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A New Method for the Extraction of Bryozoans from Hard Rocks from the Eocene of Austria

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Inhalt

Eine neue Methode zur Isolierung von Bryozoen aus eozänen Hartgesteinen Österreichs

Zusammenfassung

Bryozoenhältige, eozäne Gesteine der Waschbergzone (sowie anderer geologisch-tektonischer Einheiten, z.B. Helvetikum) sind meist stark verhärtet; die Zoarien können meist nicht durch übliche Aufschlussmethoden isoliert werden. Es wurde daher eine neue Methode ausgearbeitet, um Bryozoen und andere Mikrofossilien aus verhärteten Mergeln und Sandsteinen zu gewinnen. Dabei handelt es sich im Wesentlichen um ein Lösen des Probenmaterials in konzentrierter Essigsäure; um jedoch wirklich brauchbares Material für taxonomische Studien zu isolieren, war allerdings eine entsprechende Optimierung dieses Verfahrens – unter Anwendung einer Art „künstlicher Verwitterung“, Reinigen mit „Quaternary O“™ und dgl. mehr – erforderlich.

Abstract

Eocene rocks from the Waschberg zone and other localities (e.g. from the Helvetikum) containing Bryozoa are usually rather hard; the zoaria can therefore not be isolated by usual laboratory methods. Therefore a new extracting procedure has been developed to isolate Bryozoa and other microfossils from lithified marls and sandstones. This method includes mainly a dissolving process of the rock material in concentrated acetic acid; to yield zoaria which can be used for taxonomic studies however a more effective procedure has been necessary, involving some type of “artificial weathering”, cleaning with “Quaternary O”™ etc.

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1. Introduction

Among the different groups of microfossils from the Austrian Eocene, Bryozoa are certainly among those, which have not yet been studied to a sufficient degree. In fact our knowledge of this group is restricted to a few short remarks in the literature. The first who mentioned Bryozoa from the Austrian Eocene have obviously been TOULA (1879) and TRAUTH (1918), who reported Bryozoa from the "Goldberg limestone" (Kirchberg am Wechsel, Lower Austria). Their studies yielded only tentative determinations with the frequent use of question marks. Additional finds had been mentioned from Wimpassing (Leitha hills), from the Eocene of the Krappfeld (Carinthia, [HINTE, 1963]), and from the Helvetikum near Salzburg (VOGELTANZ, 1970). During the last years a rather rich and well-preserved bryozoan fauna was collected from the Waschberg zone (Lower Austria, VÁVRA, unpublished).

One main reason for this rather insufficient state of knowledge of bryozoan faunas (and other microfossils as well) from the Austrian Eocene is the fact, that they occur mostly in hard rocks like limestone, lithified marls, or claystone. Thus the most difficult problem for any taxonomical study is caused by the preservation of the bryozoan zoaria in these sediments. For taxonomical studies of post-Paleozoic Bryozoa a detailed knowledge of the morphology of the surface of zooecia and zoaria is essential however; therefore if the sediments do not permit any closer look at the surface of the zoaria, a systematic study is not possible.

During the investigation of Eocene Bryozoans from Slovakia (ZÁGORŠEK, 1992, 1993, 1994) the same situation occurred. To solve the problem several methods have been tested. Good results have been yielded by a method used by Hungarian colleagues for the study of Cretaceous fossils. This method of extraction of microfossils from hard rocks is based on a difference of speed of dissolving microcrystalline and macrocrystalline calcite in concentrated acetic acid. However, after dissolving Eocene sediments with Bryozoa in concentrated acetic acid the preservation of bryozoan zoaria has not been sufficient, their outer surface was not clean and did not allow precise taxonomic study.

Therefore, a new procedure has been developed. This method is a combination of several short processes, which had never been used together. The procedure has already been used with great success for material from Slovakia and Hungary. The Austrian material yields only moderate results however. To raise the success several changes have to be made in particular methods.

2. Methods Used

2.1. Sieving

We sieve and wash all the samples in sieves at least of two different sizes. The upper sieve has a diameter of meshes of 0.2 mm, the lower one has meshes of 0.09 mm. Neither Bryozoan zoaria, nor any determinable fragments of Bryozoa have been found in the fractions smaller than 0.09 mm. Therefore we believe that for paleontological study of Bryozoa the sieve with mesh diameter 0.09 mm is sufficient.

2.2. Laboratory Weathering

"Laboratory weathering" means a succession of boiling the samples in water (better with soda), and then its freezing (together with water) to about minus 18°C.

The samples have first been cut into pieces of about 5 cm in diameter, then put into the water together with soda and heated until the water was boiling. During boiling all air bubbles within the rock samples have been replaced by water. Therefore the boiling time should not be shorter than 20 minutes. Then cold water has been added to the sample to cool it. Finally the sample has been frozen (with water) in the refrigerator.

Before the frozen sample was going to be heated again, we washed and sieved the sample in sieves of mesh diameters 0.2 mm and 0.09 mm.

The method imitates in some way the natural weathering during the year (hot summer period – boiling the samples, and cold winter period – freezing the samples). This cycle can be repeated several times. We usually use this method before applying chemical methods.

2.3. Dissolving in Acetic Acid

This is the principal method of extraction of microfossils from hard rocks that we used. The method is based on a difference of speed of dissolving microcrystalline and macrocrystalline calcite in concentrated acetic acid. The inorganic sedimentary calcite being usually microcrystalline, which is dissolved in concentrated acetic acid more rapidly than macrocrystalline calcite, usually being produced by animals or plants.

The details of this procedure are about the following: the rock pieces (containing microfossils or fragments of them) are first dried. One has to be careful to exclude moisture from rock samples because the concentration of the acid should not be severely reduced. The presence of any traces of water would result in dissolving not only the sediment matrix but also the fossils. To avoid this, the rock samples have been dried at about 80–100°C at least for one day.

The dry rock samples have been covered with concentrated acetic acid (about 98 % or more) of technical quality, and the vessel has to be covered to exclude moisture. The rock sample should stay under acetic acid until a precipitation is formed. This may last from one to 12 weeks.

We usually heated the samples in a water bath to about 80°C for about 8–12 hours daily. Heating accelerates dissolving the rocks, and therefore prevents the surface of fossils from corroding .

The precipitation has to be carefully washed in cold water to remove remains of acetic acid. The washing procedure of the samples has to be very short, because when precipitation is dissolved in water, the concentration of acetic acid became low and dangerous for calcite fossils, which could be therefore easily corroded. We usually washed and sieved the sample in sieves of mesh diameters 0.2 mm and 0.09 mm.

2.4. Maceration in Acetic Acid

One of the methods, which has to be introduced during the study of Austrian material. This method helps to prepare the samples for other chemical methods to follow, mainly for cleaning by Quaternary "O"™ (see below).

Samples, cut in small pieces or after "laboratory weathering" (see above), have been soaked in acetic acid of low concentration (approx. 1 %; 10 l water/100 ml acetic acid, 98 %, technical quality) for about one to four weeks. The best results of this method have been yielded with lithified marls, or clays, which were swollen after maceration.

2.5. Cleaning in Quaternary "O"™

Quaternary "O"™ is a special chemical surfactant used to clean microfossils from clay components. The chemical formula of Quaternary "O"™ is as follows: 1-dihydroxyethyl–2-heptadekenyl imidazoline chloride = $C_2H(OH)_2$ $C(C_{10}H18)_5$ C_2HN_2Cl. Quaternary "O"™ is the trade mark of Geigy Industrial chemicals from New York (USA) where it has been manufactured until the seventies (for details see ZINGULA, 1968).

Samples have been macerated in 10 % water solution of Quaternary "O"™ about one day. For best results, samples can be boiled in Quaternary "O"™.

2.6. Ultrasonic Cleaning

Before taking photos samples have been cleaned in an ultrasonic bath, usually not more than 2 minutes, smaller specimens only 30 to 50 seconds.

3. Dissolving Procedure

During recent fieldwork, samples from 4 different localities from Austria have been collected: Reingruberhöhe, Haidhof, Haselbach, and borehole Helmberg 1. Besides that we have had 6 samples from older fieldwork.

The sediments, in which bryozoan zoaria occur, are very hard. They cannot be washed by known methods. We had to introduce a new extracting procedure, which includes the methods described above. The following descriptions concern the behaviour of each sample from localities studied during using the methods described above.

3.1. Reingruberhöhe

The locality Reingruberhöhe is situated in the so-called Waschberg zone near the village Bruderndorf (Lower Austria). The locality being an abandoned quarry exhibits a profile in calcareous sandstone containing iron, which produces the red colour of the sediment (details see GRILL, 1953). The sandstone is rich in Bryozoans and algae. Other organic remains (molluscs, Foraminifera, echinoids, and small fish teeth) are associated with them.

The samples have been taken from two different places. Samples RH 1 to RH 7 have been taken from the bottom part of the profile, and samples RH 10 to RH 13 come from the upper part of the profile.

The whole profile is about 10 m high. The lower part has a thickness of about 8–9 m; the upper layer is only about 1–2 m thick, however. The lower part is mostly formed by fine to medium grained calcareous sandstone reddish in colour. The upper part consists of rounded pebbles of algal build-ups accompanied by medium to coarse-grained calcareous sandstone. The build-ups are large, about 4 to 7 cm in diameter, of oval shape. This is probably the layer, which has previously been reported as "Bryozoan layer". The algal balls consist of concentrically arranged algal layers of a thickness of about 2–3 mm. Each algal layer has dark red to black colour at the bottom surface, probably caused by oxides of manganese.

The rock samples from the lower part of the profile were fine grained lime-sandstone with high contents of quartz grains. Most of the samples have been successfully partially disintegrated after 5 cycles of "laboratory weathering".

Samples RH 1, 5, 6, and 7 have been dissolved in acetic acid during 4–6 weeks. The washed samples are of good quality; the preservation of fossils was sufficient (see Pl. 1, Fig. 2). Besides bryozoan zoaria, the samples contain fragments of echinoids, tests of planctonic foraminifers and rare fragments of fish teeth. Sample RH 6 has been cleaned additionally by Quaternary "O"™ , but preservation of bryozoan zoaria was the same, as before, no changes have been observed.

Samples RH 2, 3, and 4 have been dissolved in acetic acid within 10–12 weeks. During this period they have been heated each weak at least once at 80°C. The washed samples showed very good quality (see Pl. I, Fig. 5). The preservation of Bryozoa has been very good; some of the smaller specimens however (for example zoaria of the genus *Crisia*) have been corroded a little by acetic acid. Beside Bryozoans, only few fragments of echinoids have been found.

Samples RH 10 to RH 12 have been taken from the upper part of the profile. Sediments, also calcareous sandstone, consist here of larger grains of quartz than in the lower part. For this sedimentary sequence the presence of rounded algal build-ups is typical. The upper surface of these build-ups is often encrusted by Bryozoans.

Samples RH 10 and RH 11 have been first submitted to 10 respectively 5 cycles of "laboratory weathering". This method has not been successful, however. When the samples had been dissolved in concentrated acetic acid, after 3 weeks they have been successfully disintegrated. Bryozoa have been preserved in very good condition, however little fragmented. The washed samples consisted mainly of fragments of algae, bryozoans, and rare fragments of larger foraminifera, molluscs, and echinoids.

Sample RH 12 has been dissolved in acetic acid for more than 4 weeks. Although the precipitation has been formed within 3 weeks, new acetic acid has been added to the sample. This innovation of method has a negative effect on the preservation of fossils, however. The washed sample contained many fragments of algae, bryozoans and the rest of the fauna was highly corroded, however (see Pl. 1, Fig. 3).

Sample RH 13 was formed only by algal build-ups. Dissolving in acetic acid was successful after 8 weeks. The algal balls were disintegrated and a number of well-preserved bryozoan zoaria has been yielded. The encrusting Bryozoa however, previously observed on the ball's surface had been destroyed. Besides Bryozoans and algae fragments the washed sample has been very poor, only a few brachiopod shell and echinoid fragments have been found.

Altogether 114 bryozoan taxa have been determined from Reingruberhöhe, among which are 7 new species and probably four new genera. Their systematic description will be a topic of another paper. The Bryozoa found in Reingruberhöhe are listed in Tab. 1.

3.2. Haselbach

The locality Haselbach is represented by a very small road-cut on the path from the foot of the hill Michelberg to its top, about 500 m south from the church in the village of Haselbach, about 8 km north-east from the city of Stockerau (Lower Austria, Waschberg zone). The sediment is

taxa	RH bottom	RH top	Haselbach	Haidhof
"Puellina" pupula (Reuss)	*			
"Tetraplaria" schreibersi (Reuss)	*	*		
Adeonella minor (Reuss)	*	*	*	
Adeonella ornatissima (Stoliczka)	*			
Adeonellopsis sp.n.1	*	*	*	
Adeonellopsis sp.n.2	*	*		
Adeonellopsis coscinophora (Reuss)	*	*		
Adeonellopsis porina (Romer)			*	
Aimulosia manzonii (Neviani)	*	*		
Alderina subtilimargo (Reuss)	*	*		*
Amphiblestrum appendiculata (Reuss)	*			
Arthropoma rugulosa (Reuss)	*			
Arthropoma sparsipora (Reuss)	*	*		
Batopora sp.n.			*	
Batopora multiradiata Reuss		*	*	
Biflustra savartii texturata (Reuss)			*	*
Bobiesipora fasciculata (Reuss)	*			
Callopora dumerlii (Savigny-Audouin)	*			
Calpensia gracilis (Munster)	*			
Cellaria reussi d'Orbigny			*	
Celleporaria globularis (Bronn)			*	*
Chlidoniopsis sp. n.		*		
Chlidoniopsis vindobonensis (Reuss)	*			
Crassimarginatella macrostoma (Reuss)	*	*	*	*
Crisia eburnea (Linnaeus)	*	*		
Crisia elongata Milne Edwards		*		
Crisia hoernesi Reuss	*	*	*	
Cyclicopora laticella Canu & Bassler	*			
Diastopora flabellum Reuss		*		
Diastopora sp.	*			
Disporella coronula (Reuss)	*	*		
Disporella grignonensis Milne Edwards	*	*		
Disporella radiata (Savigny-Audouin)	*			
Ditaxiporina septentrionalis (Waters)		*		
Escharella grotriani (Stoliczka)	*	*		
Escharella tenera (Reuss)	*	*		
Escharoides coccinea (Abildgaard)	*			
Escharoides crenilabris (Reuss)	*			
Escharoides mamillata (Wood)	*			
Exidmonea atlantica Forbes in Johnston		*		
Exidmonea giebeli (Stoliczka)		*	*	
Exidmonea hoernesi (Stoliczka)	*	*	*	
Exochoecia compressa (Reuss)		*		
Filisparsa tenella Stoliczka	*	*	*	*
Galeopsis subquadrangularis (Reuss)		*		
Gen. nov. 1 sp.n.	*	*		
Gen. nov. 2 sp. n.		*		
Gen. nov. 3 sp.n. 1		*		
Gen. nov. 3 sp.n. 2	*			
Gen. nov. 4 sp. n.			*	
Gen. nov. 5 sp. n.	*	*		
Gephyrotes convexa Canu & Bassler	*			
Gigantopora duplicata (Reuss)		*	*	
Gigantopora lyratostoma (Reuss)	*			
Hemicyclicopora parajuncta Canu & Bassller		*		
Herentia hyndmanni (Johnston)		*		
Heteropora sp.	*	*	*	
Heteropora subreticulata Reuss		*		
Hippomenella bragai Zagorsek		*		
Hippomenella megalota Reuss	*	*		
Hippomonavella exarata (Reuss)	*	*		
Hippomonavella stenosticha (Reuss)	*	*		
Hornera concatenata Reuss	*	*	*	*

taxa	RH bottom	RH top	Haselbacl
Hornera frondiculata Mong.		*	
Hornera simplicissima Braga & Barbin	*	*	*
Hornera verrucosa Reuss		*	*
Houzeauina parallela (Reuss)	*	*	
Iodictyum rubeschii (Reuss)		*	
Kionidella excelsa Koschinsky		*	*
Lacrimula perfecta (Accordi)	*		
Lagenipora ampullacea (Roemer)			*
Lagenipora tuba (Manzoni)	*		
Lagenipora urceolaris Goldfuss	*		
Mecynoecia geinitzi Reuss	*	*	
Mecynoecia proboscidea (Milne Edwards)	*	*	*
Mecynoecia pulchella (Reuss)		*	
Meniscopora syringopora (Reuss)	*	*	
Metradolium obliquum Canu & Bassler		*	
Metrarabdotos maleckii Cheetham		*	
?Micropora sp.	*		
Micropora coriacea Esper			
Micropora hexagona Zagorsek	*		
Mollia patellaria (Moll)		*	
Monoporella venusta (Reuss)			
Ogivalina cf. dimorpha (Canu)	*	*	
Oncousoecia biloba (Reuss)	*		*
Onychocella subpyriformis (d'Archiac)	*	*	*
Orbitulipora petiolus Lonsdale	*		
Polyascosoecia coronopus (Canu & Bassler)	*	*	*
Porella clavula (Canu & Bassler	*		
Poricellaria complicata (Reuss, 1869)		*	
Porina coronata (Reuss)	*	*	*
Porina duplicata (Reuss)		*	
Prenantia phymatopora (Reuss)		*	
Puellina (Cribrilaria) manzonii (Reuss)	*	*	
Puellina (Cribrilaria) radiata (Moll)	*		
Pyriora huckei Buge	*		
Reteporella simplex (Busk)		*	
Reteporella subovata (Stoliczka)			
Reteporella tuberculata (Reuss)		*	*
Reussia (Smittina) regularis (Reuss)	*	*	
Rosseliana rosselii (Audouin)	*		
Schizomavella larva (Reuss)	*	*	
Scrupocellaria brendolensis Waters	*	*	
Scrupocellaria gracilis Reuss	*	*	*
Siphonicytara cf. excentrica Gordon & d'Hondt			
Smittina cervicornis (Pallas)		*	*
Smittoidea excentrica (Reuss)	*	*	
Sparsiporina elegans (Reuss)		*	*
Steginoporella sp.n.	*	*	
Steginoporella cucullata (Reuss)	*	*	
Steginoporella elegans chattiensis P.& D.		*	
Steginoporella firma (Reuss)		*	*
Steginoporella haidingeri (Reuss)	*		*
Stenosipora simplex (Koschinsky)		*	*
Tervia serrata (Reuss)	*	*	
Trochiliopora beyrichii (Reuss)		*	*
Tubucella mamillaris (Milne Edwards)	*	*	
Tubucella papillosa (Reuss)	*	*	*
Tubulipora congesta Reuss		*	
Umbonula macrocheila (Reuss)		*	
Umbunula monoceros (Reuss)	*		
Unifissurinella boulargeri Poignant	*	*	
Vibracella trapezoidea (Reuss)	*		*
Vincularia subsymmetrica (Canu)	*		
Total number of taxa 126	**77**	**82**	**35**

Table 1. ◄◁◄
Preliminary list of Bryozoa from the Eocene of the Waschberg zone.
RH = Reingruberhöhe.

naturally disintegrated marl, so Bryozoans could be collected without any larger problem. After the usual washing and sieving many of the apertures on bryozoan zoaria have not been clean, and important morphological features could not be observed. Therefore, the samples from Haselbach have been cleaned in Quaternary "O"™ with good success. The preservation of fossils is good, after cleaning in Quaternary "O"™ all important features can be observed and documented.

Predominant fossils in the washed samples are tests of benthic foraminifera and tube fragments of Vermes. Bryozoans are common part within the sample studied, together with fragments of molluscs and echinoids. Altogether 35 different bryozoan species have been determined, among which specimens belonging to a new species of Batopora are abundant (see Tab. 1 for list of determined Bryozoa).

3.3. Haidhof

The locality Haidhof is represented by an overgrown road-cut about 900 m west from the village of Ernstbrunn (Lower Austria, Waschberg zone). We collected naturally disintegrated marls as well as yellowish lithified marl to get Bryozoans. Naturally disintegrated marls (sample HE 1) have been washed and cleaned by Quaternary "O"™. This method was sufficient and nothing else was needed.

The lithified marl (sample HE 2) has been dissolved in concentrated acetic acid during 3 weeks. The washed sample was however very poor in fossils. Only few well-preserved zoaria have been found. Fragments of larger foraminifera, and molluscs represent the rest of the fauna.

Only 14 species of Bryozoa have been found in this locality. The most abundant are the species *"Celleporaria" globularis* and *Biflustra savartii texturata*. The complete list of determined species is given in Tab. 1.

3.4. Borehole Helmberg 1

The borehole Helmberg is situated in the Helvetikum (i.e. Haunsberg) about 32 km NE from the city of Salzburg. From the borehole we received samples from depths 3180.5 to 3199 m. The borehole penetrated sub-horizontally lying Eocene bryozoan marls between 3188 and 3194 m.

Dissolving in acetic acid during one to four weeks yielded a poorly preserved fauna; most of the important morphological features have been missing.

"Laboratory weathering" after 9–11 cycles has been successful, the Bryozoans have been mostly covered by sediments however and important morphological features could not be observed. Direct cleaning with Quaternary "O"™ had not the desired effect.

When "laboratory weathered" samples have been macerated in acetic acid of low concentration for about 10–12 days and then cleaned in Quaternary "O"™ , very well preserved samples have been yielded (see Pl. I, Fig. 4). Best results have been received from samples from depths 3190, 3188 and 3193 m. Other samples were more lithified and had more calcareous content, so this-method has not been completely successful. However, the whole profile studied yielded samples for taxonomical study.

In addition to a rich Bryozoa fauna, the marls contained only a few fragments of echinoids and shells of the brachiopod genus *Argyrotheca*.

In the course of a preliminary study we discovered 109 Bryozoan species from the borehole Helmberg 1. The richest sample was from depth 3190 m, where 61 species have been found. The complete list of preliminary determinations is given in Tab. 2.

3.5. Other Samples

For testing the different varieties of the method described, we used also six old field samples: Goldberg limestone (Otterthal respectively Kirchberg a. Wechsel – samples 99 respectively 143), a sample from the Eocene of Carinthia (Dobanberg near Kl. St. Paul, sample 160; Premberg near Kl. St. Paul, sample 142), sandstone from the Helvetikum of St. Pankraz (Eocene, Haunsberg near Salzburg, sample 165), and limestone from the Kambühel area (N Ternitz, Lower Austria, sample 98).

Unfortunately all these samples gave generally rather poor results. We dissolved the samples in concentrated acetic acid for 14 weeks, but except sample number 165 (Helvetikum of St. Pankraz) only a very small part of the rock has been dissolved. Almost no recognizable fossils have been observed in the residues of samples. Washed samples contained only fragments of larger foraminifera tests, fragments of algae and echinoids. No Bryozoans or other identifiable fossils have been found.

The sample from Premberg and one of the samples from the Kambühel area yielded only a few fossils. After 14 weeks (respectively after 7 weeks) more than half of the rock had been dissolved and numbers of fossil fragments have been found. The washed sample contained mostly fragments of larger foraminifera, but also fragments of echinoids, and molluscs occur. Unfortunately no Bryozoans have been found.

4. Experimental Details

According to our experiments, the most effective procedure to yield good Bryozoan zoaria for taxonomical studies seems to be the following:

1) The rock samples have to be cut to pieces of about 5 cm in diameter.
2) For some samples it is necessary to perform "laboratory weathering"several times. This process was repeated for some samples about 10 times, until the sample was more and more decomposed.
3) The rock samples have been dried at about 80 to 100°C for about 24 to 48 hours.
4) The hot samples have been covered with concentrated acetic acid (about 98 % or more). Remember to cover the vessel to avoid admission of moisture from the air. When the samples disintegrated, they usually formed a precipitation and the rest of acetic acid evaporated. It could take 2 to 8 weeks, sometimes even 3 months.
5) When a precipitate was formed, the sample was quickly poured into a huge amount of cold water with soda. The sample was washed and sieved to remove acetic acid and to prevent corrosion of fossils. For some samples it helps if they have been covered with soda to neutralize the acetic acid. Then, for about one day the samples remained in clear water in order to dissolve the remaining acetic acid.

Table 2.
Preliminary list of Bryozoa from the borehole Helmberg 1.

taxa/sample = depth of borehole	3198	3195	3194	3193	3192	3191	3190	3188
"Puellina" chelys (Koschinsky)		*						
"Puellina" pupula (Reuss)						*		
"Schizoporella" scrobiculata (Reuss)		*			*	*		*
"Tetraplaria" schreibersi (Reuss)		*				*	*	*
Adeonella minor (Reuss)		*	*	*	*	*	*	*
Adeonella ornatissima (Stoliczka)		*						
Adeonellopsis sp.n.			*			*		*
Adeonellopsis porina (Romer)	*	*	*	*	*	*	*	*
Alderina subtilimargo (Reuss)		*				*	*	*
Amphiblestrum appendiculata (Reuss)			*			*	*	*
Arthropoma rugulosa (Reuss)						*		*
Bactridium hagenowi Reuss			*					*
Batopora multiradiata Reuss			*			*		
Batopora scrobiculata Koschinsky			*					
Berenicea rotula (Reuss)								*
Biflustra savartii texturata (Reuss)			*			*		
Bobiesipora fasciculata (Reuss)								*
Castanopora calomorpha (Reuss)						*		
Cellaria reussi d'Orbigny			*					
Celleporaria globularis (Bronn)	*	*			*			
Cheilonella prominens Reuss								*
Cheilopora orbifera Canu & Bassler					*			
Crassimarginatella macrostoma (Reuss)		*	*		*	*		*
Crisia eburnea (Linnaeus)		*	*			*		
Crisia elongata Milne Edwards			*			*	*	
Crisia hoernesi Reuss		*	*					*
Cyphonella nodosa Koschinsky			*					
Diastopora sparsa (Reuss)								*
Disporella coronula (Reuss)								*
Disporella grignonensis Milne Edwards								*
Disporella radiata (Savigny-Audouin)			*					
Ditaxipora internodia (Waters)			*					
Ditaxipora pannonensis Braga			*					
Ditaxiporina septentrionalis (Waters)							*	
Escharella tenera (Reuss)		*					*	*
Escharella ventricosa (Hassall)					*			*
Escharoides aliferus (Reuss)						*		
Exidmonea atlantica Forbes in Johnston			*				*	
Exidmonea giebeli (Stoliczka)		*			*	*	*	*
Exidmonea hoernesi (Stoliczka)		*	*	*	*	*	*	*
Exidmonea villaltae (Reguant)					*	*	*	
Exochoecia compressa (Reuss)			*					
Fedora bidentata (Reuss)		*						
Filisparsa varians Reuss		*	*			*	*	*
Gen. nov. 1 sp.n.		*	*					
Gen. nov. 2 sp.n.		*	*					
Gen. nov. 3 sp.n.			*					
Gigantopora duplicata (Reuss)			*			*		
Gigantopora lyratostoma (Reuss)			*			*		*
Herentia hyndmanni (Johnston)						*	*	*
Heteropora subreticulata Reuss						*	*	*
Hippomenella bragai Zagorsek			*		*	*	*	*
Hippomonavella exarata (Reuss)			*			*		*
Hippomonavella imbricata (Reuss)		*						
Hippoporina globulosa (d'Orbigny)						*		
Hippoporina rarepunctata (Reuss)	*							*

taxa/sample = depth of borehole	3198	3195	3194	3193	3192	3191	31
Hornera concatenata Reuss		*					
Hornera frondiculata frondiculata Mong.		*	*	*	*	*	*
Hornera simplicissima Braga & Barbin						*	*
Hornera subannulata Philippi		*		*			*
Iodictyum sp.n.		*	*				
Kionidella excelsa Koschinsky		*					
Margaretta cereoides (Ellis-Solander)			*				
Mecynoecia geinitzi Reuss	*			*			
Mecynoecia proboscidea (Milne Edwards)			*			*	*
Meniscopora syringopora (Reuss)		*	*		*		
Metradolium obliquum Canu & Bassler							
Metrarabdotos maleckii Cheetham					*	*	*
Micropora sp.n.			*				
Micropora hexagona (Zágoršek)			*				
Nematifera susannae Zágoršek	*		*		*		*
Ogivalina dimorpha (Canu)			*				
Oncousoecia biloba (Reuss)						*	
Onychocella subpyriformis (d'Archiac)		*		*		*	*
Parasmittina saccoi (Canu)			*				
Perigastrella granulata Zágoršek		*				*	
Polyascosoecia coronopus (Canu & Bassler)		*			*	*	*
Porella clavula (Canu & Bassler)							
Poricellaria complicata (Reuss, 1869)			*				
Porina sp.n.			*				
Porina coronata (Reuss)		*	*	*	*	*	*
Prenantia phymatopora (Reuss)			*	*		*	
Puellina (Cribrilaria) haueri (Reuss)							
Puellina (Cribrilaria) radiata (Moll)		*	*		*	*	*
Reteporella simplex (Busk)		*				*	
Reteporella subovata (Stoliczka)		*	*		*		*
Reteporella tuberculata (Reuss)		*	*				
Reussia (Smittina) regularis (Reuss)		*			*	*	*
Rosseliana rosselii (Audouin)			*				
Schizoporella tetragona (Reuss)					*		
Smittina cervicornis (Pallas)		*		*	*	*	*
Smittoidea excentrica (Reuss)			*				
Sparsiporina elegans (Reuss)		*					
Spiropora verticillata Goldfuss						*	
Steginoporella sp.n.						*	
Steginoporella cucullata (Reuss)			*				
Steginoporella elegans chattiensis P.& D.			*			*	
Steginoporella haidingeri (Reuss)		*	*	*	*	*	*
Stenosipora protecta (Koschinsky)							
Stenosipora reussi (Stoliczka)		*					
Stenosipora simplex (Koschinsky)		*	*			*	*
Stephanollona otophora (Reuss)		*					
Stomatopora cf. minima Roemer							
Stomatopora divaricata (Reuss)							
Tervia serrata (Reuss)			*		*	*	*
Trochiliopora beyrichii (Reuss)							
Tubucella mamillaris (Milne Edwards)							
Tubucella papillosa (Reuss)		*	*		*	*	*
Unifissurinella boulargeri Poignant			*				
Total number of taxa 109	5	41	54	11	25	48	3

6) Finally the samples were washed and sieved as usual, using sieves with 2 mm, 0.25 mm, and 0.09 mm.

If the bryozoan zoaria have not been successfully cleaned, the residues of samples were macerated in acetic acid of low concentration. After a month, the samples were washed, sieved and dried.

Dry samples have been cleaned in Quaternary "O"™ for about 2–3 days. The samples with Quaternary "O"™ have been heated in water bath to 80–100°C. Quaternary "O"™ is poorly soluble in water so the remains of it have to be washed from samples very carefully. After that, the samples are washed, sieved, and dried as usual.

Some of the samples have been cleaned in an ultrasonic cleaner for photography.

Examples of preservation of bryozoan zoaria after using different described methods are given in Pl. I.

5. Conclusion

A method to obtain and clean Bryozoa and other microfossils from lithified marls and sandstones has been developed respectively tested for a variety of samples from the Austrian Paleogene. This method combines "laboratory weathering" and treatment with concentrated acetic acid. For lithified marls and sandstones rather good results could be yielded, whereas pure limestones gave no results at all. The method is obviously most effective for lithified sediments containing clay components (marls) and for clastic sediments (mainly: fine-grained sandstone). In this way we received determinable Bryozoan material for a number of important Eocene localities from Austria; the systematic-taxonomical and paleoecological studies of these faunas will be the main aim of future papers.

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Plate 1

Fig. 1: ***Adeonellopsis* sp.**
Reingruberhöhe.
Washed specimen without any acetic acid treatment.

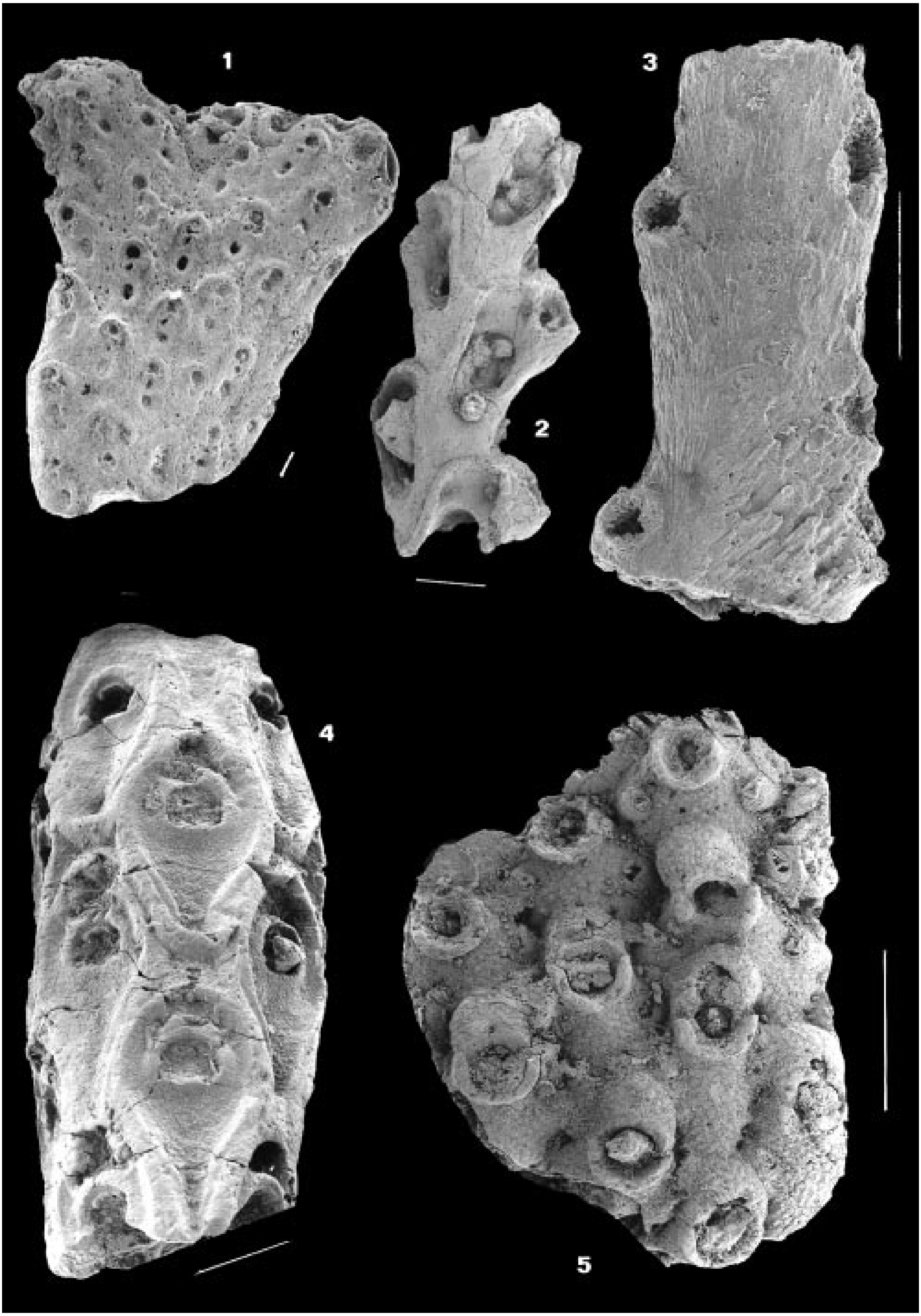
Fig. 2: ***Scrupocellaria gracilis* Reuss, 1869.**
Reingruberhöhe.
Specimen after acetic acid treatment (sample RH 6).

Fig. 3: ***Crisia* sp.**
Reingruberhöhe.
Corroded specimen after acetic acid treatment (sample RH 12).

Fig. 4: ***Cellaria reussi* d'Orbigny, 1851.**
Helmberg 1.
Specimen after maceration in acetic acid and cleaning in Quaternary "O"™.

Fig. 5: ***Escharoides mamillata* (Wood, 1844).**
Reingruberhöhe.
Specimen after acetic acid treatment (sample RH 3).

Scale bar 200 µ**m.**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