

Taxonomy and distribution of the Cretaceous coral genus *Eosiderastrea*

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Abstract: The new genus *Eosiderastrea* LÖSER, 2016, was established for Cretaceous corals formerly assigned to the extant coral genus *Diploastrea*. It represents the oldest member of the Family Siderastraeidae. The genus is characterised by an astreoid arrangement, occasionally although some have a plocoid or a cerioid calicular arrangement, and a sub-regular hexameral, heptameral, octameral or decameral septal symmetry. The septal blades are made of medium-sized trabeculae. Synapticulae are present. Almost a hundred specimens were examined, among them numerous type specimens. In total, 26 Cretaceous species were separated. Fifteen species were assigned to formally established species, three species were compared to one of these species, two species were described as new and the remaining six species were reported in open nomenclature. The genus occurs in the Cretaceous worldwide and ranges from the late Valanginian to the Santonian. It shows its greatest diversity in the earliest Aptian and early to middle Cenomanian.

Key Words: Corals; Scleractinia; Cretaceous; taxonomy; new taxa.

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Résumé : Taxinomie et répartition du genre de coraux crétacés *Eosiderastrea*.- Le nouveau genre *Eosiderastrea* LÖSER, 2016, a été érigé pour des coraux crétacés attribués auparavant au genre actuel *Diploastrea*. Il constitue le plus ancien membre de la famille des Siderastraeidae. Ce genre est caractérisé par un arrangement astréoïde, bien que de temps en temps quelques-uns montrent un arrangement caliculaire plocoidé ou cérioïde, et une symétrie septale d'ordre 6, 7, 8 ou 10 presque régulière. Les lames septales sont constituées de trabécules de taille moyenne. Des synapticules sont présents. Près d'une centaine de spécimens furent examinés, parmi lesquels des spécimens-types. Au total, 26 espèces crétacées sont distinguées. Quinze espèces sont attribuées à des espèces déjà connues, trois sont comparées à l'une d'elles, deux sont décrites comme nouvelles, et les six autres restantes sont laissées en nomenclature ouverte. Le genre est présent dans le Crétacé du monde entier et existe depuis le Valanginien supérieur jusqu'au Santonien. Il monte sa plus grande diversité à l'Aptien basal et au Cénomaniens inférieur et moyen.

Mots-clefs : Coralliaires ; Scléractiniaires ; Crétacé ; taxinomie ; nouveaux taxons.

1. Introduction

WELLS (1932) was the first to identify the extant coral genus *Diploastrea* from the Lower Cretaceous, followed by numerous authors (WELLS, 1933; BARON-SZABO, 1993, 1997; MORYCOWA & MASSE, 1998; BARON-SZABO & GONZÁLEZ LEÓN, 2003; summarised in LÖSER *et al.*, 2002). As shown by LÖSER (2016) this material cannot be assigned to *Diploastrea* and requires the creation of a new genus, *Eosiderastrea*, within the Family Siderastraeidae. In addition, it was found that numerous Cretaceous species formerly assigned to genera such as *Confusastrea*, *Diplocoenia*, *Montastraea*, *Phyllocoenia*, *Placcoenia*, and *Siderastrea* belong to this genus. The sum of all this material, mainly from localities in France, Germany, Greece, Italy, Poland, Spain and the USA, makes the genus relatively common and palaeogeographically widely distributed.

2. Material

The material comes from various localities. Most of them are listed, commented and provided with additional references in LÖSER *et al.* (2005). Only details not reported in this publication are mentioned here. If no sample number is given, the material from the locality concerned was not available for study. Each number refers to only one specimen.

Austria

- Oberösterreich, Gosau basin (A.399); Gosau Gp; Coniacian to Santonian. NHMW 1864/0040/1352.
- Oberösterreich, Gosau, Wegscheidgraben (A.576); Hochmoos Fm; late Santonian. GPSL FLX 8059.
- Salzburg, Rußbach, Neffgraben (A.575); Hochmoos Fm; late Santonian. GPSL FLX 3126, FLX 5385.
- Salzburg, Rußbach, Zimmergraben (A.969); Gosau Gp, Streideck Fm; Santonian. MHE A0601.

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France

- Ardèche, St.Remèze, Pont de Laval; late Barremian. BSPG 2003 XX 5908. - The locality and coral fauna was described by LÖSER & FERRY (2006).
- Aude, Les Corbières, Col de Escudiés; latest Cenomanian, Juddi Zone. UPS HL 025. - The stratigraphy and outcrop situation is described in BILOTTE (2007); the coral fauna is under preparation for its publication.
- Aude, Les Corbières, Sougraigne, Prat-Périé (F.275); uppermost Cenomanian, Juddi Zone. BSPG 2011 XXVI 46.
- Bouches-du-Rhône, Marseille, Calanque de la Mounine; early Hauterivian. ERNO L-5185, L-5186, L-5193. - The locality and coral fauna was described by LÖSER & FERRY (2006).
- Charente-Maritime, Fouras (F.429); early Cenomanian. ERNO L-5601, ERNO L-5614.
- Charente-Maritime, Ile d'Aix (F.52); early Cenomanian. MNHN A26591.
- Sarthe, Le Mans (F.283); Sable du Perche Fm; middle to late Cenomanian. MHNLM 2003.1. 7593, 7593b.
- Vaucluse, Ventoux Mts, combe des Glacières (F.3167); early Aptian. UJ 137P3608.
- Yonne, Chenay (F.446); Calcaire à Spatangues; early Hauterivian. MNHN A25815.
- Yonne, Gy-l'Evêque, fields SW Gy-l'Evêque, 3 (F.2732); Calcaire à Spatangues; early Hauterivian. BSPG 2003 XX 6455, 6458, 6486, 6539, 6602, 6603.

Germany

- Bayern, Allgäuer Helvetikum, Falkenberg (D.2295); Schrattenkalk; late Barremian to early Aptian. BSPG 1994 XI 292, 53; BSPG 1997 V 113-2.
- Bayern, Allgäuer Helvetikum, NE Hoher Ifen, Kühberg; Schrattenkalk; late Barremian to early Aptian. BSPG 1996 VI 2. - The outcrop area belongs to the same unit described by SCHOLZ (1984).
- Bayern, Allgäuer Helvetikum, Tiefenbach (D.256); Schrattenkalk; late Barremian to early Aptian. BSPG 1994 XI 13, 293, 294.
- Bayern, Roßstein-Almen; Branderfleck Fm; middle Cenomanian. BSPG 1947 XVI 47; BSPG 1991 X 97. - The geology, stratigraphy and coral fauna was described by LÖSER *et al.* (2013).
- Nordrhein/Westfalen, Mülheim/Ruhr, Kassenberg (D.510); Rotkalke; early Cenomanian. BSPG 2003 XX 1086, 1147.
- Sachsen, Meißen-Zscheila, Trinitatis church (D.697); Meissen Fm; early Cenomanian. SNSD-MMG SaKL253, SaKL542; BSPG 2003 XX 0955.

Greece

- Fokída, Mariolada, Kria Vrissi spring, east of (GR.975); early Cenomanian. ERNO L-5992.
- Kozani, Kozani, Nea Nikopolis, c4; early Cenomanian. BSPG 2003 XX 5812, 5829, 5846, 5868, 5900, 6145.

Iran

- Esfahan, Esfahan Basin, Dizlu; late Aptian to Albian. PIUEN b45. - Geology, stratigraphy and the coral fauna was described by BARON-SZABO *et al.* (2003).

Israel

- Palestine, Mulergat Well; Lower Cretaceous. NHM R43455. - No data are available about this outcrop since it deals with an isolated collection sample.

Italy

- Abruzzi, L'Aquila, Monti d'Ocre, Fossa Cerasetti (I.1734); early Aptian. PU 17965, 17993, 18099.
- Abruzzi, L'Aquila, Monti d'Ocre, Fossa Mezza Spada (I.1732); early Aptian. PU 17963, 17964; BSPG 2003 XX 6834.

Japan

- Iwate-ken, Shimohei-gun, Iwaizumi-cho, Moshi, Matsushima (J.154); Miyako Gr, Hiraiga Fm, Hiraiga sandstone; uppermost Aptian. TUM 65480.
- Iwate-ken, Shimohei-gun, Tanohata-mura, Haibe, southern cliff; Miyako Gr, Hiraiga Fm, Hiraiga sandstone; uppermost Aptian. TUM 65317.
- Iwate-ken, Shimohei-gun, Tanohata-mura, Koikoro (J.3326); Miyako Gr, Tanohata Fm, Moshi sandstone; late Aptian. TUM 65367, 65481.

Mexico

- Baja California, Eréndira, N Playa Blanca; Alisitos Fm; early Albian. ERNO L-134915. - The section was described by PAYNE *et al.* (2004). The coral fauna is under preparation for publication.
- Oaxaca, Tepelmeme, El Rodeo Ranch (MEX.115); Teposcolula Fm; early Albian. IGM 2734.
- Puebla, Tehuacán, San Antonio Texcala (MEX. 764); Zapotitlán; Barremian. GPSL FLX 2050.
- Sonora, Municipio Opodepe, Tuape, Cerro de la Espina (MEX.3202); Mural Limestone, Cerro La Espina Mbr; early Albian. ERNO 3155.
- Sonora, Municipio San Pedro de la Cueva, Tepache, Lampazos area, Espinazo de Diablo (MEX.3025); Espinazo del Diablo Fm; middle Albian. ERNO L-130206, L-130135.

Poland

- Malopolskie, Wadowice, Lanckorona, Jastrzebia (PL.1170); Grodziszczce Sandstones; early Aptian. ERNO L-5428.

Spain

- Cantabria, Santander, Cobreces, Luaña playa (E.2088); Altamira Fm; early Cenomanian. BSPG 2007 V 061, 199, 309, 329.
- Cataluña, Lérida, Com. Alt Urgell, Mun. Coll de Nargó, Set Comelles, El Caso section (E.2040); Font Bordonera Fm; uppermost Aptian. BSPG 2003 XX 4027.
- Cataluña, Lérida, Com. La Noguera, Mun. Vilanova de Meià, Montsec de Rubies, section NW La Cabrua quarry (E.1766); early late Aptian. ERNO L-7368.
- Cataluña, Tarragona, Com. Baix Penedés, Mun. Olivella, Can Grau (E.834); Montmell Fm; earliest Albian. MV 13539.
- Murcia, Sierra Larga; late Valanginian. ERNO L-121509. - The Sierra Larga with sediments of the almost entire Cretaceous in the Prebetic zone encompasses various coral faunas that are partly under investigation. See VILAS *et al.* (2003) for details on the geology.

- Valencia, Castellón, La Avellà, Catí; Hauterivian. FGUB AV-155-B4. - The sedimentology and coral fauna was described by GÖTZ *et al.* (2005).

USA

- Texas, Bell County, Santa Fe Railroad quarry (USA.1266); Fredericksburg Gp, Comanche Peak Limestone; middle Albian. NMNH I-313352.
- Texas, Blanco and Hays Counties, Blanco River, narrows (USA.1211); Trinity Gp, Lower Glen Rose Limestone; earliest Albian. TMM UT-11482.
- Texas, Buda Hill; early Cenomanian. TMM UT-10642.
- Texas, Burnet County, Cox's Crossing, Austin-Marble Falls road (USA.1218); Trinity Gp, Cow Creek Limestone; early late Aptian. TMM UT-11474.
- Texas, Dawson County, 5 mi. S O'donnell, John Earle ranch, Lone Star Materials Crushing Plant; Fredericksburg Gp; middle Albian. TMM 1449TX6. - The outcrop is not formally described since it is only known from collection material.
- Texas, Kendall County, Guadalupe River Ranch; Trinity Gp, Lower Glen Rose Limestone; early Albian. ERNO L-4789. - The outcrop area is not yet described.
- Texas, Kerr County, Kerrville, Hiram Hall Ranch (USA.1252); Fredericksburg Gp, Lower Segovia Limestone; middle Albian. NMNH I-75128.
- Texas, Kerr County, SE part; Fredericksburg Gp, Edwards Limestone; middle Albian. TMM 1448TX1. - There are no details known about the exact spot.
- Texas, Pecos County, Leon springs (USA.1276); Fredericksburg Gp, Fort Terrell Limestone; middle Albian. TMM UT-14180B.
- Texas, Travis County, Travis Peak, Cow Creek (USA.1217); Trinity Gp, Cow Creek Limestone; early late Aptian. NMNH I-75126.

Ukraine

- Sakarpatskaya, Lushanka river basin (UA.1003); Kamenelina Fm; late Barremian to early Aptian.

3. Methods

Corals were cut and polished and thin sections were prepared where possible. Microphotographs for measurements and illustrative purposes were obtained using a transparency scanner, Epson Perfection V750-M Pro, with an optical resolution of 6400 dots per inch. Their quality was improved using histogram contrast manipulation (contrast stretching) where possible. The measurements and septal counts in the descriptions are based on systematic measurements of the calicular dimensions and counts of the septa, carried out using the computer program PaleoTax/Measure (<http://www.paleotax.de/measure>). The first interval for septal counts is only provided when the number of counts is higher than nine.

Species separation was carried out using distance analysis of metric data. The unweighted euclidean distance was applied as the data were very homogenous (MUCHA, 1992). Data visualisation was done through agglomerative

cluster analysis using the single-linkage method (SHI, 1993; LÖSER, 2002). The computer program PaleoTax/Graph was applied for data processing and visualisation. Because the morphological data are not normally distributed (LÖSER, 2012), an analysis of variance (ANOVA) would not allow distinguishing specimens or taxa. Non-parametric statistical methods would demand more data for each single coral colony that are simply not available.

The synonymy lists encompass - with a few exceptions - only samples that were available for observation. The distribution data are almost entirely based on well-examined material. Material only mentioned in the literature and material not available or insufficiently described and illustrated in the literature has not been taken into account. To obtain better insight into the distribution patterns of the genus, numerous yet-unpublished material - indicated under 'Material' by a collection acronym and sample number in parenthesis - has been included. Therefore distribution data indicated under 'Occurrence' are also provided for species remaining in open nomenclature.

Institutional abbreviations: BSPG, Bayerische Staatssammlung für Paläontologie und Geologie, München, Germany; ERNO, Universidad Nacional Autónoma de México, Instituto de Geología, Estación Regional de Noroeste, Hermosillo, Mexico; FGUB, Facultad de Geología de la Universidad de Barcelona, Spain; GPSL, Geologische und Paläontologische Sammlung der Universität Leipzig, Germany; MGSB, Museo Geológico del Seminario de Barcelona, Spain; MHE, Matthias Heinrich, Eckental, Germany; MHNLM, Musée Vert, Le Mans, France; MNHN, Muséum National d'Histoire Naturelle, Paris, France; NHM, The Natural History Museum, London, England; NHMW, Naturhistorisches Museum, Wien, Austria; MV, Vinseum, Vilafrance del Penedés, Spain; NHM, The Natural History Museum, London, UK; NHMW, Naturhistorisches Museum, Wien, Austria; NMNH, National Museum of Natural History, Washington, D.C., USA; PIUEN, Paläontologisches Institut, Erlangen, Germany; PU, Museo di Geologia e Paleontologia dell' Università di Torino, Italy; TMM, Texas Memorial Museum, Austin, Texas, USA; TUM, The Tohoku University Museum, Sendai, Japan; UJ, Jagiellonian University, Instytut Nauk Geologicznych, Kraków, Poland; UPS, Université Paul Sabatier, Laboratoire de Géologie Sédimentaire et Paléontologie, Toulouse, France.

Abbreviations of measurements: Ccd, distance between calicular centres; clmax, larger calicular diameter (calicular pit); clmin, smaller calicular diameter (calicular pit); cmax, larger outer calicular diameter; cmin, smaller outer calicular diameter; s, number of radial elements in adult calices.

For each type of measurement (calicular diameter and distance, number of septa) in one thin section the following values were obtained and/or calculated: *n*, number of measurements; min-max, lowest and highest measured value; μ : arithmetic mean (average); *s*, standard deviation; *cv*, coefficient of variation; $\mu \pm s$, first interval.

Abbreviations in synonymy lists: The abbreviations used in the synonymy lists follow MATTHEWS (1973): *, earliest valid publication of the species name; *p*, the described material belongs only in part to the species concerned; *v*, the specimen was observed by the author.

4. Systematic paleontology

Order Scleractinia BOURNE, 1900

?Suborder Fungiina VERRILL, 1870

Remarks: The position of the family within the Suborder Fungiina is provisional. The suborder was, for a long time (VAUGHAN & WELLS, 1943, ALLOITEAU, 1952, WELLS, 1956), considered to gather all corals that have perforated septa and presence of synapticalae. GILL (1981) proposed that Fungiina sensu stricto shows synaptical bars or compound synapticalae (fulturae). Former fungiid corals with pennulae (see GILL, 1967) were later separated into the Suborder Microsolenina (MORYCOWA & RONIEWICZ, 1995), and highly perforated non-pennular corals into the Suborder Poritina (VERON, 1995). Presently the Suborder Fungiina includes various families that differ much in their morphology but show synapticalae (not even all have perforated septa). As already mentioned by MORYCOWA & RONIEWICZ (1995), the suborder needs profound revision. The Superfamily Thamnasterioidea is characterised by the presence of synapticalae and remains, for the time being, in the Suborder Fungiina, but a profound modification of the whole classification system of the Mesozoic Scleractinia is required to gain more consistency.

Superfamily Thamnasterioidea REUSS, 1864

Family Siderastraeidae VAUGHAN & WELLS, 1943

Remarks: Details on morphology, evolution and genera were provided by LÖSER (2016).

Genus *Eosiderastrea* LÖSER, 2016

Type species: *Siderastrea cuyleri* WELLS, 1932, by original designation.

Diagnosis: Plocoid, sometimes also cerioid or astreoid colonies. Septa made of medium-large trabeculae with rare pores at their inner margin. Septal symmetry subregular, in varying

systems. Septal lateral face with thorns, septal upper border granulated. Synapticalae present. Columella styliform or by septal fusion. Endotheca and wall absent. Budding extracalicular.

Description: Cerioid, astreoid or plocoid colony. Calicular outline circular to polygonal, often slightly elongated. Septa can have pores at the inner margins. Microstructure of medium-sized trabeculae. In cross section septa (and costae) are thick at the wall and thinner towards the centre. Symmetry of septa radial, presenting hexameral, heptameral, octameral, and decameral symmetries. Cycles of septa sub-regular. Septal cycles differ in length. Generally, two septal cycles reach the centre of the calice, further cycles are shorter. Septa of the younger cycles are often attached to those of the older cycles. Septal upper border granulated, lateral face has numerous, irregularly distributed fine thorns, the inner margin is slightly swollen in places. Some septa may be attached to the columella. Costae present, non-confluent to confluent. Synapticalae present, mainly in the wall region. Columella styliform and by septal fusion in the centre of the calice. Endotheca consists of numerous thin tabulae. Wall subcompact or absent, septothecal, with synapticalae. Coenosteum narrow in some species with isolated trabeculae from the external margins of the costae. Budding extracalicular.

Remarks: The calicular arrangement varies within the genus. Depending on the compactness of the wall and the confluence of the costae, there exist species with a cerioid arrangement (e.g., *E. cuyleri*), with an astreoid arrangement (e.g., *E. paragrandidipora*) or plocoid arrangement (e.g., *E. harrisi*). The amount of synapticalae, which defines whether a wall exists or not, and so characterises the organisation form, varies from species to species but is constant within one specimen.

The microstructure of the septa is made of medium-sized trabeculae in the sense that the trabeculae are easily recognisable but do not give shape to the sepum (as for instance in members of the Montlivaltiidae and Synastraeidae). Small trabeculae are not visible or only as a medium dark line. The absolute size of the trabeculae depends on the thickness of septa. The septa are thicker in the Siderastraeidae than, for instance, in the very similar Thamnasteriidae because the structures are generally larger, e.g., the calices are bigger and the septa thicker in the Siderastraeidae and the individuals are smaller and the septa are thinner in the Thamnasteriidae. The trabeculae have, therefore, a differing absolute size but are in both families medium-sized, related to the thickness of septa.

Table 1: Distinction of species. (1) The stratigraphy of the Iran locality is not well constrained. (2) The occurrence of the species in the Campanian is in doubt. (3) The stratigraphy of the Palestine locality is not well constrained.

Septa		Smaller outer diameter			Wall	Name	Stratigraphy	
sym.	cycles	min	max	average				
6	3	2.3	3.2	2.8	absent	<i>cuyleri</i>	late Aptian – early Cenomanian	
		2.5	4.1	3.3	present	<i>nagaoi</i>	Hauterivian – early Albian	
		3.9	5.8	4.9	present	<i>hilli</i>	middle Albian	
	4	4	3.5	4.3	3.9	present	sp. 1	late Valanginian
			4	6	5.0	present	<i>dolfusi</i>	Aptian – early Albian
			3.8	6.3	5.1	absent	<i>paragrandipora</i>	Cenomanian
			4.9	7	6.0	absent	sp. 2	early Hauterivian
			5.6	7.2	6.4	absent	<i>grandipora</i>	middle Albian – early Cenomanian.
	7	3	7	9.5	8.3	present	<i>crassa</i>	late Barremian – middle Albian
3.6			4	3.8	present	<i>cotteaui</i>	early Hauterivian	
8	3	4.1	4.7	4.4	present	cf. <i>cotteaui</i>	early Hauterivian	
		2.7	3.4	3.1	present	<i>cyclops</i>	Hauterivian – Barremian	
		3.1	4.5	3.8	absent	aff. <i>cuyleri</i>	late Aptian – early Cenomanian	
		4	4.2	4.1	present	cf. <i>cyclops</i>	Hauterivian	
		4.5	6.2	5.4	present	<i>harrisi</i>	Hauterivian – early Albian	
	4	4	4	7.2	5.6	absent	<i>villaltai</i>	late Barremian – early Albian (1)
			3.3	4.4	3.9	absent	sp. 3	early Cenomanian
			5.5	7.3	6.4	present	<i>splendida</i>	early Aptian
			1.4	3.2	2.3	present	<i>vaughani</i>	middle Albian (2)
10	3	3.5	5.4	4.5	present	<i>felixi</i>	Aptian	
		3.5	6.3	4.9	absent	<i>stefani</i>	Cenomanian (3)	
		5	7.9	6.5	present	<i>crassicosta</i>	Hauterivian – early Aptian	
		5.7	8.2	7.0	absent	sp. 4	latest Aptian – Cenomanian	
	4	4	4	5.1	4.6	absent	sp. 5	early Cenomanian
			6.2	8.2	7.2	absent	sp. 6	early – middle Cenomanian
			7.4	10.4	8.9	absent	<i>reussi</i>	Santonian

Species separation: The distinction of species in Mesozoic scleractinian corals is almost entirely based on (1) the dimensions of the corallites, the distance of the corallites and the width of calicular rows in meandrinoid corals respectively, (2) the number of regular septal systems (if present) and (3) the number and/or density of the septa (LÖSER, 2012). The specimens assigned to *Eosiderastrea* offer a wide range of numerical morphometric data: The larger and smaller inner and outer calicular diameters, the calicular centre distances, septal symmetry, absolute number of septa and the number of septal cycles. To find out which of these characteristics are most suitable for the separation of taxa, the calicular dimensions were systematically measured in all available samples and the septa counted. The highest available number of measurements and counts were obtained. The results (for details refer to

the species) show that the most constant character within a colony is septal symmetry, which is the same for all individuals in a colony. Hence, the number of septa also shows a certain variation, as the number of septa increases constantly with increasing calicular diameter. So the septal cycles are not regular. Among the calicular dimensions the distance of calicular centres shows the highest variation. The inner (larger and smaller) calicular diameter can only be measured when a wall is clearly marked, which was not the case for all the specimens. However, the outer calicular diameter (smaller and larger) can be obtained for all specimens. Generally, smaller and larger calicular diameters were distinguished in all colonies. The smaller calicular diameter has a lower variation. It was also found that the absence or presence of even an incomplete wall, which defines whether the colony is astreoid or plocoid, is

constant within one colony and was included in the analysis. For species separation, the septal symmetry, the number of septal cycles, the smaller outer calicular diameter, the distance of calicular centres and the absence or presence of a wall were used.

Other differences, such as the fine structure of the corallite wall, the formation of the columella, the coenosteum, or differences in the number and arrangement of synapticalae and dissepiments vary within one colony considerably, and are often difficult to observe and to quantify. The variation of the thickness of the septa is low.

Species: In the present study 26 species were distinguished, six of them remain in open nomenclature as the poor number of available samples does not allow a new species to be established for the moment. For the distinction of the species see Table 1.

Range: Late Valanginian to Santonian.

***Eosiderastrea cotteai*
(ORBIGNY, 1850)**

(Pl. 1, fig. 1)

Material: MNHN A25815; 1 thin section.

Synonymy:

*v 1850 *Phyllocoenia Cottaldina* - ORBIGNY, (2), p. 91

Dimensions:

(MNHN A25815)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	7	3.58-4.06	3.78	0.16	4.3	3.62-3.95
ccd	7	4.26-6.17	5.48	0.62	11.3	4.86-6.10
s	5	29-31	30.0	0.70	2.3	

Remarks: The material provides a very rare case of heptamerous symmetry. The calices are in a plocoid arrangement. The costae show all types of confluence. The septa appear in three septal cycles. A wall is present but incomplete. The material encompasses three syntypes that seem to be conspecific. There is one thin section that is poorly preserved.

Occurrence: Lower Hauterivian (Radiatus Zone) of France (Yonne) Chenay.

***Eosiderastrea cf. cotteai*
(ORBIGNY, 1850)**

(Pl. 1, figs. 2-3)

Material: BSPG 2003 XX 6458; 1 thin section.

Synonymy:

v 2001 *Placocoenia cotteai* (ORBIGNY 1850) - LÖSER, p. 44, Pl. 2, fig. 5

Dimensions:

(BSPG 2003 XX 6458)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	10	2.31-3.59	3.02	0.44	14.5	2.58-3.46
cmin	5	3.99-4.75	4.41	0.27	6.2	4.14-4.68
ccd	14	2.52-4.92	3.65	0.66	18.1	2.99-4.31
s	6	24-30	27.3	2.1	7.5	

Remarks: The only specimen has smaller dimensions than *E. cotteai*.

Occurrence: Lower Hauterivian (Radiatus Zone) of France (Yonne) Gy-l'Evêque, fields SW Gy-l'Evêque.

***Eosiderastrea crassa*
(KUZMICHEVA, 1980)**

(Pl. 1, figs. 4-5)

Material: TMM 1449TX6; 6 thin sections.

Synonymy:

1980 *Diploastraea crassa* KUZMICHEVA, p. 105, Pl. 39, fig. 2

Dimensions:

(TMM 1449TX6)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	3	7.42-8.02	7.64	0.33	4.3	7.30-7.97
cmin	3	9.07-9.48	9.28	0.20	2.2	9.07-9.48
ccd	10	6.14-12.52	9.12	2.01	22.0	7.11-11.14
s	3	43-48	46.33	2.88	6.2	

Remarks: Based on the illustrations of KUZMICHEVA (1980), the species seems to be mainly astreoid with confluent or sub-confluent septa and an incomplete wall. The symmetry seems to be hexamerous with four cycles. The material from Texas is not well preserved and the thin section is very small, which makes systematic measurement almost impossible. In terms of its dimensions it is slightly larger than the material described by KUZMICHEVA.

Occurrence: Upper Barremian to lower Aptian of Ukraine (Sakarpatskaya) Lushanka river basin; middle Albian of USA (Texas) Dawson County, 5 mi. S O'donnell, John Earle ranch, Lone Star Materials crushing Plant.

***Eosiderastrea crassicostata*
(MORYCOWA & MASSE, 1998)**

(Pl. 1, fig. 6)

Material: BSPG 2003 XX 6603, ERNO L-5428, UJ 137P3608; 5 thin sections.

Synonymy:

v 1998 *?Diploastrea crassicostata* MORYCOWA & MASSE, p. 755, Fig. 19.1-2

Dimensions:**(BSPG 2003 XX 4027)**

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	10	6.20-8.06	7.00	0.55	7.9	6.44-7.56
ccd	7	5.84-9.62	7.72	1.13	14.6	6.58-8.85
s	6	39-47	43.66	2.8	6.4	

(BSPG 2003 XX 5428)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	9	4.39-5.72	4.94	0.47	9.5	4.47-5.41
cmin	7	5.19-8.00	6.81	1.06	15.6	5.75-7.88
ccd	10	6.67-9.74	8.27	0.83	10.1	7.43-9.10
s	3	41-44	42.33	1.52	3.6	

(BSPG 2003 XX 5846)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	20	3.80-5.55	4.77	0.44	9.3	4.32-5.21
cmin	15	5.91-8.04	6.96	0.64	9.2	6.32-7.61
ccd	20	5.11-7.71	6.55	0.85	12.9	5.70-7.40
s	12	39-47	41.83	2.4	5.7	39-44

(UJ 137P3608)

	n	min-max	μ	s	cv	$\mu \pm s$
cmin	5	5.76-6.87	6.27	0.52	8.4	5.74-6.79
cmax	3	7.04-7.92	7.40	0.46	6.2	6.94-7.86
ccd	10	4.96-8.74	6.94	1.22	17.6	5.71-8.16
s	5	39-43	41.0	1.58	3.8	

Remarks: The species shows an astreoid calicular arrangement with mainly non-confluent costae. The septa show decamerall symmetry and three cycles. A wall does not exist. The species is well documented; therefore, it is not necessary to reiterate the type material.

Occurrence: Lower Hauterivian (Radiatus Zone) of France (Yonne) Gy-l'Evêque, fields SW Gy-l'Evêque; lower Aptian of France (Vaucluse) Ventoux Mts, combe des Glacières; Poland (Małopolskie, Wadowice) Lanckorona, Jastrzebia.

***Eosiderastrea cuyleri* (WELLS, 1932)**

(Pl. 1, figs. 7-9)

Material: ERNO L-5992, TMM UT-11474; 3 thin sections.

Synonymy:

*v 1932 *Siderastraea cuyleri* WELLS, p. 243, Pl. 37, fig. 9; Pl. 39, fig. 1

v 2016 *Eosiderastraea cuyleri* (WELLS, 1932) - LÖSER

Dimensions:**(TMM UT-11474)**

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	30	2.35-3.41	2.87	0.30	10.6	2.56-3.17
clmax	30	3.05-4.29	3.50	0.35	10.0	3.15-3.86
ccd	40	2.46-3.92	3.12	0.35	11.4	2.77-3.48
s	20	24-36	30.25	4.25	14	26-35

(BSPG 2003 XX 5992)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	10	2.34-2.90	2.52	0.20	8.1	2.32-2.73
cmin	10	2.07-2.76	2.50	0.21	8.6	2.29-2.72
ccd	20	1.93-3.45	2.74	0.39	14.3	2.34-3.13
s	5	24-25	24.4	0.54	2.2	

Remarks: The astreoid species has very small dimensions. The septal symmetry is hexamerall with three complete cycles and the beginnings of a fourth one. A wall is practically absent, and the costae are mainly non-confluent.

Occurrence: Lower upper Aptian of USA (Texas) Burnet County, Cox's Crossing, Austin-Marble Falls road; lower Cenomanian of Greece (Fokída) Mariolada, Kria Vrissi spring.

***Eosiderastrea aff. cuyleri* (WELLS, 1932)**

(Pl. 1, fig. 10)

Material: ERNO L-134915, NMNH I-75126, TMM UT-10642; 3 thin sections.

Synonymy:

vp 1932 *Siderastraea cuyleri* WELLS, p. 243, Pl. 37, fig. 9; Pl. 39, fig. 1

Dimensions:**(TMM UT-10642)**

	n	min-max	μ	s	cv	$\mu \pm s$
cmin	20	2.66-4.53	3.59	0.46	12.9	3.13-4.06
cmax	15	3.04-5.00	3.97	0.54	13.6	3.42-4.51
ccd	20	2.66-4.72	3.59	0.57	15.9	3.01-4.16
s	15	31-43	36.86	3.66	9.9	33-41

Remarks: This species encompasses the paratype of *E. cuyleri*, which shows a different septal symmetry and has larger dimensions than the holotype. The material is clearly astreoid; a wall is absent. The symmetry is octamerall with three cycles and the beginnings of a fourth.

Occurrence: Lower upper Aptian of USA (Texas) Travis County, Travis Peak, Cow Creek; lower Albian of Mexico (Baja California) Eréndira, N Playa Blanca; lower Cenomanian of USA (Texas) Buda Hill.

***Eosiderastrea cyclops* (FELIX, 1891)**

(Pl. 3, fig. 3)

Material: BSPG 2003 XX 6455, GPSL FLX 2050; 1 thin section.**Synonymy:**

- *v 1891 *Phyllocoenia cyclops* FELIX, p. 155, Pl. 23, figs. 3, 3.a, 5
- v 2006 ?*Diploastrea cyclops* (FELIX, 1891) - LÖSER, p. 30, fig. 2.I

Dimensions:

(GPSL FLX 2050)						
	n	min-max	μ	s	cv	$\mu \pm s$
clmin	20	2.56-3.51	3.05	0.30	10.1	2.74-3.36
cmin	20	2.83-4.84	3.89	0.63	16.3	3.25-4.52
s	ca. 32					

(BSPG 2003 XX 6602)						
	n	min-max	μ	s	cv	$\mu \pm s$
clmin	6	3.98-4.19	4.08	0.07	1.9	4.00-4.16
cmin	6	5.22-5.92	5.72	0.25	4.4	5.47-5.98
ccd	9	4.04-7.10	5.98	0.83	13.8	5.15-6.81
s	3	31-34				

Remarks: The lectotype of the species is poorly preserved and does not allow for the preparation of thin sections (see LÖSER, 2006, for details). Therefore, the species is not well defined. The Hauterivian material shows a more plocoid calicular arrangement with sub-confluent costae. The wall is incomplete. The septal symmetry is octameral.

Occurrence: Lower Hauterivian (Radiatus Zone) of France (Yonne) Gy-l'Evêque, fields SW Gy-l'Evêque. Barremian of Mexico (Puebla) Tehuacán, San Antonio Texcala.

***Eosiderastrea cf. cyclops* (FELIX, 1891)**

(Pl. 1, figs. 11-12)

Material: BSPG 2003 XX 6602; 1 thin section.**Dimensions:**

(BSPG 2003 XX 6602)						
	n	min-max	μ	s	cv	$\mu \pm s$
clmin	6	3.98-4.19	4.08	0.07	1.9	4.00-4.16
cmin	6	5.22-5.92	5.72	0.25	4.4	5.47-5.98
ccd	9	4.04-7.10	5.98	0.83	13.8	5.15-6.81
s	3	31-34				

Remarks: The material has larger dimensions than *E. cyclops*. The calicular arrangement is plocoid, the costae show varying stages of confluence and the septal symmetry is octameral.

Occurrence: Lower Hauterivian (Radiatus Zone) of France (Yonne) Gy-l'Evêque, fields SW Gy-l'Evêque.

***Eosiderastrea dollfusi* (PREVER, 1909)**

(Pl. 2, fig. 6)

Material: IGM 2734, PU 17963, 17964.**Synonymy:**

- *v 1909 *Confusastraea Dollfusi* PREVER, p. 89, Pl. 5, figs. 2, 2.a & 3
- v 1983 *Diploastrea harrisi* WELLS, 1932 - REYEROS de CASTILLO, p. 27, Pl. 18, fig. 1

Dimensions:

(PU 17964)						
	n	min-max	μ	s	cv	$\mu \pm s$
clmin	10	3.71-4.97	4.13	0.39	9.5	3.73-4.53
cmin	8	4.24-5.37	4.85	0.45	9.3	4.39-5.30
ccd	15	3.90-5.39	4.56	0.47	10.4	4.09-5.04
s	4	42-50	46.5	3.69	7.9	

Remarks: PU 17964 is here designated as the lectotype. PU 17963 becomes the paralectotype. The species forms astreoid colonies with sub or non-confluent septa. The septa appear in six systems and four septal cycles, which are often not quite complete. A wall does not exist. The lectotype of the species is small and no thin sections or topotypical material exists.

Occurrence: Lower Aptian of Italy (Abruzzi, L'Aquila) Monti d'Ocre, Fossa Mezza Spada; lower Albian of Mexico (Oaxaca) Tepelmeme, El Rodeo Ranch.

***Eosiderastrea felixi* (PREVER, 1909)**

(Pl. 2, figs. 1-5)

Material: BSPG 2003 XX 6834, PU 17965, TUM 65481; 4 thin sections.**Synonymy:**

- *v 1909 *Confusastraea Felixi* PREVER, p. 88, Pl. 5, fig. 1
- v 1951 *Placocoenia tanohataensis* EGUCHI, p. 26, Pl. 3, figs. 6-8

Dimensions:

(PU 17965)						
	n	min-max	μ	s	cv	$\mu \pm s$
cmin	7	3.65-5.07	4.27	0.46	10.9	3.81-4.74
cmax	5	4.63-6.42	5.18	0.74	14.3	4.44-5.92
ccd	6	4.20-5.85	5.05	0.52	10.4	4.52-5.57
s	38-43					

(BSPG 2003 XX 6834)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	25	2.07-3.25	2.71	0.37	13.6	2.34-3.08
cmax	20	3.69-5.86	4.59	0.57	12.4	4.02-5.16
cmin	20	3.16-4.71	3.95	0.42	10.7	3.53-4.38
ccd	20	3.42-5.57	4.45	0.76	17.0	3.69-5.21
s	6	38-44	41.16	2.56	6.2	39-44

(TUM 65481) 4.5-5.4

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	20	3.39-4.33	3.78	0.29	7.7	3.48-4.07
cmin	20	4.14-5.76	4.93	0.44	9.0	4.49-5.38
ccd	20	4.01-5.71	4.95	0.48	9.8	4.47-5.44
s	15	34-43	38.9	2.7	6.9	36-42

Remarks: The type specimen is too small to provide significant morphometric values. The topotypic specimen, BSPG 2003 XX 6834, has slightly smaller dimensions.

Occurrence: Lower Albian of Italy (Abruzzi, L'Aquila) Monti d'Ocre, Fossa Cerasetti; Fossa Mezza Spada; upper Aptian of Japan (Iwateken) Shimohei-gun, Tanohata-mura, Koikorobe.

Eosiderastrea grandipora
(ORBIGNY, 1850)

(Pl. 3, figs. 1-2)

Material: BSPG 2003 XX 1086, 5900, BSPG 2007 V 199, MNHN A26591, NMNH I-313352; 4 thin sections.

Synonymy:

- *v 1850 *Stephanocoenia grandipora* ORBIGNY, (2), p. 182
- vp 1933 *Favoidioseris fredericksburgensis* WELLS, p. 98, Pl. 8, figs. 15-18
- vp 1994 *Baryphyllia haimei* FROMENTEL, 1857 - LÖSER, p. 38, Figs. 26-27; Pl. 8, fig. 1; Pl. 12, figs. 10-11

Dimensions:**(MNHN A26591)**

cmin	6-7
ccd	7.5-8
s	48-52

(BSPG 2003 XX 5900)

	n	min-max	μ	s	cv	$\mu \pm s$
cmin	14	5.77-7.37	6.67	0.54	8.1	6.13-7.22
ccd	20	6.23-9.27	7.62	0.92	12.0	6.70-8.55
s	5	50-61	53.8	4.26	7.9	

Remarks: The astreoid species has large dimensions. The septal symmetry is hexamerall with four complete cycles and the beginnings of a fifth one. A wall is practically absent, and the costae are mainly non-confluent.

Occurrence: Middle Albian (Lautus Zone) of USA (Texas) Bell County, Santa Fe Railroad quarry; lower Cenomanian (Mantelli Zone) of Germany (Nordrhein/Westfalen) Mülheim/Ruhr, Kassenberg; lower Cenomanian of France (Charente-Maritime) Ile d'Aix; Greece (Kozani) Kozani, Nea Nikopolis; lower Cenomanian (Dixoni Zone) of Spain (Cantabria, Santander) Cobreces, Luaña playa.

***Eosiderastrea harrisi* (WELLS, 1932)**

(Pl. 3, figs. 4-9)

Material: BSPG 2003 XX 6486, FGUB AV-155-B4, PU 18099, TMM UT-11482, TUM 65367, 65480; 12 thin sections.

Synonymy:

- v 1909 *Orbicella Simonyi* - PREVER, p. 87, Pl. 4, fig. 6
- *v 1932 *Diploastrea harrisi* WELLS, p. 248, Pl. 30, fig. 9; Pl. 37, fig. 6; Pl. 38, figs. 5-6
- v 1951 *Placocoenia orbitoides* EGUCHI, p. 26, Pl. 3, figs. 3-5
- v 1992 (no name) - BUDD & COATES, fig. 2.B

Dimensions:**(PU 18099)**

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	14	3.32-4.03	3.65	0.22	6.0	3.43-3.87
cmin	10	5.01-5.88	5.54	0.27	5.0	5.26-5.82
ccd	20	4.56-6.02	5.39	0.40	7.4	4.98-5.79
s	5	39-44	41.2	2.16	5.2	

(TMM UT-11482)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	10	4.20-4.91	4.58	0.24	5.4	4.33-4.83
clmax	10	3.84-4.85	4.52	0.35	7.8	4.16-4.87
cmin	10	4.92-6.49	5.54	0.49	8.8	5.04-6.03
cmax	10	5.42-6.56	6.14	0.43	7.0	5.71-6.58
ccd	20	4.48-6.75	5.58	0.64	11.5	4.94-6.23
s	7	32-36	34.4	1.6	4.7	

(TUM 65367)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	20	3.53-4.53	4.03	0.26	6.5	3.76-4.29
cmin	20	4.76-6.03	5.34	0.36	6.8	4.98-5.71
ccd	20	4.31-6.93	5.35	0.65	12.2	4.69-6.00
s	10	29-34	30.6	1.42	4.6	29-32

(BSPG 2003 XX 6486)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	7	3.30-4.12	3.74	0.34	9.1	3.40-4.08
cmin	5	4.42-5.39	4.83	0.36	7.5	4.47-5.20
ccd	10	3.24-5.74	4.36	0.82	18.9	3.53-5.19
s	32					

Remarks: *E. harrisi* is an astreoid to plocoid species with a more or less compact wall. The septa are generally sub to non-confluent. They appear in eight systems and three cycles. The material shows some variation in the number of septa. Some samples have a larger or smaller number of septa compared to the type material of the type specimen. The Hauterivian material (BSPG 2003 XX 6486; FGUB AV 155 B 4) has slightly smaller dimensions.

Occurrence: Hauterivian of Spain (Valencia, Castellón) La Avellà, Catí; lower Hauterivian (Radiatus Zone) of France (Yonne) Gy-l'Evêque, fields SW Gy-l'Evêque; lower Aptian of Italy (Abruzzi, L'Aquila) Monti d'Ocre, Fossa Cerasetti; upper Aptian of Japan (Iwate-ken) Shimohei-gun, Tanohata-mura, Koikorobe; uppermost Aptian of Japan (Iwate-ken) Shimohei-gun, Iwaizumi-cho, Moshi, Matsushima; lowermost Albian (Tardefurcata Zone) of USA (Texas) Blanco and Hays Counties, Blanco River narrows.

***Eosiderastrea hilli* (WELLS, 1933)**

(Pl. 3, figs. 10-12)

Material: TMM 1448TX1, UT-14180B; 4 thin sections.

Synonymy:

*v 1933 *Diploastrea hilli* WELLS, p. 93, Pl. 2, figs. 13-14; Pl. 8, fig. 12

Dimensions:

(TMM UT-14180)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	8	2.65-3.35	3.00	0.24	8.1	2.76-3.25
cmin	8	3.78-5.10	4.41	0.47	10.6	3.94-4.88
ccd	9	3.67-5.24	4.47	0.52	11.8	3.94-5.00
s	3	24-26	24.7	1.15	4.6	

(TMM 1448TX1)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	10	3.32-4.49	3.84	0.38	10.0	3.45-4.23
cmin	5	4.56-6.09	5.26	0.58	11.1	4.67-5.85
ccd	8	4.53-6.98	5.55	0.79	14.2	4.76-6.34
s	24					

Remarks: The holotype of *E. hilli* is a small specimen that almost does not allow for the measurement of significant morphometric values. The species has six septal system with three septal cycles. It is clearly plocoid, occasionally with confluent costae. A wall is present. Only the type specimen is known. Specimen TMM 1448 TX1 is very similar to the holotype of *E. hilli* but clearly has larger dimensions. It is, as with *E. hilli*, a plocoid form with confluent to sub-confluent septa. A wall is present. The septa show hexamer symmetry in three cycles.

Occurrence: Middle Albian of USA (Texas) Kerr County, SE part; middle Albian (Lautus Zone) of USA (Texas) Pecos County, Leon springs.

***Eosiderastrea nagaoui* (EGUCHI, 1951)**

(Pl. 4, figs. 1-6)

Material: BSPG 2003 XX 5908, ERNO 3155, L-5185, L-5186, L-5193, TUM 65317; 12 thin sections.

Synonymy:

*v 1951 *Montastrea nagaoui* EGUCHI, p. 25, Pl. 3, figs. 1-2
 v 2003 *Diploastrea harrisi* WELLS, 1932 - BARON-SZABO & GONZÁLEZ LEÓN, p. 212, Fig. 8.B & 8.E
 v 2006 *Kobyastrea* sp. - LÖSER & FERRY, p. 489, Fig. 5.3

Dimensions:

(TUM 65317)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	30	1.62-2.19	1.90	0.17	8.9	1.73-2.07
clmax	30	1.72-2.64	2.33	0.19	8.2	2.13-2.52
cmin	25	2.86-4.02	3.28	0.31	9.7	2.96-3.60
cmax	25	3.10-4.22	3.66	0.31	8.6	3.35-3.98
ccd	30	2.39-3.62	3.01	0.33	11.1	2.68-3.34
s	10	30-40	33.9	3.0	8.9	31-37

(ERNO 3155)

	n	min-max	μ	s	cv	$\mu \pm s$
cmin	25	3.02-4.49	3.75	0.35	9.5	3.39-4.10
ccd	25	3.16-4.25	3.70	0.28	7.6	3.42-3.99
s	10	23-30	26.1	2.28	8.7	24-28

(BSPG 2003 XX 5186)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	15	2.26-3.20	2.78	0.28	10.0	2.50-3.06
cmin	10	3.21-4.10	3.60	0.23	6.4	3.37-3.84
ccd	20	2.65-4.13	3.39	0.44	12.9	2.95-3.83
s	10	25-30	28.4	2.0	7.0	27-30

(BSPG 2003 XX 5193)

	n	min-max	μ	s	cv	$\mu \pm s$
cmin	20	2.72-3.70	3.12	0.27	8.9	2.84-3.40
ccd	30	2.47-3.89	3.31	0.38	11.4	2.93-3.69
s	20	26-34	28.15	1.87	6.6	26-30

(BSPG 2003 XX 5908)

	n	min-max	μ	s	cv	$\mu \pm s$
cmin	20	2.44-3.49	2.91	0.36	12.4	2.55-3.27
ccd	25	2.17-3.47	3.03	0.36	11.9	2.66-3.39
s	8	28-34	30.5	2.0	6.5	

Remarks: The species has a plocoid calicular arrangement. The costae are sub or non-confluent. The wall is nearly complete. The septa appear in six systems and three cycles with the beginnings of a fourth cycle.

Occurrence: Lower Hauterivian of France (Bouches-du-Rhône) Marseille, Calanque de la Mounine; upper Barremian of France (Ardèche) St.Remèze, Pont de Laval; uppermost Aptian of Japan (Iwate-ken) Shimohei-gun, Tanohatamura, Haipe, southern cliff; lower Albian of Mexico (Sonora) Municipio Opodepe, Tuape, Cerro de la Espina.

***Eosiderastrea paragrandidora* n. sp.**

(Pl. 4, figs. 7-9)

Synonymy:

vp 1994 *Baryphyllia haimeii* FROMENTEL, 1857 - LÖSER, p. 38, Figs. 26-27; Pl. 8, fig. 1; Pl. 12, figs. 10-11

Origin of the name: In relation to the very similar species *E. grandipora*.

Holotype: BSPG 2007 V 309.

Paratype: BSPG 2007 V 329.

Material studied: Holotype, paratype, four further specimens (BSPG 2003 XX 1147, 5812, 5868, BSPG 2011 XXVI 46) from different localities.

Type locality: Spain, Cantabria, Santander, Cobreces, Luaña playa. 43°23'53"N 4°12'50"W (WGS 84).

Type level: Cretaceous, lower Cenomanian, Dixoni Zone.

Diagnosis: *Eosiderastrea* with an astreoid calicular arrangement, non to sub-confluent costae and septa in hexamerall symmetry with four septal cycles (43 to 51 septa in the holotype).

Description: Astreoid colony. Calicular outline circular to polygonal. Septa are compact. In cross section, the septa (and costae) in the wall are thick, thinning towards the centre. Symmetry of septa radial is hexamerall with sub-regular cycles. Septal cycles differ in length. Generally, two septal cycles reach the centre of the calice, further cycles are shorter. Septa of the last cycle are often attached to those of the third cycle. Septal upper border granulated, lateral face with numerous, irregularly distributed fine thorns, inner margin slightly swollen in places. Costae present, non-confluent to confluent. Synapticulae present, but not common, mainly in the wall region. Columella by septal fusion. Endotheca consists of numerous thin tabulae. Wall absent. Coenosteum narrow. Budding extracalicular.

Dimensions:

(BSPG 2007 V 309)

	n	min-max	μ	s	cv	μ±s
clmin	20	54.70-6.5	5.53	0.50	9.1	5.02-6.03
clmax	20	4.88-7.00	5.80	0.60	10.4	5.20-6.41
ccd	40	4.10-6.65	5.47	0.72	13.1	4.75-6.19
s	20	43-51	46.3	2.5	5.3	44-49

(BSPG 2007 V 329)

	n	min-max	μ	s	cv	μ±s
clmin	10	3.65-5.18	4.52	0.50	11.1	4.01-5.02
clmax	10	4.38-6.82	5.59	0.90	16.1	4.68-6.50
ccd	10	4.15-5.84	4.82	0.47	9.8	4.35-5.29
s	10	35-47	40.30	3.59	8.9	37-44

(BSPG 2003 XX 1147)

	n	min-max	μ	s	cv	μ±s
clmin	6	4.20-5.67	5.17	0.54	10.4	4.63-5.72
clmax	6	5.32-5.85	5.66	0.21	3.7	5.45-5.87
ccd	8	4.65-6.06	5.37	0.58	10.8	4.78-5.95
s	3	51-64	59.33	7.23	12.1	

(BSPG 2003 XX 5812)

	n	min-max	μ	s	cv	μ±s
cmin	15	4.66-6.21	5.50	0.43	7.9	5.06-5.94
ccd	20	3.92-6.91	5.40	0.86	16.0	4.53-6.27
s	7	42-44	42.85	0.69	1.6	

Comparisons: In its calicular dimensions the new species is comparable to *E. dollfusi*, which clearly shows a wall. It is similar to *E. grandipora* but has smaller dimensions.

Occurrence: Lower Cenomanian (Mantelli Zone) of Germany (Nordrhein/Westfalen) Mülheim/Ruhr, Kassenberg; lower Cenomanian of Greece (Kozani) Kozani, Nea Nikopolis; lower Cenomanian (Dixoni Zone) of Spain (Cantabria, Santander) Cobreces, Luaña playa; uppermost Cenomanian (Juddi Zone) of France (Aude) Les Corbières, Sougraigne, Prat-Péridé.

***Eosiderastrea reussi*
(MILNE EDWARDS, 1857)**

(Pl. 5, figs. 1-5)

Material: GPSL FLX 3126, FLX 5385, FLX 8059, MHE A0601, NHMW 1864/0040/1352; 6 thin sections.

Synonymy:

v 1854 *Pleurocora Haueri* M. EDW. et H. - REUSS, p. 112, Pl. 6, figs. 26-27
*v 1857 *Pleurocora Reussi* MILNE EDWARDS, (2), p. 602

- 1930 *Pleurocora reussi* MILNE-EDWARDS -
OPPENHEIM, p. 365, Pl. 35, fig. 12; Pl.
45, fig. 9
- 1982 *Neocaeniopsis reussi* (H. MILNE-ED-
WARDS) 1857 - BEAUVAIS, (2), p. 109, Pl.
36, fig. 5

Dimensions:

(NHMW 1864/0040/1352)	
cmin	9.62
s	90

(MHE A0601)						
	n	min-max	μ	s	cv	$\mu \pm s$
cmin	4	7.11-9.19	8.30	0.86	10.4	7.44-9.17
cmax	4	9.55-12.33	10.98	1.18	10.8	9.80-12.17
ccd	7	6.46-9.73	7.87	1.08	13.7	6.79-8.95
s	4	58-74	68.25	7.32	10.7	

Remarks: *E. reussi* is a problematic species because it has never been properly recognised. The holotype is small and has a polished surface on only one calice. Additional material has been difficult to obtain. The species seems to be extremely rare in the Santonian of the Gosau Valley. All the specimens from the GPSL Felix collection are small, only the MHE sample allowed some modest statistical analysis of the species. *E. reussi* is the species with the largest dimensions. The calicular arrangement is astreoid, the costae are non-confluent and the septal symmetry is hexamerale with four septal cycles.

Occurrence: Coniacian to Santonian of Austria (Oberösterreich) Gosau basin. Santonian of Austria (Salzburg) Rußbach, Zimmergraben and Neffgraben; Austria (Oberösterreich) Gosau, Wegscheidgraben.

Eosiderastrea splendida
(PREVER, 1909)

(Pl. 5, figs. 6-7)

Material: PU 17993.

Synonymy:

- *v 1909 *Diplocoenia splendida* PREVER, p. 127,
Pl. 13, fig. 19

Dimensions:

(PU 17993)						
	n	min-max	μ	s	cv	$\mu \pm s$
clmin	4	3.40-5.13	4.28	0.75	17.7	3.52-5.04
cmin	4	5.38-6.35	5.88	0.43	7.3	5.45-6.31
ccd	9	5.59-7.32	6.20	0.56	9.1	5.63-6.76
s	60-65					

Remarks: There is only the small and poorly preserved type specimen known. It is a plocoid colony with non-confluent costae. The septal are arranged in octamerale symmetry forming four septal cycles with about 60 to 65 septa. Due to the poor state of the preservation, precise septal counts are difficult to make.

Occurrence: Lower Aptian of Italy (Abruzzi, L'Aquila) Monti d'Ocre, Fossa Cerasetti

***Eosiderastrea stefani* n. sp.**

(Pl. 2, figs. 7-9)

Synonymy:

- v 2013 ?*Diploastrea tanohataensis* (EGUCHI, 1951) - LÖSER, WERNER & DARGA, p. 46, Pl. 2, figs. 7-9
- v 2015 "*Diploastrea*" *tanohataensis* EGUCHI, 1951 - LÖSER, p. 281, Fig. 193.B

Dimensions:

(BSPG 2007 V 61)						
	n	min-max	μ	s	cv	$\mu \pm s$
cmin	17	4.35-6.31	5.33	0.63	11.9	4.69-5.97
cmax	17	5.04-8.17	6.44	0.89	13.8	5.55-7.34
ccd	20	4.05-8.26	5.90	1.39	23.6	4.50-7.30
s	6	41-46	44.5	2.34	5.2	

(MHNLM 2003.1.7593b)						
	n	min-max	μ	s	cv	$\mu \pm s$
ccd	15	4.38-7.03	5.58	0.71	12.7	4.87-6.30
cmax	15	4.72-7.75	5.90	0.80	13.6	5.09-6.70
cmin	15	4.71-6.76	5.61	0.66	11.7	4.95-6.27
s	5	34-44	40.80	4.14	10.1	36.65-44.94

Origin of the name: Named after Stefan GÖTZ (1965-2012) who in 2007 initiated the massive re-collection of fossils (mainly corals) at the type locality and who invited me to revise the corals (which are the subject of a paper in progress).

Holotype: BSPG 2007 V 61.

Material studied: Holotype, six further specimens (BSPG 1947 XVI 47, 2003 XX 6145, ERNO L-5614, MHNLM 2003.1.7593, 2003.1.7593b, NHM R43455; 7 thin sections.) from different localities.

Type locality: Spain, Cantabria, Santander, Cobreces, Luaña playa. 43°23'46"N 4°12'56"W (WGS 84).

Type level: Cretaceous, lower Cenomanian, Dixoni Zone.

Diagnosis: *Eosiderastrea* with an astreoid calicular arrangement, sub-confluent costae and septa in decamerale symmetry with three septal cycles (41 to 46 septa in the holotype).

Description: Astreoid colony. Calicular outline circular. Septa have a few perforations at the inner margins. In cross section the septa (and costae) in the wall are thick, thinning towards the centre. Symmetry of septa radial is decamerall with sub-regular cycles. Septal cycles differ in length. Generally, two septal cycles reach the centre of the calice, the third cycle is shorter. Septa of the third cycle are attached to those of the second cycle in places. Septal upper border granulated, lateral face with numerous, irregularly distributed fine thorns, inner margin smooth. Costae present, non-confluent to confluent, but rather non-confluent. Synapticulae not common. Columella by septal fusion. Endotheca consists of a few thin dissepiments. Wall absent. Coenosteum narrow. Budding extracalicular.

Comparisons: The new species is only comparable to *E. felixi*; however, it differs due to the absence of a wall. *E. tanohatoensis*, to which the material was formerly assigned, is now assigned to *E. felixi*.

Occurrence: Lower Cretaceous of Palestine, Mulergat Well; lower Cenomanian of France (Charente-Maritime) Fouras; Greece (Kozani) Kozani, Nea Nikopolis; lower Cenomanian (Dixon Zone) of Spain (Cantabria, Santander) Cobreces, Luaña playa; middle Cenomanian of Germany (Bayern) Roßstein-Almen; middle to upper Cenomanian (Rhotomagense - Naviculare Zone) of France (Sarthe) Le Mans.

***Eosiderastrea vaughani* (WELLS, 1933)**

(Pl. 5, figs. 9-11)

Material: NMNH I-75128, TMM 1454TX1; 5 thin sections.

Synonymy:

*v 1933 *Diploastraea vaughani* WELLS, p. 94, Pl. 8, figs. 13-14

Dimensions:

(USNM I-75128)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	30	2.07-2.70	2.38	0.18	7.7	2.19-2.56
clmax	30	2.18-3.47	2.88	0.27	9.4	2.61-3.16
ccd	30	2.76-4.32	3.43	0.43	12.7	3.00-3.87
s	10	37-46	41.30	2.62	6.3	39-44

(TMM 1454TX1)

	n	min-max	μ	s	cv	$\mu \pm s$
cmin	30	1.10-2.02	1.65	0.21	13.2	1.43-1.87
clmax	30	1.65-2.42	2.01	0.22	11.0	1.79-2.24
ccd	30	2.32-3.50	2.86	0.30	10.4	2.56-3.16
s	15	34-46	39.1	3.7	9.5	35-43

Remarks: *E. vaughani* is the species with the smallest dimensions. The species is characterised by an extremely extended coenosteum and a high amount of synapticulae in the coenosteum. The specimen 1454TX1 is very similar to the type of *E. vaughani* but has smaller dimensions. It also shows a more extended coenosteum and more synapticulae than other specimens. The locality of the latter specimen is indicated as 'Texas, Travis County, Pilot Knob, north rim, with an early late Campanian age. This locality is doubted. Material from the Pilot Knob was available for study, also in thin sections, and all the coral specimens were much more poorly preserved. The lithology of the TMM 1454TX1 is more similar to corals from the upper Aptian or lower Albian outcrops in Texas.

Occurrence: Middle Albian (Lautus Zone) of USA (Texas) Kerr County, Kerrville, Hiram Hall Ranch.

Eosiderastrea villaltai

(REIG ORIOL, 1991)

(Pl. 6, figs. 1-3)

Material: BSPG 1994 XI 13, 292, 293, 294, 53, BSPG 1996 VI 2, BSPG 1997 V 113-2, ERNO L-4789, L-7368, MV 13539, PIUEN b45; 9 thin sections.

Synonymy:

- *v 1991 *Plesiofavia villaltai* REIG ORIOL, p. 19, Pl. 4, fig. 9
- v 1997 *Isastrea neocomiensis* FROMENTEL, 1857 - BARON-SZABO, p. 70, Pl. 7, figs. 2 & 4
- v 2003 *Diploastrea harrisi* WELLS, 1932 - BARON-SZABO *et al.*, p. 210, Pl. 37, fig. 3; Pl. 38, fig. 2; Pl. 39, fig. 4

Dimensions:

(BSPG 1994 XI 53)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	30	3.34-4.46	3.93	0.29	7.6	3.63-4.23
clmax	30	4.13-5.43	4.70	0.36	7.7	4.33-5.06
cmin	30	4.74-6.18	5.50	0.43	7.9	5.06-5.93
cmax	30	5.31-7.35	6.16	0.59	9.7	5.56-6.76
ccd	40	4.54-6.72	5.67	0.60	10.7	5.06-6.27
s	25	34-44	39.1	3.1	7.9	36-42

Remarks: The species forms astreoid colonies that possess no wall. The septa are non-confluent. The symmetry is octamerall with three to four septal cycles. In its dimensions, it is comparable to *E. splendida* but differs by the absence of a wall.

Occurrence: Upper Barremian to lower Aptian (Sartousi - Weissi Zone) of Germany (Bayern) Allgäuer Helvetikum, Falkenberg; NE Hoher Ifen, Kühberg; Tiefenbach; lower upper Aptian of Spain (Cataluña, Lérida) Com. La Noguera, Mun. Vilanova de Meià, Montsec de Rubies, section NW La Cabrua quarry; upper Aptian to Albian of Iran (Esfahan) Esfahan Basin, Dizlu; lowermost Albian (Tardefurcata Zone) of Spain (Cataluña, Tarragona) Com. Baix Penedés, Mun. Olivella, Can Grau; lower Albian of USA (Texas) Kendall County, Guadalupe River Ranch.

***Eosiderastrea* sp. 1**

(Pl. 6, figs. 4-6)

Material: ERNO L-121509; 2 thin sections.

Dimensions:

(ERNO L-121509)

	n	min-max	μ	s	cv	$\mu \pm s$
cmin	13	2.84-4.47	3.73	0.56	15.1	3.16-4.29
ccd	16	5.68-7.92	6.76	0.60	8.9	6.15-7.36
s	9	46-61	51.55	5.3	10.2	46-57

Remarks: This astreoid species with mainly non-confluent septa and an incomplete wall shows hexamerall symmetry with four septal cycles. It is the oldest known species.

Occurrence: Upper Valanginian of Spain (Murcia) Sierra Larga.

***Eosiderastrea* sp. 2**

(Pl. 5, fig. 8)

Material: BSPG 2003 XX 6539; 1 thin section.

Synonymy:

v 2013 "*Diploastrea*" sp. - LÖSER, Fig. 2.3

Dimensions:

(BSPG 2003 XX 6539)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	7	3.63-5.59	4.64	0.63	13.6	4.01-5.28
cmin	7	4.68-7.39	5.97	1.05	17.6	4.92-7.03
ccd	11	5.71-8.83	7.16	1.10	15.4	6.05-8.26
s	3	43-60				

Remarks: This species shows an astreoid calicular arrangement. The wall is absent. The septa are non to sub-confluent. The septal symmetry is hexamerall.

Occurrence: Lower Hauterivian (Radiatus Zone) of France (Yonne) Gy-l'Evêque, fields SW Gy-l'Evêque.

***Eosiderastrea* sp. 3**

(Pl. 6, figs. 7-9)

Material: SNSD-MMG SaKL542; 2 thin sections.

Synonymy:

v 2014 "*Diploastrea*" sp. 2 - LÖSER, p. 28, Fig. 4.b

Dimensions:

(SNSD-MMG SaKL542)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	10	2.12-2.74	2.34	0.19	8.3	2.15-2.54
clmax	10	2.54-3.35	2.78	0.26	9.5	2.52-3.05
cmin	10	2.92-4.08	3.65	0.40	11.0	3.24-4.05
cmax	10	3.75-4.54	4.15	0.29	7.0	3.86-4.44
ccd	10	3.26-4.21	3.70	0.33	9.1	3.36-4.04
s	6	50-63	53.83	4.66	8.6	

Remarks: This astreoid form shows octamerall symmetry with a strong bilateral component. It is most similar to *Siderastraea*, but the wall is incomplete and very weak. The septal microstructure is partly preserved. The columella is made up of a group of isolated trabeculae, which is rarely visible in other species.

Occurrence: Lower Cenomanian (Dixoni Zone) of Germany (Sachsen) Meißen-Zscheila, Trinitatis church.

***Eosiderastrea* sp. 4**

(Pl. 7, figs. 4-6)

Material: BSPG 2003 XX 4027, 2003 XX 5846, ERNO L-130135, L-130206, L-5601, UPS HL-025; 8 thin sections.

Dimensions:

(BSPG 003 XX 5846)

	n	min-max	μ	s	cv	$\mu \pm s$
clmin	20	3.80-5.55	4.77	0.44	9.3	4.32-5.21
cmin	15	5.91-8.04	6.96	0.64	9.2	6.32-7.61
ccd	20	5.11-7.71	6.55	0.85	12.9	5.70-7.40
s	12	39-47	41.83	2.40	5.7	39-44

Remarks: The astreoid species shows non to sub-confluent septa. A wall is absent. The septal symmetry is decamerall.

Occurrence: Uppermost Aptian of Spain (Cataluña, Lérida) Com. Alt Urgell, Mun. Coll de Nargó, Set Comelles, El Caso section; middle Albian of Mexico (Sonora) Municipio San Pedro de la Cueva, Tepache, Lampazos area, Espinazo de Diablo; lower Cenomanian of France (Charente-Maritime) Fouras; Greece (Kozani) Kozani, Nea Nikopolis; uppermost Cenomanian (Juddi Zone) of France (Aude) Col de Escudíés.

Eosiderastrea sp. 5

(Pl. 7, figs. 1-3)

Material: BSPG 1991 X 97, 2003 XX 5829; 4 thin sections.

Synonymy:

v 2013 ?*Diploastrea* sp. - LÖSER *et al.*, p. 48, Pl. 1, figs. 5-6

Dimensions:

(BSPG 1991 X 97)						
	n	min-max	μ	s	cv	μ±s
cmin	3	7.50-7.56	7.53	0.03	0.4	7.50-7.56
ccd	7	5.16-8.26	6.84	1.25	18.2	5.59-8.09
s	60-70					

(BSPG 2003 XX 5829)						
	n	min-max	μ	s	cv	μ±s
cmin	6	5.82-8.42	7.11	1.05	14.8	6.06-8.17
ccd	12	6.05-8.37	7.09	0.84	11.9	6.24-7.93
s	5	51-63	57.8	5.8		

Remarks: This species forms astreoid colonies with sub to non-confluent septa. The septal symmetry is difficult to decipher, most likely it is decamerall with three to four cycles. A wall does not exist. Both specimens show higher septal perforations than any other species.

Occurrence: Lower Cenomanian of Greece (Kozani) Kozani, Nea Nikopolis; middle Cenomanian of Germany (Bayern) Roßstein-Almen.

Eosiderastrea sp. 6

(Pl. 6, figs. 10-11)

Material: ERNO L-0955, SNSD-MMG SaKL253; 3 thin sections.

Synonymy:

v 1989 *Brachyphyllia* sp. - LÖSER, p. 138, Figs. 39-40; Pl. 27, figs. 1-2
 v 2014 "*Diploastrea*" sp. 1 - LÖSER, p. 28, Fig. 4.a

Dimensions:

(SNSD-MMG SaKL253)	
cmin	4.8-5.1
ccd	4.3-4.9
s	ca. 70

Remarks: This species shows an astreoid calicular arrangement with non-confluent septa. A wall does not exist. The septal symmetry is probably decamerall with almost four cycles.

Occurrence: Lower Cenomanian (Dixoni Zone) of Germany (Sachsen) Meißen-Zscheila, Trinitatis church.

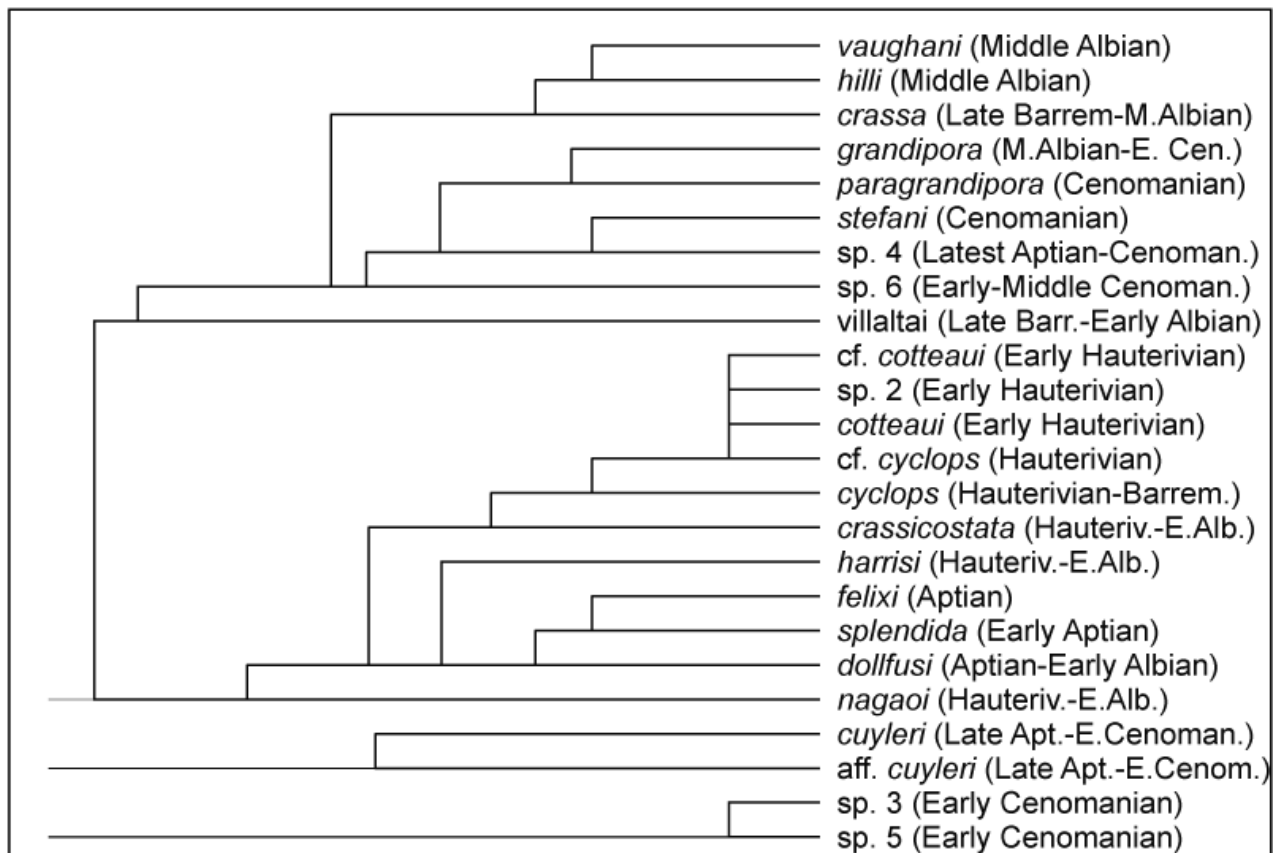


Figure 1: Correlation of the *Eosiderastrea* species based on their occurrence in the palaeo-provinces. The Correlation Ratio coefficient was applied. The graph is logarithmic.

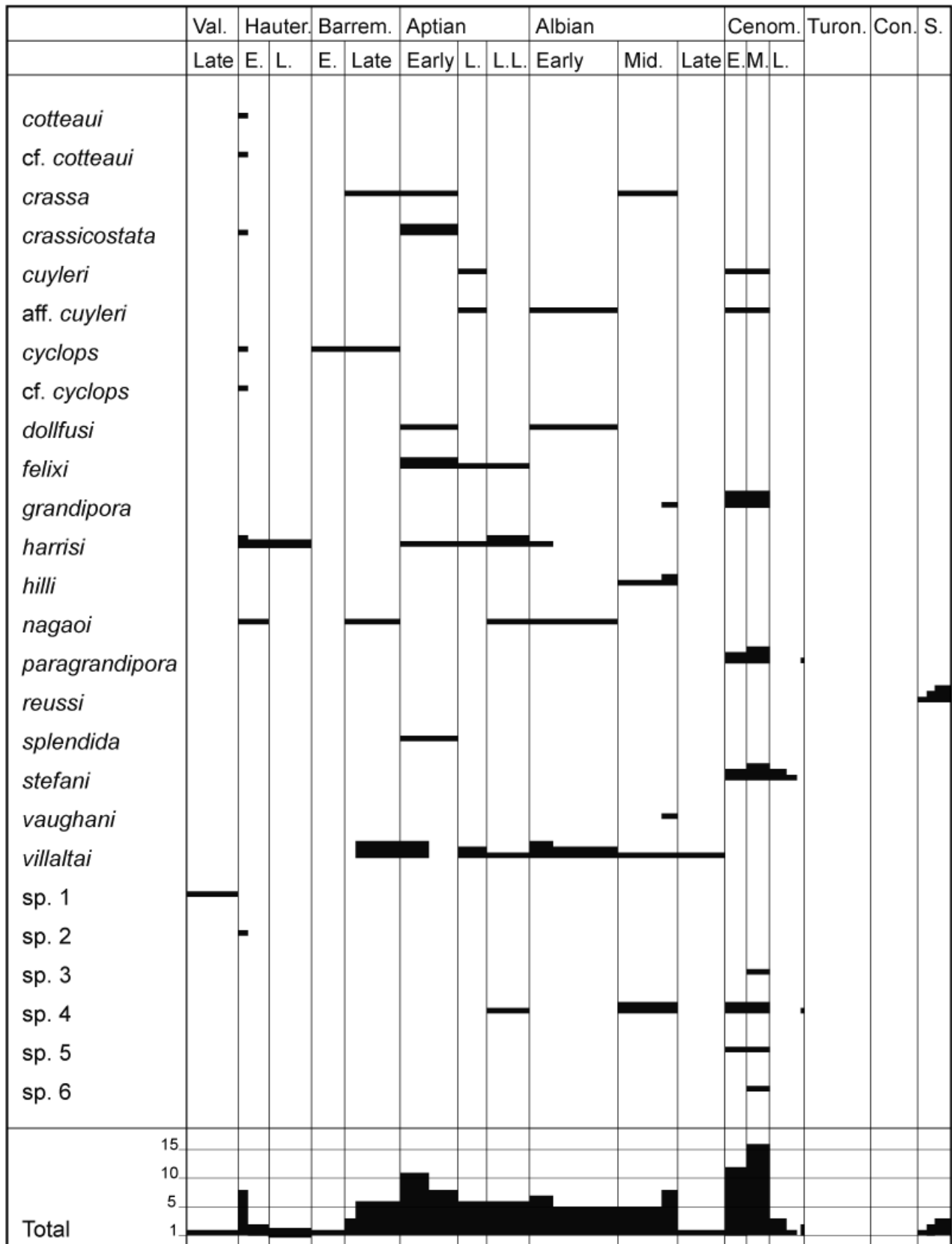


Figure 2: Cumulative stratigraphic distribution of the *Eosiderastrea* species. The thickness of the bars corresponds to the number of specimens from the various time intervals. The bar at the bottom summarises the occurrences and indicates diversity peaks in the earliest Aptian and early to middle Cenomanian.

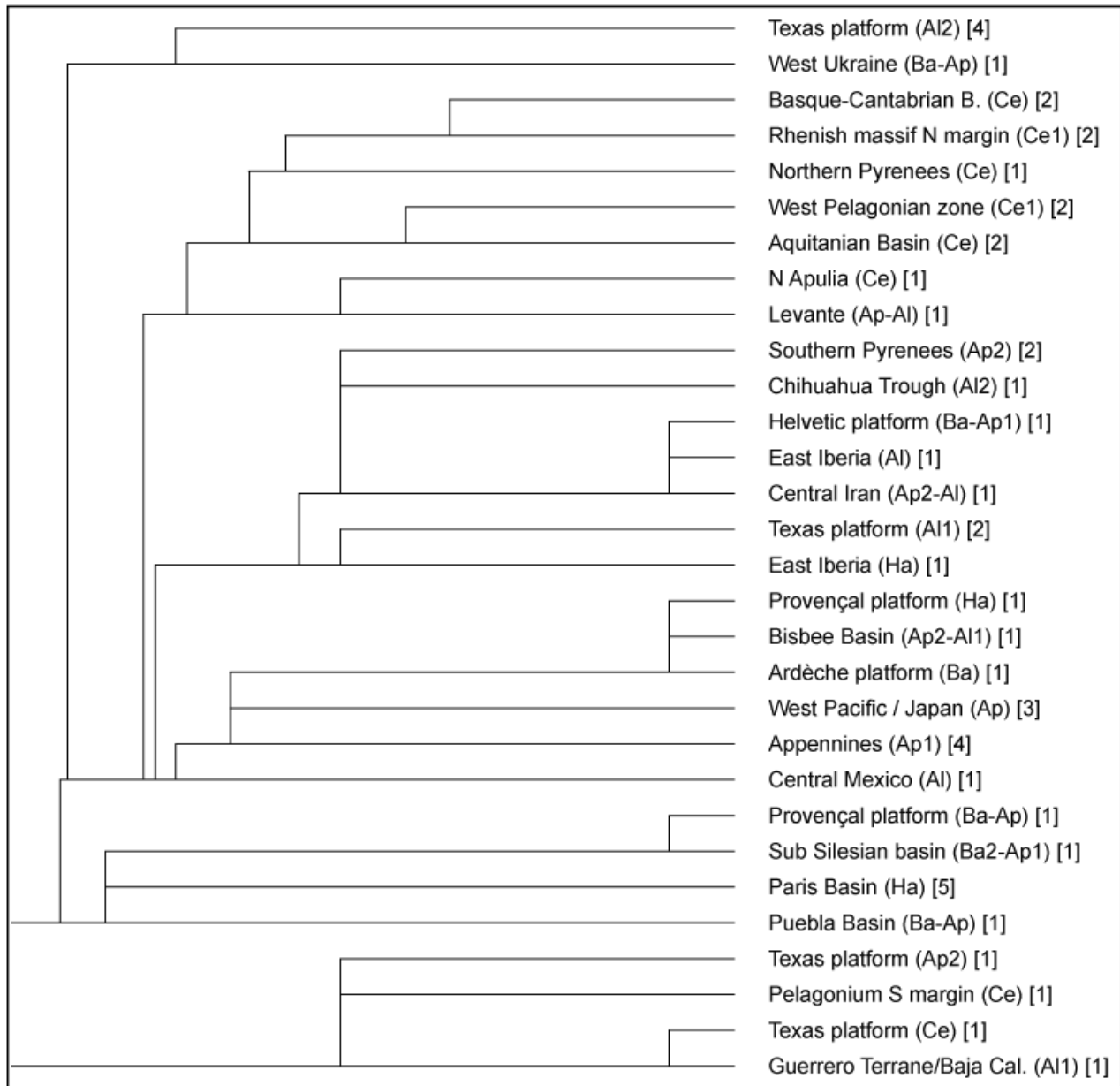


Figure 3: Correlation of provinces with joint species in the study area. The Correlation Ratio coefficient was applied. For details of the calculation see LÖSER & MINOR (2007).

FURTHER MATERIAL

KUZMICHEVA (2002, Pl. 27, fig. 5) depicts a specimen from the upper Aptian of Uzbekistan, *Hemiporites jacobi*, that clearly belongs to *Eosiderastrea* but cannot be assigned to any species. The indicated magnification factor (2x) would indicate a smaller outer calicular diameter of more than 10mm. The symmetry is hexamerous with three cycles of septa. Since the number of septa generally increases with the calicular diameter (see Table 1), the indicated magnification is in doubt. The same applies to the material presented by BARON-SZABO (1993, Pl. 4, fig. 6) as *Diploastrea harrisi*; the measured small calicular diameter of seven to eight millimetres does not coincide with the comparably low number of septa (32).

Baryphyllia gasseri REIG ORIOL, 1995, from the lowermost Albian of East Iberia may belong to *Eosiderastrea*, but the type is small and has neither a polished section nor thin sections.

5. Discussion

Species separation: To cross check the taxonomic assignments and to identify possible synonyms, the co-occurrences of the taxa in palaeo-provinces (see LÖSER & MINOR, 2007) were correlated resulting in a correlation dendrogram (Fig. 1). Highly correlated species with comparable morphological characteristics (septal systems, calicular dimensions) could be synonymous. A high palaeobiogeographic correlation was seen in the following species:

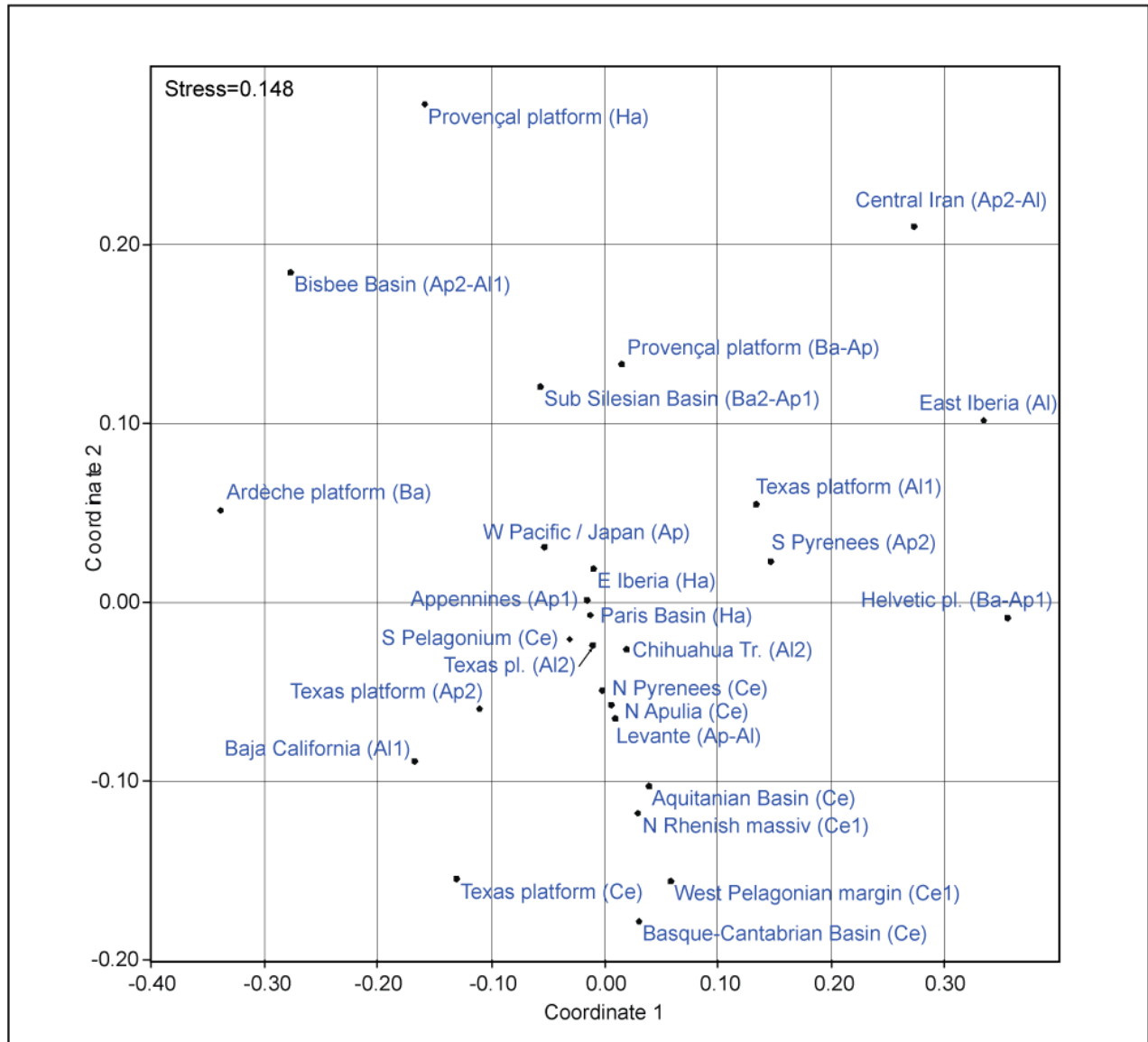


Figure 4: Multidimensional scaling (Euclidean), based on the correlation in figure 3. The STRESS value is relatively high due to the low number of occurrences in comparison to the high number of species.

- *E. grandipora* and the new species *E. paragrandidipora*: both species differ clearly in their calicular dimensions.
- *E. cotteai* and *E. cf. cotteai*: the species differ only in their calicular dimensions. It is possible that both species are synonymous but more and better preserved material is necessary to understand the variability of the complex.
- *E. cyclops* and *E. cf. cyclops*: the species differ only by their calicular dimensions. *E. cyclops* is not well defined. Material, aside from the type material, consists of small colonies that do not allow the estimation of intraspecific variability.
- *E. cuyleri* and *E. cf. cuyleri* (holotype and paratype of the species *cuyleri*): the species differ clearly in their calicular dimensions and the septal symmetry.

Stratigraphic distribution: The genus diversified during the earliest Hauterivian but is not present from there to the early Barremian (Fig. 2). From the early Barremian onwards, the genus was rich in species, surprisingly also in the Albian. Coral faunas from this age are poorly represented in the Tethys but common in the Western Atlantic, where most species of this age are derived. There is a gap again in the late Albian, but the genus reached its highest diversity in the early to middle Cenomanian, with a drop in the late Cenomanian. One last species is known from the Santonian. The gap in the Turonian and Coniacian is probably due to a lack of available collections. The genus is widely distributed throughout clastic and carbonatic sediments. It seems to be more common in clastic sediments but this may be also due to a sample bias because corals are more difficult

to obtain from massive limestones and can be more easily collected from clastic sediments.

Palaeobiogeography: The genus shows an almost worldwide distribution, being most abundant in the Tethys and less abundant in the Western Atlantic and Western Pacific, except for the Albian when coral faunas were more common in the Western Atlantic than in the Tethys. No clear palaeobiogeographic relationships exist (Fig. 3). The number of species is high, but the number of specimens (and therefore occurrences) is comparatively low, which makes a correlation difficult. A certain correlation of provinces with the same age can be observed. A multidimensional scaling analysis (based on a correlation of the absence or presence in palaeo-provinces) for all occurrences (Fig. 4) also shows a correlation between species that co-occur in the same stages, in general in the Cenomanian and Barremian to Aptian. A more detailed palaeobiogeographic analysis is difficult to provide because of the low amount of data.

Evolution: There is an interesting tendency for an increase in calicular diameter during the Cretaceous. The species with small diameters occurred predominantly during the Hauterivian to Aptian; while species with larger dimensions occurred mainly during the Cenomanian and the Santonian. With the increasing size of the corallites, the number of septa also increased, so the species with the highest number of septa are mainly found in the early Late Cretaceous.

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Plates

Plate 1:

- 1) *Eosiderastrea cotteai* (ORBIGNY, 1850), syntype MNHN A25815, colony surface;
2-3) *Eosiderastrea* cf. *cotteai* (ORBIGNY, 1850), BSPG 2003 XX 6458; 2) transversal slab; 3) transversal slab, detail;
4-5) *Eosiderastrea crassa* (KUZMICHEVA, 1980), TMM 1449TX6; 4) transversal thin section; 5) transversal thin section, detail with microstructures;
6) *Eosiderastrea crassicostata* (MORYCOWA & MASSE, 1998), BSPG 2003 XX 6603, transversal thin section;
7-9) *Eosiderastrea cuyleri* (WELLS, 1932), holotype TMM UT-11474; 7) transversal thin section; 8) transversal thin section, detail; 9) longitudinal thin section;
10) *Eosiderastrea* aff. *cuyleri* (WELLS, 1932), TMM UT-10642, transversal thin section;
11-12) *Eosiderastrea* cf. *cyclops* (FELIX, 1891), BSPG 2003 XX 6602; 11) transversal thin section; 12) transversal thin section, detail.
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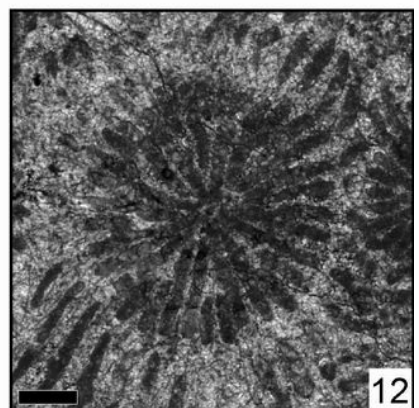
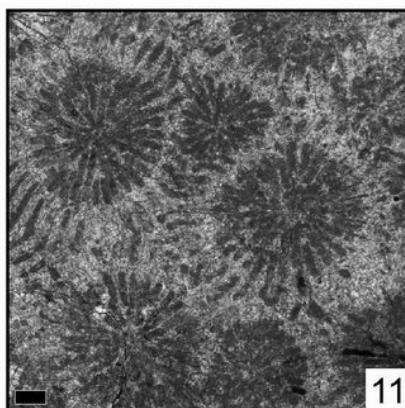
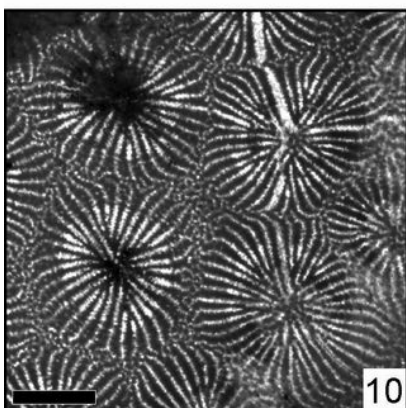
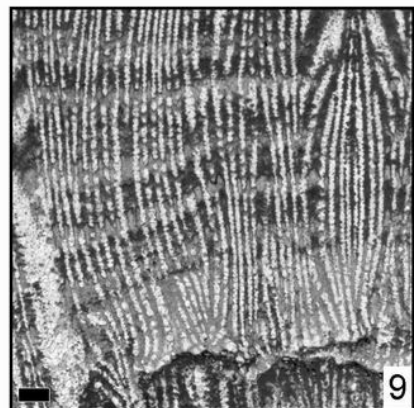
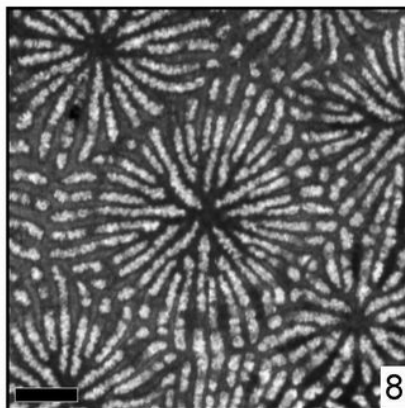
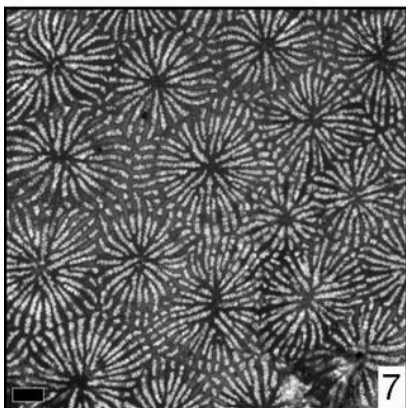
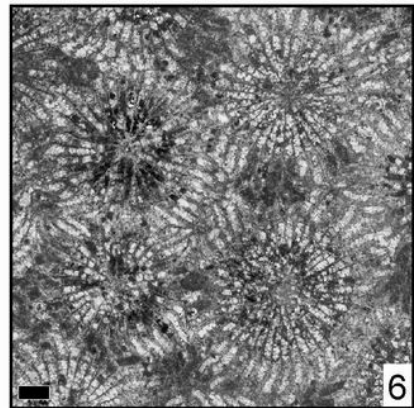
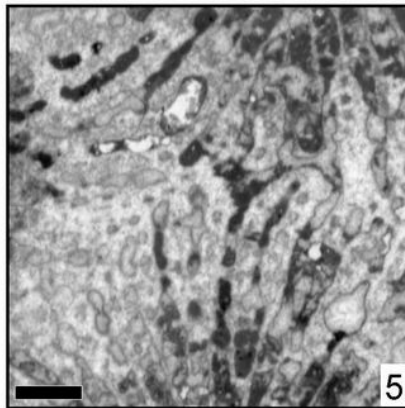
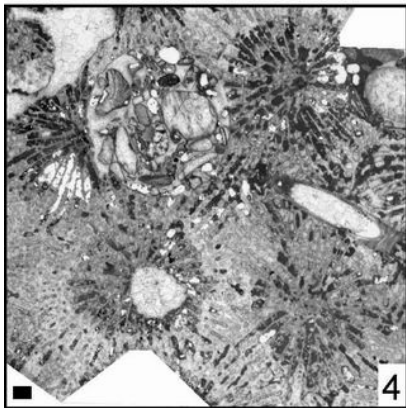
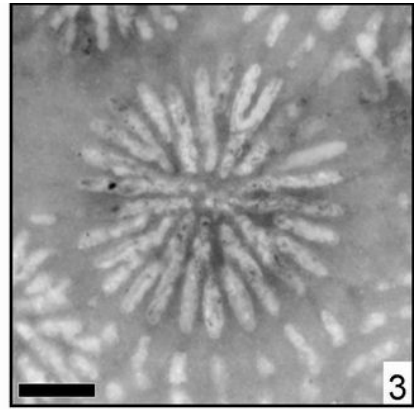
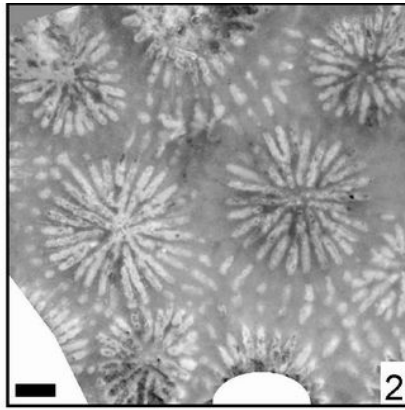
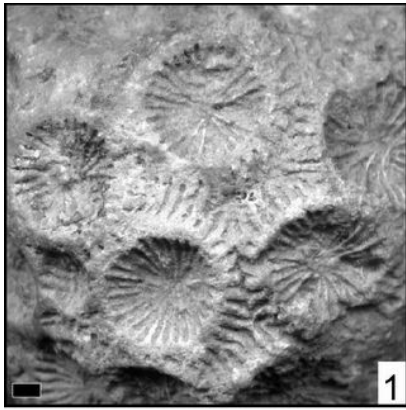


Plate 2:

1-5) *Eosiderastrea felixi* (PREVER, 1909), holotype PU 17965; 1) transversal slab; 2) longitudinal slab; 3) BSPG 2003 XX 6834, transversal thin section; 4) transversal thin section, detail; 5) transversal thin section, detail;
6) *Eosiderastrea dollfusi* (PREVER, 1909), lectotype PU 17964, transversal slab;
7-9) *Eosiderastrea stefani* n.sp., holotype BSPG 2007 V 061; 7) transversal thin section; 8) transversal thin section, detail; 9) longitudinal thin section.

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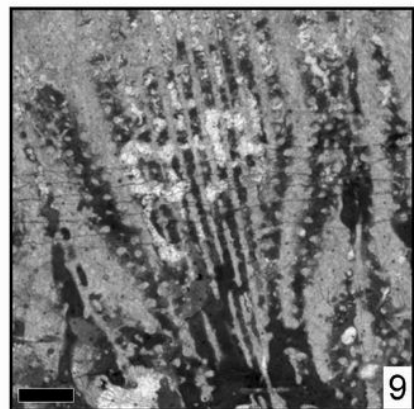
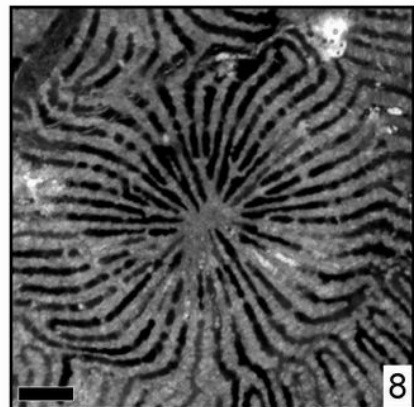
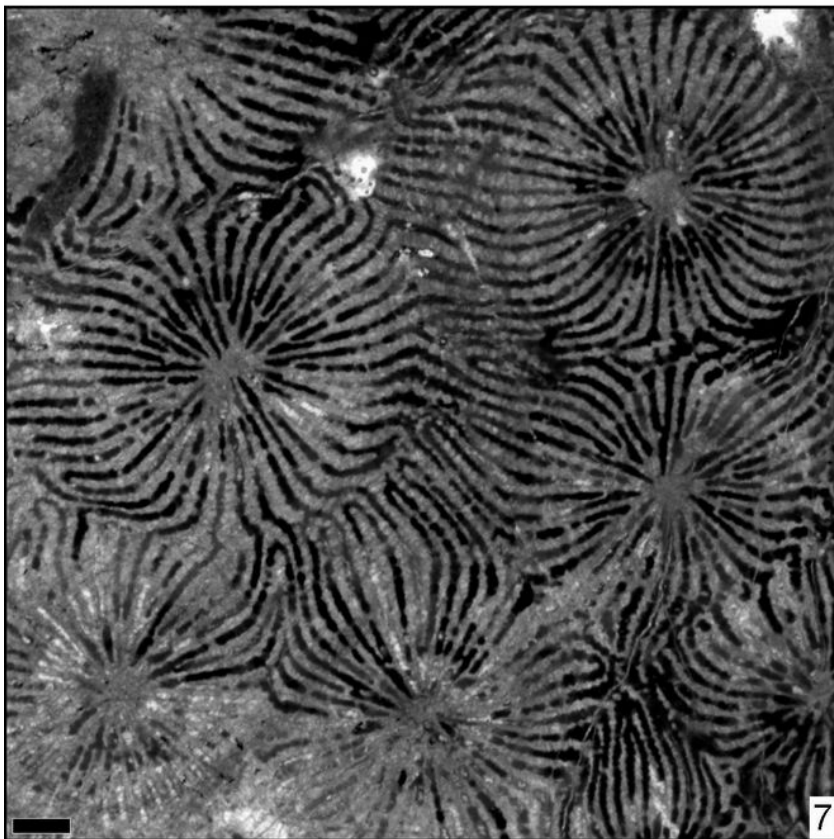
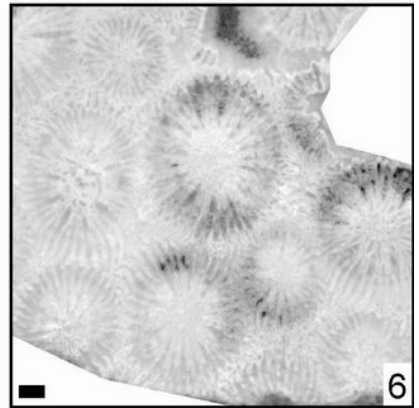
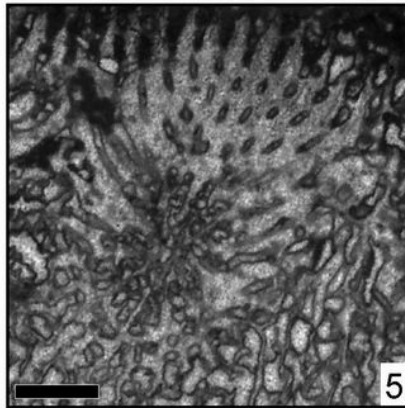
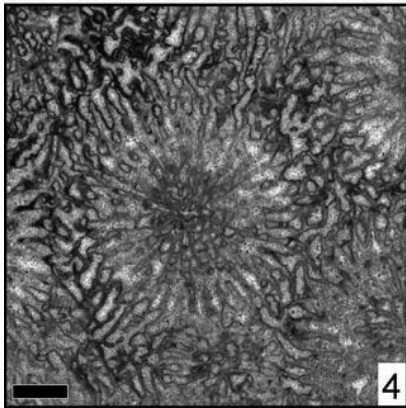
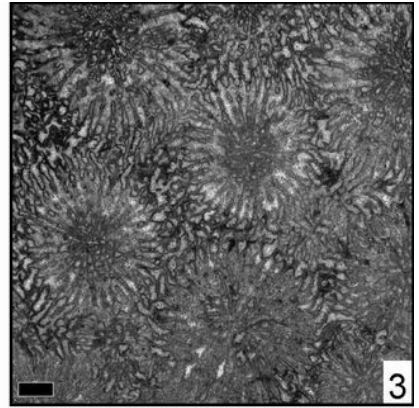
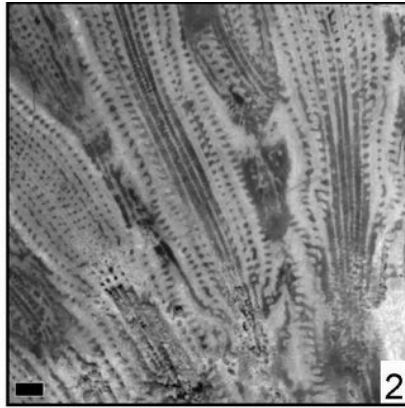
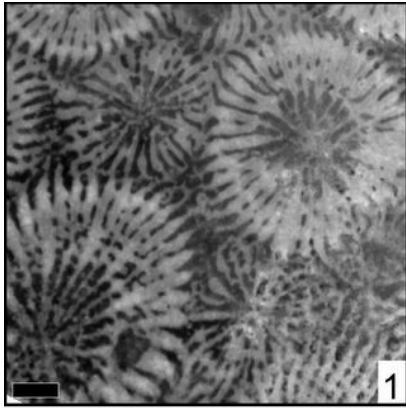


Plate 3:

1-2) *Eosiderastrea grandipora* (ORBIGNY, 1849), syntype MNHN A26591; 1) coral surface; 2) BSPG 2007 V 199, transversal thin section;

3) *Eosiderastrea cyclops* (FELIX, 1891), BSPG 2003 XX 6455, transversal thin section;

4-6) *Eosiderastrea harrisi* (WELLS, 1932), holotype TMM UT-11482; 4) transversal thin section; 5) transversal thin section, detail; 6) longitudinal thin section;

7-9) *Eosiderastrea harrisi* (WELLS, 1932), holotype of *Placocoenia orbitoides* TUM 65367; 7) transversal thin section; 8) transversal thin section, detail; 9) longitudinal thin section; Z10-12) *Eosiderastrea hilli* (WELLS, 1933), holotype TMM UT-14180B; 10) transversal section; 11) TMM 1448TX1, transversal thin section; 12) transversal thin section, detail.

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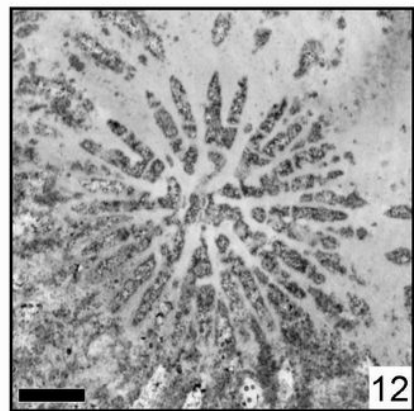
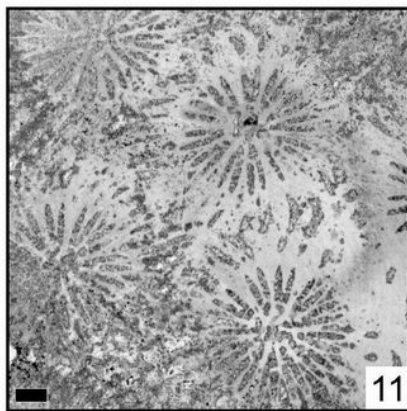
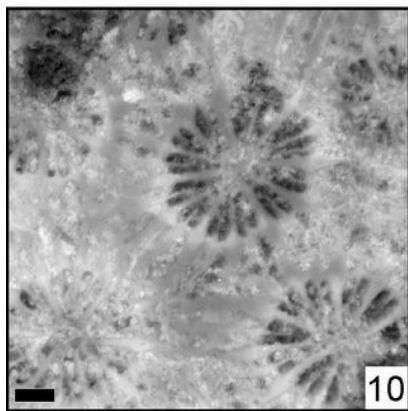
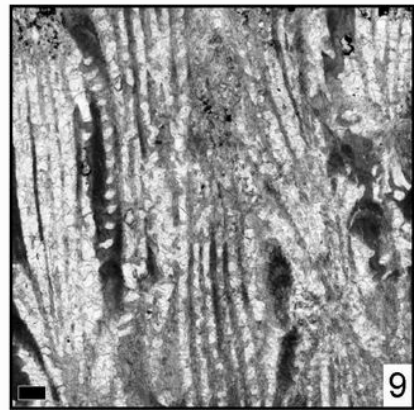
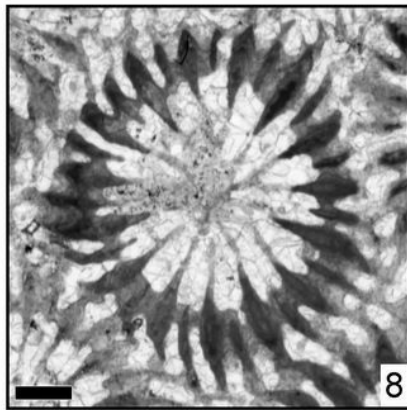
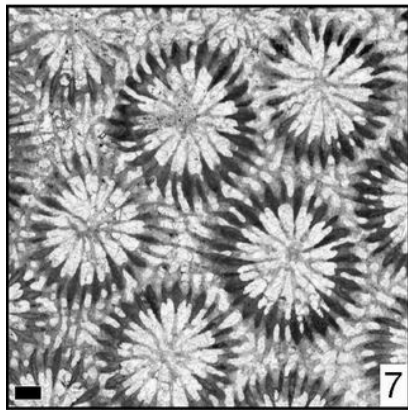
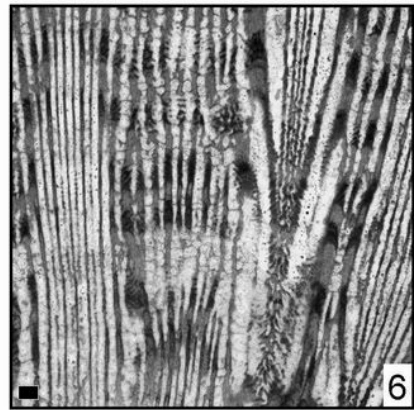
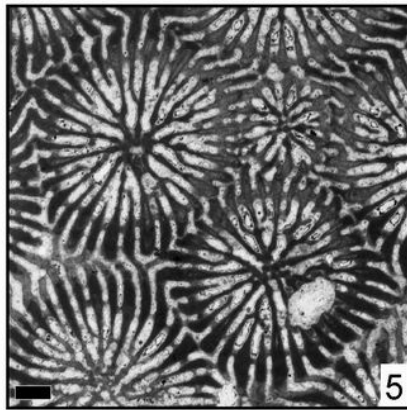
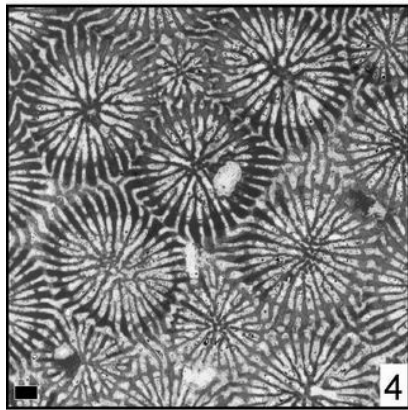
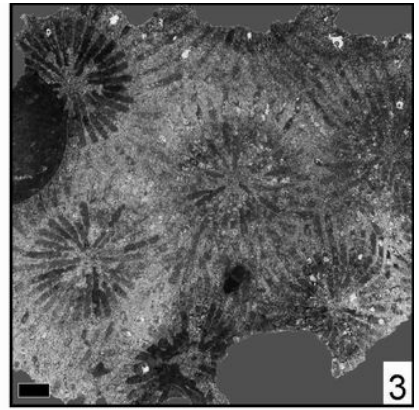
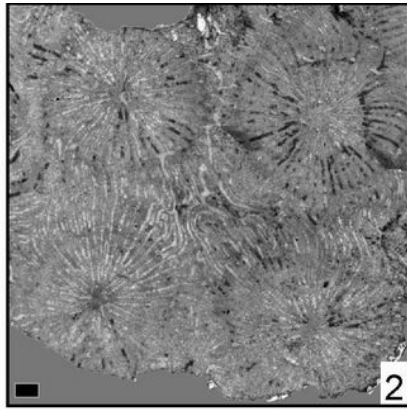
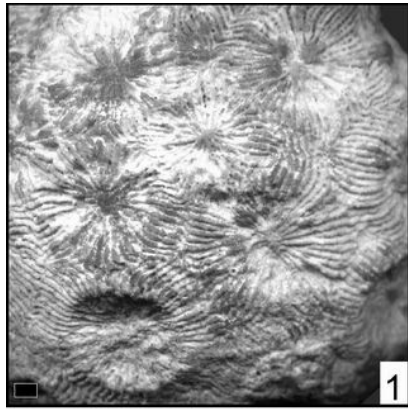


Plate 4:

1-6) *Eosiderastrea nagaoui* (EGUCHI, 1951), holotype TUM 65317; 1) transversal thin section; 2) transversal thin section, detail; 3) longitudinal thin section; 4) ERNO L-5193, transversal thin section; 5) transversal thin section, detail; 6) transversal thin section, detail;

7-9) *Eosiderastrea paragrandidipora* n. sp., holotype BSPG 2007 V 309; 7) transversal thin section; 8) transversal thin section, detail; 9) longitudinal thin section.

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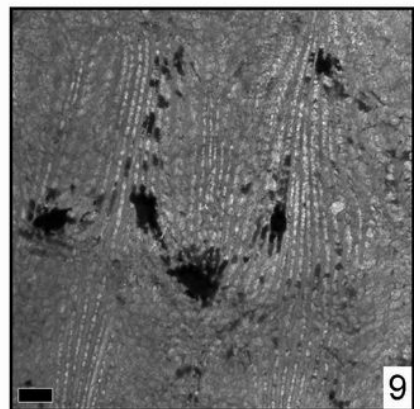
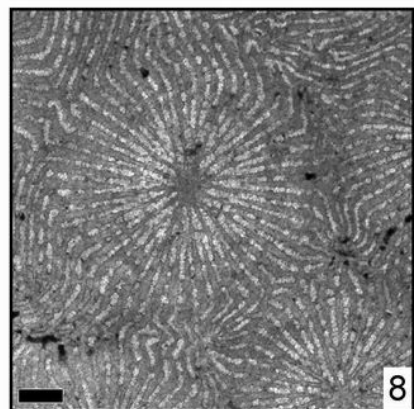
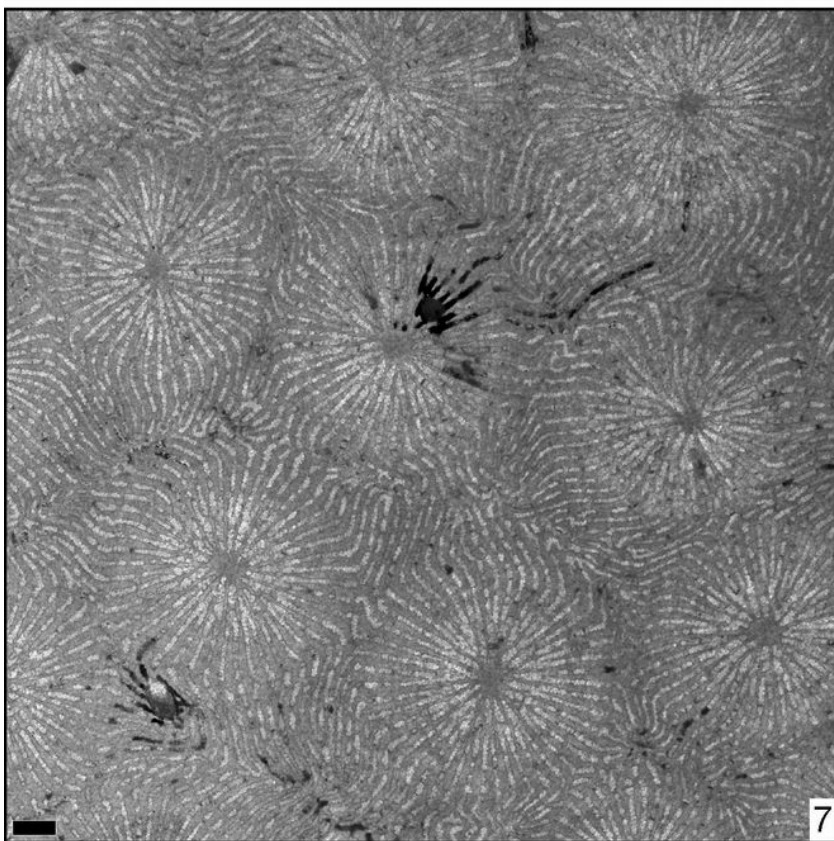
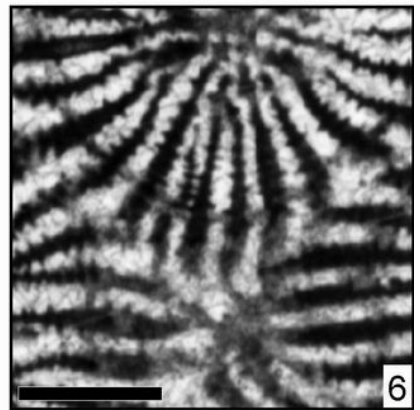
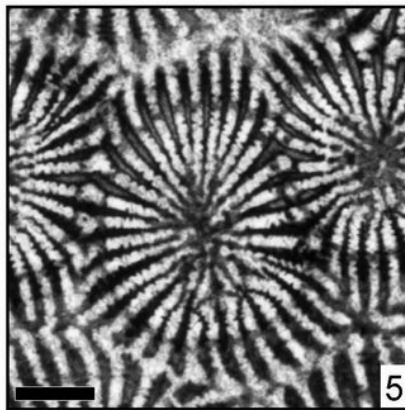
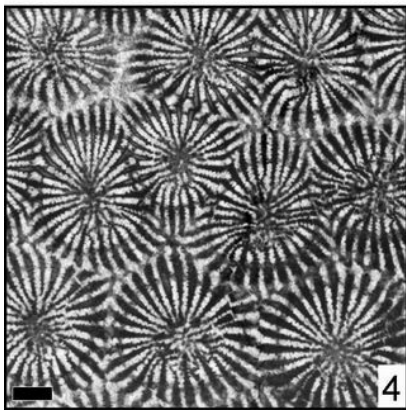
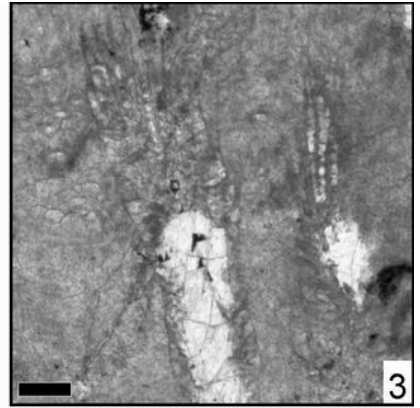
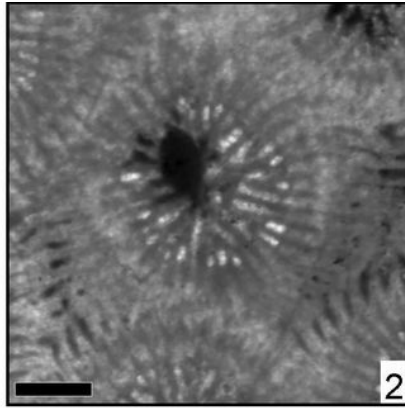
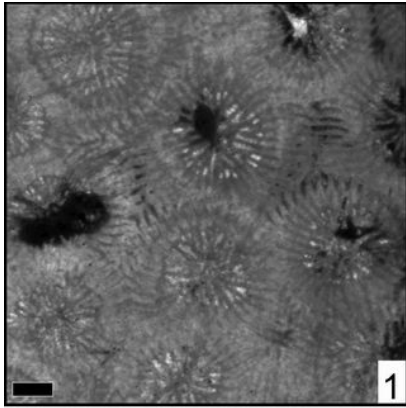


Plate 5:

1-5) *Eosiderastrea reussi* (MILNE EDWARDS, 1857), MHE A0601; 1) coral surface; 2) transversal section; 3) holotype NHMW 1864/0040/1352, transversal polished section; 4) GPSL FLX 8059, transversal thin section; 5) longitudinal thin section;

6-7) *Eosiderastrea splendida* (PREVER, 1909), holotype PU 17993; 6) transversal acetate peel; 7) transversal acetate peel, detail; 8) *Eosiderastrea* sp. 2, BSPG 2003 XX 6539, transversal thin section;

9-11) *Eosiderastrea vaughani* (WELLS, 1933), holotype NMNH I-75128; 9) coral surface; 10) TMM 1454TX1, transversal thin section; 11) transversal thin section, detail.

[Scale bar 1mm]

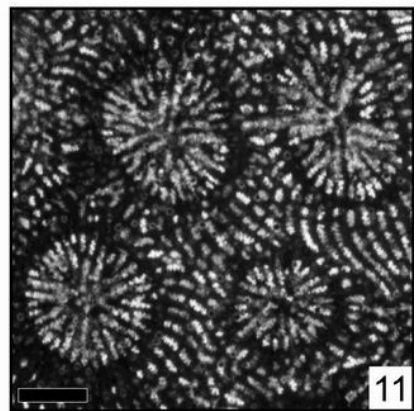
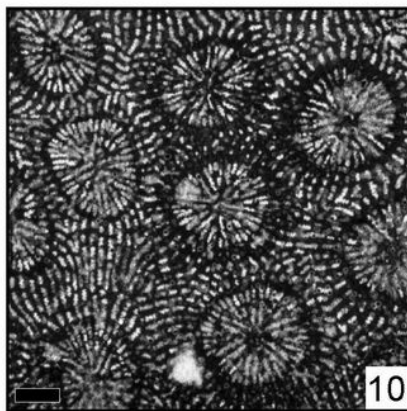
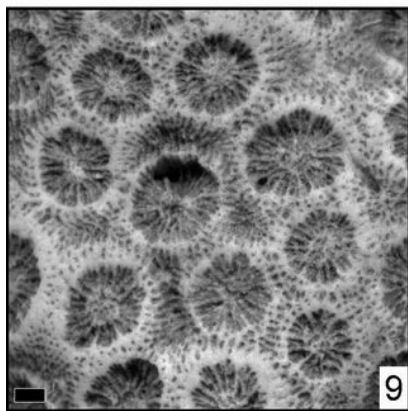
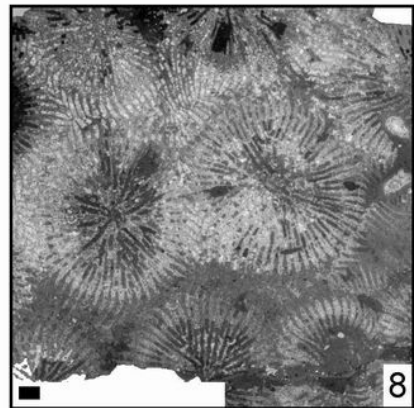
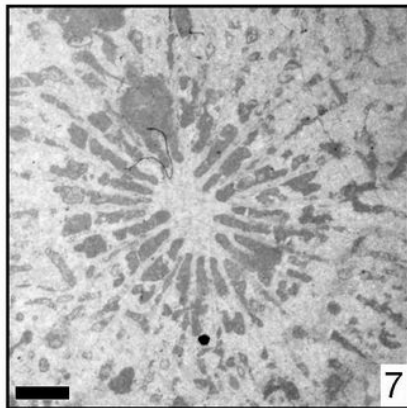
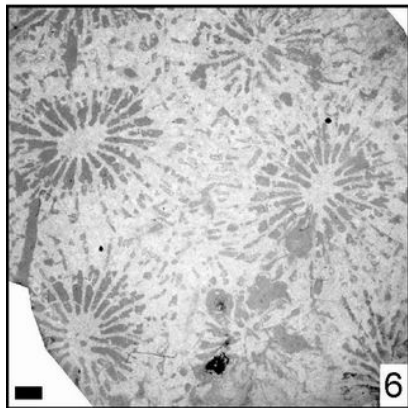
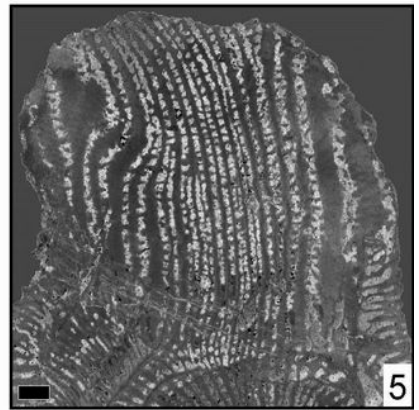
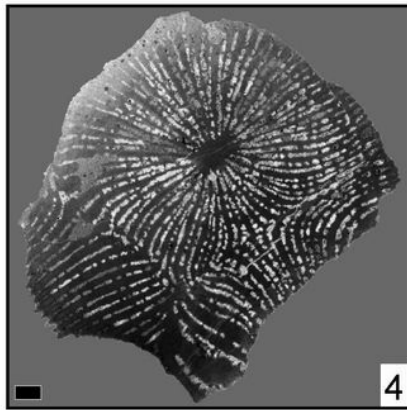
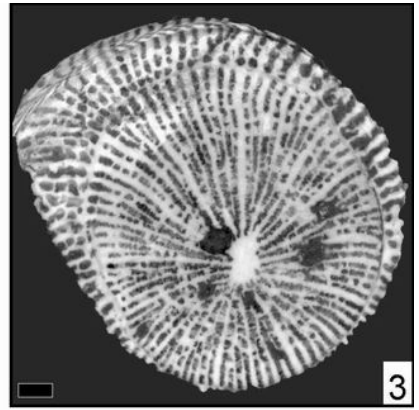
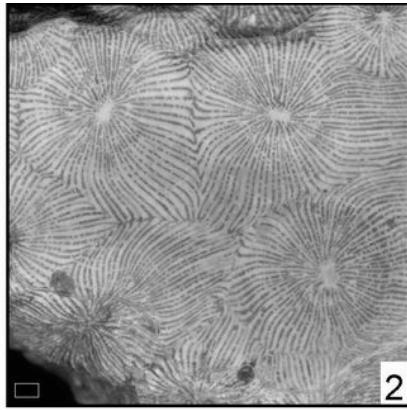
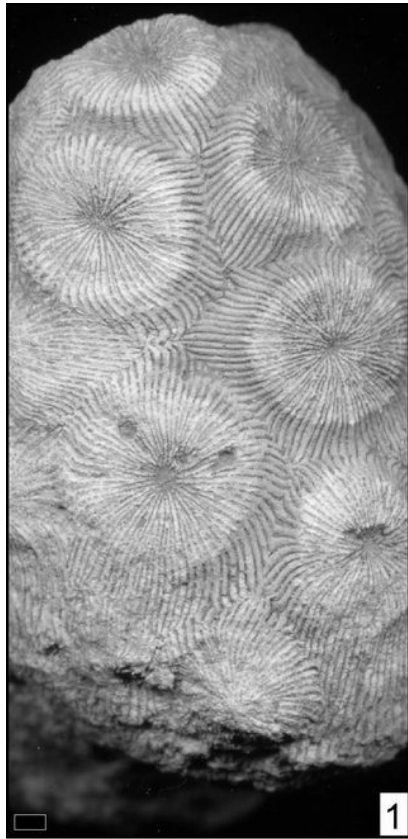


Plate 6:

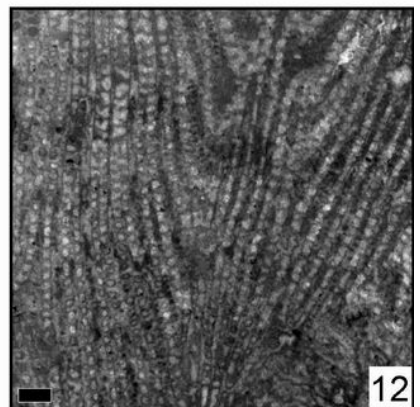
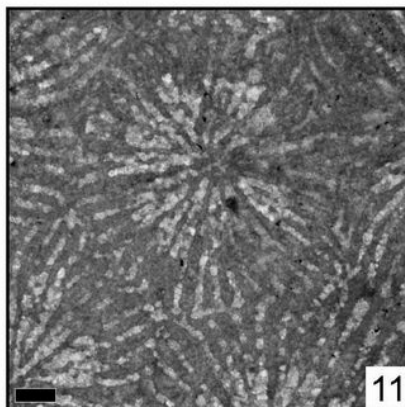
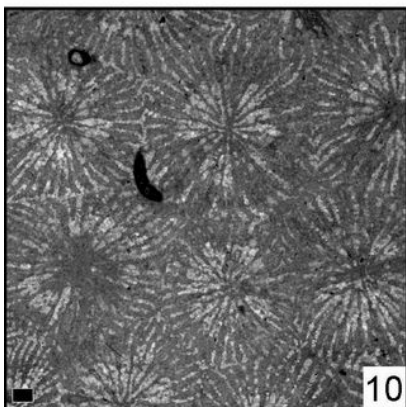
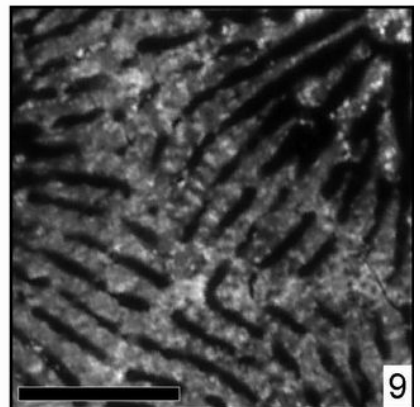
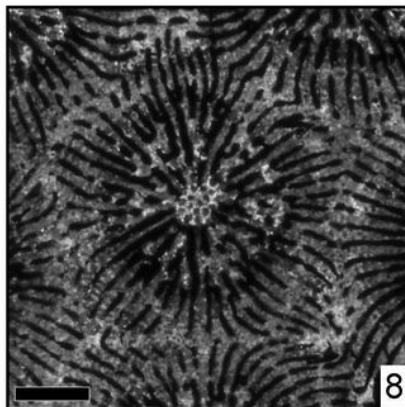
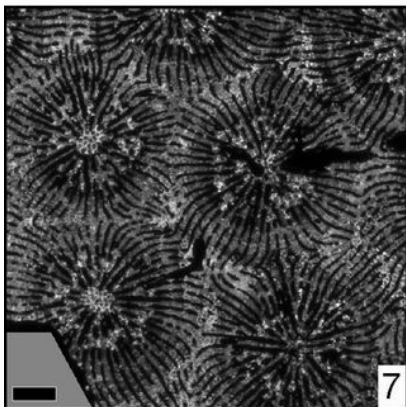
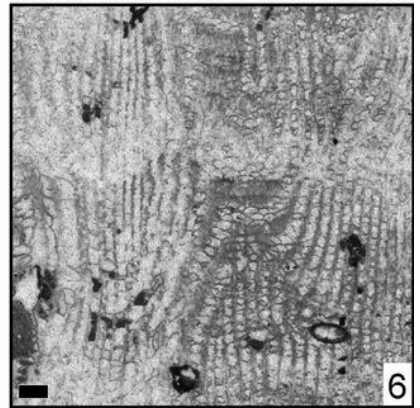
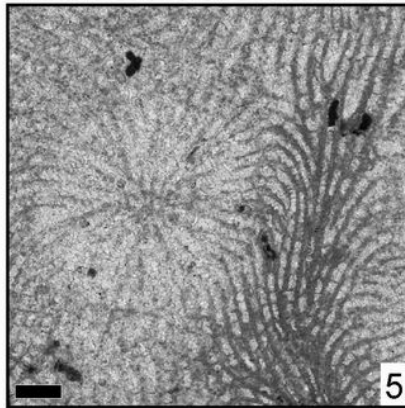
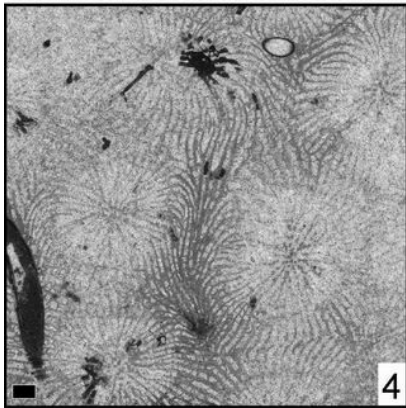
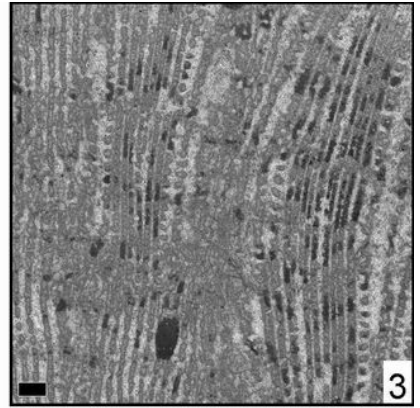
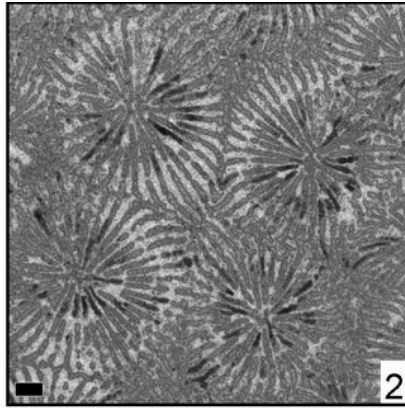
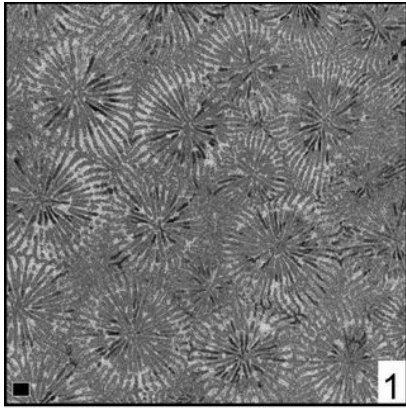
1-3) *Eosiderastrea villaltai* (REIG ORIOL, 1991), BSPG 1994 XI 53; 1) transversal thin section; 2) transversal thin section, detail; 3) longitudinal thin section;

4-6) *Eosiderastrea* sp. 1, ERNO L-121509; 4) transversal thin section; 5) transversal thin section, detail; 6) longitudinal thin section;

7-9) *Eosiderastrea* sp. 3, SNSD-MMG SaKL542; 7) transversal thin section; 8) transversal thin section, detail; 9) transversal thin section, detail of the microstructures;

10-12) *Eosiderastrea* sp. 4, BSPG 2003 XX 5846; 10) transversal thin section; 11) transversal thin section, detail; 12) longitudinal thin section.

[Scale bar 1mm]



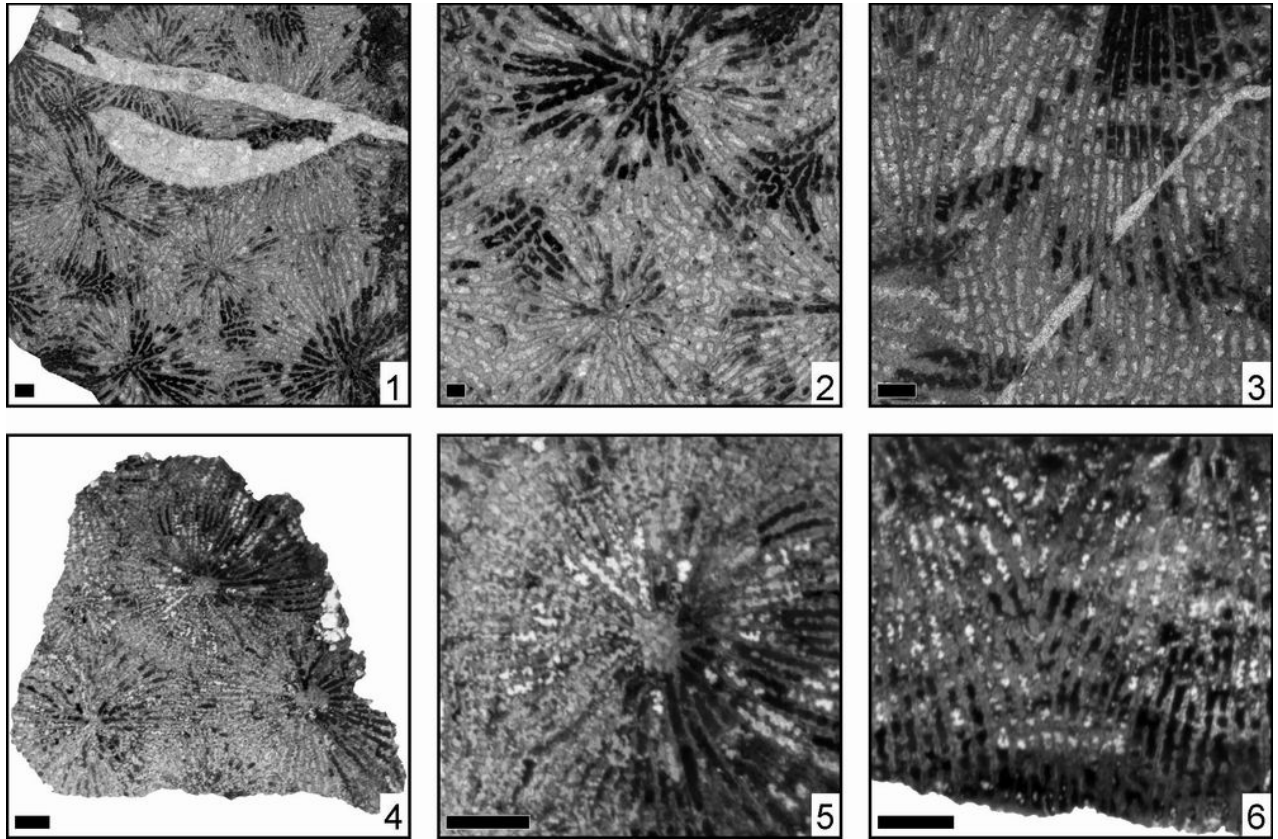


Plate 7:

1-3) *Eosiderastrea* sp. 5, BSPG 2003 XX 5829; 1) transversal thin section; 2) transversal thin section, detail; 3) longitudinal thin section;

4-6) *Eosiderastrea* sp. 6, SNSD-MMG SaKL253; 4) transversal thin section; 5) transversal thin section, detail; 6) longitudinal thin section.

[Scale bar 1mm]