior cause the uncertainty of the systematic position.

A similar shell form appears in several higher systematic groups but the preservation of *P. zitteli* suggests that this species has possessed calcitic shell structure; therefore it is most probably a patellogastropod. GATTO & MONARI (2010) revised a similar species from DE TONI'S (1912) collection in which the foliated calcitic shell structure was preserved. Within this group, some genera of the extant Lottiidae (Patelloidea) have comparable shell shape; in reality there are no significant conchological differences in their shells (*Acmaea*, *Scurria*, *Asteracmaea*, etc.), however the use of the name *Pseudorhytidopilus* seems better from the methodological point of view for the Jurassic forms.

Neritaemorphi

Neritopsis elegantissima HÖRNES, 1853 (Neritopsidae) is one of the most frequent species of the gastropod fauna in the type locality of the Hierlatz Limestone. It has two shell morphotypes, both appear also in the Plankeraumoos association; one has more prominent, sparser and sharper outer varices than the other that possesses moderately elevated, rounded varices / costae. These differences, though they are sometimes rather marked, seem to remain within the intraspecific variability.

There is a similar species in the Hochfelln Limestone fauna (*N. compressula* GÜMBEL, 1861) that differs in having a flattened ramp below the adapical suture with an angulation at its abaxial rim; this ramp is lacking *N. elegantissima*. However, phylogenetic relation between these species is probable.

Vetigastropoda

Pleurotomarioidea

Wortheniopsis sp. (Raphistomatidae), a single, poorly preserved specimen is found that has an obscure, weak ornament. Its shell shape is most similar to that of *Wortheniopsis* (*Wortheniopsis*) *urkutensis* SZABÓ, 2009 but this latter bears a rather marked ornament of collabral and spiral threads.

In the Plankeraumoos fauna three species of Pleurotomariidae occurred sparsely. *Pleurotomaria debuchi* DESLONGCHAMPS, 1849 is represented only by a flattened, almost discoidal morphotype. This is one of the rare species that occurs in common with the "stable" European Early Jurassic gastropod fauna. However, this species is so variable and so poorly known that further studies are necessary even to elucidate whether this name covers really a single species or more.

The name of *Pleurotomaria* aff. *anglica* (J. SOWERBY, 1818) refers to pleurotomariid specimens that have similar shape and ornament to those, which have been given the same name by SZABÓ (2009) in the Hierlatz Alpe fauna. Further material and studies are necessary to solve the identification problems.

Pleurotomaria aff. *emmrichi* GÜMBEL, 1861 belongs to a form group of conical or feebly gradate Early Jurassic *Pleurotomaria*, badly needing a revision in order to ascertain what the lots of applied names *(princeps*, *principalis*, *emmrichi*, *basilicata*, *precatoria*, etc.) really mean; in some cases they seem to be synonymous.

Fissurelloidea (slit and keyhole limpets)

This superfamily is represented by sporadic occurrence of two emarginulid species, *Emarginula nestii* G.G. GEMMELLARO, 1879 and *Emarginula (Tauschia)* cf. *busambrensis* G.G. GEMMELLARO, 1879 that have been never published from the gastropod fauna of the Hierlatz Limestone Formation before. The species are rather well identifiable with the original description and figuration from the Rocca Busambra (Sicily, Italy) Lower Jurassic limestone of shallow water plateau origin but the latter one is rather badly damaged.

Trochoidea

Four "epulotrochiform" species belong to this group, the inner moulds of which are the most frequent gastropod remains in the studied locality: *Muricotrochus*? sp. (low whorls with 3 granulose spiral threads), *"Epulotrochus"*? sp. 1 (smooth whorls, being higher than in "sp. 2"), *"Epulotrochus"*? sp. 2 (whorls smooth and lower than in "sp. 1"), *"Epulotrochus"*? sp. 3 (low whorls with 3 spiral threads without granules). These species are hardly distinguishable when they are preserved as inner mould without shell fragment or imprint of outer shell surface. The shell morphology of these species needs reconstruction.

Because of its frequency, this is one of the most important groups of gastropods for a palaeoecological analysis.

Eucycloidea

Two poorly preserved species, *Eucyclomphalus* aff. *hierlatzensis* AMMON, 1892 and *Riselloidea noszkyi* SZABÓ, 1995 were found from Eucyclidae. *E. hierlatzensis* is the most common gastropod in the type locality but the significantly different Plankeraumoos species is less frequent.

HICKMAN & MCLEAN (1990) placed these gastropods as "Eucyclini" into the Trochoidea mainly based on soft body characters; anyway, eucyclids seem to be good palaeoecological indices.

Turbinoidea

A rare species, *Ataphrus* (*Endianaulax*)? sp. represents Ataphridae, a mainly Mesozoic family that shows an Early Jurassic evolutionary explosion after an insignificant Triassic representation in the faunas. The Early Jurassic diversification, that is obvious from the Sinemurian, has not yet been recognized in the Plankeraumoos fauna.

New family (?Trochoidea)

A conical-trochiform species with never seen last whorl and aperture construction needs introduction. Its relations are still being investigated.

Cirroidea

Mainly poorly preserved inner moulds of *Discocirrus tricarinatus* (GÜMBEL, 1861) occurred, but imprints and shell fragments too support the identification. *Discocirrus* is a hyperstrophically (false) sinistral gastropod.

?Discohelicoidea (Vetigastropoda?)

Discohelicidae is an uncertain family, no species fits to the nacreous shell structure of the original diagnosis, therefore an emendation is wanted. *Discohelix hallstattensis* SZABÓ, 2009, *D. excavata* (REUSS, 1852), *D.* aff. *ornata* (HÖRNES, 1853) are identified in the Plankeraumoos fauna; all seem derived from a nodose ancestor, like *D. ferox* (GÜMBEL, 1861) of the Hochfelln Limestone or *D. lorioli* GEMMELLARO, 1879 from the Rocca Busambra (Sicily, Italy) limestone of shallow water plateau origin.

A probable predecessor of *Pentagonodiscus reussi* (HÖRNES, 1853), having already the peculiar pentagonal outline but in trochospiral shell, was also found in the Rocca Busambra limestone (*"Solarium" mellonii* GEMMELLARO, 1879).

Caenogastropoda

Zygopleuroidea

A well preserved shell helped to find the correct generic name for *"Chemnitzia" hierlatzensis* STOLICZKA, 1861 that had been known from its monotype, a fragmentary juvenile shell and a similar specimen from Rocche Rosse (Trapani, Sicily, Italy; GEMMELLARO, 1911). On the post-juvenile whorls of the new specimen, the costellae of the early shell parts, typical for *Anoptychia,* disappeared. However, *Anoptychia hierlatzensis* (STOLICZKA, 1861) remains a rare species with three well-known specimens.

The needle shaped, almost cylindrical *Anoptychia*? *acicula* (STOLICZKA, 1861) and a *Katosira*? species are also present as sporadic fragments.

?Pseudomelanoidea

Without the early whorls, the species identification of *Oonia*? cf. *pseudovesta* (GÜMBEL, 1861) remains dubious; the available shell may belong also to other smooth-shelled caenogastropod genera.

Cerithioidea

Cerithinella italica (GEMMELLARO, 1879) is a common component of the faunas of living plateau origin in Sicily and along the Apennines but has not yet been published from Hierlatz Limestone. The presence of the other two genera (*Procerithium* sp., *Cryptaulax*? sp.) mean also faunistical novelties in this lithological type.

Heterobranchia

The members of Heterobranchia belong also to the group of "exotic" gastropods in the Hierlatz Limestone. A single specimen of *Euconactaeon* aff. *concavus* (EUDES-DESLONGCHAMPS, 1842) is the first published representative of Actaeonoidea in this formation.

Clathrobaculus? cf. *alpicolus* (GÜMBEL, 1861) and *Promathildia*? sp. (?Mathildoidea) are present also with single specimens. *Clathrobaculus*? *fistulosus* (STOLICZKA, 1861), based on a monotype from the type locality of the Hierlatz Limestone, is the first species, which has been published from this group.

Depositional environment

On the highest systematic levels, the Plankeraumoos gastropod fauna shows a composition just slightly different from the typical Hierlatz Limestone assemblages. Vetigastropods predominate in the species list, and at the same time they are more abundant in the strata than the remaining groups, which represent the higher evolutionary levels. However, the fauna contains many "exotic" elements that hold important palaeoecological and faunal history information.

Most prominent species, unusual in the Hierlatz Limestone, is the patellogastropod *Pseudorhytidopilus zitteli* (GEMMELLARO, 1879). Its type stratum is of shallow water carbonate plateau origin (Lower Sinemurian, Rocca Busambra, Sicily, Italy). Patellogastropods are unknown in the previously studied Upper Sinemurian and Pliensbachian Hierlatz Limestones.

Recent patellogastropods are living typically on hard substrate in and above the tidal zone but also occur on the sea bottom of a constant shallow water cover; the Mesozoic occurrences suggest similar environmental preference. Their frequency in the studied fauna suggests rather shallow water origin of the Plankerau Hierlatz Limestone, at least partially.

Further species, in common with the Rocca Busambra fauna, also support this suggestion *(Emarginula nestii, Emarginula [Tauschia]* cf. *busambrensis* and *Cerithinella italica).*

Several species *(Pleurotomaria* aff. *emmrichi, Discocirrus tricarinatus*, *Oonia*? cf. *pseudovesta, Clathrobaculus*? cf. *alpicolus,* nodose species of *Discohelix* and "epulotrochiform" trochoideans) show strong relations to another fauna of not really deep water origin. This is known from the Hochfelln Limestone (AMMON, 1892); SEUSS et al. (2005) recognised the patch reef environment origin of this fauna.

The concomitant rarity of the eucyclids in the fauna supports the assumption of not very deep-water environment inhabited. HICKMAN & MCLEAN (1990) observed deep sublitoral to abyssal biotopes for the members of the family and the Jurassic species seemed to live on the sea bottom of similar depths (SZABÓ, 1995). Probably, the Plankerau Hierlatz Limestone preserved documents from an early phase of the subsidence of the former shallow water carbonate plateau. In contrast, *Eucyclomphalus hierlatzensis* is one of the two most common species of the type area of the Hierlatz Limestone (Hallstatt, Hierlatz Alpe, Upper Sinemurian).

Bivalvia

(István Szente)

The Hierlatz Limestone of this locality yielded the bulk of the bivalve material collected during this project. The moderately diverse fauna consists of about a dozen taxa. The lack of shallow-water forms indicates that the bivalves lived in a deeper-water marine environment. Only suspension feeders are present of which epifaunal forms are predominant, indicating that hard substrate necessary for attachment was well available. The assemblage slightly differs, both in taxonomic and ecological composition, from the fauna of the type locality of Hierlatz Limestone studied by STOLICZKA (1861) and SZENTE (1996). Infaunal, shallow burrowing forms are almost exclusively represented by *Praeconia tetragona* (TERQUEM, 1855) and are much less frequent (6 % of the specimens) than in the fauna of the type locality.

Parallelodon sp.

(Pl. 12, Fig. 8)

The material available consists only of about a dozen incomplete and relatively featureless specimens which cannot be assigned to any species described in the literature, including those recorded by STOLICZKA (1861) from the type Hierlatz Limestone.

Oxytoma (O.) inequivalvis (J. SOWERBY, 1819)

(Pl. 12, Figs. 11–13)

According to W.J. ARKELL (1904–1958, recognized British authority on Jurassic rocks and fossils) *O. (O.) inequivalvis* – due to its remarkable morphological variability – produced more differences of opinion than any other Jurassic bivalve species. It has an extremely long stratigraphic range from the Upper Triassic to the Lower Cretaceous and was widely distributed around the world. The valves are considerably unequal both in shape and ornamentation. The left ones are well inflated and bear radial ribs while the right ones are flat and smooth. Left valves can be found in the Hierlatz Limestone much more frequently than right ones. More than 20 specimens were found, most of them of remarkably small size.

Oxytoma sp.

(Pl. 12, Figs. 14)

A single, flat and incomplete valve bearing narrow ribs is assigned, with some uncertainty, to *Oxytoma*.

Praechlamys palosa (STOLICZKA, 1861)
(Pl. 12, Figs. 16, 17)

Pectinids are common bivalves in the Hierlatz Limestone and the remarkable variability displayed by the specimens often makes their identification difficult. *P. palosa*, however, can be easily distinguished by the unequal nature of their valves of which the left one bear a few narrow riblets while the right one is smooth. Some ten specimens are available.

Praechlamys subreticulata (STOLICZKA, 1861)
(Pl. 12, Figs. 19–24)

About a dozen scallop specimens of the Hierlatz Limestone exposed at Loc. Plk 1 bear fine radial as well as more or less developed commarginal ribs, forming a reticulate ornamentation. These features are also characteristic of *Agerchlamys*, a genus introduced by DAMBORENEA (1993) for a suite of peculiar Early Jurassic pectinids widespread at high latitudes on both the Northern and Southern hemispheres. Fine antimarginal striae (i. e. perpendicular to the valve margin), a further distinctive feature of *Agerchlamys*, however, can not be observed on the Hierlatz Limestone specimens. Recently some low-latitude forms found in the uppermost Triassic and lowermost Jurassic of the Northern Calcareous Alps were also attributed – without any description – to *Agerchlamys*. Some of the figured specimens (HILLEBRANDT & KMENT, 2009, Abb. 23) resemble to scallops known from the Hierlatz Limestone.

Until the presence of antimarginal ornamentation is proved, the abundant pectinids of the Hierlatz Limestone are most clearly attributed to *Praechlamys* ALLASINAZ, 1972 and are interpreted as representatives of the highly variable species *subreticulata*.

Terquemia pectiniformis (EUDES-DESLONGCHAMPS, 1860)
(Pl. 12, Figs. 25–28)

This irregular form is a characteristic element of the bivalve fauna of the Hierlatz Limestone. Some 20 specimens were found during this study.

Placunopsis? sp.
(Pl. 12, Figs. 33)

Variable and usually indistinct bivalves are assigned to the genus *Placunopsis* MORRIS & LYCETT, 1853 whose taxonomy is thus far from clear. The specimen figured here is a small-sized left (free) valve bearing antimarginal ribs formed by imbricate lamellae, thus differing from *"Anomia" numismalis* QUENSTEDT, 1856 recorded from the Hierlatz Limestone by STOLICZKA (1861).

Ctenostreon rugosum (SMITH, 1817)
(Pl. 12, Figs. 29–31)

The Bad Mitterndorf specimens agree well with *C. rugosum* described in the literature. The genus *Ctenostreon* EICHWALD, 1862 includes highly variable forms probably representing a single species for which several names are available. Among them, *"rugosum"* is the oldest one. It is now recorded for the first time in the Hierlatz Limestone.

Plagiostoma punctatum J. SOWERBY, 1805
(Pl. 12, Figs. 34–36)

The specimens forming about 20 % of the material bear a high number of very low riblets separated by punctate grooves and thus can be assigned with certainty to the largely Early Jurassic species *P. punctatum*.

Myoconcha sp. B
(Pl. 12, Fig. 37)

A single internal mould of a right valve represents the first record of *Myoconcha* s.l. from the Hierlatz Limestone.

Praeconia tetragona (TERQUEM, 1855)
(Pl. 12, Figs. 38, 39)

This species is a characteristic element of the Sinemurian Hierlatz Limestone of the Northern Calcareous Alps. At the locality Plk 1 it can usually be found as internal moulds on which the muscle scars of the valve interior occur as protuberances.

Fossil Sites and Faunal Content

The specimens figured on Pls. 1 to 6 and on Fig. 8 of Pl. 11 are housed in the collection of the Hungarian Natural History Museum in Budapest (M 2010.xxx); the specimens on Pls. 7 to 11 are housed in the collection of the Geologische Bundesanstalt Vienna (GBA 2010/091/xxxx). All other figured specimens as well as rock-thin-sections of Pls. 15 to 17 are housed in the working collections of the respective authors.

Bergerwald east of Bad Mitterndorf [N 47° 33' 30,1" / E 14° 00' 02,8"]
Small outcrops in the creek.

Lithology: Allgäu Beds (spotted grey marly limestones and marlstones with ammonites, bivalves, rare belemnites).

Ammonite fauna (det. J. Schlögl):
Collection Schlögl from the studied outcrop.
Tropidoceras cf. *calliplocum* (GEMMELLARO)
Coleoidea
Private collection (E. Pfusterer)
Partschiceras sp., *Metaderoceras* sp., *Uptonia jamesoni* (SOWERBY), *Uptonia angusta* (QUENSTEDT), *Tropidoceras mediterraneum* (GEMMELLARO), *Tropidoceras* cf. *zitteli* FUCINI, *Atractites* sp.

Age: The studied outcrop is most probably of Early Pliensbachian age (probably Tragophylloceras ibex Zone), but the specimens from the private collection indicate a larger stratigraphic extent of the facies (starting in the early Early Pliensbachian Uptonia jamesoni Zone).

BWA 1 [N 47° 37' 12" / E 13° 55' 51"]
Bergwald south of Zwicker Kogel, outside of the area of Text-Fig. 2.
Lithology: Agatha Limestone (bedded to nodular red limestone).

Brachiopod fauna (coll. & det. M. Siblík):
Nucleata rupicola (ZITT.).

Age: Late Jurassic.

F 4 [locality see Text-Fig. 2]
Lithology: grey to pinkish micritic limestone.
Bivalve fauna (coll. & det. I. Szente):
Praechlamys valoniensis (DEFRANCE, 1825) (Pl. 12, Fig. 1)
A single left valve bearing nearly 50 radial smooth plicae may represent this species whose remains are widespread in the Rhaetian as well as in the Lower Jurassic (Hettangian and Sinemurian stages) of Europe (JOHNSON, 1984).
Pectinid bivalvia, gen. et sp. indet. (Pl. 12, Fig. 2)

A single internal mould with traces of about 20 radial plicae seems to belong to the Pectinidae.

Liostrea? sp. (Pl. 12, Fig. 3)

Although broken surfaces of the rock samples yielded by the locality commonly display sections of dark-coloured oyster shells, only poorly preserved specimens are available for study. They are attributed, with doubt, to *Liostrea*, a long-ranging (Late Triassic – Late Cretaceous; MALCHUS, 1990) genus of Mesozoic oysters.

Promysidiella sp. (Pl. 12, Fig. 4)

A single mytiliform right valve most probably represents the Triassic genus *Promysidiella* WALLER, 2005.

Gruenewaldia? sp. (Pl. 12, Fig. 5)

A single right valve displaying strong commarginal ribs, well defined carina and an antecarinal depression as well as a commarginally ornamented area, is attributed to *Gruenewaldia* WÖHRMANN, 1889, a genus known from the Middle and Late Triassic. It may represent, however, the morphologically similar (see HAUTMANN, 2003) Permian–Triassic genus *Elegantinia* WAAGEN, 1906 (= *Lyriomyophoria* KOBAYASHI, 1954) as well.

Myoconcha sp. A (Pl. 12, Figs. 6, 7)

Three valves are attributed to the largely Mesozoic (Late Triassic – Late Cretaceous) genus *Myoconcha* J. DE C. SOWERBY, 1824 sensu lato.

Age: probably Late Triassic.

Flo 1 [N 47° 38' 15,5" / E 13° 56' 22,7"]

Many small outcrops and isolated blocks in a small valley.

Lithology: Hierlatz Formation. Mainly white and grey, micritic crinoidal limestones with many brachiopods, bivalves, gastropods and ammonites, rare belemnites. Some blocks contain numerous "stromatactis like" structures parallel with bedding.

Ammonite fauna (coll. & det. J. Schlögl):

Sample 1

Phylloceras sp., *Togaticeras stella* (SOWERBY, 1833), *Geyeroceras cylindricum* (SOWERBY, 1831), *Juraphyllites* sp., ?*Vermiceras* sp., *Arnioceras* sp., *Arnioceras* sp. 2, *Arnioceras* gr. *semilaeve* (HAUER, 1853), *Arnioceras ceratitoides* (QUENSTEDT, 1849).

Age: Early Sinemurian.

Sample 2

Zetoceras pseudozetes (FUCINI, 1908), *Togaticeras stella* (SOWERBY, 1833), *Geyeroceras cylindricum* (SOWERBY, 1831), *Lytoconites* cf. *pecchioli*, *Schreyenbachites* sp., *Vermiceras* sp., *Arnioceras* sp., *Arnioceras* sp. 2, *Arnioceras* gr. *semilaeve*, HAUER, 1853), *Promicroceras* sp.

Age: Early Sinemurian.

Sample 3

Arnioceras sp. 2

Age: Early Sinemurian.

Sample 4 (probably the same layer as Sample 1)

Phylloceras sp., *Arnioceras* sp. juv., *Paracymbites* aff. *dennyi* (SIMPSON).

Age: Early Sinemurian or early Late Sinemurian.

Sample 5

Zetoceras sp., *Arnioceras* sp., *Arnioceras* gr. *paucicostatum* FUCINI, 1902.

Age: Early Sinemurian.

Brachiopod fauna (coll. & det. M. Siblík):

Sample A

Red and white limestones in isolated blocks on the slope.

Apringia ex gr. *paolii* (CAN.), *Prionorhynchia guembeli* (OPP.), *P. polyptycha* (OPP.), *Salgirella albertii* (OPP.), *Jakubirhynchia latifrons* (STUR in GEYER), *Calcirhynchia* (?) *plicatissima* (QUENST.), *Cisnerospira angulata* (OPP.), *Liospiriferina* aff. *alpina* (OPP.), *L.* cf. *decipiens* (BÖSE-SCHL.), *Securina partschi* (OPP.), *Linguithyris aspasia* (ZITT.), *Zeilleria baldaccii* GEMM., *Z. mutabilis* (OPP.).

Age: Sinemurian.

Sample B

White Hierlatz Limestone in blocks along the old forest road and in the upper part of the slope.

Apringia ex gr. *paolii* (CAN.) (very variable specimens), *Cirpa subcostellata* (GEMM.), *Jakubirhynchia latifrons* (STUR in GEYER), *Calcirhynchia zugmayeri* (GEMM.), *Cuneirhynchia* cf. *cartieri* (OPP.), *Salgirella* cf. *magnicostata* (ORMÓS), *Prionorhynchia belemnitica* (QUENST.), *P. greppini rimata* (GEYER), *Liospiriferina acuta* (STUR in GEYER), *L.* aff. *alpina* (OPP.), *L.* cf. *decipiens* (BÖSE-SCHL.), *Securina partschi* (OPP.), *Bakonyithyris* aff. *meneghinii* (PAR.), *Zeilleria mutabilis* (OPP.), *Zeilleria* sp.

Age: Sinemurian.

Flo 2 [N 47° 38' 12,2" / E 13° 56' 33,3"]

Lithology: Hierlatz Formation. Probably synsedimentary breccias composed of clasts of red and white more or less crinoidal limestones, some clasts are rich in brachiopods and ammonites; bivalves and gastropods are locally also present. Breccia matrix is micritic, locally rich in crinoidal debris. Blocks (or clasts) were sampled separately under different numbers.

Ammonite fauna (coll. & det. J. Schlögl):

Remarks: Ammonite fauna come from different clasts of red micritic crinoidal limestones with radiaxial calcite, accumulated in a synsedimentary breccia, therefore the geological age of separate associations is not always the same. It ranges from Early Sinemurian to early Late Sinemurian, probably *A. obtusum* Zone.

Sample 1

?*Parasteroceras* sp.

Age: probably early Late Sinemurian.

Sample 7

Arnioceras sp., *Arnioceras* aff. *miserabile* FUCINI, 1902

Age: Early Sinemurian.

Sample 11

Juraphyllites sp., *Asteroceras* sp.

Age: early Late Sinemurian.

Sample 12

Arnioceras sp. juv.

Age: Early Sinemurian.

Sample 13–14

Arnioceras sp., *Arnioceras* gr. *ambiguum* (GEYER, 1886)

Age: Early Sinemurian.

Sample 15 (most numerous material)

Red micritic or sparitic limestone with ammonites, gastropods, bivalves and brachiopods. Abundant crinoidal debris.

Atractites sp., *Phylloceras* cf. *costoradiatum* STUR m. s. in GEYER, 1886, *Partschiceras striatocostatum* (MENEGHINI, 1853), *Zetoceras pseudozetes* (FUCINI, 1908), *Juraphyllites planispira* (REYNÉS, 1868), *Lytoceras celticum* (GEYER, 1886), *Lytoceratina* indet., *?Euagassiceras* sp., *Angulaticeras* sp. juv., *?Arnioceras* sp. juv., *Asteroceras* cf. *brooki* (SOWERBY).

Age: probably late Early or early Late Sinemurian.

Sample 16

Phylloceras costoradiatum STUR m. s. in GEYER, 1886

Zetoceras sp., *Lytoceratina* indet., *Arnioceras* sp., *Arnioceras* sp. 2

Age: Early Sinemurian.

Sample 17
Arnioceras ceratitoides (QUENSTEDT, 1849)
Age: Early Sinemurian.

Brachiopod fauna (coll. & det. M. Siblík):
Sample A (white Hierlatz Limestone)
Prionorhynchia greppini (OPP.), *Liospiriferina brevirostris* (OPP.), *L. obtusa* (OPP.), *L. alpina* (OPP.), *Securina partschi* (OPP.), *?Antiptychina rothpletzi* (DI-STEF.), *Zeilleria batilla* (GEYER), *Z. mutabilis* (OPP.), *Z. alpina* (OPP.), *Z. venusta* (UHL.).
Sample B (red Hierlatz Limestone)
Prionorhynchia greppini (OPP.), *P. polyptycha* (OPP.), *P. fraasi* (OPP.), *Calcirhynchia zugmayeri* (GEMM.), *Cuneirhynchia retusifrons* (OPP.), *Homoeorhynchia* (?) *prona* (OPP.), *Cirpa planifrons* (ORMÓS), *Gibbirhynchia* (?) aff. *curviceps* (QUENST.), *Cisnerospira angulata* (OPP.), *Liospiriferina brevirostris* (OPP.), *L.* aff. *obtusa* (OPP.), *L.* cf. *decipiens* (BÖSE-SCHL.), *L.* cf. *alpina* (OPP.), *Lobothyris punctata* (SOW.), *L.* (?) aff. *sospirolensis* (UHL.), *Securina partschi* (OPP.), *Zeilleria mutabilis* (OPP.), *Z. venusta* (UHL.), *Z. choffati* (HAAS).
Age of both samples: Sinemurian.

Flo 3/1 [N 47° 38,103' / E 13° 56,445']
Small valley with discontinuous outcrops of several types of Hierlatz Limestone.
Lithology: mostly white crinoidal wacke- to packstones, less sorted, rich in brachiopods; local red micritic limestones with dispersed crinoids and scarce fauna.

Ammonite fauna (coll. & det. J. Schlögl):
Sample 1
Greyish micritic limestone with dispersed scarce crinoids.
Asteroceras sp. juv. or *Caenisites* sp. juv.
Age: Late Sinemurian.

Sample 2
White crinoidal limestone.
Fauna: crinoids, brachiopods, gastropods, bivalves, ammonites.
Paltechioceras cf. *oosteri* (DUMORTIER, 1867), *Paltechioceras tardecrescens* (HAUER, 1856)
Age: late Late Sinemurian.

Sample 3
Red micritic limestones with dispersed crinoids, wackestones.
Juraphyllites sp., *Coeloceras* sp.
Age: early Early Pliensbachian.

Sample 4
Red and greenish micritic limestone with dispersed crinoids.
Lytoceras sp.
Paltechioceras sp. (aff. *romanicum* (UHLIG, 1900)), *Paltechioceras* cf. *tardecrescens* (HAUER, 1856)
Age: late Late Sinemurian.

Sample 5
Reddish to yellowish micritic limestone with dispersed crinoids.
Epideroceras cf. *lorioli* (HUG, 1899)
Age: late Late Sinemurian.

Sample 6
Red micritic limestone with dispersed large crinoids.
Gemmellaroceras sp., *Epideroceras* sp.
Age: late Late Sinemurian.

Sample 7
Red micritic crinoidal limestone.
Aegoceras (Aegoceras) cf. *maculatum* (YOUNG & BIRD, 1822)
Age: early Early Pliensbachian.

Brachiopod fauna (coll. & det. M. Siblík):
Sample A
White crinoidal limestones.
Prionorhynchia flabellum (GEMM.), *P. greppini* (OPP.), *P. belemnitica* (QUENST.), *Liospiriferina* cf. *obtusa* (OPP.), *Buckmanithyris nimbata* (OPP.), *Rhapidothyris beyrichi* (OPP.), *Securina* aff. *partschi* (OPP.), *Zeilleria alpina* (GEYER), *Zeilleria mutabilis* (OPP.)
Sample B
White micritic or poorly crinoidal limestones.
Prionorhynchia greppini (OPP.), *P. guembeli rimata* (OPP.), *Furcirhynchia* aff. *striata* (QUENST.), *"Rhynchonella"* aff. *belemnitica* (QUENST.), *Liospiriferina* sp., *Buckmanithyris nimbata* (OPP.), *Zeilleria mutabilis* (OPP.), *Zeilleria* aff. *perforata* (PIETTE).
Age of both samples: Sinemurian.

Flo 3/2 [BMN 495 577 / 277 555]
Lithology: Hierlatz Limestone (grey and red crinoidal limestones).
Brachiopod fauna:
Sample A (coll. & det. A. Vörös):
Apringia paolii (CANAVARI), *Jakubirhynchia* cf. *laevicosta* (GEYER), *Jakubirhynchia* cf. *latifrons* (GEYER), *Cirpa planifrons* (ORMÓS) ?, *Cirpa* ? sp., *Pisirhynchia* cf. *retroplicata* (ZITTEL), *Cuneirhynchia dalmasi* (DUMORTIER), *Cuneirhynchia* aff. *dalmasi* (DUMORTIER), *Saubachia* ? sp., *Liospiriferina* cf. *alpina* (OPPEL), *Rhapidothyris* cf. *beyrichi* (OPPEL), *Linguithyris* cf. *aspasia* (ZITTEL), *Bakonyithyris ewaldi* (OPPEL), Terebratulida indet.
Age: possibly Pliensbachian.

Sample B (coll. & det. M. Siblík):
Cirpa fronto (QUENST.), *Cuneirhynchia retusifrons* (OPP.), *Prionorhynchia greppini* (OPP.), *P. guembeli* (OPP.), *P.* cf. *greppini* (OPP.), *"Rhynchonella"* aff. *belemnitica* (QUENST.), *Liospiriferina* cf. *brevirostris* (OPP.), *L.* cf. *alpina* (OPP.), *Buckmanithyris nimbata* (OPP.), *Linguithyris aspasia* (ZITT.), *Bakonyithyris apenninica* (ZITT.), *Zeilleria* cf. *mutabilis* (OPP.).
Age: Late (?) Sinemurian.

Flo 3/3 (locality see Text-Fig. 2)
Lithology: grey and red micritic limestones.
Brachiopod fauna (coll. & det. M. Siblík):
Apringia aff. *paolii* (CAN.), *Prionorhynchia greppini* (OPP.), *P.* cf. *greppini* (OPP.), *P. fraasi* (OPP.), *P.* aff. *glycinna* (GEMM.), *Cisnerospira angulata* (OPP.), *Liospiriferina* cf. *alpina* (OPP.), *Antiptychina* (?) *rothpletzi* (BÖSE), *Linguithyris aspasia* (ZITT.), *Zeilleria mutabilis* (OPP.), *Z. catharinae* (GEMM.), *Zeilleria* sp.
Age: Late (?) Sinemurian.

Flo 4 [N 47° 38,047' / E 13° 56,341']
Lithology: Greenish, grey-greenish and red micrites with horizons of synsedimentary breccias and crinoidal packstones and brachiopod shell-beds (lenses).

Fauna: crinoids, brachiopods, scarce gastropods, bivalves, ammonites.
Ammonite fauna (coll. & det. J. Schlögl):
Samples 013/0
White to yellowish brachiopod and crinoidal-brachiopod shell-beds.
Juraphyllites sp., *Epophioceras* sp., *Arnioceras* sp., *Epideroceras* sp.
Sample 013/1 from debris
Geyeroceras cylindricum (SOWERBY), *Juraphyllites* sp., *Arnioceras* cf. *miserabile* (QUENSTEDT), *Arnioceras* cf. *semicostatum* (YOUNG & BIRD), *Arnioceras* cf. *ceratitoides* (QUENSTEDT).
Age: Late Sinemurian.

Brachiopod fauna (coll. & det. M. Siblík):

Samples 013/0

Apringia paolii (CAN.), *Zeilleria* ex gr. *mutabilis* (OPP.).

Sample 013/1

Jakubirhynchia latifrons (STUR in GEYER), *Prionorhynchia greppini rimata* (GEYER), *P. belemnitica* (QUENST.), *Cuneirhynchia* (?) *palmata* (OPP.), *"Rhynchonella"* aff. *latissima* FUC., *Cisnerospira angulata* (OPP.), *Liospiriferina acuta* (STUR in GEYER), *L. obtusa* (OPP.), *L.* cf. *obtusa* (OPP.), *L.* cf. *alpina* (OPP.), *L.* cf. *gryphoides* (UHL.), *Buckmanithyris nimbata* (OPP.), *Securina partschi* (OPP.), *S. hierlatzica* (OPP.), *Zeilleria mutabilis* (OPP.).

Age: Sinemurian.

Flo 5 [N 47° 38,045' / E 13° 56,486']

Lithology: Grey micritic limestones with dispersed crinoids and lenses of brachiopod accumulations (pack- to grainstones), scarce ammonites, geopetal structures.

Ammonite fauna (coll. & det. J. Schlögl):

Juraphyllites sp., *Lytoceras* sp., *Leptechioceras* sp., *Leptechioceras* cf. *meigeni* (HUG, 1899), *Leptechioceras macdonnelli* (PORTLOCK, 1843), *Paltechioceras* sp., *Gemmellaroceras* sp., Oxynoticeratidae indet.

Age: late Late Sinemurian.

Brachiopod fauna (coll. & det. M. Siblík):

Sample A (red micrite)

Apringia paolii (CAN.), *Prionorhynchia flabellum* (GEMM.), *P. polyptycha* (OPP.), *Pisirhynchia retroplicata* (ZITT.), ?*Piarorhynchia* sp., *Liospiriferina obtusa* (OPP.), *L. alpina* (OPP.), *L. cordiformis* (BÖSE), *L.* aff. *sicula* (GEMM.), *Koninckodonta* cf. *pichleri* (BITTN.), *Viallithyris gozzanensis* (PAR.), *Linguithyris aspasia* (ZITT.), *Securithyris adnethensis* (SUESS), *S.* aff. *paronai* (CAN.), *Bakonyithyris ewaldi* (OPP.), *B. ovimontana* (BÖSE), *B. apenninica* (ZITT.), *Zeilleria alpina* (GEYER), *Z. mutabilis* (OPP.), *Z. oenana* (BÖSE), Z. aff. *oenana* (BÖSE)? juv.

Age: Pliensbachian.

Sample B

Another block at the eastern part of the locality, light grey micritic and reddish crinoidal limestone.

Cirpa fronto (QUENST.), *Cirpa* ? *subfurcillata* (BÖSE), *Prionorhynchia greppini* (OPP.), *P. guembeli* (OPP.), *Cuneirhynchia* (?) *fraasi* (OPP.), *Liospiriferina alpina* (OPP.), *L.* ex gr. *alpina* (OPP.), *L. obtusa* (OPP.), *Securina partschi* (OPP.).

Age: Upper (?) Sinemurian.

Sample C (eastnortheast of Flo 5)

Pisirhynchia pisoides (ZITT.), *Apringia paolii* (CAN.), *Liospiriferina globosa* (BÖSE), *L.* cf. *alpina* (OPP.), *L.* aff. *cordiformis* (BÖSE), *L.* aff. *apenninica* (CAN.), *Viallithyris gozzanensis* (PAR.), *Linguithyris aspasia* (ZITT.), *Securithyris adnethensis* (SUESS), *Bakonyithyris ewaldi* (OPP.), *B.* aff. *pedemontana* (PAR.), *Zeilleria alpina* (OPP.), *Z. oenana* (BÖSE), *Z. mutabilis* (OPP.).

Age: Pliensbachian.

Flo 6 [N 47° 38,080' / E 13° 56,530']

Lithology: Red micritic crinoidal wacke- to packstones, lenses with coarse bioclasts of crinoids, brachiopods, ammonites.

Ammonite fauna (coll. & det. J. Schlögl):

Paltechioceras sp., *Epideroceras* sp.

Age: Probably late Late Sinemurian.

Flo 7 [locality see Text-Fig. 2]

Brachiopod fauna (coll. & det. A. Dulai):

Jakubirhynchia latifrons (STUR in GEYER), *Jakubirhynchia*? *fascicostata* (UHLIG), *Prionorhynchia* cf. *greppini* (OPPEL), *Prionorhynchia guembeli* (OPPEL), *Prionorhynchia polyptycha* (OPPEL), *Cirpa*? *subcostellata* (GEMMELLARO), *Calcirhynchia*? cf. *hungarica* (BÖCKH), *Cuneirhynchia cartieri* (OPPEL), Rhynchonellida indet., *Liospiriferina* cf. *acuta* (STUR in GEYER), *Liospiriferina alpina* (OPPEL), *Liospiriferina brevirostris* (OPPEL), *Liospiriferina* aff. *obtusa* (OPPEL), Spiriferinida indet., *Cisnerospira angulata* (OPPEL), *Cisnerospira darwini* (GEMMELLARO), *Cisnerospira sylvia* (GEMMELLARO), *Zeilleria alpina* (GEYER), *Zeilleria baldaccii* GEMMELLARO, *Zeilleria* cf. *mutabilis* (OPPEL), *Zeilleria venusta* (UHLIG), *Securina hierlatzica* (OPPEL), *Securina securiformis* (GEMMELLARO), Terebratulida indet.

Age: Sinemurian.

Flo 8 [locality see Text-Fig. 2]

Brachiopod fauna (coll. & det. A. Dulai):

Prionorhynchia polyptycha (OPPEL), *Salgirella* cf. *albertii* (OPPEL), *Gibbirhynchia* ? sp., Rhynchonellida indet., *Liospiriferina alpina* (OPPEL), Spiriferinida indet., *Zeilleria alpina* (GEYER), *Zeilleria engelhardti* (OPPEL), *Securina hierlatzica* (OPPEL).

Age: Sinemurian.

Flo 9 [locality see Text-Fig. 2]

Brachiopod fauna (coll. & det. M. Siblík):

Sample A

Fallen blocks of red Hierlatz Limestone.

Salgirella albertii (OPP.), *Liospiriferina* aff. *alpina* (OPP.), *Securina partschi* (OPP.), *Zeilleria alpina* (OPP.).

Age: Sinemurian.

Sample B

Reddish limestone along the steep forest road from Flo 9 to the Flodring summit.

Cirpa planifrons (ORMÓS), *Salgirella albertii* (OPP.), *Rimirhynchia* sp., *Prionorhynchia* cf. *polyptycha* (OPP.), *Liospiriferina obtusa* (OPP.), *L.* cf. *brevirostris* (OPP.), *Securina* cf. *partschi* (OPP.), *Zeilleria batilla* (GEYER), *Z. mutabilis* (OPP.), *Z. alpina* (OPP.), *Z. stapia* (OPP.).

Age: Sinemurian.

Klaus 1 [N 47° 37,860' / E 13° 56,626']

Lithology: pink to red micritic limestone with ammonites, bivalves, belemnites; signs of condensation, ammonites covered with ferruginous films, geopetal infillings of the chambers, fragmented, randomly oriented, Fe/Mn crusts.

Ammonite fauna (coll. & det. J. Schlögl):

Calliphylloceras nilsoni (HEBERT, 1866), *Ptychophylloceras (Tatrophylloceras) chronomphalum* (VACEK, 1886), *Lytoceras cornucopiae* (YOUNG & BIRD), *?Zugodactylites* sp., *Porpoceras vortex* (SIMPSON), *Catacoeloceras dumortieri* DE BRUN, *Catacoeloceras* cf. *crassum* (YOUNG & BIRD), *Hildoceras bifrons* (BRUG.), *Paroniceras* gr. *sternale* (D'ORBIGNY, 1844), *Phymatoceras robustum* HYATT, *Podagrosites* sp., *Podagrosites* cf. *aratum* (BUCKMAN), *Grammoceras* sp.

Age: Middle and early Late Toarcian. The listed taxa include only the ammonites collected during our fieldtrip in 2005. Revision of some private collections would be necessary. Stratigraphic extent of the red condensed limestone probably reaches at least Early Aalenian, because of e.g. Erycites fallifax Arkel, taxon of the L. opalinum Zone, found in the private collection of E. Pfusterer.

Bivalve fauna (coll. & det. I. Szente):

Parallelodon? *problematicus* (VACEK, 1886), (Pl. 12, Figs. 9, 10)

The poor fragments collected by the author and much more the fine specimens seen at the private collection of E. Pfusterer represent this characteristic species described from the Toarcian–Aalenian San Vigilio Oolite of the Southern Alps.

Praechlamys sp. (Pl. 12, Fig. 18)

Praechlamys subreticulata (STOLICZKA, 1861), (Pl. 12, Fig. 19)

A fragment found in pink crinoidal limestone represents *Praechlamys subreticulata* (STOLICZKA, 1861).

Klaus 2 [N 47° 37' 54,6" / E 13° 56' 32,9"]
Lithology: red micritic limestones, encrusted ammonites, scarce gastropods, bivalves. Small outcrop on the slope.
Ammonite fauna (coll. & det. J. Schlögl):
The fauna is not determined in detail, but contains some *Hildoceras* sp.
Age: Toarcian.

Klaus 3 [N 47° 37' 57,1" / E 13° 56' 29,9"]
Lithology: Hierlatz Limestone; red, mostly sparitic crinoidal limestones with mostly disarticulated big crinoidal particles, brachiopods and small ammonites. Crinoidal debris locally accumulated in laminae up to 3–4 cm thick with indications of sorting.

Ammonite fauna (coll. & det. J. Schlögl):
Sample 1
Phylloceras sp., *Juraphyllites* sp., *Polymorphites* sp. or microconchs of *Platypleuroceras* sp., *Platypleuroceras* cf. *brevispina* (Sowerby), *Gemmellaroceras* sp.
Age: Fauna is indicative of Early Pliensbachian (Carixian).

Remarks: The geological age agrees well with the youngest ammonite association described by Rakus (1999) from the Hierlatz type locality.

Sample 2
Red micritic limestones with dispersed or accumulated crinoids, ammonites and brachiopods.
Tropidoceras sp. *demonense* (Gemmellaro, 1884) and 2 other different species of *Tropidoceras*, *Acanthopleuroceras* gr. *lepidum* (Tutcher & Trueman, 1925).
Age: Early Pliensbachian.

Sample 3
Yellowish to brownish micritic limestones with dispersed crinoids.
Juraphyllites sp., *Paltechioceras* sp.
Age: Late Sinemurian.

Sample 4
Reddish crinoidal packstones with rare ammonites.
?*Arnioceras* sp.
Age: Sinemurian.

Brachiopod fauna (coll. & det. M. Siblík):
Sample A
Red micritic limestones with rests of Fe/Mn crusts**.**
Prionorhynchia (?) *hagaviensis* (Böse), *P. flabellum* (Gemm.), *Apringia paolii* (Can.), *A. atlaeformis* (Böse), *A. diptycha* (Böse), *Cuneirhynchia retusifrons* (Opp.), *Cirpa briseis* (Gemm.), *Cirpa* aff. *subcostellata* (Gemm.), *Pisirhynchia retroplicata* (Zitt.), *Liospiriferina alpina* (Opp.), *L.* aff. *alpina* (Opp.), *Viallithyris gozzanensis* (Par.), *Antiptychina* cf. *rothpletzi* (Di-Stef.), *Bakonyithyris* aff. *ovimontana* (Böse), *B. apenninica* (Zitt.).
Age: Pliensbachian.

K 04 (locality see Text-Fig. 2)
Brachiopod fauna (coll. & det. M. Siblík):
Prionorhynchia greppini (Opp.), *P. greppini rimata* (Geyer), *Liospiriferina obtusa* (Opp.), *L. brevirostris* (Opp.), *L.* cf. *alpina* (Opp.).
Age: Sinemurian.

Bivalve fauna (coll. & det. I. Szente):
Pectinid bivalve, gen. et sp. indet. (Pl. 12, Fig. 15), *Praechlamys subreticulata* (Stoliczka, 1861) (Pl. 12, Fig. 20).

K 04/1 (locality see Text-Fig. 2)
Lithology: pink and red Hierlatz Limestone.

Brachiopod fauna (coll. & det. M. Siblík):
Cirpa fronto (Quenst.), *Prionorhynchia polyptycha* (Opp.), *P. palmata* (Opp.), *Liospiriferina obtusa* (Opp.), *L.* cf. *alpina* (Opp.), *L.* cf. *brevirostris* (Opp.), *Lobothyris* ex gr. *punctata* (Sow.), *Securina partschi* (Opp.), *Securina hierlatzica* (Opp.), *Bakonyithyris ewaldi* (Opp.), *Zeilleria alpina* (Geyer), *Z. mutabilis* (Opp.).
Age: Sinemurian.

Samples dispersed between K 04/1 and Stub 1

Brachiopod fauna (coll. & det. M. Siblík):
Prionorhynchia greppini (Opp.), *P. albertii* (Opp.), *Liospiriferina alpina* (Opp.), *L.* cf. *sicula* (Gemm.), *Securina partschi* (Opp.), *Bakonyithyris ewaldi* (Opp.).
Age: Sinemurian.

Klb 1 [N 47° 37,056' / E 13° 57,884']
Deforested slope above the forest road, blocks and small outcrops.
Lithology: white, yellowish to red, more or less crinoidal limestones, breccias are less common.

Fauna: crinoids, brachiopods, ammonites, scarce gastropods. Fauna not yet determined.

Klb 2 [N 47° 37,068' / E 13° 57,992']
Lithology: white, grey and pink micritic crinoidal wackestone with ammonites, brachiopods, small bivalves and scarce gastropods.

Ammonite fauna (coll. & det. J. Schlögl):
Juraphyllites sp., *Geyeroceras cylindricum* (Sowerby), *Arnioceras rejectum* Fucini, 1902.
Age: Early Sinemurian.

Brachiopod fauna (coll. & det. M. Siblík):
Apringia aff. *paolii* (Can.), *Cuneirhynchia retusifrons* (Opp.), *Calcirhynchia plicatissima* (Quenst.), *Prionorhynchia polyptycha* (Opp.), ?*Cirpa* sp., *Cisnerospira angulata* (Opp.), *Liospiriferina obtusa* (Opp.), *L.* cf. *obtusa* (Opp.), *L.* cf. *alpina* (Opp.), *Bakonyithyris ewaldi* (Opp.), *B.* (?) aff. *catharinae* Gemm., *Securina partschi* (Opp.), *Zeilleria mutabilis* (Opp.), *Z.* aff. *venusta* (Uhl.).
Age: Sinemurian.

Klb 3 [N 47° 37,045' / E 13° 58,165']
Edge of a small plateau.
Lithology: red limestones with brachiopod accumulations (empty or with sparitic infill), crinoidal wacke- to pack-/grainstone. Levels with synsedimentary breccias, lithoclasts angular to rounded, mainly of micritic and coquina limestones in red micrite.

Fauna: crinoids, brachiopods, scarce ammonites, bivalves, gastropods.
Ammonite fauna (coll. & det. J. Schlögl):
Atractites sp., *Agassiceras* sp.
Age: Early Sinemurian.

Klb 4 [N 47° 37,054' / E 13° 58,178']

Lithology: Red stromatactis limestones with scarce ammonites, brachiopods.

Ammonite fauna (coll. & det. J. Schlögl):
Sample 1
Angulaticeras sp. (cf. *angustisulcatus* (Geyer, 1886)), *Arnioceras* sp. (2 species).
Age: Early Sinemurian.

Sample 2
Loose block some meters to the E from sample 1, large terebratulids and rhynchonellids.
Arnioceras sp.

Sample 3
Downslope, approx. 10 m to the S from sample 1, with ammonites, gastropods, brachiopods.
Cenoceras sp., *Angulaticeras* sp., *?Agassiceras* sp. juv., *Arnioceras* sp.
Age: Early Sinemurian.

Klb 5 [N 47° 37,052' / E 13° 58,127']
Lithology: Loose block sparitic grainstone with brachiopods, scarce ammonites.

Ammonite fauna (coll. & det. J. Schlögl):
Arnioceras sp.
Age: probably Early Sinemurian.

Klb 6 (locality see Text-Fig. 2)
Lithology: red micritic and crinoidal limestones, loose blocks on the slope.

Brachiopod fauna (coll. & det. M. Siblík):
Cirpa fronto (QUENST.), *Cuneirhynchia retusifrons* (OPP.), *C. cartieri* (OPP.), *Prionorhynchia polyptycha* (OPP.), *P. greppini rimata* (GEYER), *P.* aff. *calderinii* (PAR.), *Liospiriferina obtusa* (OPP.), *L.* cf. *darwini* (GEMM.), *Liospiriferina* sp., *Lobothyris* sp., *Bakonyithyris ewaldi* (OPP.), *B. pedemontana* (PAR.), *B.* aff. *meneghinii* (PAR.), *Zeilleria alpina* (GEYER), *Z. perforata* (PIETTE), *Z. venusta* (UHL.), *Z.* aff. *waehneri* GEMM., *Z.* aff. *choffati* (HAAS).
Age: Late (?) Sinemurian.

Nr. 1/10 (locality see Text-Fig. 2)
Brachiopod fauna (coll. & det. A. Dulai):
Jakubirhynchia? cf. *fascicostata* (UHLIG), *Prionorhynchia* cf. *pseudopolyptycha* (BÖCKH), *Cirpa*? *subcostellata* juv. (GEMMELLARO), *Homoeorhynchia prona* (OPPEL), *Cuneirhynchia* cf. *cartieri* (OPPEL), *Gibbirhynchia* sp., Rhynchonellida indet., *Liospiriferina* cf. *alpina* (OPPEL), *Liospiriferina* cf. *obtusa* (OPPEL), *Zeilleria* cf. *choffati* (HAAS), *Zeilleria mutabilis* (OPPEL), *Securina* cf. *hierlatzica* (OPPEL), Terebratulida indet.
Age: Sinemurian.

Nr. 08 Schwarzwald
Lithology: white Hierlatz Limestone.

Brachiopod fauna (coll. & det. M. Siblík):
Cirpa fronto (QUENST.), *Prionorhynchia greppini* (OPP.), *Liospiriferina obtusa* (OPP.), *L.* aff. *sicula* (GEMM.) *L.* cf. *alpina* (OPP.), *L.* cf. *obtusa* (OPP.), *Lobothyris* sp.
Age: Sinemurian.

Nr. 09 Schwarzwald [N 47° 38,345' / E 13° 55,871']
Lithology: light micritic limestone with lenses of crinoidal and lithoclastic packstones

Fauna: crinoids, brachiopods, bivalves, gastropods and ammonites.

Brachiopod fauna (coll. & det. M. Siblík):
Jakubirhynchia latifrons (STUR in GEYER*), Apringia paolii* (CAN.), *Tetrarhynchia zitteli* (GEMM.), *Prionorhynchia greppini rimata* (GEYER), *P. polyptycha* (OPP.), *Piarorhynchia* (?) *caroli* (GEMM.), *Homoeorhynchia* (?) aff. *ptinoides* (DI-STEF.), *Cirpa* aff. *subcostellata* (GEMM.), *"Rhynchonella" triquetra* GEMM., *"Rhynchonella"* aff. *latissima* FUC., *"Rhynchonella"* aff. *diptycha* (BÖSE), *Cisnerospira angulata* (OPP.), *Liospiriferina obtusa* (OPP.), *L. alpina* (OPP.), *L.* cf. *alpina* (OPP.), *L.* aff. *sicula* (GEMM.), *Lobothyris* cf. *andleri* (OPP.), *Securithyris* aff. *adnethensis* (SUESS), *Linguithyris aspasia* (ZITT.), *Securina partschi* (OPP.), *S. hierlatzica* (OPP.), *S. hierlatzica plicata* (GEYER), *Zeilleria batilla* (GEYER), *Z. alpina* (GEYER), *Z. mutabilis* (OPP.), *Z. livingstonei* (GEMM.), *Z.* aff. *fucinii* (Greco), *Z.* aff. *stapia* (OPP.).
Age: Late (?) Sinemurian.

Nr. 10 Schwarzwald [N 47° 38,289' / E 13° 55,800']
Lithology: Bedded limestones with brachiopod accumulations (shell beds), sparitic matrix, chaotical orientation, more or less parallel to bedding.

Brachiopod fauna (coll. & det. M. Siblík):
Nearly monospecific fauna of *"Terebratula"* aff. *ascia* GIRARD, rarely *Zeilleria mutabilis* (OPP.) and *Z. choffati* (HAAS).
Age: Sinemurian.

Plk 1 [N 47° 37,789' / E 13° 57,790] = [BMN 497 380 / 276 977]
Lithology: Hierlatz Limestone, pale-pink ammonite-brachiopod-echinoderm wackestone with abundant moulds of ammonites and white pack- to grainstone with gastropods, brachiopods and echinoderms (especially echinoid spines); very rich in fossils.

Ammonite fauna (coll. & det. J. Schlögl):
The ammonite fauna was collected separately from the uppermost 10 cm horizon and from the underlying horizon, 10–15 cm thick. Additional fauna that couldn't be related to a certain horizon will be dealt with separately below.
Sampling level 10–20 cm
Atractites sp., *Partschiceras striatocostatum* (MENEGHINI, 1853), *Togaticeras stella* (SOWERBY, 1833), *Geyeroceras cylindricum* (SOWERBY, 1931), *Juraphyllites* cf. *quadrii* (MENEGHINI), *Lytoceras* sp., ?*Bouhamidoceras* sp. juv., *Angulaticeras* sp., *Angulaticeras lacunatum* (GEYER, 1886), *Arnioceras miserabile* (QUENSTEDT, 1858), *Arnioceras* gr. *ambiguum* (GEYER, 1886), *Arnioceras* gr. *semilaeve* (HAUER, 1853), *Arnioceras insigne* FUCINI, 1902, ?*Cymbites* sp.
Not related collection
Zetoceras pseudozetes (FUCINI, 1908), *Juraphyllites dorsoplanatus* (FUCINI, 1908), *Juraphyllites* cf. *diopsis* (GEMMELLARO, 1884), *Angulaticeras angustisulcatus* (GEYER, 1886), ?*Plesechioceras* sp., *Microderoceras* cf. *olenoptychum* (FUCINI, 1903).
Age: probably Early Sinemurian, but see also the discussion in the Ammonoidea chapter

Brachiopod fauna (coll. & det. M. Siblík):
Cirpa fronto (QUENST.), *Prionorhynchia polyptycha* (OPP.), *P. greppini* (OPP.), *P. greppini rimata* (GEYER), *P. palmata* (OPP.), *Jakubirhynchia latifrons* (STUR in GEYER), *Cuneirhynchia retusifrons* (OPP.*), Salgirella* aff. *magnicostata* (ORMÓS), *Liospiriferina brevirostris* (OPPEL), *L. obtusa* (OPPEL), *L. darwini* (GEMM.), *L.* aff. *sicula* (GEMM.), *Liospiriferina* cf. *alpina* (OPP.), *Liospiriferina* sp., *Lobothyris* cf. *andleri* (OPP.), *Securina partschi* (OPP.), *Bakonyithyris* (?) aff. *engelhardti* (OPP.), *Zeilleria alpina* (GEYER), *Z. mutabilis* (OPP.), *Z. choffati* (HAAS), *Z.* aff. *venusta* (UHL.), *Z.* aff. *norica* (SUESS).
Age: Sinemurian.

Brachiopod fauna (coll. & det. A. Dulai):
Apringia paolii (CANAVARI), *Jakubirhynchia latifrons* (STUR in GEYER), *Jakubirhynchia*? *fascicostata* (UHLIG), *Prionorhynchia*? *flabellum* (MENEGHINI), *Prionorhynchia* cf. *greppini* (OPPEL), *Cirpa planifrons* (ORMÓS), *Salgirella* cf. *albertii* (OPPEL), *Salgirella* aff. *albertii* (OPPEL), *Piarorhynchia caroli* (GEMMELLARO), *Cuneirhynchia cartieri* (OPPEL), *Pisirhynchia inversa* (OPPEL), *Pisirhynchia retroplicata* (ZITTEL), *Gibbirhynchia* sp., Rhynchonellida indet., *Liospiriferina alpina* (OPPEL), *Liospiriferina salomoni* (BÖSE), *Liospiriferina* cf. *sicula* (GEMMELLARO), *Liospiriferina* sp., *Cisnerospira darwini* (GEMMELLARO), *Cisnerospira* aff. *darwini* (GEMMELLARO), Spiriferinida indet., *Lobothyris andleri* (OPPEL), *Lobothyris punctata* (SOWERBY), *Linguithyris aspasia* (ZITTEL), *Linguithyris aspasia* juv. (ZITTEL), *Zeilleria alpina* (GEYER), *Zeilleria choffati* (HAAS), *Zeilleria mutabilis* (OPPEL), *Zeilleria perforata* (PIETTE), *Zeilleria* cf. *subnumismalis* (DAVIDSON), Terebratulida indet.

Bivalve fauna (coll. & det. I. Szente):

Parallelodon sp., *Oxytoma (O.) inequivalvis* (J. SOWERBY, 1819), *Oxytoma* sp., *Praechlamys palosa* (STOLICZKA, 1861), *Praechlamys subreticulata* (STOLICZKA, 1861), *Terquemia pectiniformis* (EUDES-DESLONGCHAMPS, 1860), *Placunopsis*? sp., *Ctenostreon rugosum* (SMITH, 1817), *Plagiostoma punctatum* J. SOWERBY, 1805, *Myoconcha* sp. B, *Praeconia tetragona* (TERQUEM, 1855).

Gastropod fauna (coll. & det. J. Szabó):

Pseudorhytidopilus zitteli (G.G. GEMMELLARO, 1879), *Neritopsis elegantissima* HÖRNES, 1853, *Wortheniopsis* sp., *Pleurotomaria debuchi* J. A. DESLONGCHAMPS, 1849, *Pleurotomaria* aff. *anglica* (J. SOWERBY, 1818), *Pleurotomaria* aff. *emmrichi* GÜMBEL, 1861, *Emarginula nestii* G.G. GEMMELLARO, 1879, *Emarginula* (*Tauschia*) cf. *busambrensis* G.G. GEMMELLARO, 1879, *Eucyclomphalus* aff. *hierlatzensis* AMMON, 1892, *Riselloidea noszkyi* SZABÓ, 1995, *Muricotrochus*? sp., *"Epulotrochus"*? sp. 1, *"Epulotrochus"*? sp. 2, *"Epulotrochus"*? sp. 3, *Ataphrus* (*Endianaulax*)? sp., *Discocirrus* cf. *tricarinatus* GÜMBEL, 1861, *Discohelix hallstattensis* SZABÓ, 2009, *Discohelix excavata* (REUSS, 1852), *Discohelix* aff. *ornata* (HÖRNES, 1853), *Pentagonodiscus reussi* (HÖRNES, 1853), *Anoptychia hierlatzensis* (STOLICZKA, 1861), *Anoptychia*? *acicula* (STOLICZKA, 1861), *Katosira*? sp., *Oonia*? cf. *pseudovesta* (GÜMBEL, 1861), *Cerithinella italica* (G.G. GEMMELLARO, 1879), *Procerithium* sp., *Cryptaulax*? sp., *Euconactaeon* aff. *concavus* (E. EUDES-DESLONGCHAMPS, 1842), *Clathrobaculus*? cf. *alpicolus* (GÜMBEL, 1861), *Promathildia*? sp.

Plk 2 [N 47° 37' 50,2" / E 13° 57' 44,7"]

Very small outcrop.

Lithology: Hierlatz Formation; white micritic crinoidal limestones with brachiopods and rare ammonites. Probably a small olistolith within Upper Jurassic limestones.

Ammonite fauna (coll. A. Dulai, det. J. Schlögl):

Juraphyllites nardii MENEGHINI, 1853.

Age: Sinemurian.

Plk 3 [N 47° 37' 46,8" / E 13° 57' 41,9"]

Probably meter-sized olistoliths within the surrounding Upper Jurassic limestones**.**

Lithology: Hierlatz Limestone; white micritic brachiopod coquina with ammonites. Ammonites enveloped with radiaxial calcite.

Ammonite fauna (coll. & det. J. Schlögl):

Arnioceras gr. *mendax* FUCINI, 1902 or *A. dimorphus* PARONA, 1897, *Arnioceras insolitum* FUCINI, 1902.

Age: Early Sinemurian.

Brachiopod fauna (coll. & det. A. Dulai):

Sample Plk 3a

Jakubirhynchia? *fascicostata* (UHLIG), *Prionorhynchia forticostata* (BÖCKH), *Prionorhynchia greppini* (OPPEL), *Prionorhynchia* aff. *guembeli* (OPPEL), *Prionorhynchia*? *hagaviensis* (BÖSE), *Prionorhynchia polyptycha* (OPPEL), *Cirpa planifrons* (ORMÓS), *Cirpa briseis* (GEMMELLARO), *Cuneirhynchia retusifrons* (OPPEL), Rhynchonellida indet., *Liospiriferina brevirostris* (OPPEL), *Liospiriferina* cf. *obtusa* (OPPEL), *Liospiriferina* cf. *sicula* (GEMMELLARO), *Liospiriferina salomoni* (BÖSE), *Liospiriferina alpina* (OPPEL), *Cisnerospira darwini* (GEMMELLARO), Spiriferinida indet., *Lobothyris andleri* (OPPEL), *Lobothyris delta* (NEUMAYR), *Lobothyris punctata* (SOWERBY), *Zeilleria alpina* (GEYER), *Zeilleria baldaccii* GEMMELLARO, *Zeilleria choffati* (HAAS), *Zeilleria mutabilis* (OPPEL), *Zeilleria perforata* (PIETTE), *Zeilleria stapia* (OPPEL), *Zeilleria venusta* (UHLIG), *Zeilleria* sp., *Bakonyithyris ewaldi* (OPPEL), *Securina hierlatzica* (OPPEL), Terebratulida indet.

Sample Plk 3b

Jakubirhynchia? *fascicostata* (UHLIG), *Jakubirhynchia latifrons* (STUR in GEYER), *Prionorhynchia greppini* (OPPEL), *Prionorhynchia* aff. *guembeli* (OPPEL), *Prionorhynchia*? *hagaviensis* (BÖSE), *Prionorhynchia polyptycha* (OPPEL), *Calcirhynchia*? *hungarica* (BÖCKH), *Cirpa planifrons* (ORMÓS), *Cirpa*? *subcostellata* (GEMMELLARO), *Cuneirhynchia retusifrons* (OPPEL), *Gibbirhynchia sordellii* (PARONA), Rhynchonellida indet., *Liospiriferina alpina* (OPPEL), *Liospiriferina brevirostris* (OPPEL), *Liospiriferina* cf. *gryphoidea* (UHLIG), *Liospiriferina* cf. *obtusa* (OPPEL), *Cisnerospira angulata* (OPPEL), *Cisnerospira darwini* (GEMMELLARO), *Cisnerospira sylvia* (GEMMELLARO), Spiriferinida indet., *Koninckodonta waehneri* (BITTNER), *Lobothyris punctata* (SOWERBY), *Lobothyris andleri* (OPPEL), *Zeilleria alpina* (GEYER), *Zeilleria baldaccii* GEMMELLARO, *Zeilleria batilla* (GEYER), *Zeilleria* cf. *bicolor* (BÖSE), *Zeilleria choffati* (HAAS), *Zeilleria mutabilis* (OPPEL), *Zeilleria perforata* (PIETTE), *Zeilleria* cf. *venusta* (UHLIG), *Securina* cf. *hierlatzica* (OPPEL), Terebratulida indet.

Age: both samples Sinemurian.

Plk 4 [N 47° 37' 47,3" / E 13° 57' 40,4"]

Short stratigraphic section, showing Upper Jurassic red limestones with olistoliths of Lower Jurassic limestones, see Text-Fig. 4.

Ammonite fauna (coll. & det. J. Schlögl):

Sample 1 (from bed number 7 in the section)

Red micritic limestones with ammonites, brachiopods and bivalves.

Sowerbyceras loryi (MUNIER-CHALMAS, 1875), *"Haploceras" jungens* NEUMAYR, 1873), *Hemihaploceras (Hemihaploceras) nobile* (NEUMAYR, 1873), *Sutneria* cf. *eumela* (D'ORBIGNY, 1847).

Age: Late Kimmeridgian.

Sample 2 (from bed number 11 in the section)

Red and grey micritic limestone.

The fauna is still not prepared. But surprisingly it looks older than the above mentioned fauna of underlying bed number 7.

Trenerites sp. (aff. *evolutus* GEMMELLARO, 1876), *Trenerites* sp. (cf. *enayi* SARTI, 1993).

Age: Genus Trenerites is known mainly from the Early Kimmeridgian.

Brachiopod fauna (coll. & det. M. Siblík)

Sample A (from bed number 7 in the section)

"Terebratula" aff. *bilimeki* SUESS.

Age: Late Jurassic.

Sample B (olistolith [approx. 30×60 cm] in bed number 6 in the section).

Beige limestone with brachiopod lumachelle.

Prionorhynchia palmata (OPP.), *P. guembeli* (OPP.), *P.* aff. *belemnitica* (QUENST.), *Liospiriferina obtusa* (OPP.), *Liospiriferina* cf. *obtusa* (OPP.), *Liospiriferina* cf. *alpina* (OPP.), *Linguithyris aspasia* (ZITT.), *Bakonyithyris apenninica* (ZITT.), *Zeilleria alpina* (OPP.).

Age: Late (?) Sinemurian.

Sample C (small olistoliths in red limestones of bed number 6 and/or upper part of bed number 5).

Light red and spotted micrites with big crinoids.

Apringia paolii (CAN.), *Prionorhynchia flabellum* (GEMM.), *P.* cf. *polyptycha* (OPP.), *Linguithyris aspasia* (ZITT.), *Bakonyithyris ewaldi* (OPP.), *B.* aff. *pedemontana* (PAR.), *Zeilleria alpina* (OPP.).

Age: Late (?) Sinemurian.

Sample D (taken from the scree below the outcrop).

Grey micritic limestones.

Prionorhynchia fraasi (OPP.), *P. belemnitica* (QUENST.), *Apringia* ? *atlaeformis* (BÖSE), *Liospiriferina acuta* (STUR in GEYER), *L.* cf. *decipiens* (BÖSE-SCHL.), *Zeilleria* sp.
Age: Late (?) Sinemurian.

Brachiopod fauna (coll. & det. A. Dulai):
The fauna has been taken from the scree below the outcrop; probably it originates from the grey limestones in the lower part of the section.
Jakubirhynchia? *fascicostata* (UHLIG), *Jakubirhynchia*? cf. *laevicosta* (STUR in GEYER), *Prionorhynchia greppini* (OPPEL), *Prionorhynchia* cf. *guembeli* (OPPEL), *Prionorhynchia* aff. *guembeli* (OPPEL), *Prionorhynchia* cf. *polyptycha* (OPPEL), *Cirpa*? *subcostellata* (GEMMELLARO), *Cirpa* sp., *Calcirhynchia*? aff. *hungarica* (BÖCKH), *Calcirhynchia* aff. *zugmayeri* (GEMMELLARO), *Salgirella* cf. *albertii* (OPPEL), *Homoeorhynchia* ? cf. *prona* (OPPEL), *Cuneirhynchia cartieri* (OPPEL), *Cuneirhynchia* ? *fraasi* (OPPEL), *Cuneirhynchia retusifrons* (OPPEL), Rhynchonellida indet., *Liospiriferina alpina* (OPPEL), *Liospiriferina* cf. *obtusa* (OPPEL), *Liospiriferina* cf. *semicircularis* (BÖSE), *Liospiriferina* sp., *Cisnerospira angulata* (OPPEL), *Cisnerospira darwini* (GEMMELLARO), Spiriferinida indet., *Lobothyris delta* (NEUMAYR), *Lobothyris punctata* (SOWERBY), *Lobothyris* sp., *Papodina* cf. *bimammata* (ROTHPLETZ), *Zeilleria alpina* (GEYER), *Zeilleria baldaccii* GEMMELLARO, *Zeilleria engelhardti* (OPPEL), *Zeilleria mutabilis* (OPPEL), *Zeilleria perforata* (PIETTE), *Zeilleria subnumismalis* (DAVIDSON), *Zeilleria* cf. *venusta* (UHLIG), Terebratulida indet.
Age: Sinemurian.

Plk 5 [N 47° 37' 47,4" / E 13° 57' 45,3"]
Lithology: Hierlatz Limestone; white, poorly or moderately sorted crinoidal packstones with abundant brachiopods and rare ammonites.

Ammonite fauna (coll. & det. J. Schlögl):
Zetoceras sp., *Arnioceras* sp., Eoderoceratidae indet.
Age: probably Early Sinemurian.

Brachiopod fauna (coll. & det. M. Siblík):
Sample A (light grey Hierlatz Limestone)
Salgirella albertii (OPP.), *Prionorhynchia* aff. *flabellum* (GEMM.), *Cisnerospira angulata* (OPP.), *Liospiriferina* cf. *alpina* (OPP.), *Securina partschi* (OPP.), *Bakonyithyris ewaldi* (OPP.), *Zeilleria alpina* (OPP.), *Z.* cf. *alpina* (OPP.).
Sample B (red Hierlatz Limestone)
Salgirella albertii (OPP.), *Jakubirhynchia* aff. *latifrons* (STUR in GEYER), *Cirpa* sp., *Apringia* aff. *diptycha* (BÖSE), *Liospiriferina obtusa* (OPP.), *L.* cf. *alpina* (OPP.), *L.* cf. *brevirostris* (OPP.), *Securina partschi* (OPP.), *Zeilleria mutabilis* (OPP.), *Z. venusta* (UHL.), *Z. baldaccii* (GEMM.), *Z. alpina* (OPP.), *Z.* aff. *alpina* (OPP.).
Age of both samples: Sinemurian.

Plk 6 [N 47° 37,758' / E 13° 57,708']
Lithology: Reddish micritic limestones with dispersed to accumulated crinoids, ammonites, brachiopods, rare bivalves.

Ammonite fauna (coll. & det. J. Schlögl):
Nebrodites (Nebrodites) macerrimus (QUENSTEDT, 1888), *Taramelliceras (Taramelliceras) trachinotum* (OPPEL, 1863).
Age: Early Kimmeridgian.

Plk 7 [N 47° 37,777' / E 13° 57,729']
Lithology: Grey micritic limestones, locally dispersed crinoidal debris, ammonites.

Ammonite fauna (coll. & det. J. Schlögl):
Nebrodites (Mesosimoceras) herbichi (VON HAUER).
Age: Early Kimmeridgian.

Plk 8 [N 47° 37,834' / E 13° 57,687'] = [BMN 497 262 / 277 057]
Small outcrops on the slope.
Lithology: Grey and reddish micritic limestones with decimeter-sized olistoliths of white Hierlatz Limestone.

Sample from the matrix:
Ammonite fauna (coll. & det. J. Schlögl):
Nebrodites cf. *beogradensis* ANDELKOVIC, 1966; *Sutneria* cf. *cyclodorsata* (MOESCH, 1867).
Age: Kimmeridgian (late Early or early Late Kimmeridgian to Late Kimmeridgian).

Samples from olistoliths:
Ammonite fauna (coll. M. Siblík & det. J. Schlögl):
Geyeroceras cylindricum (SOWERBY, 1931).
Age: Sinemurian.

Brachiopod fauna (coll. & det. M. Siblík):
Cuneirhynchia retusifrons (OPP.), *Prionorhynchia polyptycha* (OPP.), *P. greppini* (OPP.), *Cisnerospira angulata* (OPP.), *Liospiriferina alpina* (OPP.), *L. obtusa* (OPP.), *Lobothyris punctata* (Sow.), *Securina partschi* (OPP.), *Zeilleria mutabilis* (OPP.), *Z. alpina* (GEYER), *Z. choffati* (HAAS), *Z. stapia* (OPP.), *Zeilleria* sp.
Age: Sinemurian.

Plk 9 (locality see Text-Fig. 2)
Lithology: Hierlatz Limestone; white and reddish micritic crinoidal limestones.

Brachiopod fauna (coll. & det. M. Siblík):
Prionorhynchia belemnitica (QUENST.), *P.* (?) aff. *belemnitica* (QUENST.), *Salgirella albertii* (OPP.), *Cirpa fronto* (QUENST.), *Liospiriferina alpina* (OPP.), *L. obtusa* (OPP.), *L. sicula* (GEMM.), *L.* cf. *brevirostris* (OPP.), *Rhapidothyris beyrichi* (OPP.), *Zeilleria mutabilis* (OPP.).
Age: Sinemurian.

Plk 10 (Upper Jurassic ammonite locality of private collectors, approx. position see Text-Fig. 3).
Lithology: Tressenstein Limestone.

Bivalve fauna (coll. & det. I. Szente):
Placunopsis cf. *radiata* (PHILLIPS, 1929) (Pl. 12, Fig. 32).
According to HÖLDER (1990), *Placunopsis* specimens referred to as *"P. tatrica* ZITTEL, 1870" in the literature of the peri-Mediterranean Upper Jurassic represent the long-ranging species *P. radiata.* The fine radial riblets characteristic of the species cannot be observed on the specimen. Their lack may be most probably due to the nature of preservation.
Brachiopod fauna (coll. & det. M. Siblík):
Sample from olistoliths (white and pink Hierlatz Limestone) in the surroundings of Plk 10
Cuneirhynchia retusifrons (OPP.), *Prionorhynchia greppini* (OPP.), *Liospiriferina brevirostris* (OPP.), *L.* cf. *semicircularis* (BÖSE), *Lobothyris punctata* (Sow.), *Bakonyithyris ewaldi* (OPP.), *B.* (?) *engelhardti* (OPP.), *Zeilleria alpina* (GEYER), *Z. mutabilis* (OPP.), *Z. thurwieseri* (BÖSE), *Z. venusta* (UHL.), *Z. catharinae* (GEMM.), *Z.* aff. *stapia* (OPP.).
Sample from olistoliths (beige micrites) in the surroundings of Plk 10:
Septocrurella uhligi (HAAS), *Liospiriferina* sp., *Zeilleria* sp.
Age of both samples: Sinemurian.

Stub 1 [N 47° 37' 56,9" / E 13° 56' 47,1"]
Lithology: Hierlatz Limestone; pink and red crinoidal wacke- to packstone.

Ammonite fauna (coll. & det. J. Schlögl):
Paltechioceras sp.
Age: Late Sinemurian.

Stub 2 (locality see Text-Fig. 2)
Lithology: Hierlatz Limestone; pink grainstone with ammonites.

Ammonite fauna (coll. & det. J. Schlögl):
Arnioceras sp.
Age: Probably Early Sinemurian.

T 6 (locality see Text-Fig. 3)
Lithology: red micritic limestone with crinoids, ammonites, gastropods, belemnites and coral fragments, matrix rich in protoglobigerinids. Components frequently coated with ferromanganese crusts, contacts affected by stylolitization. Intercalation within Tressenstein Limestone, the lithology resembles the Agatha Limestone.

Age: probably Late Jurassic.

T 12 (locality see Text-Fig. 3)
Lithology: Tressenstein Limestone

Ammonite fauna (det. J. Schlögl):
Aspidoceras sp.
Age: Late Jurassic.

T 13 (locality see Text-Fig. 3)
Lithology: grey micritic limestone of Late Jurassic age (Taramelliceras sp.) containing crinoids, coral fragments, protoglobigerinids and decimeter-sized olistoliths with Sinemurian brachiopods.

Brachiopod fauna (coll. & det. A. Dulai):
Jakubirhynchia? *fascicostata* (Uhlig), *Prionorhynchia greppini* (Oppel), *Prionorhynchia*? *hagaviensis* (Böse), *Prionorhynchia polyptycha* (Oppel), *Prionorhynchia* sp., *Cirpa planifrons* (Ormós), *Calcirhynchia*? cf. *hungarica* (Quenstedt), Rhynchonellida indet., *Liospiriferina alpina* (Oppel), *Liospiriferina obtusa* (Oppel), *Liospiriferina* cf. *sicula* (Gemmellaro), *Liospiriferina* sp. indet., *Cisnerospira* cf. *angulata* (Oppel), *Lobothyris andleri* (Oppel), *Zeilleria alpina* (Geyer), *Zeilleria choffati* (Haas), *Zeilleria mutabilis* (Oppel), *Zeilleria* sp., Terebratulida indet.
Age: Sinemurian.

T 14 (Pyrmoos-Brandwald south of Salza-Alm)
Lithology: grey and brownish detritic limestone (Tressenstein Limestone) with centimetre-sized clasts of Lower Triassic Werfen Beds (sandstone and shales). The fine grained matrix contains Saccocoma.

Age: Late Jurassic.

T 15 (locality see Text-Fig. 3)
Lithology: Tressenstein Limestone with a decimeter-sized olistolith of Hierlatz Limestone

Ammonite fauna (det. J. Schlögl):
Perisphinctidae gen. et sp. indet.
Age: Late Jurassic.

Brachiopod fauna from olistolith (coll. & det. M. Siblík):
Cirpa fronto (Quenst.), *Prionorhynchia polyptycha* (Oppel), *Prionorhynchia greppini* (Oppel), *Prionorhynchia greppini rimata* (Geyer), *Salgirella* aff. *magnicostata* (Ormós), *Liospiriferina* cf. *alpina* (Oppel), *Liospiriferina brevirostris* (Oppel) *Liospiriferina obtusa* (Oppel), *Liospiriferina* aff. *sicula* (Gemmellaro), *Liospiriferina darwini* (Gemm.), *Lobothyris* cf. *andleri* (Oppel), *Zeilleria alpina* (Geyer), *Zeilleria mutabilis* (Oppel), *Zeilleria choffati* Haas, *Zeilleria* aff. *venusta* (Uhlig).
Age: Sinemurian.

T 16 (locality see Text-Fig. 3)
Lithology: several meters-sized olistolith of Hierlatz Limestone

Brachiopod fauna (coll. & det. A. Dulai):
Jakubirhynchia latifrons (Stur in Geyer), *Jakubirhynchia*? cf. *fascicostata* (Uhlig), *Prionorhynchia greppini* (Oppel), *Prionorhynchia*? cf. *hagaviensis* (Böse), *Prionorhynchia* cf. *polyptycha* (Oppel), *Cirpa briseis* (Gemmellaro), *Cirpa planifrons* (Ormós), *Cirpa* sp., *Cuneirhynchia retusifrons* (Oppel), *Cuneirhynchia* sp., *Pisirhynchia inversa* (Oppel), Rhynchonellida indet., *Liospiriferina alpina* (Oppel), *Cisnerospira angulata* (Oppel), *Cisnerospira darwini* (Gemmellaro), Spiriferinida indet., *Lobothyris* cf. *delta* (Neumayr), *Zeilleria alpina* (Geyer), *Zeilleria baldaccii* Gemmellaro, *Zeilleria bicolor* (Böse), *Zeilleria choffati* (Haas), *Zeilleria mutabilis* (Oppel), *Zeilleria perforata* (Piette), *Zeilleria stapia* (Oppel), Terebratulida indet.
Age: Sinemurian.

T 19 (locality see Text-Fig. 2)
Lithology: several centimeters to decimeters-sized clasts of white to red crinoidal limestones (Hierlatz Limestone) within greenish-grey micritic matrix probably of Tressenstein Limestone.

Brachiopod fauna (coll. & det. A. Dulai):
Prionorhynchia cf. *guembeli* (Oppel), *Prionorhynchia*? *hagaviensis* (Böse), *Cirpa briseis* (Gemmellaro), *Calcirhynchia*? cf. *hungarica* (Böckh), *Pisirhynchia pisoides* (Zittel), Rhynchonellida indet., *Liospiriferina alpina* (Oppel), *Liospiriferina* sp., Spiriferinida indet., *Koninckodonta waehneri* (Bittner), *Linguithyris* cf. *aspasia* (Zittel), *Zeilleria alpina* (Geyer), Terebratulida indet.
Age: Sinemurian.

T 25 (locality see Text-Fig. 3)
Lithology: reddish and grey micritic limestone with ammonites, crinoids, gastropods and abundant protoglobigerinids, interbedded with detritic Tressenstein Limestone.
Age: Late Jurassic.

T 26 (locality see Text-Fig. 3)
Lithology: grey micritic beds of Tressenstein Limestone.

Ammonite fauna (coll. H. Meierl & det. J. Schlögl):
"Aspidoceras" sp.
Age: Late Jurassic.

T 29 (locality see Text-Fig. 3)
Lithology: Hierlatz Limestone, white to pale pink ammonite-brachiopod-echinoderm wackestone-floatstone.

Ammonite fauna (coll. G.W. Mandl & det. J. Schlögl):
Geyeroceras sp.
Age: Early Jurassic.

T 30 (locality see Text-Fig. 3)
Lithology: Tressenstein Limestone, grey-greenish to reddish micritic limestone with ammonites

Ammonite fauna (coll. G.W. Mandl & det. J. Schlögl):
Sowerbyceras loryi (MUNIER CHALMAS, 1875)
Laevaptychus sp.
Age: Late Jurassic, probably Kimmeridgian.

Wild 1 (approx. locality see Text-Fig. 1)
Eastern slope in the upper part of the Wildgraben valley.
Lithology: Oberalm beds; bedded grey micritic limestones with dispersed bioclasts (crinoids, ammonites), locally bioturbated or with cherts.

Ammonite fauna (coll. & det. J. Schlögl):
Lissoceratoides sp., *«Haploceras» balanense* NEUMAYR, *Taramelliceras (T.)* sp., *Pseudowaagenia micropla* (OPPEL, 1863), *Nebrodites (Nebrodites) macerrimus* (QUENSTEDT, 1888)
Age: late Early Kimmeridgian or early Late Kimmeridgian.

Wild 2 (approx. locality see Text-Fig. 1)
Wildgraben, middle part; talus blocks of red micrites.

Brachiopod fauna (coll. & det. M. Siblík):
Apringia paolii (CAN.), *Cirpa fronto* (QUENST.), *C.* aff. *briseis* (GEMM.), *Jakubirhynchia* aff. *latifrons* (STUR in GEYER), *Prionorhynchia* (?) *hagaviensis* (BÖSE), *Liospiriferina obtusa* (OPP.), *L.* cf. *brevirostris* (OPP.), *L.* cf. *alpina* (OPP.), *L.* aff. *sicula* (GEMM.), *L.* aff. *cordiformis* (BÖSE), *Bakonyithyris ewaldi* (OPP.), *B. ovimontana* (BÖSE), *B. apenninica* (ZITT.), *Linguithyris aspasia* (ZITT.), *Rhapidothyris* cf. *beyrichi* (OPP.), *Zeilleria alpina* (GEYER).
Age: Upper Sinemurian.

Wild 3 (approx. locality see Text-Fig. 1)
Crossing of the bottom of Wildgraben and Öderntal.

Brachiopod fauna (coll. & det. M. Siblík):
Talus blocks of white Hierlatz Limestone: *Prionorhynchia greppini* (OPP.), *Liospiriferina* cf. *obtusa* (OPP.), *L.* cf. *alpina* (OPP.), *Zeilleria alpina* (GEYER), *Z. thurwieseri* (BÖSE), *Z. baldaccii* (GEMM.).
Block of red micrites: *Piarorhynchia* aff. *pusilla* (GEMM.).
Age: Sinemurian.

Wolf 1 [N 47° 37,878’ / E 13° 56,285’]
Lithology: Contact of pinky crinoidal wacke- to packstone with violet bedded crinoidal packstone. On the southern side of the small hill is a hardground visible with borings.

Ammonite fauna (coll. & det. J. Schlögl):
Fuciniceras gr. *ambiguum* (FUCINI, 1904), *Fuciniceras* cf. *inclitum* (FUCINI, 1904), *Fuciniceras* cf. *cornacaldense* (TAUSCH, 1980), *Arieticeras* sp.
Age: Late Pliensbachian (Domerian).

Brachiopod fauna (coll. & det. M. Siblík):
Apringia paolii (CAN.), *A. diptycha* (BÖSE), *A. piccininii* (ZITT.), *Prionorhynchia* cf. *scherina* (GEMM.), *P.* cf. *flabellum* (GEMM.), *Liospiriferina* cf. *alpina* (OPP.), *L.* cf. *obtusa* (OPP.), *L.* aff. *sicula* (GEMM.), *Linguithyris aspasia* (ZITT.), *Securithyris* cf. *adnethensis* (SUESS), *Bakonyithyris apenninica* (ZITT.), *B.* aff. *ovimontana* (BÖSE), *Zeilleria mutabilis* (OPP.), *Z. alpina* (GEYER), *Z. bicolor* (BÖSE).
Age: Pliensbachian.

Wolf 3 [N 47° 37,720’ / E 13° 56,327’]
Lithology: sparitic monospecific brachiopod lumachelle.

Brachiopod fauna (coll. & det. M. Siblík):
Rhynchonellina suessi GEMM.
Age: Sinemurian.

ZF (locality see Text-Fig. 2)
Lithology: well bedded, greenish-grey siliceous(?) limestone with layers of crinoidal debris, on top of the hill also containing clasts of red Hierlatz Limestone and red “Bositra” limestone; in Text-Fig. 2 indicated as Tressenstein Limestone, but the Late Jurassic age of the matrix is not proved.

Brachiopod fauna (coll. & det. M. Siblík):
Cisnerospira cf. *sylvia* (GEMM.), *Liospiriferina* sp., *“Rhynchonella”* sp.
Age: Sinemurian.

ZS (outside the area of Text-Fig. 2, small outcrops on the SW slope of Kleiner Zwicker; for approx. position see Text-Fig. 1 and map of SCHÖLLNBERGER, 1974).
Lithology: Agatha Limestone, well bedded to nodular red limestone.

Brachiopod fauna (coll. & det. M. Siblík):
Nucleata rupicola (ZITTEL), *Fortunella* ? aff. *capillata* (ZITTEL).
Age: Late Jurassic.

Z 00 (locality see Text-Fig. 2)
Tractor road between Zwicker and Wolfskogel, curve in the uppermost part of the road.
Lithology: lumachelle with oysters and brachiopods within reefoidal Dachstein Limestone.

Brachiopod fauna (coll. & det. M. Siblík):
Fissirhynchia fissicostata (SUESS), *Oxycolpella eurycolpos* (BITTN.) juv.?, fragments of *Rhaetina gregaria* (SUESS) and *Laballa suessi* (ZUGM.).
Age: Norian–Rhaetian.

Z 01 (locality see Text-Fig. 2)
Tractor road between Zwicker and Wolfskogel, uppermost part of the road.
Lithology: 20 cm thick greenish-grey micritic limestone bed, directly resting on reefoidal Dachstein Limestone.

Conodont fauna (coll. G.W. Mandl, det. L. Krystyn):
Norigondolella steinbergensis (MOSHER); *Parvigondolella andrusovi* KOZUR & MOCK, *Zieglericonus rhaeticus* KOZUR & MOCK, *Chirodella* sp.
Age: Rhaetian 1 (Paracochloceras suessi Zone).

Z 02 (locality see Text-Fig. 2)
Tractor road between Zwicker and Wolfskogel, uppermost part.
Lithology: greenish-grey micritic limestone bed, directly resting on reefoidal Dachstein Limestone; same bed as Z 01.

Conodont fauna (coll. G.W. Mandl, det. L. Krystyn):
Norigondolella steinbergensis (MOSHER); *Zieglericonus rhaeticus* KOZUR & MOCK.
Age: Rhaetian 1 (Paracochloceras suessi Zone).

Z 07 [N 47° 37’ 43,1” / E 13° 56’ 06,1”]
Tractor road between Zwicker and Wolfskogel, uppermost part.
Lithology: grey spotted limestone with marly intercalations; crinoidal limestones, locally silicified (spiculite); with echinoid spines, rare brachiopods.

Ammonite fauna (coll. & det. J. Schlögl):
Schlotheimia sp.
Age: Late Hettangian (S. angulata Zone).

Plate 1

Sinemurian brachiopods from southwestern Totes Gebirge, coll. & det. A. Dulai.
The specimens are figured in dorsal (a), lateral (b) and anterior (c) views if not stated otherwise.

Fig. 1: *Apringia paolii* (CANAVARI, 1880).
Location Plk 1; L: 10.8 mm, W: 11.9 mm, Th: 5.6 mm.
M 2010.344.1, 2×.

Fig. 2: *Jakubirhynchia latifrons* (STUR in GEYER, 1889).
Location T 16; L: 13.8 mm, W: 16.3 mm, Th: 9.4 mm.
M 2010.345.1, 2×.

Fig. 3: *Jakubirhynchia latifrons* (STUR in GEYER, 1889).
Location T 16; L: 12.6 mm, W: 15.1 mm, Th: 8.0 mm.
M 2010.346.1, 2×.

Fig. 4: *Jakubirhynchia*? *fascicostata* (UHLIG, 1880).
Location T 16; L: 10.1 mm, W: 11.0 mm, Th: 4.8 mm.
M 2010.347.1, 2×.

Fig. 5: *Jakubirhynchia*? *laevicosta* (GEYER, 1889).
Location Plk 4; L: 10.7 mm, W: 12.4 mm, Th: 7.4 mm.
M 2010.348.1, 2×.
a – dorsal view, b – lateral view.

Fig. 6: *Prionorhynchia forticostata* (BÖCKH, 1874).
Location Plk 3a; L: 14.4 mm, W: 15.2 mm, Th: 10.8 mm.
M 2010.349.1, 2×.

Fig. 7: *Prionorhynchia*? *flabellum* (MENEGHINI in GEMMELLARO, 1874).
Location Plk 1; L: 14.2 mm, W: 18.8 mm, Th: 8.6 mm.
M 2010.350.1, 2×.

Fig. 8: *Prionorhynchia greppini* (OPPEL, 1861).
Location T 16; L: 17.4 mm, W: 20.0 mm; Th: 12.2 mm.
M 2010.351.1, 2×.

Fig. 9: *Prionorhynchia guembeli* (OPPEL, 1861).
Location Plk 4; L: 16.8 mm, W: 17.0 mm, Th: 11.2 mm.
M 2010.352.1, 2×.

Fig. 10: *Prionorhynchia* aff. *guembeli* (OPPEL, 1861).
Location Plk 3a; L: 14.6 mm, W: 15.7 mm, Th: 8.6 mm.
M 2010.353.1, 2×.

Fig. 11: *Prionorhynchia*? *hagaviensis* (BÖSE, 1898).
Location Plk 3b; L: 13.3 mm, W: 16.0 mm, Th: 7.3 mm.
M 2010.354.1, 2×.

Fig. 12: *Prionorhynchia polyptycha* (OPPEL, 1861).
Location T 13; L: 19.2 mm, W: 24.0 mm, Th: 13.2 mm.
M 2010.355.1, 2×.

Fig. 13: *Prionorhynchia pseudopolyptycha* (BÖCKH, 1874).
Location Flo 7; L: 15.2 mm, W: 19.2 mm, Th: 10.7 mm.
M 2010.356.1, 2×.

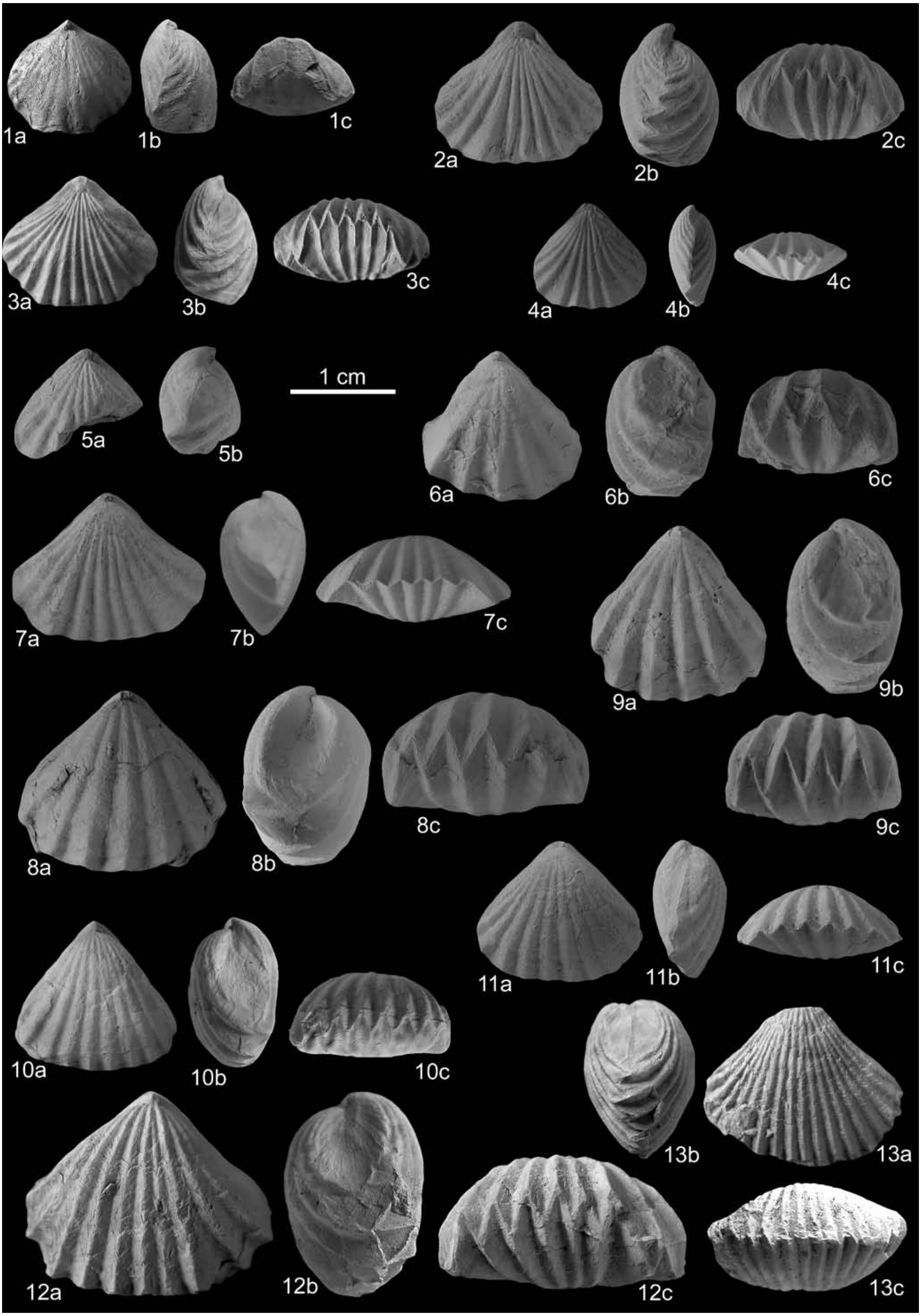

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Plate 2

Sinemurian brachiopods from southwestern Totes Gebirge, coll. & det. A. Dulai.
a – dorsal view, b – lateral view, c – anterior view.

Fig. 1: *Cirpa briseis* (Gemmellaro, 1874).
Location Plk 3a; L: 17.1 mm, W: 17.4 mm, Th: 9.8 mm.
M 2010.357.1, 2×.

Fig. 2: *Cirpa planifrons* (Ormós, 1937).
Location T 16; L: 20.5 mm, W: 23.6 mm, Th: 15.1 mm.
M 2010.358.1, 2×.

Fig. 3: *Cirpa*? *subcostellata* (Gemmellaro, 1878).
Location Flo 7; L: 10.5 mm, W: 11.9 mm, Th: 5.7 mm.
M 2010.359.1, 2×.

Fig. 4: *Calcirhynchia*? *hungarica* (Böckh, 1874).
Location Plk 4; L: 13.8 mm, W: 14.9 mm, Th: 7.5 mm.
M 2010.360.1, 2×.

Fig. 5: *Calcirhynchia*? *hungarica* (Böckh, 1874).
Location Plk 3b; L: 12.7 mm, W: 14.7 mm, Th: 6.7 mm.
M 2010.361.1, 2×.

Fig. 6: *Calcirhynchia*? aff. *hungarica* (Böckh, 1874).
Location Plk 4; L: 18.2 mm, W: 20.2 mm, Th: 12.0 mm.
M 2010.362.1, 2×.

Fig. 7: *Calcirhynchia* aff. *zugmayeri* (Gemmellaro, 1878).
Location Plk 4; L: 13.6 mm, W: 12.9 mm, Th: 7.5 mm.
M 2010.363.1, 2×.

Fig. 8: *Salgirella* aff. *albertii* (Oppel, 1861).
Location Plk 1; L: 16.2 mm, W: 18.3 mm, Th: 8.6 mm.
M 2010.364.1, 2×.

Fig. 9: *Homoeorhynchia*? *prona* (Oppel, 1861).
Location T 1/10; L: 12.8 mm, W: 14.9 mm, Th: 6.4 mm.
M 2010.365.1, 2×.

Fig. 10: *Piarorhynchia*? *caroli* (Gemmellaro, 1878).
Location Plk 1; L: 8.7 mm, W: 10.3 mm, Th: 6.3 mm.
M 2010.366.1, 2×.

Fig. 11: *Cuneirhynchia cartieri* (Oppel, 1861).
Location Plk 4; L: 9.5 mm, W: 10.9 mm, Th: 6.2 mm.
M 2010.367.1, 2×.

Fig. 12: *Cuneirhynchia fraasi* (Oppel, 1861).
Location Plk 4; L: 13.9 mm, W: 12.9 mm, Th: 10.5 mm.
M 2010.368.1, 2×.

Fig. 13: *Cuneirhynchia retusifrons* (Oppel, 1861).
Location Plk 4; L: 8.3 mm, W: 10.0 mm, Th: 6.4 mm.
M 2010.369.1, 2×.

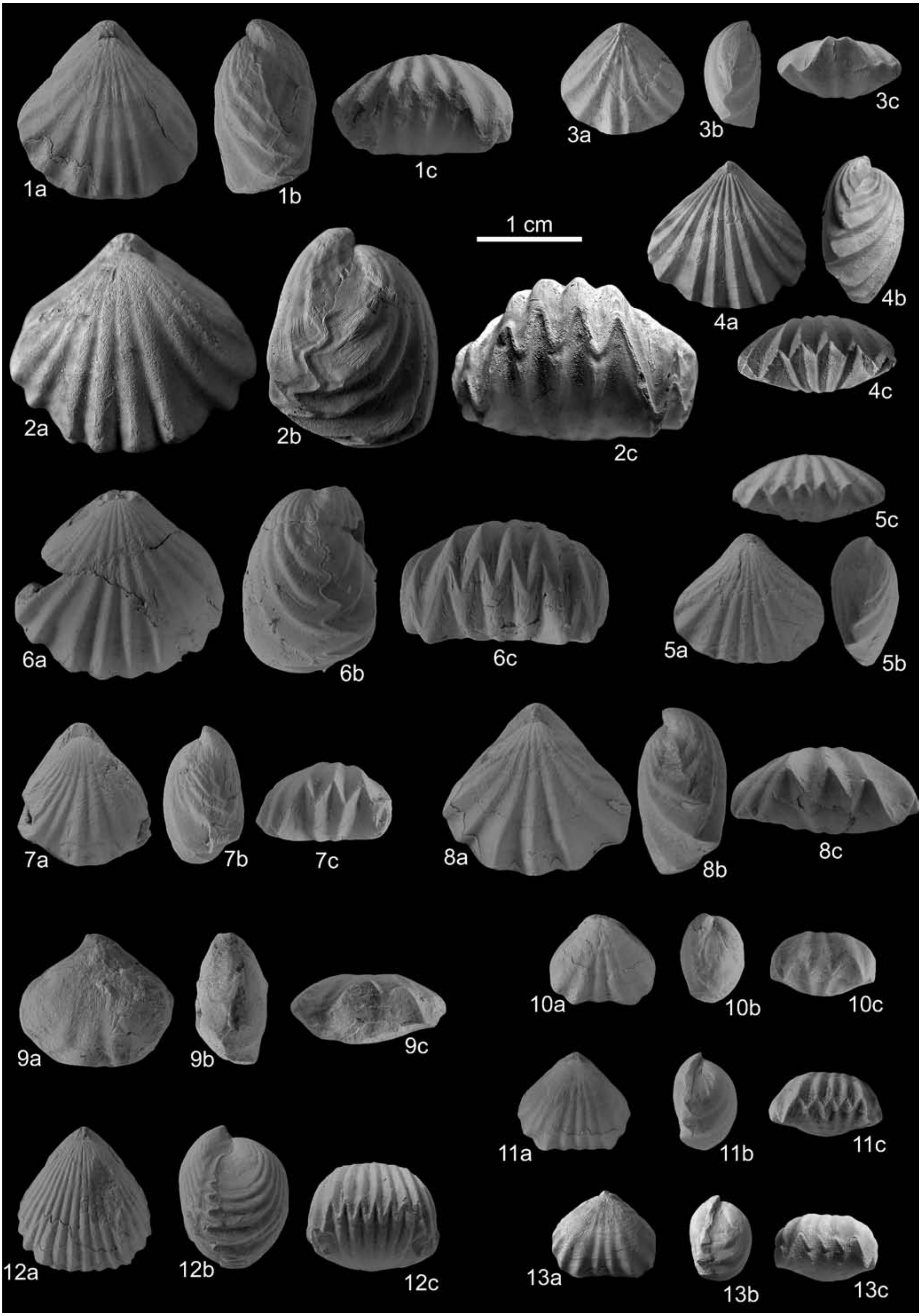
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Plate 3

Sinemurian brachiopods from southwestern Totes Gebirge, coll. & det. A. Dulai.

Fig. 1: *Gibbirhynchia*? *sordellii* (PARONA, 1880).
a – dorsal view, b – lateral view, c – anterior view.
Location Plk 3b; L: 13.3 mm, W: 13.1 mm, Th: 9.9 mm.
M 2010.370.1, 2×.

Fig. 2: *Gibbirhynchia*? *sordellii* (PARONA, 1880).
a – dorsal view, b – lateral view, c – anterior view.
Location Plk 3b; L: 13.4 mm, W: 12.9 mm, Th: 11.0 mm.
M 2010.371.1, 2×.

Fig. 3: *Liospiriferina acuta* (STUR in GEYER, 1889).
a – dorsal view, b – lateral view.
Location Flo 7; L: 13.3 mm, W: 14.5 mm, Th: 14.0 mm.
M 2010.372.1, 2×.

Fig. 4: *Liospiriferina alpina* (OPPEL, 1861).
a – dorsal view, b – lateral view, c – anterior view.
Location Plk 3a; L: 18.4 mm, W: 17.9 mm, Th: 10.7 mm.
M 2010.373.1, 2×.

Fig. 5: *Liospiriferina brevirostris* (OPPEL, 1861).
a – dorsal view, b – lateral view, c – anterior view.
Location Flo 7; L: 19.1 mm, W: 17.1 mm, Th: 11.1 mm.
M 2010.374.1, 2×.

Fig. 6: *Liospiriferina gryphoidea* (UHLIG, 1880).
a – ventral view, b – lateral view.
Location Plk 3b; L: 24.5 mm, W: 21.1 mm, Th: 14.1 mm.
M 2010.375.1, 2×.

Fig. 7: *Liospiriferina obtusa* (OPPEL, 1861).
a – dorsal view, b – lateral view, c – anterior view.
Location T 13; L: 15.6 mm, W: 18.6 mm, Th: 12.4 mm.
M 2010.376.1, 2×.

Fig. 8: *Liospiriferina* aff. *obtusa* (OPPEL, 1861).
a – dorsal view, b – lateral view, c – anterior view.
Location Flo 7; L: 12.7 mm, W: 15.4 mm, Th: 9.2 mm.
M 2010.377.1, 2×.

Fig. 9: *Liospiriferina salomoni* (BÖSE, 1898).
a – dorsal view, b – lateral view, c – ventral view.
Location Plk 1; L: 18.2 mm, W: 14.7 mm.
M 2010.378.1, 2×.

Fig. 10: *Liospiriferina sicula* (GEMMELLARO, 1874).
a – dorsal view.
Location T 13; L: 17.3 mm, W: 24.0 mm.
M 2010.379.1, 2×.

Fig. 11: *Liospiriferina semicircularis* (BÖSE, 1898).
a – dorsal view, b – lateral view.
Location Plk 4; L: 22.6 mm, W: 26.5 mm, Th: 13.2 mm.
M 2010.380.1, 2×.

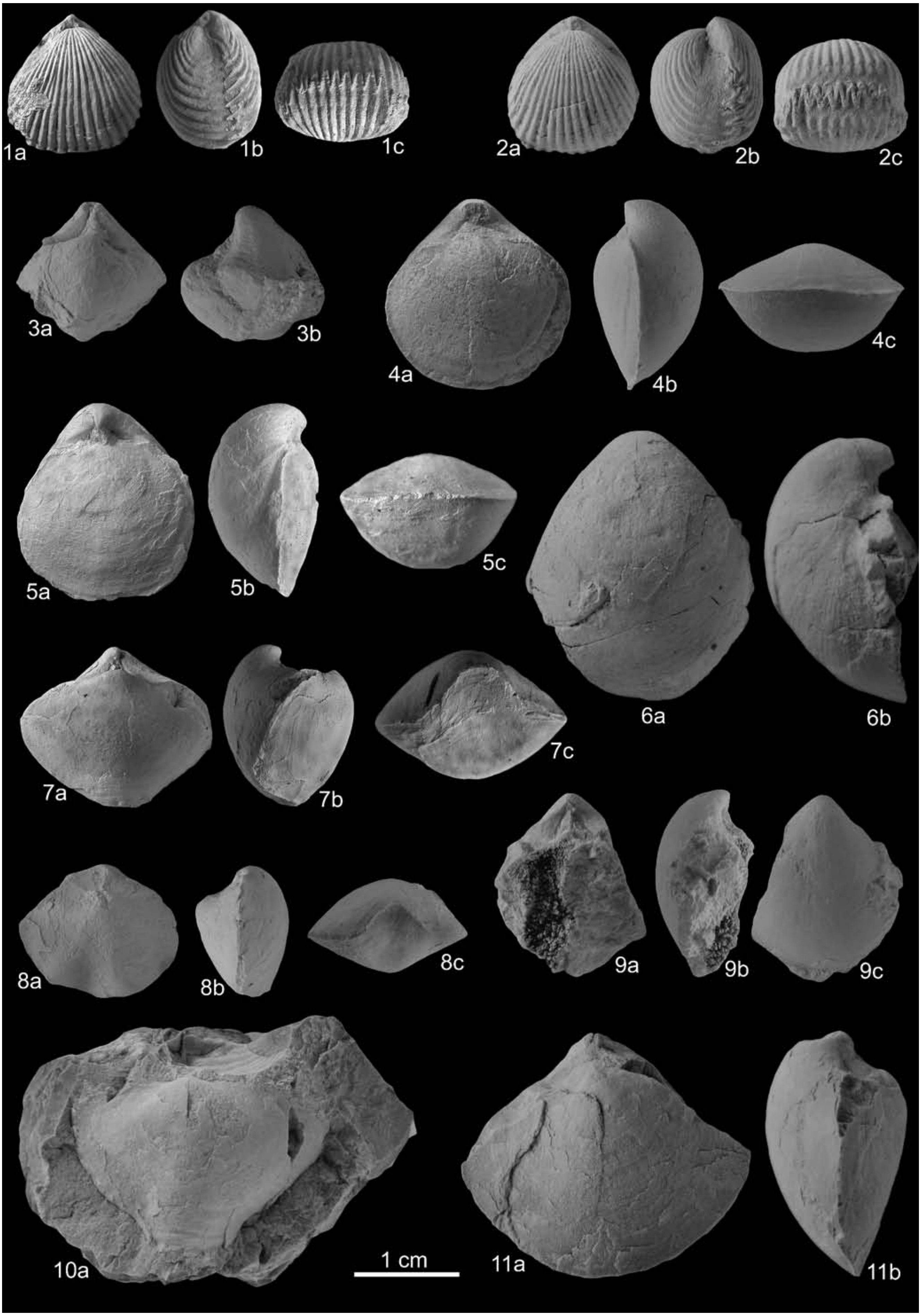
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Plate 4

Sinemurian brachiopods from southwestern Totes Gebirge, coll. & det. A. Dulai.

Fig. 1: *Liospiriferina* sp.
a – dorsal view, b – lateral view, c – ventral view.
Location Plk 1; L: 33.0 mm, W: 35.4 mm, Th: 23.2 mm.
M 2010.381.1, 2×.

Fig. 2: *Cisnerospira angulata* (Oppel, 1861).
a – dorsal view, b – lateral view, c – ventral view.
Location T 16; L: 21.3 mm, W: 24.2 mm, Th: 16.8 mm.
M 2010.382.1, 2×.

Fig. 3: *Cisnerospira darwini* (Gemmellaro, 1878).
a – dorsal view, b – lateral view.
Location Plk 3a; L: 16.3 mm, W: 13.6 mm, Th: 9.7 mm.
M 2010.383.1, 2×.

Fig. 4: *Cisnerospira darwini* (Gemmellaro, 1878).
a – dorsal view, b – lateral view, c – anterior view.
Location Plk 3a; L: 20.1 mm, W: 19.7 mm, Th: 14.0 mm.
M 2010.384.1, 2×.

Fig. 5: *Cisnerospira* aff. *darwini* (Gemmellaro, 1878).
a – dorsal view, b – lateral view, c – anterior view.
Location Plk 1; L: 11.7 mm, W: 14.4 mm, Th: 8.1 mm.
M 2010.385.1, 2×.

Fig. 6: *Cisnerospira sylvia* (Gemmellaro, 1878).
a – dorsal view, b – lateral view.
Location Flo 7; L: 16.4 mm, W: 14.9 mm, Th: 11.2 mm.
M 2010.386.1, 2×.

Fig. 7: *Lobothyris punctata* (Sowerby, 1812).
a – dorsal view, b – lateral view, c – anterior view.
Location Plk 3a; L: 17.6 mm, W: 15.8 mm, Th: 7.0 mm.
M 2010.387.1, 2×.

Fig. 8: *Lobothyris andleri* (Oppel, 1861).
a – dorsal view, b – lateral view, c – anterior view.
Location Plk 1; L: 26.2 mm, W: 23.2 mm, Th: 11.5 mm.
M 2010.388.1, 2×

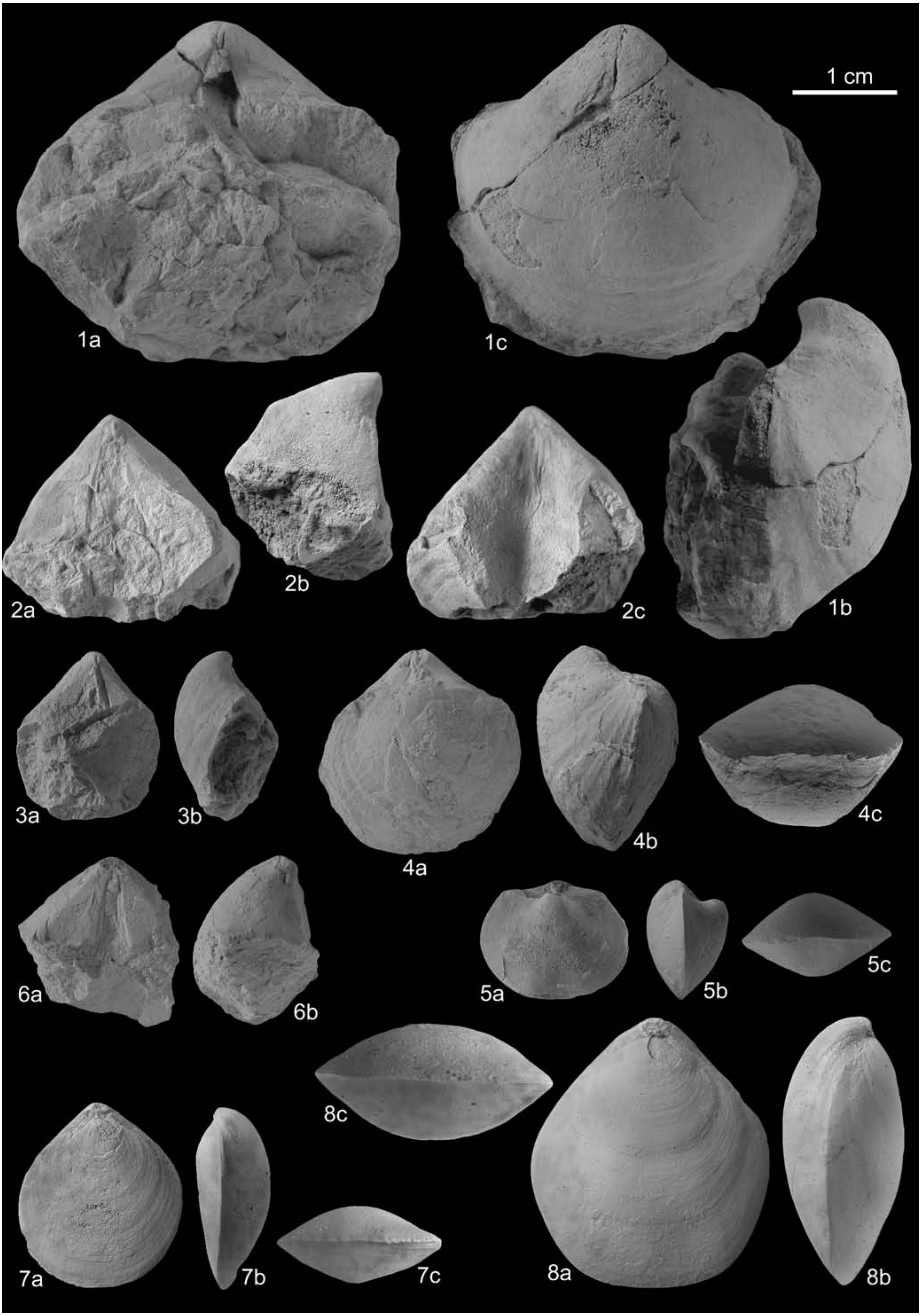
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Plate 5

Sinemurian brachiopods from southwestern Totes Gebirge, coll. & det. A. Dulai.
The specimens are figured in dorsal (a), lateral (b) and anterior (c) views if not stated otherwise.

Fig. 1: *Lobothyris delta* (NEUMAYR, 1879).
Location Plk 3a; L: 28.5 mm, W: 22.4 mm, Th: 15.2 mm.
M 2010.389.1, 2×.

Fig. 2: *Linguithyris aspasia* (ZITTEL, 1869).
Location Plk 1; L: 8.6 mm, W: 9.6 mm, Th: 5.0 mm.
M 2010.390.1, 2×.

Fig. 3: *Papodina bimammata* (ROTHPLETZ, 1886).
Location Plk 4; L: 9.9 mm, W: 6.7 mm, Th: 5.6 mm.
M 2010.391.1, 2×.
a – dorsal view, b – lateral view.

Fig. 4: *Zeilleria alpina* (GEYER, 1889).
Location Plk 3a; L: 12.1 mm, W: 10.9 mm, Th: 4.8 mm.
M 2010.392.1, 2×.

Fig. 5: *Zeilleria baldaccii* GEMMELLARO, 1874.
Location Flo 7; L: 14.6 mm, W: 12.3 mm, Th: 6.9 mm.
M 2010.393.1, 2×.

Fig. 6: *Zeilleria batilla* (GEYER, 1889).
Location Plk 3b; L: 11.9 mm, W: 10.4 mm, Th: 7.2 mm.
M 2010.394.1, 2×.

Fig. 7: *Zeilleria bicolor* (BÖSE, 1898).
Location Plk 3b; L: 12.3 mm, W: 10.6 mm, Th: 6.2 mm.
M 2010.395.1, 2×.

Fig. 8: *Zeilleria choffati* (HAAS, 1885).
Location Plk 1; L: 17.6 mm, W: 15.7 mm, Th: 10.0 mm.
M 2010.396.1, 2×.

Fig. 9: *Zeilleria engelhardti* (OPPEL, 1861).
Location Flo 8; L: 21.0 mm, W: 16.8 mm, Th: 11.7 mm.
M 2010.397.1, 2×.

Fig. 10: *Zeilleria mutabilis* (OPPEL, 1861).
Location T 16; L: 16.5 mm, W: 16.0 mm, Th: 7.8 mm.
M 2010.398.1, 2×.

Fig. 11: *Zeilleria perforata* (PIETTE, 1856).
Location Plk 4; L: 11.8 mm, W: 10.9 mm, Th: 8.1 mm.
M 2010.399.1, 2×.

Fig. 12: *Zeilleria oenana* (BÖSE, 1898).
Location Plk 1; L: 13.2 mm, W: 13.7 mm, Th: 6.1 mm.
M 2010.400.1, 2×.

Fig. 13: *Zeilleria* aff. *oenana* (BÖSE, 1898).
Location Flo 7; L: 15.2 mm, W: 18.2 mm, Th: 6.9 mm.
M 2010.401.1, 2×.

Fig. 14: *Zeilleria subnumismalis* (DAVIDSON, 1851).
Location Plk 4; L: 23.3 mm, W: 21.2 mm, Th: 12.0 mm.
M 2010.402.1, 2×.

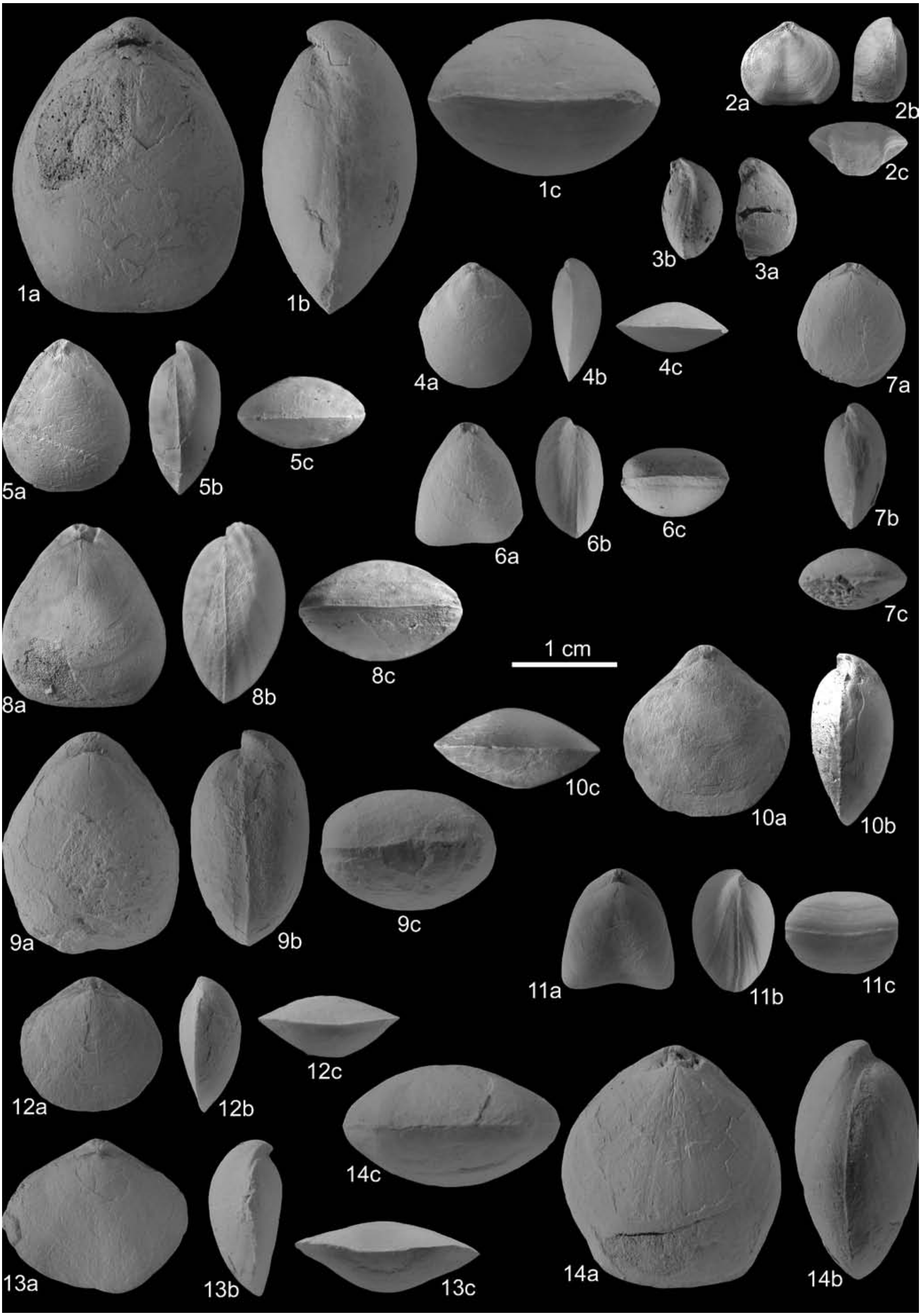
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Plate 6

Sinemurian brachiopods from southwestern Totes Gebirge, coll. & det. A. Dulai.

Fig. 1: *Zeilleria stapia* (Oppel, 1861).
a – dorsal view, b – lateral view, c – anterior view.
Location Plk 3a; L: 12.2 mm, W: 10.5 mm, Th: 7.4 mm.
M 2010.403.1, 2×.

Fig. 2: *Zeilleria venusta* (Uhlig, 1879).
a – dorsal view, b – lateral view, c – anterior view.
Location Plk 3a; L: 13.0 mm, W: 10.8 mm, Th: 10.0 mm.
M 2010.404.1, 2×.

Fig. 3: *Bakonyithyris ewaldi* (Oppel, 1861).
a – dorsal view, b – lateral view, c – anterior view.
Location Plk 3a; L: 15.6 mm, W: 16.9 mm, Th: 9.4 mm.
M 2010.405.1, 2×.

Fig. 4: *Securina hierlatzica* (Oppel, 1861).
a – dorsal view, b – lateral view, c – anterior view.
Location Flo 7; L: 15.7 mm, W: 13.6 mm, Th: 9.7 mm.
M 2010.406.1, 2×.

Fig. 5: *Securina securiformis* (Gemmellaro, 1874).
a – dorsal view, b – lateral view, c – anterior view.
Location Flo 7; L: 14.9 mm, W: 18.3 mm, Th: 10,9 mm.
M 2010.407.1, 2×.

Fig. 6: *Salgirella* cf. *albertii* (Oppel, 1861).
a – dorsal view, b – lateral view.
Location Flo 8; L: 23.9 mm, W: 27.2 mm, Th: 15.4 mm.
M 2010.408.1, 2×.

Fig. 7: *Jakubirhynchia*? *fascicostata* (Uhlig, 1880).
dorsal view.
Location Plk 3b; L: 5.5 mm, W: 6.1 mm, Th: 2.4 mm.
M 2010.414.1, 6×.

Fig. 8: *Prionorhynchia hagaviensis* (Böse, 1898).
dorsal view.
Location T 16; L: 7.7 mm, W: 6.9 mm, Th: 4.1 mm.
M 2010.409.1, 6×.

Fig. 9: *Pisirhynchia pisoides* (Zittel, 1869).
dorsal view.
Location T 19; L: 6.4 mm, W: 6.2 mm, Th: 5.0 mm.
M 2010.410.1, 6×.

Fig. 10: *Pisirhynchia inversa* (Oppel, 1861).
dorsal view.
Location T 16; L: 5.6 mm, W: 6.2 mm, Th: 3.7 mm.
M 2010.412.1, 6×.

Fig. 11: *Pisirhynchia inversa* (Oppel, 1861).
anterior view.
Location Plk 1; L: 6.3 mm, W: 7.0 mm, Th: 5.2 mm.
M 2010.413.1, 6×.

Fig. 12: *Pisirhynchia retroplicata* (Zittel, 1869).
dorsal view.
Location Plk 1; L: 7.0 mm, W: 7.8 mm, Th: 4.4 mm.
M 2010.411.1, 6×.

Fig. 13: *Koninckodonta waehneri* (Bittner, 1894).
dorsal view.
Location Plk 3b; L: 5.0 mm, W: 5.0 mm, Th: 1.6 mm.
M 2010.416.1, 6×.

Fig. 14: *Koninckodonta waehneri* (Bittner, 1894).
ventral view.
Location Plk 3b; L: 4.5 mm, W: 5.2 mm, Th: 1.8 mm.
M 2010.417.1, 6×.

Fig. 15: *Koninckodonta waehneri* (Bittner, 1894).
lateral view.
Location Plk 3b; L: 4.2 mm, W: 5.2 mm, Th: 1.5 mm.
M 2010.418.1, 6×.

Fig. 16: *Linguithyris aspasia* juv. (Zittel, 1869).
dorsal view.
Location Plk 1; L: 6.0 mm, W: 5.8 mm, Th: 2.4 mm.
M 2010.419.1, 6×.

Fig. 17: *Zeilleria alpina* juv. (Geyer, 1889).
dorsal view.
Location Plk 3a; L: 4.7 mm, W: 4.4 mm, Th: 1.8 mm.
M 2010.420.1, 6×.

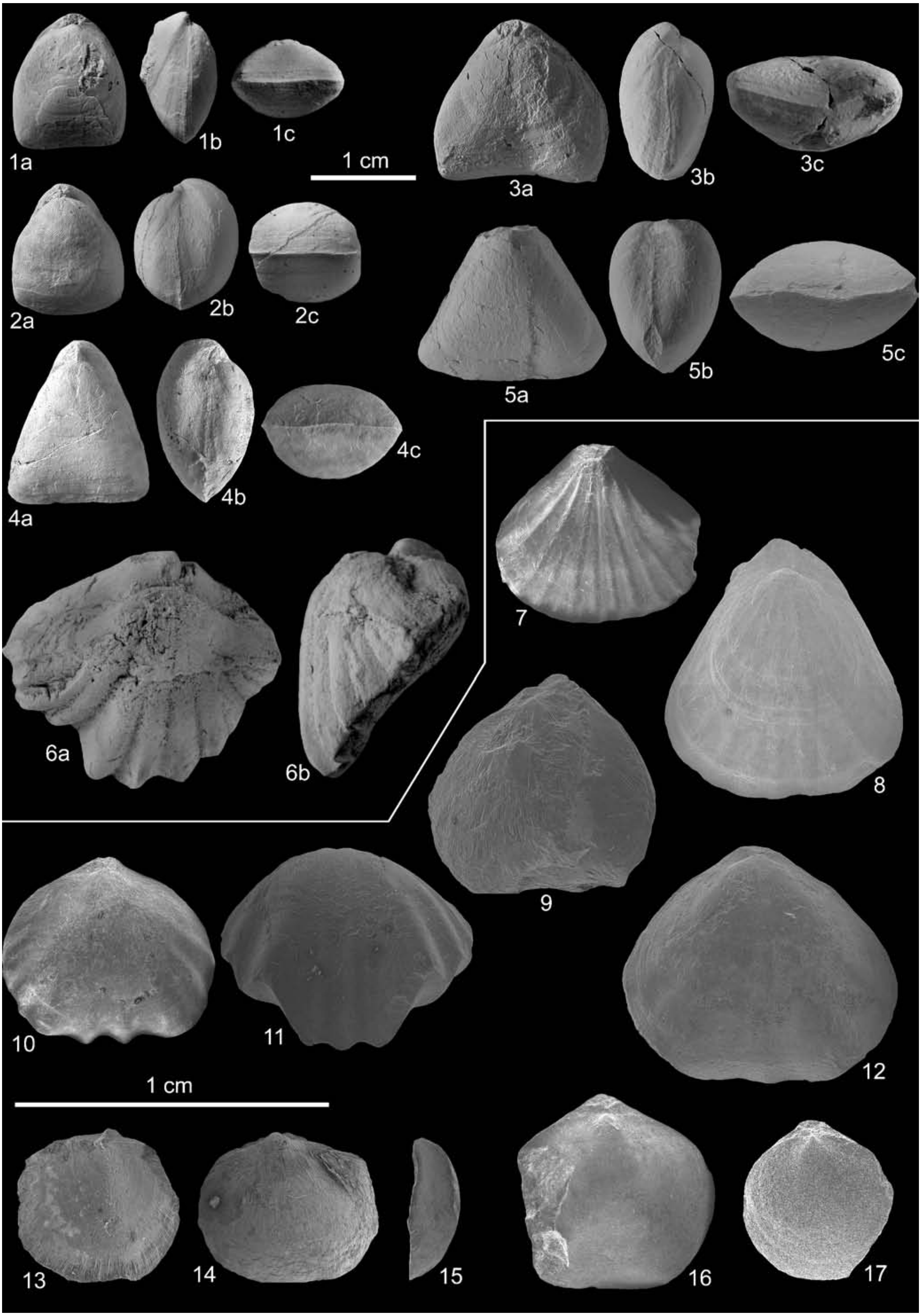
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Plate 7

Brachiopods from southwestern Totes Gebirge, coll. & det. M. Siblík.
The specimens are figured in dorsal (a), lateral (b) and anterior (c) views if not stated otherwise.

Fig. 1: *Cirpa briseis* (Gemmellaro, 1874).
Location Klaus 3; L: 17.0 mm, W: 17.6 mm, Th: 12.4 mm.
Pliensbachian.
GBA 2010/091/0001, 2×.

Fig. 2: *Pisirhynchia retroplicata* (Zittel, 1869).
Location Flo 5; L: 6.5mm, W: 6.8mm, Th: 4.5 mm.
Pliensbachian.
GBA 2010/091/0002, 3×.

Fig. 3: *Cirpa fronto* (Quenstedt, 1871).
Location 8; L: 17.0 mm, W: 19.2 mm, Th: 13.5 mm.
Sinemurian.
GBA 2010/091/0003, 2×.

Fig. 4: *Prionorhynchia* (?) *hagaviensis* (Böse, 1898).
Location Klaus 3; L: 11.6 mm, W: 12.0 mm, Th: 7.0 mm.
Pliensbachian.
GBA 2010/091/0004, 2×.

Fig. 5: *Cirpa fronto* (Quenstedt, 1871).
Location Plk 9; L: 17.5 mm, W: 20.0 mm, Th: 13.0 mm.
Sinemurian.
GBA 2010/091/0005, 2×.

Fig. 6: *Salgirella albertii* (Oppel, 1861).
Location Plk 5; L: 23.0 mm, W: 27.6 mm, Th: 17.7 mm.
red Hierlatz Lm., Sinemurian.
GBA 2010/091/0006, 1.5×.

Fig. 7: *Prionorhynchia belemnitica* (Quenstedt, 1858).
Location Flo 3/1; L: 15.0 mm, W: 17.8 mm, Th: 10.7 mm.
Sinemurian.
GBA 2010/091/0007, 2×.

Fig. 8: *Prionorhynchia greppini* (Oppel, 1861).
Location 8; L: 17.5 mm, W: 18.5 mm, Th: 10.5 mm.
Sinemurian.
GBA 2010/091/0008, 2×.

Fig. 9: *Salgirella albertii* (Oppel, 1861).
Between K 04/1 and Stub 1; L: 22.5 mm, W: 26.5 mm, Th: 14.5 mm.
red micrites, Sinemurian.
GBA 2010/091/0009, 1.5×.

Fig. 10: *Prionorhynchia* aff. *belemnitica* (Quenstedt, 1858).
Location Plk 4; L: 13.0 mm, W: 15.0 mm, Th: 10.4 mm.
Sinemurian.
GBA 2010/091/0010, 2×.

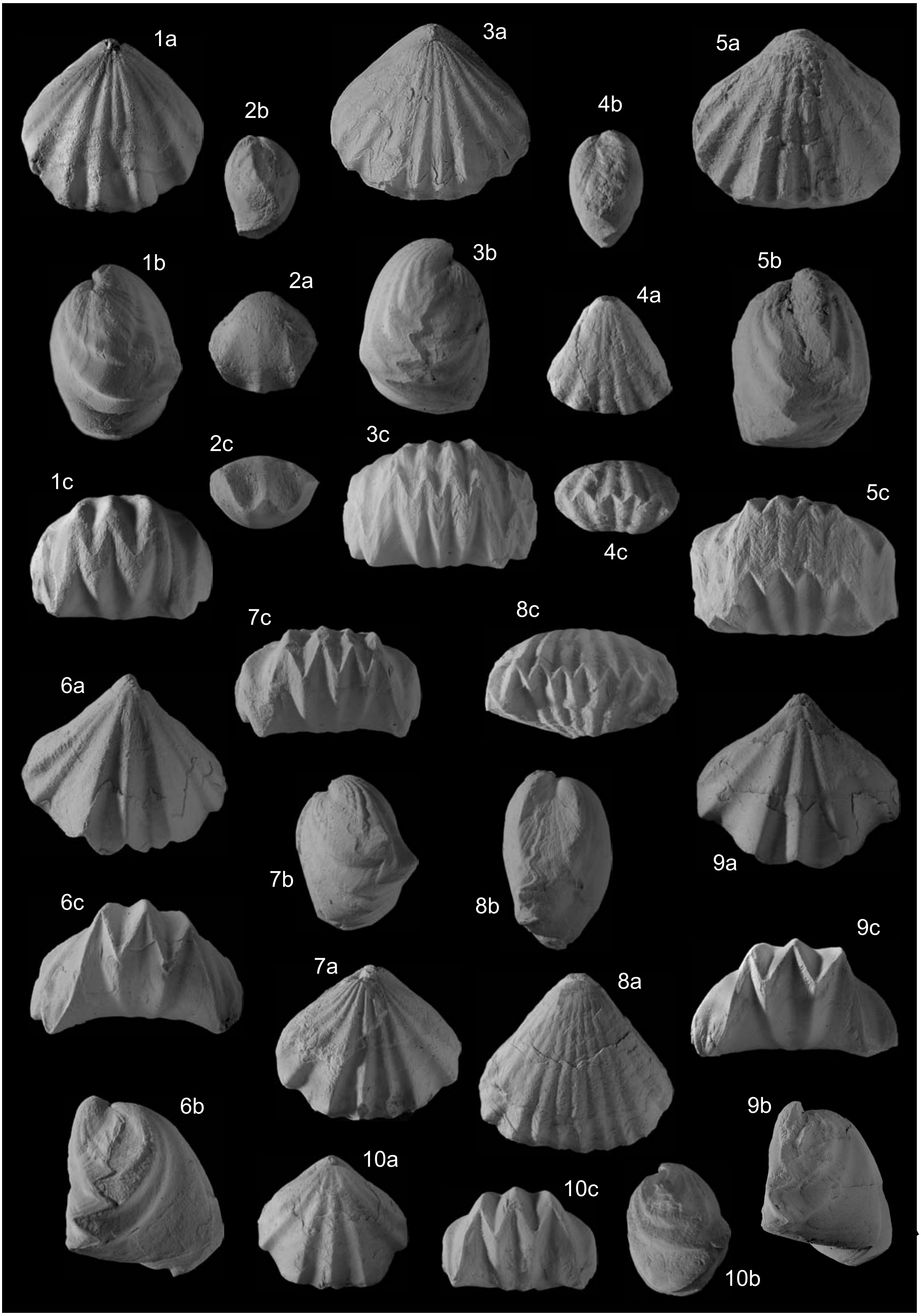
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Plate 8

Brachiopods from southwestern Totes Gebirge, coll. & det. M. Siblík.
The specimens are figured in dorsal (a), lateral (b) and anterior (c) views if not stated otherwise.

Fig. 1: *"Rhynchonella"* aff. *latissima* FUCINI, 1894.
Location Flo 4; L: 15.5 mm, W: 20.2 mm, Th: 8.5 mm.
Sinemurian.
GBA 2010/091/0011, 2×.

Fig. 2: *"Rhynchonella"* aff. *latissima* FUCINI, 1894.
Location 9; L: 18.0 mm, W: 22.8 mm, Th: 11.0 mm. Specimen with extreme plication.
Upper (?) Sinemurian.
GBA 2010/091/0012, 2×.

Fig. 3: *Cuneirhynchia* (?) *palmata* (OPPEL, 1861).
Location Flo 4; L: 15.3 mm, W: 22.8 mm, Th: 11.5 mm.
Sinemurian.
GBA 2010/091/0013, 2×.

Fig. 4: *Prionorhynchia greppini rimata* (GEYER, 1889).
Location Klb 6; L: 20.2 mm, W: 22.4 mm, Th: 13.5 mm.
Sinemurian.
GBA 2010/091/0014, 2×.

Fig. 5: *Prionorhynchia* aff. *calderinii* (PARONA, 1880).
Location Klb 6; ca. L: 19.0 mm, W: 26.0 mm, Th: 14.5 mm.
red Hierlatz Lm., Sinemurian.
GBA 2010/091/0015, 1.5×.

Fig. 6: *Apringia diptycha* (BÖSE, 1898).
Location Wolf 1; L: 14.2 mm, W: 14.5 mm, Th: 7.8 mm.
Pliensbachian.
GBA 2010/091/0016, 2×.

Fig. 7: *Septocrurella uhligi* (HAAS, 1884).
Location Plankeraumoos, S of Location Plk 1; L: 11.2 mm, W: 13.0 mm, Th: 6.2 mm.
Sinemurian.
GBA 2010/091/0017, 2×.

Fig. 8: *Prionorhynchia flabellum* (GEMMELLARO, 1874).
Location Flo 5; L: 14.8 mm, W: 17.0 mm, Th: 8.0 mm.
Pliensbachian.
GBA 2010/091/0018, 2×.

Fig. 9: *Cuneirhynchia retusifrons* (OPPEL, 1861).
Location Klb 2; L: 10.0 mm, W: 12.8 mm, Th: 7.4 mm.
Sinemurian.
GBA 2010/091/0019, 2×.

Fig. 10: *Cuneirhynchia retusifrons* (OPPEL, 1861).
Location Flo 3/2; L: 11.4 mm, W: 13.0 mm, Th: 8.5 mm.
Sinemurian.
GBA 2010/091/0020, 2×.

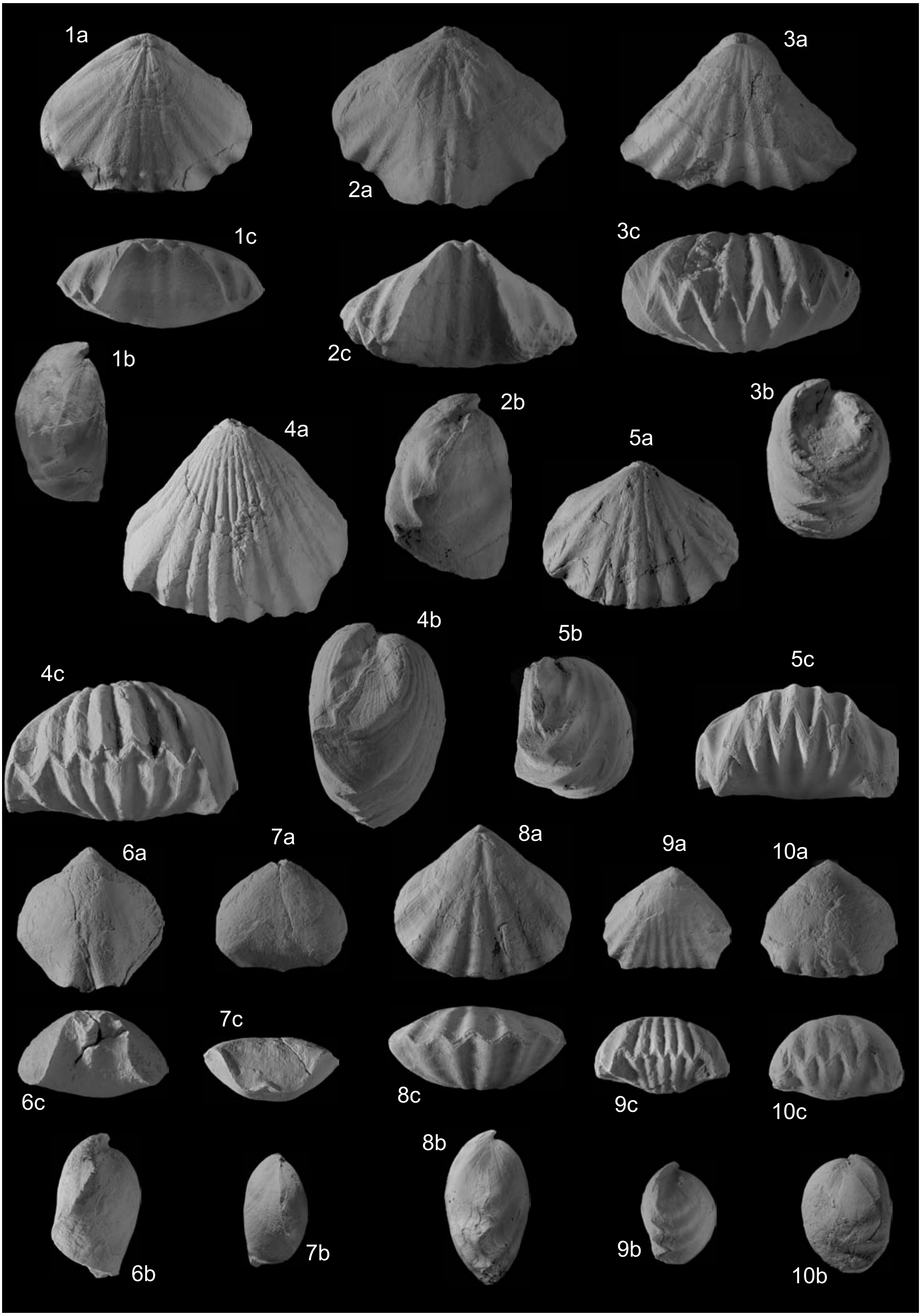
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Plate 9

Brachiopods from southwestern Totes Gebirge, coll. & det. M. Siblík.
The specimens are figured in dorsal (a), lateral (b) and anterior (c) views if not stated otherwise.

Fig. 1: *Securina hierlatzica* (OPPEL, 1861).
Location 9; L: 17.0 mm, W: 18.6 mm, Th: 11.5 mm.
Upper (?) Sinemurian.
GBA 2010/091/0021, 2×.

Fig. 2: *Koninckodonta* cf. *pichleri* (BITTNER, 1893).
a – ventral view, b – dorsal view.
Location Flo 5; L: 7.4 mm, W: 9.0 mm.
Pliensbachian.
GBA 2010/091/0022, 3×.

Fig. 3: *Liospiriferina* aff. *sicula* (GEMMELLARO, 1874).
Location 9; L: 14.8 mm, W: 18.2 mm, Th: 13.0 mm.
Upper (?) Sinemurian.
GBA 2010/091/0023, 2×.

Fig. 4: *Liospiriferina brevirostris* (OPPEL, 1861).
Location K 04; L: 20.7 mm, W: 18.4 mm, Th: 11.7 mm.
Sinemurian.
GBA 2010/091/0024, 2×.

Fig. 5: *Salgirella albertii* (OPPEL, 1861).
Location Plk 9; L: 14.2 mm, W: 16.0 mm, Th: 10.8 mm.
Sinemurian.
GBA 2010/091/0025, 2×.

Fig. 6: *Liospiriferina cordiformis* (BÖSE, 1898).
Location Flo 5; L: 13.0 mm, W: 13.0 mm, Th: 10.2 mm.
Pliensbachian.
GBA 2010/091/0026, 2×.

Fig. 7: *Oxycolpella eurycolpos* (BITTNER, 1890) juv.
Uppermost part of the section Z 1 – Z 15; L: 16.0 mm, W: 17.4 mm, Th: 10.0 mm.
Upper Triassic.
GBA 2010/091/0027, 2×.

Fig. 8: *Jakubirhynchia latifrons* (STUR in GEYER, 1889).
Location 9; L: 14.5 mm, W: 18.7 mm, Th: 9.0 mm.
Upper (?) Sinemurian.
GBA 2010/091/0028, 2×.

Fig. 9: *Liospiriferina obtusa* (OPPEL, 1861).
Location Klb 2; L: 15.3 mm, W: 17.5 mm, Th: 10.5 mm.
Sinemurian.
GBA 2010/091/0029, 2×.

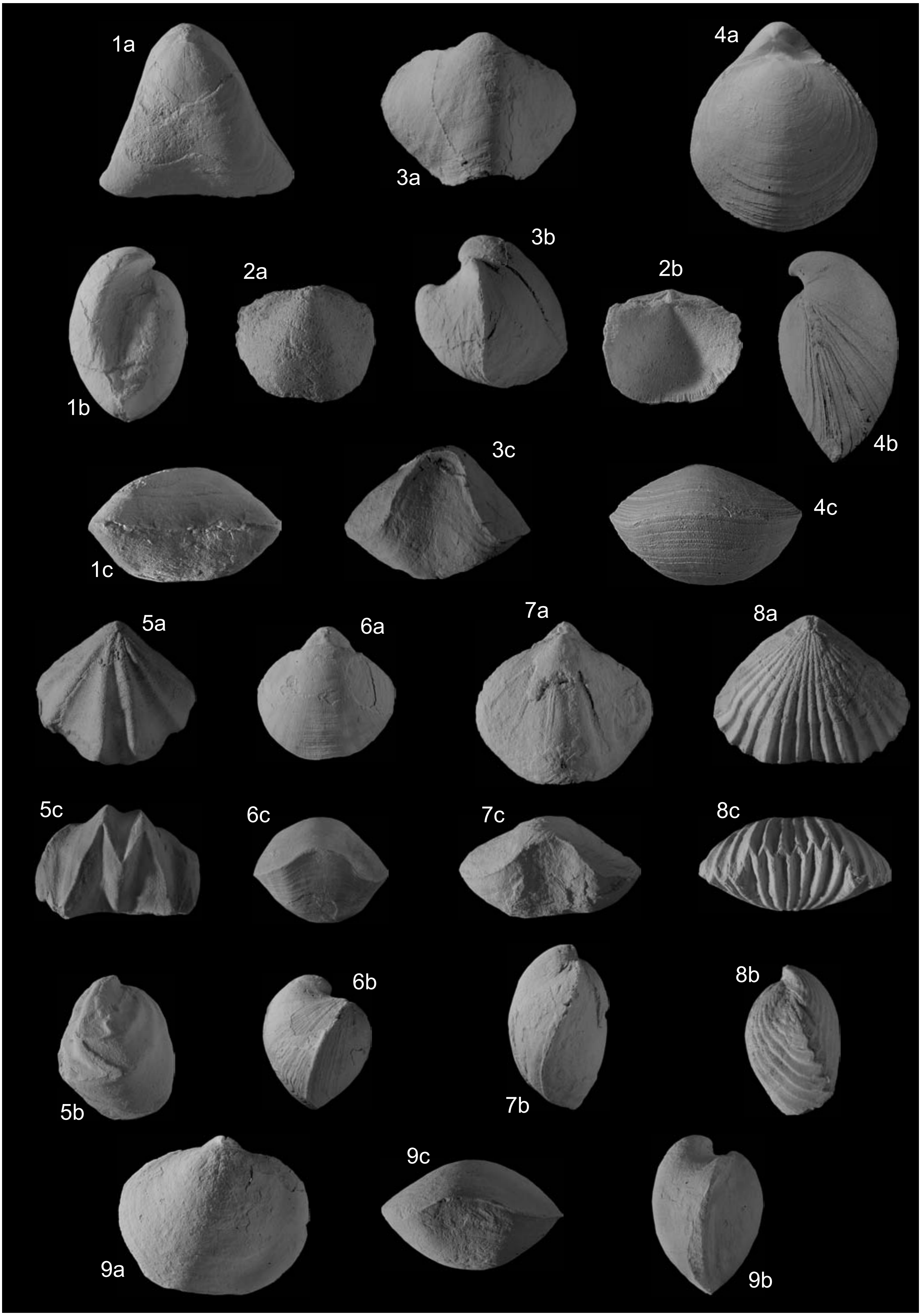
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Plate 10

Brachiopods from southwestern Totes Gebirge, coll. & det. M. Siblík.
The specimens are figured in dorsal (a), lateral (b) and anterior (c) views if not stated otherwise.

Fig. 1: *Securithyris adnethensis* (SUESS, 1855).
ENE of Location Flo 5; L: 26.7 mm, W: 20.6 mm, Th: 16.4 mm.
Pliensbachian.
GBA 2010/091/0030, 2×.

Fig. 2: *Securithyris* aff. *paronai* (CANAVARI, 1880).
Location Flo 5; L: 17.3 mm, W: 20.8 mm, Th: 11.3 mm.
Pliensbachian.
GBA 2010/091/0031, 2×.

Fig. 3: *Viallithyris gozzanensis* (PARONA, 1880).
Location Flo 5; L: 26.0 mm, W: 26.4 mm, Th: 16.0 mm.
Pliensbachian.
GBA 2010/091/0032, 2×.

Fig. 4: *Antiptychina* (?) *rothpletzi* (DI STEFANO, 1891).
Location Flo 3/3; L: 16.5 mm, W: 15.0 mm, Th: 9.4 mm.
Sinemurian.
GBA 2010/091/0033, 2×.

Fig. 5: *Rhapidothyris beyrichi* (OPPEL, 1861).
Location Flo 3/1; L: 17.5 mm, W: 16.3 mm, Th: 9.5 mm.
Sinemurian.
GBA 2010/091/0034, 2×.

Fig. 6: *Prionorhynchia* (?) aff. *belemnitica* (QUENSTEDT, 1858).
Location Plk 9; L: 13.6 mm, W: 16.8 mm, Th: 7.6 mm.
Sinemurian.
2010/091/0035, 2×.

Fig. 7: *“Terebratula”* aff. *ascia* GIRARD, 1843.
Location 10; L: 16.4 mm, W: 12.0 mm, Th: 8.6 mm.
Sinemurian.
GBA 2010/091/0036, 2×.

Fig. 8: *Linguithyris aspasia* (ZITTEL, 1869).
Wildgraben, middle part of slope; L: 10.8 mm, W: 17.2 mm, Th: 7.4 mm.
Upper Sinemurian.
GBA 2010/091/0037, 2×.

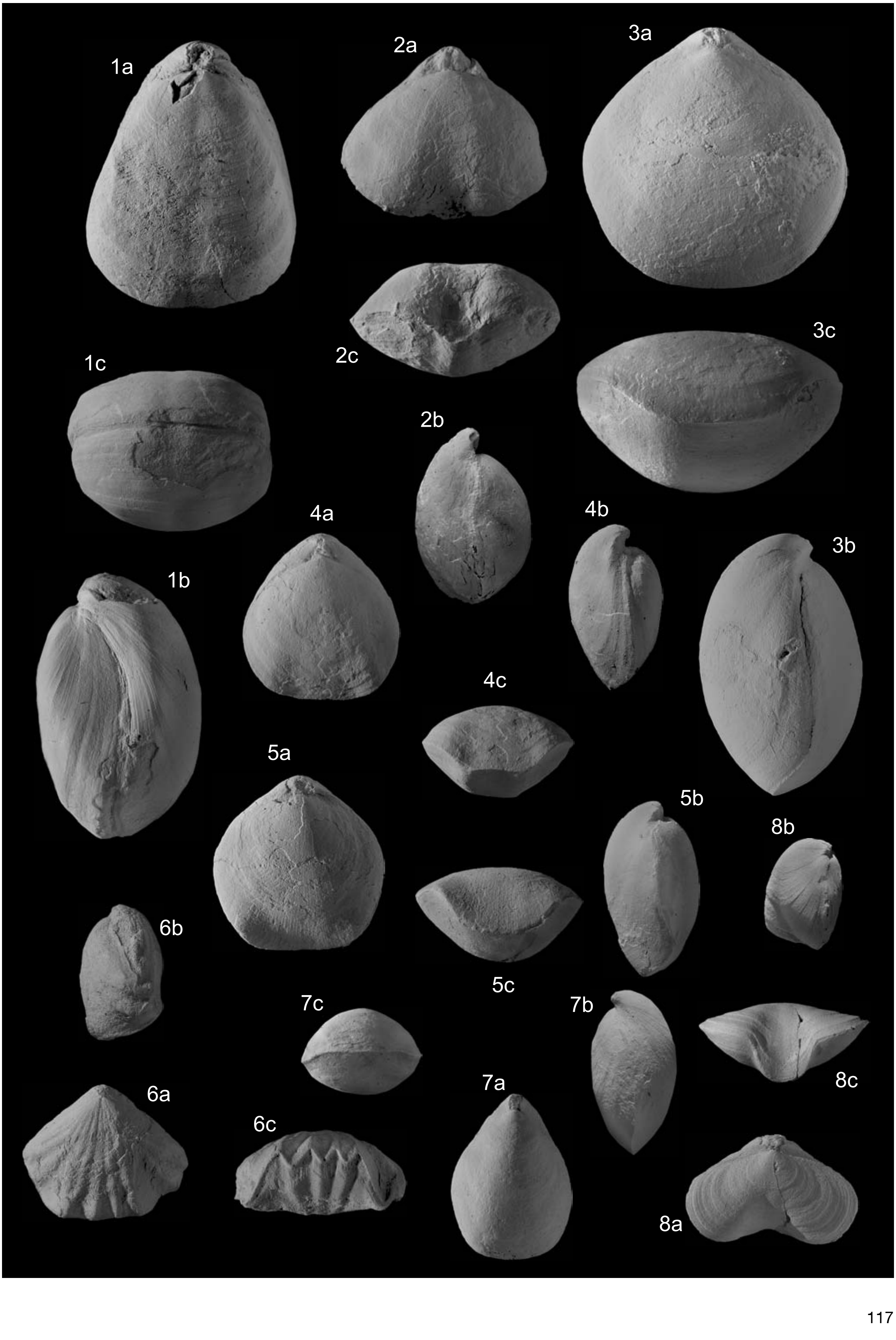
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Plate 11

Brachiopods from southwestern Totes Gebirge, coll. & det. M. Siblík.
The specimens are figured in dorsal (a), lateral (b) and anterior (c) views if not stated otherwise.

Fig. 1: *Bakonyithyris* (?) aff. *catharinae* (Gemmellaro, 1874).
Location Klb 2; L: 13.8 mm, W: 14.5 mm, Th: 9.4 mm.
Sinemurian.
GBA 2010/091/0038, 2×.

Fig. 2: *Zeilleria mutabilis* (Oppel, 1861).
Location Flo 4; L: 27.8 mm, W: 25.4 mm, Th: 14.8 mm.
Sinemurian.
GBA 2010/091/0039, 1.5x.

Fig. 3: *Buckmanithyris nimbata* (Oppel, 1861).
Location Flo 3/1; L: 13.5 mm, W: 15.0 mm, Th: 9.0 mm.
Sinemurian.
GBA 2010/091/0040, 2×.

Fig. 4: *Bakonyithyris* (?) *engelhardti* (Oppel, 1861).
Plankeraumoos, S of Location Plk 1; L: 15.9 mm, W: 15.0 mm, Th: 7.8 mm.
Sinemurian.
GBA 2010/091/0041, 2×.

Fig. 5: *Bakonyithyris* aff. *ovimontana* (Böse, 1898).
Location Klaus 3; L: 12.0 mm, W: 11.2 mm, Th: 7.8 mm.
Pliensbachian.
GBA 2010/091/0042, 2×.

Fig. 6: *Apringia paolii* (Canavari, 1880).
Wildgraben, middle part of slope; L: 16.5 mm, W: 17.9 mm, Th: 9.0 mm.
Upper Sinemurian.
GBA 2010/091/0043, 2×.

Fig. 7: *Rhynchonellina suessi* Gemmellaro, 1871.
Location Wolf 3; L: 23.8 mm, W: 24.6 mm, Th: 11.8 mm.
Sinemurian.
GBA 2010/091/0044, 2×.

Fig. 8: *"Terebratula"* aff. *bilimeki* Suess, 1858.
Location Plk 4 / bed 7; L: 38.1 mm, W: 34.9 mm, Th: 24.8 mm.
Upper Jurassic.
M 2010.510.1 (Coll. Hung. Nat.-Hist. Museum, Budapest), 2×.

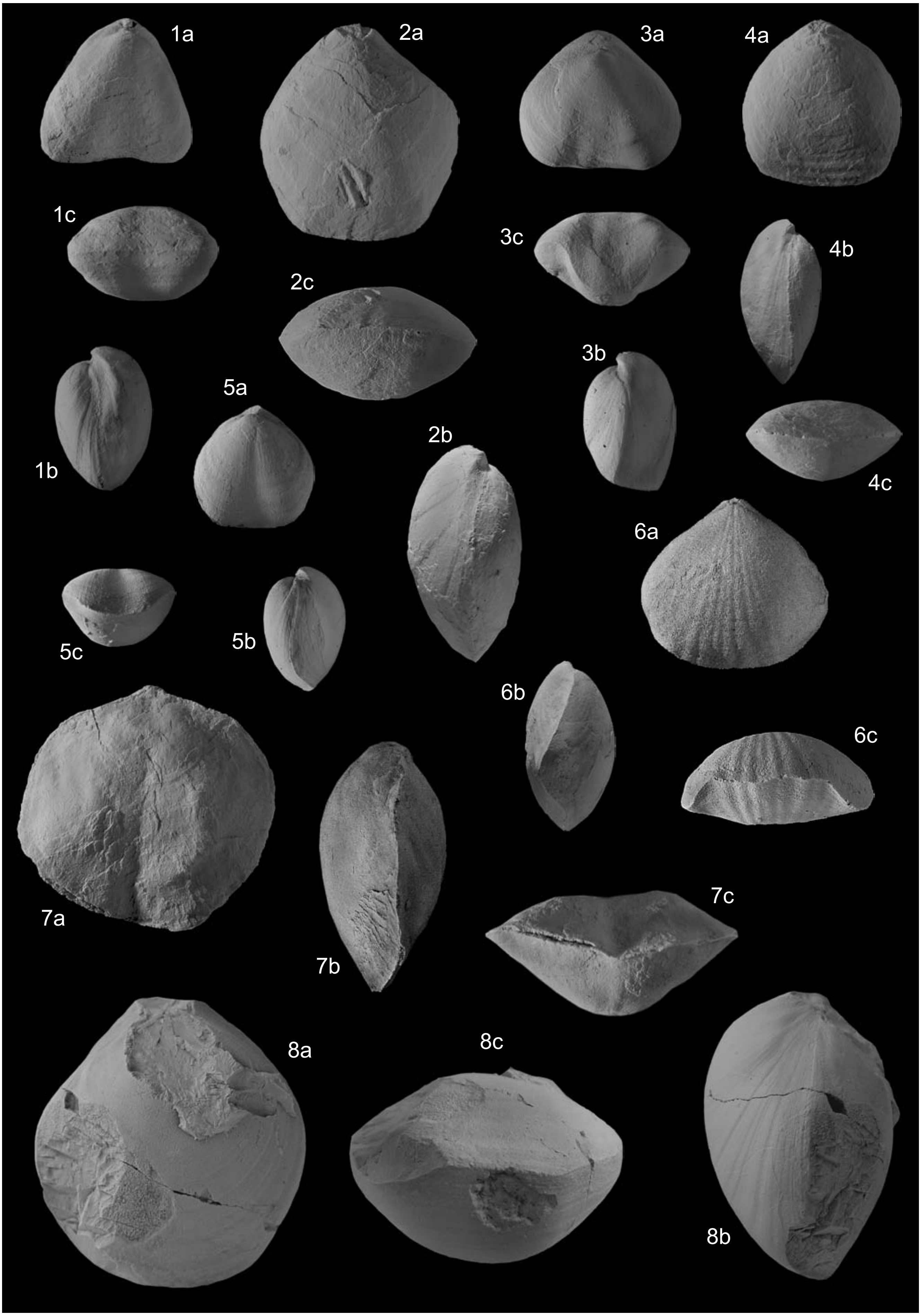
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Plate 12

Triassic (Figs. 1–7) and Jurassic (Figs. 8–39) bivalves from southwestern Totes Gebirge, coll. & det. I. Szente.
The specimens are figured in natural size unless indicated otherwise.

Fig. 1: *Praechlamys valonensis* (DEFRANCE, 1825).
Location F 4.

Fig. 2: pectinid, gen. et sp. indet.
Location F 4.

Fig. 3: *Liostrea*? sp.
Location F 4.

Fig. 4: *Promysidiella* sp.
Location F 4.

Fig. 5: *Gruenewaldia* ? sp.
Location F 4; 2×.

Figs. 6, 7: *Myoconcha* sp. A.
Location F 4.

Fig. 8: *Parallelodon* sp.
Location Plk 1.

Figs. 9, 10: *Parallelodon*? *problematicus* (VACEK, 1886).
Location Klaus 1; 2× (Fig. 9).

Figs. 11–13: *Oxytoma* (*O.*) *inequivalvis* (J. SOWERBY, 1819).
Location Plk 1; 2× (all).

Fig. 14: *Oxytoma* sp.
Location Plk 1; 4×.

Fig. 15: pectinid, gen. et sp. indet.
Location K 04

Figs. 16, 17: *Praechlamys palosa* (STOLICZKA, 1861).
Location Plk 1.

Fig. 18: *Praechlamys* sp.
Location Klaus 1.

Figs. 19–24: *Praechlamys subreticulata* (STOLICZKA, 1861).
Location Klaus 1; Fig. 19, 2×.
Location K 04; Fig. 20.
Location Plk 1; Figs. 21–24 (21, 24: 2×; 22: 4×).

Figs. 25–28: *Terquemia pectiniformis* (EUDES-DESLONGCHAMPS, 1860).
Location Plk 1.

Figs. 29–31: *Ctenostreon rugosum* (SMITH, 1817).
Location Plk 1.

Fig. 32: *Placunopsis* cf. *radiata* (PHILLIPS, 1829).
Location Plk 10.

Fig. 33: *Placunopsis* ? sp.
Location Plk 1; 1.5×.

Figs. 34–36: *Plagiostoma punctatum* J. SOWERBY, 1805.
Location Plk 1.

Fig. 37: *Myoconcha* sp. B.
Location Plk 1.

Figs. 38, 39: *Praeconia tetragona* (TERQUEM, 1855).
Location Plk 1.

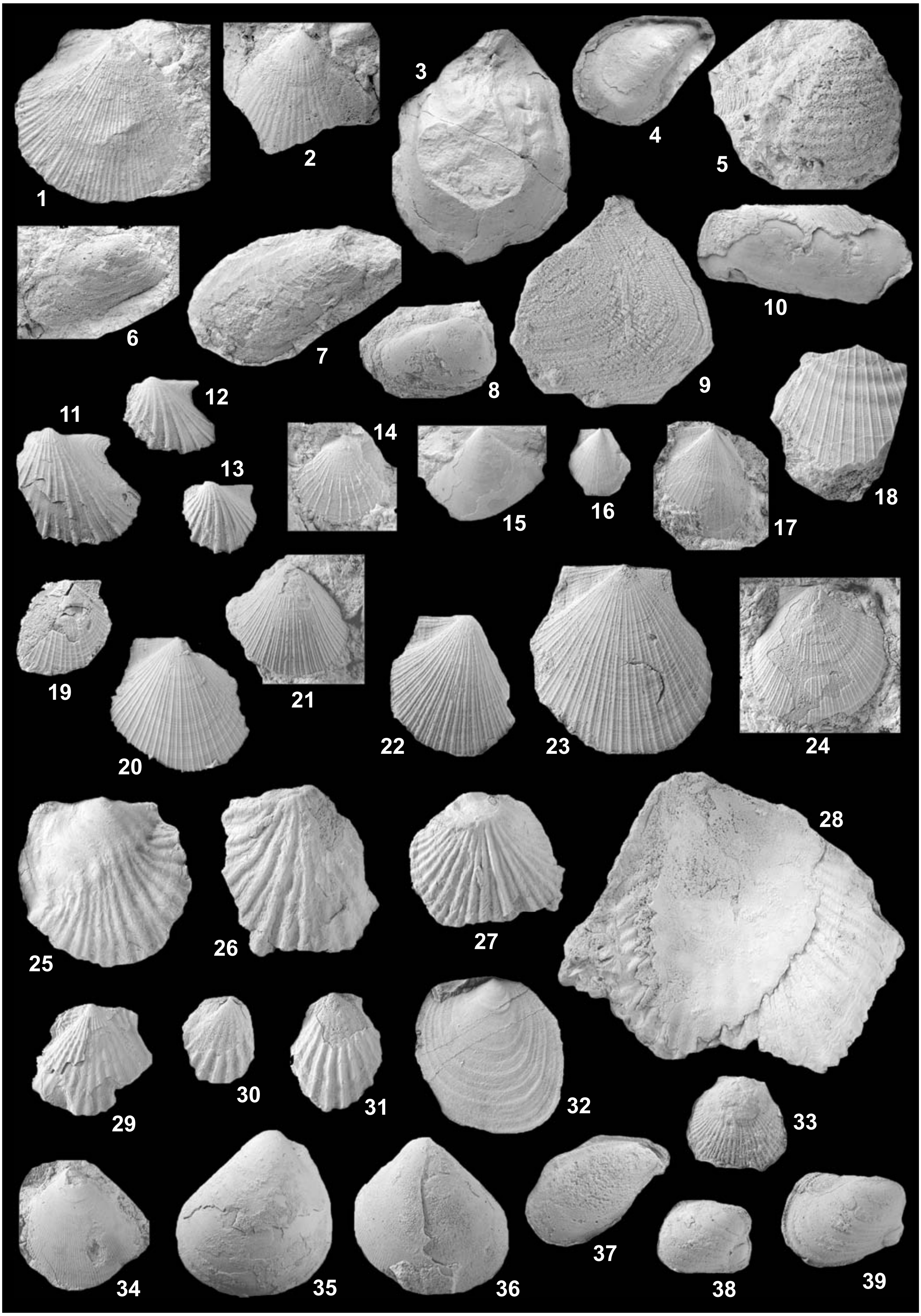
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Plate 13

Gastropods from southwestern Totes Gebirge, all from location Plk 1; coll. & det. J. Szabó.

Fig. 1: Surface of a sample from locality Plk 1 to demonstrate the preservation and some species from the faunal list; 2.5×.
A: *Katosira*? sp.
B: “*Epulotrochus*”? sp. 2 specimen (exceptionally with shell).
C: imprint of *Muricotrochus*? sp.
D–E: inner moulds of “*Epulotrochus*”? sp. 2.
F: the only specimen of *Clathrobaculus*? cf. *alpicolus* (VON GÜMBEL, 1861).

Fig. 2: *Discocirrus tricarinatus* (VON GÜMBEL, 1861); 2.5×.

Fig. 3: *Pentagonodiscus reussi* (HÖRNES, 1853); 2.5×.
The species is well identifiable even on the basis of the characteristic inner mould.

Figs. 4–5: *Pseudorhytidopilus zitteli* (G.G. GEMMELLARO, 1879); 2.5×.

Fig. 6: *Anoptychia hierlatzensis* (STOLICZKA, 1861); 2×.

Fig. 7: *Neritopsis elegantissima* HÖRNES, 1853; 2×.

Fig. 8: *Discohelix* aff. *ornata* (HÖRNES, 1853); 1×.

Fig. 9: *Pleurotomaria* aff. *emmrichi* VON GÜMBEL, 1861; 2×.

Figs. 10–12: *Euconactaeon* aff. *concavus* (J.A. EUDES-DESLONGCHAMPS, 1842); 2×.

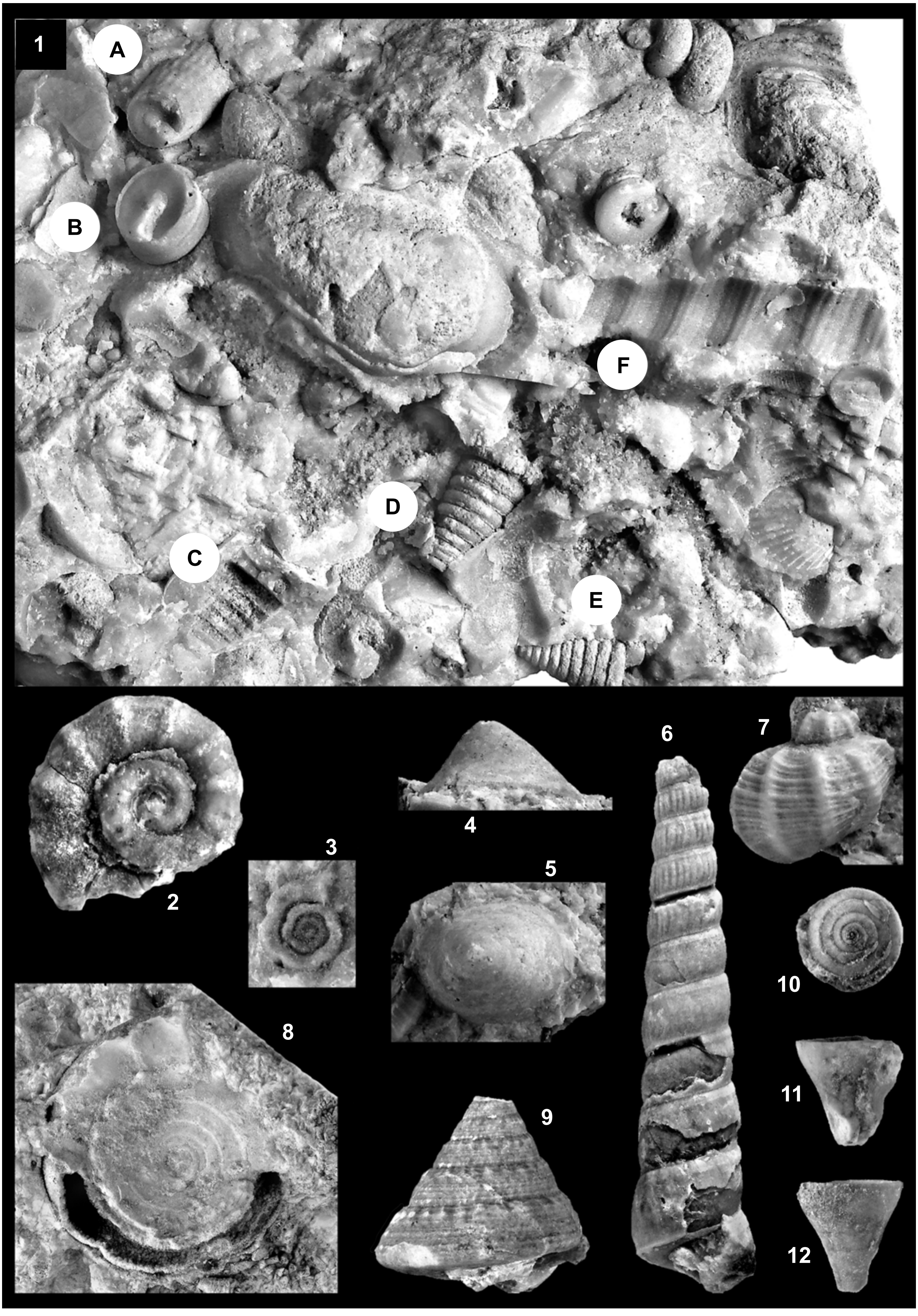
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Plate 14

Ammonites from southwestern Totes Gebirge, coll. & det. J. Schlögl.
Natural size, except Fig. 4 (1.5×).

Fig. 1: *Schlotheimia* sp.
Location Z 07, Upper Hettangian.

Fig. 2: *Arnioceras insigne* FUCINI, 1902.
Location Plk 1, Lower Sinemurian.

Fig. 3: *Angulaticeras* sp.
Location Plk 1, Lower Sinemurian.

Fig. 4: *Arnioceras ambiguum* (GEYER, 1886).
Location Plk 1, Lower Sinemurian.

Fig. 5: *Arnioceras rejectum* FUCINI, 1902.
Location Klb 2, Lower Sinemurian.

Fig. 6: *Asteroceras* cf. *brooki* (SOWERBY, 1818).
Location Flo 2, probably late Lower or early Upper Sinemurian.

Fig. 7: *Paltechioceras* cf. *oosteri* (DUMORTIER, 1867).
Location Flo 3, late Upper Sinemurian.

Fig. 8: *Tropidoceras demonense* (GEMMELLARO, 1884).
Location Klaus 3, Upper Pliensbachian.

Fig. 9: *Platypleuroceras* cf. *brevispina* (SOWERBY).
Location Klaus 3, Upper Pliensbachian.

Fig. 10: *Fuciniceras* gr. *ambiguum* (FUCINI, 1904).
Location Wolf 1, Upper Pliensbachian.

Fig. 11: *Paltechioceras* gr. *tardecrescens* (HAUER, 1856).
Location Flo 3, Upper Sinemurian.

Fig. 12: *Polymorphites* sp.
Location Klaus 3, Lower Pliensbachian.

Fig. 13: *Platypleuroceras* sp. 1.
Location Klaus 3, Lower Pliensbachian.

Fig. 14: *Platypleuroceras* sp. 2.
Location Klaus 3, Lower Pliensbachian.

Fig. 15: *Fuciniceras* cf. *inclitum* (FUCINI, 1904).
Location Wolf 1, Upper Pliensbachian.

Fig. 16: *Hildoceras bifrons* (BRUGUIERES, 1792).
Location Klaus 1, Middle Toarcian.

Fig. 17: *Nebrodites (Nebrodites) macerrimus* (QUENSTEDT, 1888).
Location Wild 1, Kimmeridgian.

Fig. 18: *Nebrodites (Mesosimoceras) herbichi* (VON HAUER, 1866).
Location Plk 7, Lower Kimmerdgian.

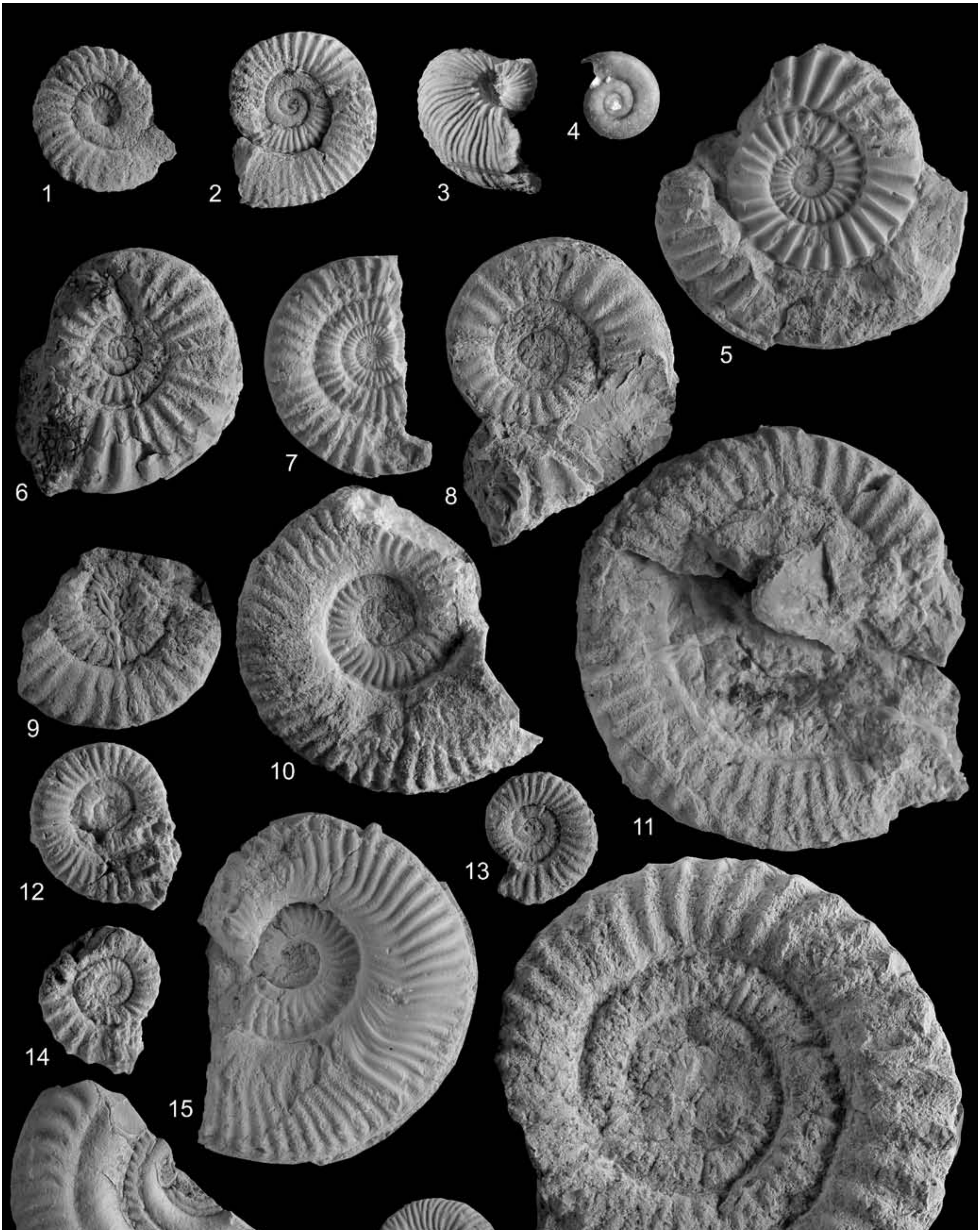
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Plate 15

Lower to (?)Middle Jurassic limestones in outcrops and rock thin-sections.

Fig. 1: (?) Middle Jurassic limestone breccia.
Outcrop at locality 07/73.

Fig. 2: (?) Middle Jurassic limestone breccia.
Clasts of various types of Hierlatz Limestone and red *"Bositra"* limestone (white arrows).
Polished slab, scale bar 1 cm. Locality 07/75.

Fig. 3: Detail of Fig. 1. Clast of red limestone with micro-lumachelle of mostly subparallel oriented *"Bositra"* shells and layers of crinoidal debris.
Acetat peel, scale bar 5 mm.

Fig. 4: Red micritic crinoidal limestone with intraclasts, angular fragments of ferromanganese crusts and abundant belemnites.
Scale bar 5 cm. Meter-sized block at Klaushöfl west.

Fig. 5: Hierlatz Limestone with abundant large crinoid fragments.
Scale bar 5 cm. Locality Klaus 3.

Fig. 6: Hierlatz Limestone; red micritic limestone with abundant mollusc shells and foraminifer *Involutina liassica* (enlarged insert picture) .
Thin-section, scale bar 5 mm.
Decimeter-sized olistolith at locality Plk 5.

Fig. 7: Allgäu Beds.
Grey micritic limestone with abundant sponge-spicules and a few mollusc shells with geopetal fillings.
Thin-section, scale bar 5 mm. Locality Z 07.

Fig. 8: Brachiopod lumachelle.
Nearly monospecific shell accumulation.
Scale bar 1 cm. Locality Nr. 10 Schwarzwald.

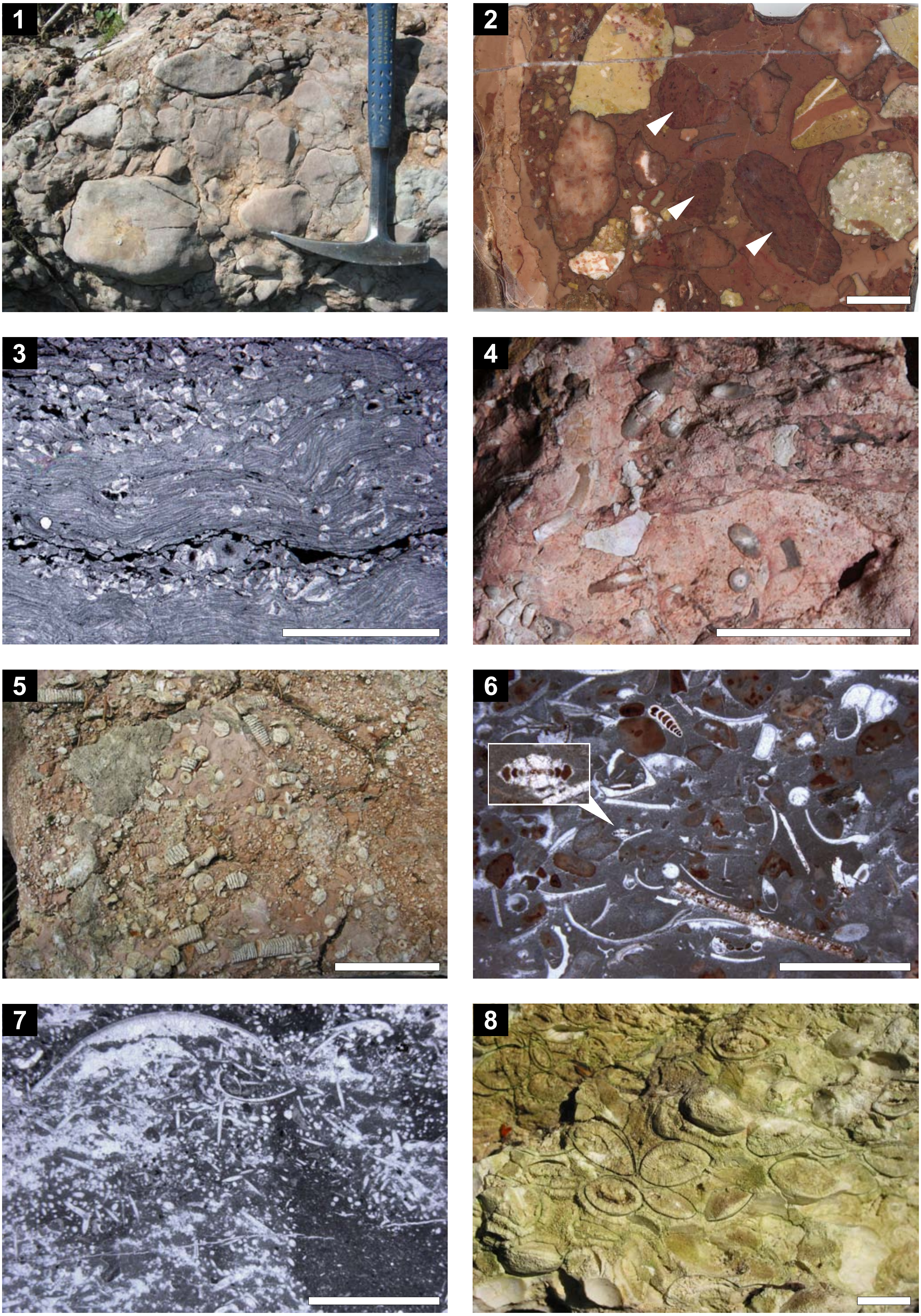
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Plate 16

Late Jurassic limestones in outcrops and rock thin-sections.

Fig. 1: Clasts in basal Tressenstein Limestone.
(A) Dachstein Limestone with corals; (B) yellowish-grey brachiopod lumachelle and (C) red crinoidal Hierlatz Limestone.
Scale bar 5 cm, outcrop at locality T 34.

Fig. 2: Basal breccia in Tressenstein Limestone: Dachstein Limestone with corals in contact to Upper Jurassic matrix of micritic/microsparitic laminated limestone.
Thin-section, scale bar 5 mm; locality F 2.

Fig. 3: Tressenstein Limestone with coarse grained detritus including angular clasts of redbrown to greenish Lower Triassic Werfen Beds.
Scale bar 5 cm. Outcrop at locality T 14 Pyrmoos-Brandwald south of Salza-Alm.

Fig. 4: Detail to Fig. 3. Angular clasts of Werfen sandstones and redbrown sandy shales in fine grained carbonate matrix.
Thin-section, scale bar 5 mm.

Fig. 5: Detail to Fig. 3. Fine grained carbonate matrix with several elements of *Saccocoma*.
Thin-section, scale bar 1 mm.

Fig. 6: Oberalm Limestone.
Decimeter-bedded micritic limestone with nodules and layers of chert.
Scale bar about 50 cm. Outcrops along the forest road northeast of Steinklemme.

Fig. 7: Micritic layers within Tressenstein Limestone, containing ammonites.
Thin-section, scale bar 5 mm. Locality T 15, Plankerau.

Fig. 8: Micritic layers alternating with fine grained bioclastic layers, containing sponge-spicules, radiolarians and ammonite fragments; intercalation in Tressenstein Limestone.
Thin-section, scale bar 5 mm. Locality F 3.

Fig. 9: Red to grey micritic limestone with abundant crinoids and ammonites and less frequent gastropods.
Not visible in this magnification frequent protoglobigerinids. Intercalation within Tressenstein Limestone at locality T 25, lithology resembles to Agatha Limestone.
Thin-section, scale bar 5 mm.

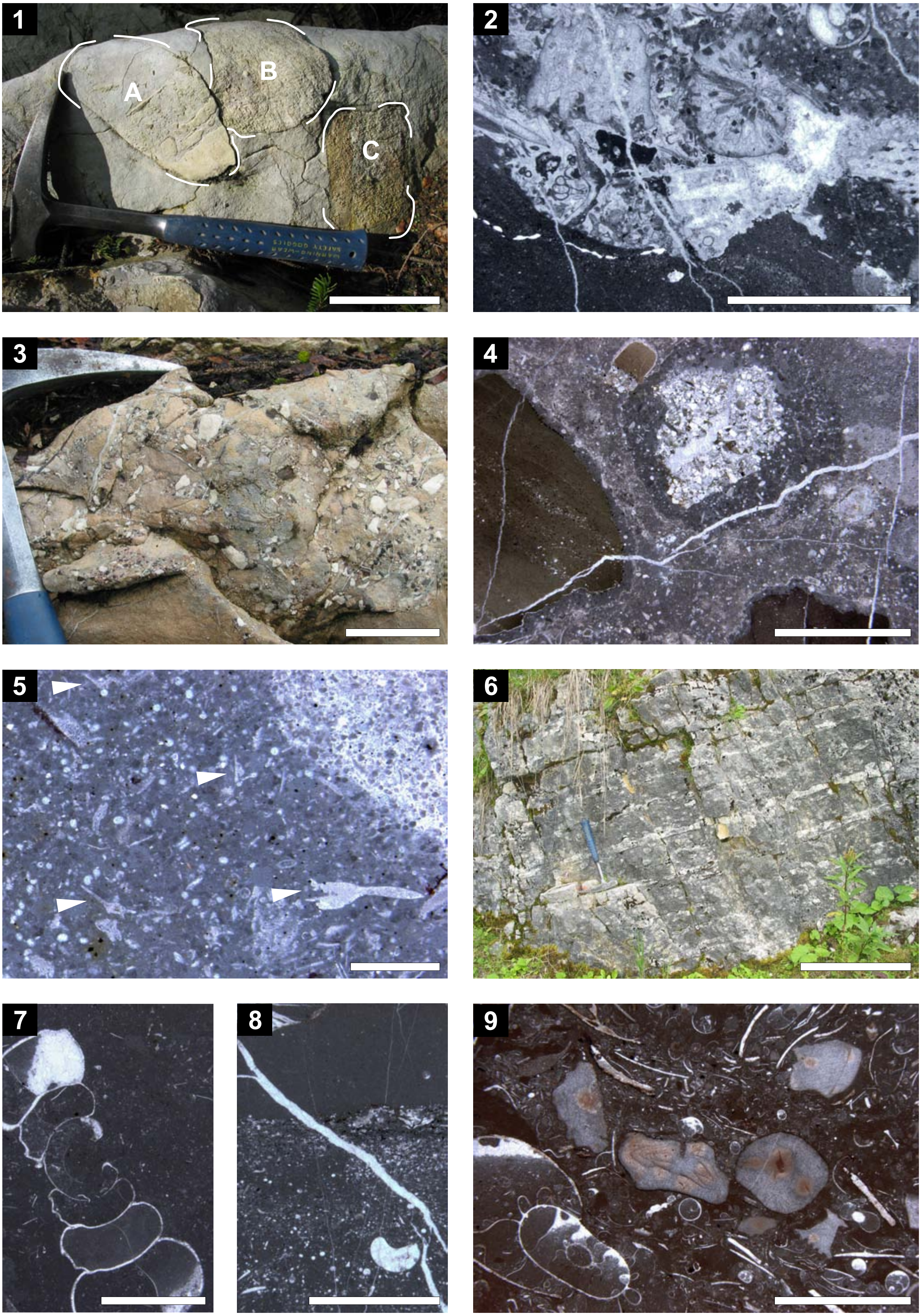
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Plate 17

Olistoliths and surrounding Upper Jurassic limestones in the Plankerau area in outcrops and rock thin-sections.

Fig. 1: View of Plankerau locality Plk 1.
Large olistolith of Lower Jurassic Hierlatz Limestone.

Fig. 2: View of Plankerau locality Plk 21.
Meter-sized olistolith of Lower Jurassic Hierlatz Limestone embedded in Upper Jurassic Tressenstein Limestone.

Fig. 3: Sparitic cemented shell accumulations alternating with biomicritic limestone, containing crinoidal debris and also sponge spicules (upper left).
Hierlatz Limestone, olistolith at locality Plk 1.
Thin-section, scale bar 5 mm.

Fig. 4: Abundant foraminifer *Involutina liassica* (white arrows) in Hierlatz Limestone of olistolith T 21.
Thin-section, scale bar 2 mm.

Fig. 5: Example of carbonate-clastic facies of Tressenstein Limestone with dominant echinodermal fragments. Micritic filled ammonite shell in lower middle.
Thin-section, scale bar 5 mm; bed T 20 in Fig. 2.

Fig. 6: Example of micritic layer within Tressenstein Limestone with very abundant protoglobigerinids.
Thin-section, scale bar 5 mm; bed T 22 in Fig. 2.

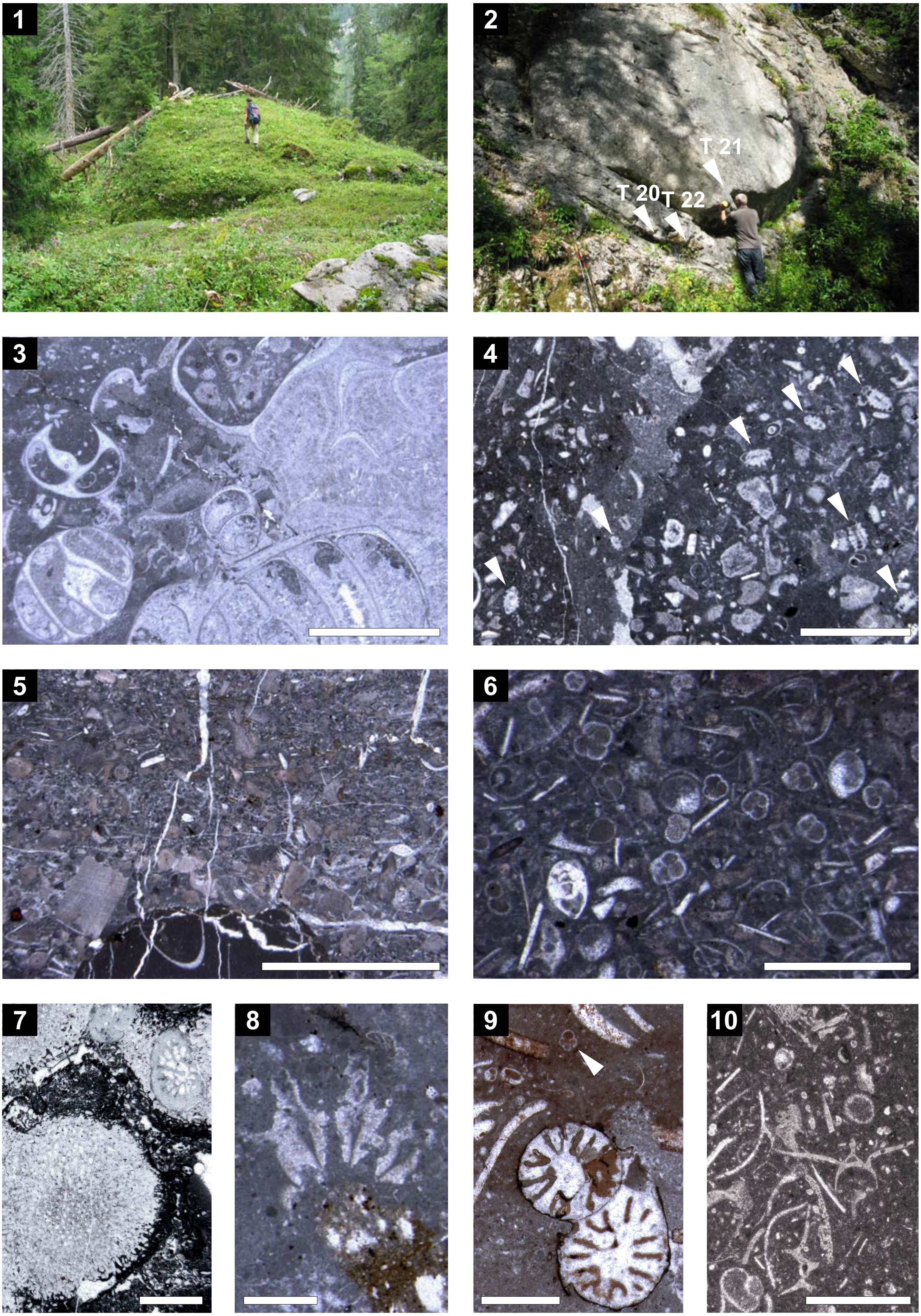
Figs. 7–9: Examples (thin-sections) of platform derived bioclasts in Tressenstein Limestone:

Fig. 7: Spongiomorpha and corals (upper right), scale bar 2 mm, locality T 11.

Fig. 8: Fragment of dasycladacean *Clypeina*; scale bar 0.5 mm, locality T 11.

Fig. 9: Corals in a red micritic matrix with protoglobigerinids (white arrow).
Intercalation within Tressenstein Limestone, lithology resembles the Agatha Limestone.
Scale bar 1 mm, locality T 6.

Fig. 10: Red micritic limestone with abundant fragments of floating crinoid *Saccocoma*.
The lithology resembles the Agatha Limestone.
Section Plk 4, top of bed 5 (see also Text-Fig. 4).
Thin-section, scale bar 0.5 mm.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Conclusions

According to our biostratigraphic data the sequence of Jurassic rocks shows sedimentary gaps and seems to belong to two different successions.

In the Zwicker-Wolfskogel succession Upper Hettangian to Lower Pliensbachian Allgäu Beds are covering a Lower Rhaetian reefoidal Dachstein Limestone after a sedimentary gap (Upper Rhaetian – Lower Hettangian). Allgäu Beds are followed by Upper Pliensbachian Hierlatz Limestone and – after a hardground and a breccia horizon with Hierlatz components – by a fine grained red crinoidal limestone with *"Bositra"* microlumachelles of probably Middle Jurassic age. The succession is completed by a few indications of Ruhpolding Radiolarite.

The second succession represents the Jurassic of the southwestern Totes Gebirge in the Flodring-Klaushöfl area. Dachstein Limestone of a reefoidal facies is overlain by Hierlatz Limestone of mainly Sinemurian age. Hettangian is completely missing as yet, Pliensbachian and especially Toarcian have been found at a few localities. Middle Jurassic might be represented (at least partly) by a breccia, containing components of a red *„Bositra"* limestone. A few meters of red radiolarite of probably Oxfordian age appear only at the locality Klaushöfl.

Kimmeridgian basinal limestones are resting discordantly on both of the Lower to Middle Jurassic successions, thus indicating their neighbourhood at least since Late Jurassic times. Together with the phenomenon of extraclasts of Lower Triassic Werfen Beds and frequent olistoliths of Hierlatz Limestone within the Tressenstein Limestone all these observations support the hypothesis of intra-Jurassic (gravitational) tectonics, even if no strong proof for the allochthony of the Zwicker-Wolfskogel succession can be given at the moment.

The Hierlatz Limestone of the large olistolith at Plk 1 has yielded a remarkable rich invertebrate fauna:

The majority of ammonites point to an Early Sinemurian age (*A. semicostatum* Zone and/or *C. turneri* Zone) although some taphonomic condensation can not be excluded mainly due to the presence of scarce specimens reminding Upper Sinemurian echioceratids. The association is dominated by juvenile forms of various species of the genus *Arnioceras*.

The brachiopod fauna is diverse; twenty seven species of fourteen genera of Rhynchonelliformea subphylum have been determined within more than two hundred specimens prepared so far. *Zeilleria* and *Liospiriferina* are the most common genera.

Thirty one species of gastropods have been distinguished, vetigastropods predominate. Some "exotic" elements are of palaeoecological importance, pointing at a rather shallow origin contrary to the type locality of Hierlatz Limestone, where eucyclids are dominating.

Eleven taxa of bivalves have been found at Plk 1. Epifaunal forms of suspension feeders are predominating; infaunal burrowing forms are much rarer than at the Hierlatz type locality. In contrary to the gastropod data shallow water forms are missing amongst the bivalves.

Much more detailed mapping will be necessary, to find stronger field evidence, if the Dachstein reef limestone of Zwicker Kogel and the connected Zlambach Marls are part of the Totes Gebirge or a part of the Jurassic gliding masses. Maybe additional olistoliths of a lithology other than Hierlatz Limestone can be found. At two places (not indicated on the sketch maps) we have recognized small occurrences of Permian Haselgebirge (strongly weathered variegated shales and gypsum) with questionable contact to surrounding Jurassic rocks. Also the "cherty Allgäu Beds" should be revised for their age, for possibly enclosed olistoliths and for their contact to the Dachstein Limestone of Zwicker Kogel.

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The macroscopic brachiopod photos of Pls. 1–6 and Fig. 8 on Pl. 11 were taken by Eszter Hankó. The SEM micrographs were taken in the SEM Laboratory of the Hungarian Natural History Museum, Budapest (Hitachi S-2600N).

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We dedicate this paper to our colleague and friend Miloslav Rakús from Bratislava, who died in May 2005 after a short but malignant illness. We remember many years of cooperation and several excursions with him in the Triassic and Jurassic of the Northern Calcareous Alps, as well as in the Carpathian Mountains. In 2004 he just had visited in a joint excursion the newly discovered fossiliferous locality at Plankerau, but he wasn't granted anymore to participate in the following years of research. But his former research on the ammonite fauna of the Hierlatz Limestone type locality has contributed essentially to our stratigraphic knowledge and to all further investigations.

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