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RESEARCH PAPER

Update of the dimorphic genus *Olorizia* (Ataxioceratidae, Ammonitina) and establishment of the species *Olorizia calandensis* sp. nov

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Abstract

Ataxioceratinae of the genus *Olorizia* are characteristic ammonites of the Kimmeridgian Eastern Iberian platform. *Olorizia* was established as a dimorphic monospecific genus that containing a single species (*Olorizia olorizi*) endowed with a remarkably wide phenotypic variability. Its morphological plasticity allowed recognizing three morphotypes. They are interpreted as endemic forms and the product of in situ evolution, through a cladogenetic split from the autochthonous lineage of *Ardescia* Atrops during the Early Kimmeridgian (Platynota Chron); they are also interpreted as one of the greatest exponents of derived morphology in the group due to the achievement of costulation with double connections (ataxioceratoid and subpolyplocoid ribs). In this work, a new dimorphic species is stablished, *Olorizia calandensis* sp. nov.; the scarce graphic illustration of specimens of the various morphotypes of *Olorizia olorizi* existing to date is also corrected and the change of institution for the custody of fossil remains is reported, as well as the new identification acronyms.

Keywords Ataxioceratinae · Ammonites · Lower Kimmeridgian · Jurassic · Iberian Chain · Endemic species

Resumen

Los Ataxioceratinae del género *Olorizia* Moliner [m, M] son ammonites característicos de la plataforma ibérica oriental en el Kimmeridgiense. *Olorizia* se estableció como un género monoespecífico dimórfico que incluía una única especie (*O. olorizi*) dotada de una variabilidad fenotípica muy amplia. Su plasticidad morfológica permitió reconocer tres morfotipos. Se interpretan como formas endémicas y producto de la evolución in situ, mediante una escisión cladogenética a partir del linaje autóctono de *Ardescia* Atrops [m, M] durante el Kimmeridgiense temprano (Cron Platynota); también se interpretan como uno de los máximos exponentes de morfología derivada en el grupo por la consecución de costulación con dobles conexiones (costillas ataxioceratoides y subpoliplocoides). En este trabajo se establece una nueva especie dimórfica, *Olorizia calandensis* sp. nov. [m, M]; también se subsana la escasa ilustración gráfica de ejemplares de los diversos morfotipos de *O. olorizi* existente hasta la fecha y se informa del cambio de institución para la custodia de los restos fósiles y de las nuevas siglas de identificación.

Palabras clave Ataxioceratinae · Ammonites · Kimmeridgiense Inferior · Jurásico · Cadena Ibérica · Especie endémica

1 Introduction

Ataxioceratins are late Jurassic ammonites that developed shells with complex ornamentation as a phenotypic expression of important evolutionary innovations (e.g., Callomon in Donovan et al., 1981) and thrived mainly on epicontinental platforms of the Tethys, developing extreme phenotypes with a recurrent pattern called diachronic homeomorphism, consisting in the appearance of complex ribs with double connections such as: *Ataxioceras (Parataxioceras) praehomalinum* Atrops, *Schneidia* Atrops and *Olorizia* Moliner during the Platynota Chron and *Ataxioceras* Fontannes, *Parataxioceras* Schindewolf and *Geyericeras* Moliner & Olóriz during the Hypselocyclum Chron, interpreted as forms derived from different species of the genera *Ardescia* Atrops [m, M] and *Lithacosphinctes* Oloriz [m, M].

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Institutional abbreviations.—UGR, University of Granada, Spain (palaeontological collection of the Department of Palaeontology). MPZ, University of Zaragoza, Spain (palaeontological collection of the Museum of Natural Sciences of the University of Zaragoza).

Other abbreviations: maximum shell diameter measured (Dm), maximum fragmocone diameter (Ph); umbilicus size (U); whorl high (H); whorl width (W); number of umbilical ribs per complete whorl (UR), number of umbilical ribs per half – a – whorl (UR/2); ribbing index calculated as the number of peripheral ribs per ten umbilical ribs (RI), number of constrictions (C). Macroconchs (M), microconchs (m); both dimorphs, macroconch and microconch, identified in a given species (M, m). First Appearance Datum (FAD).

Material storage: The 2066 fossil remains of ataxioceratine ammonites counted in the province of Teruel (eastern Iberian Chain) and collected by Moliner (2009) were deposited in the paleontological collection of the Department of Paleontology of the University of Granada (UGR) from 2009 to 2019, when they were all transferred to the palaeontological collections of the Museum of Natural Sciences of the University of Zaragoza (MPZ), deposit act EMPZ 2019/31, where they are currently housed. The equivalence between the old and current acronyms of all *Olorizia* specimens is detailed in Table 1.

2 Geological and geographical setting

The examined ataxioceratins ammonites come from the detailed and systematic sampling of fifteen sections studied by Moliner (2009) for his doctoral thesis located in the localities of Alcorisa (Gallipuén reservoir and Las Umbrías), Calanda and Foz-Calanda (surroundings of the Calanda reservoir), Berge (San Cristóbal ravine), Molinos (Mezquitilla road), Montoro de Mezquita (Carrera ravine), Villarluengo (La Garrucha mountain range) and Alacón (Cerro Felío), all of them in the NE quadrant of the province of Teruel, Spain (Fig. 1).

Table 1 Equivalence between the current acronyms (MPZ) and the old ones (UGR) of the specimens assigned to the ammonites of the genus *Olorizia*

Current acronym	Previous acronym	Current acronym	Previous acronym	Current acronym	Previous acronym
MPZ 2023/252	UGRMTG1.10.17	MPZ 2023/253	UGRMTG1.12.4	MPZ 2023/254	UGRMTG1.12.21
MPZ 2023/255	UGRMTG1.12.23	MPZ 2023/256	UGRMCH.12.2	MPZ 2023/257	UGRMCH.16.1
MPZ 2023/258	UGRMCH.16.3	MPZ 2023/259	UGRMCH.16.4	MPZ 2023/260	UGRMCH.16.6
MPZ 2023/261	UGRMCH.16.8	MPZ 2023/262	UGRMCH.16.12	MPZ 2023/263	UGRMCH.17.2
MPZ 2023/264	UGRMCH.17.5	MPZ 2023/265	UGRMCH.17.7	MPZ 2023/266	UGRMCH.17.11
MPZ 2023/267	UGRMCH.18.3	MPZ 2023/268	UGRMCH.19.1	MPZ 2023/269	UGRMCH.19.2
MPZ 2023/270	UGRMCH.19.4	MPZ 2023/271	UGRMSC.13.30	MPZ 2023/272	UGRMPC.17.3
MPZ 2023/273	UGRMLG.16.2	MPZ 2023/274	UGRMLG.18.7	MPZ 2023/275	UGRMMM.23.3
MPZ 2023/276	UGRMMM.23.4	MPZ 2023/277	UGRMMM.26.4	MPZ 2023/278	UGRMMM.26.5
MPZ 2023/279	UGRMBP.24.7	MPZ 2023/280	UGRMTG1.11.10	MPZ 2023/281	UGRMTG1.13.9
MPZ 2023/282	UGRMTG1.13.58	MPZ 2023/283	UGRMTG1.14.1	MPZ 2023/284	UGRMCH.14.1
MPZ 2023/285	UGRMCH.17.3	MPZ 2023/286	UGRMCH.20.1	MPZ 2023/287	UGRMSC.10.6
MPZ 2023/288	UGRMPC.17.2	MPZ 2023/289	UGRMBP.24.8	MPZ 2023/290	UGRMTG1.12.11
MPZ 2023/291	UGRMTG1.15.71	MPZ 2023/292	UGRMCH.16.2	MPZ 2023/293	UGRMMM.23.5
MPZ 2023/294	UGRMLG.18.10	MPZ 2023/295	UGRMPC.15.4	MPZ 2023/296	UGRMTG1.13.62
MPZ 2023/297	UGRMTG1.14.31	MPZ 2023/298	UGRMTG1.14.60	MPZ 2023/299	UGRMCH.16.5
MPZ 2023/300	UGRMCH.16.11	MPZ 2023/301	UGRMCH.20.2	MPZ 2023/302	UGRMMM.14.5
MPZ 2023/303	UGRMBP.24.9	MPZ 2023/304	UGRMTG1.8.19	MPZ 2023/305	UGRMTG1.11.62
MPZ 2023/306	UGRMSC.11.4	MPZ 2023/307	UGRMSC.12.1	MPZ 2023/308	UGRMSC.14.13
MPZ 2023/309	UGRMPC.14.2	MPZ 2023/310	UGRMBP.21.1	MPZ 2023/311	UGRMBP.22.2
MPZ 2023/312	UGRMBP.23.2	MPZ 2023/313	UGRMBC.15.13	MPZ 2023/314	UGRMSC.10.8
MPZ 2023/315	UGRMSC.13.38	MPZ 2023/316	UGRMBC.11a.2	MPZ 2023/317	UGRMBC.11a.3
MPZ 2023/318	UGRMBC.14.6	MPZ 2023/319	UGRMTG1.10.42	MPZ 2023/320	UGRMPC.13.2
MPZ 2023/321	UGRMPC.14.5	MPZ 2023/322	UGRMSC.16.9	MPZ 2023/323	UGRMMM.26.3
MPZ 2023/324	UGRMVP.15.3	MPZ 2023/325	UGRMMM.26.2	MPZ 2023/326	UGRMTG1.11.63
MPZ 2023/327	UGRMPC.15.3	MPZ 2023/328	UGRMBP.24.2	MPZ 2023/329	UGRMPR.14.3
MPZ 2023/330	UGRMVP.25.2	MPZ 2023/331	UGRMPC.18.18	-	-

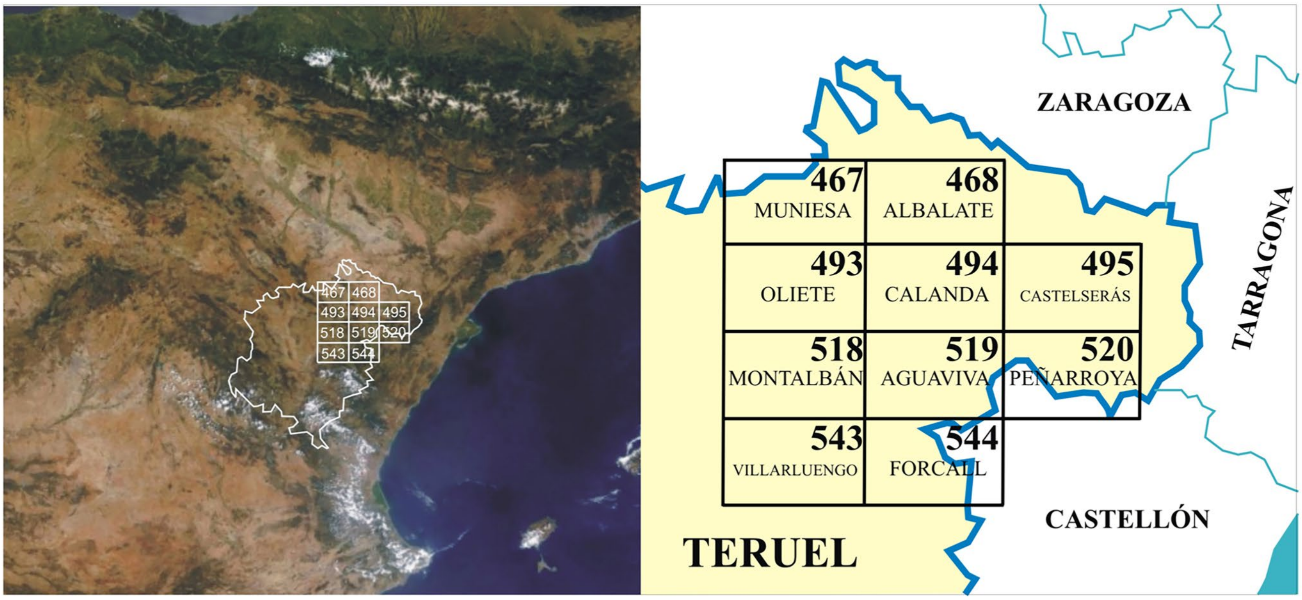


Fig. 1 Geographic location with reference to the sheets of the National Topographic Map at a scale of 1:50,000

They are located in outcrops of Lower Kimmeridgian materials of the Aragonese Branch of the eastern Iberian Chain and the north of the Maestrazgo, within the so-called Maestrazgo Basin (Figs. 1, 2).

The Maestrazgo Basin of eastern Iberia was formed during the Late Jurassic-Early Cretaceous rifting event that affected Iberia coinciding with the northward spreading of the Central Atlantic rift and the opening of the Tethys Ocean (Aurell et al., 2019; Salas et al., 2001). The Maestrazgo Basin was divided into four sub-basins (depocentres): Aguilón, Oliete, Galve and Morella, controlled by the synsedimentary activity of local tectonic structures between the Late Jurassic and Early Cretaceous.

The outcrops are located in the Morella sub-basin (Aurell et al., 2019), within carbonate rocks (limestones and marls) deposited in a shallow marine carbonate ramp (e.g., Aurell, 1990; Aurell et al., 2019; Bádenas & Aurell, 2001; Moliner, 2009), in the first stage of synrift sequence 1 during the Lower Kimmeridgian.

The rhythmic succession of limestones and marls is included in the Calanda limestones and marls Member. (Meléndez et al., 1990) of the Loriguilla Calcareous Ritmite Formation (Gómez & Goy, 1979).

The Calanda Member contains a high number of ataxioceatine ammonites that allowed us to recognize, with minor changes, the three biochronozones widely identified in the Submediterranean Province and that support the secondary standard for the Submediterranean Lower Kimmeridgian (Fig. 3): Biochronozones of *Sutneria platynota*, of *Ataxioceras hypselocyclum* (reinterpreted at a regional level by Moliner in 2009 as *Ataxioceras lothari*) and of *Crussoliceras divisum*.

Olóriz et al. (1988) interpreted a turbid shallow-water environment, rich in nutrients and with a restricted connection to the open sea during the Platynota Chron.

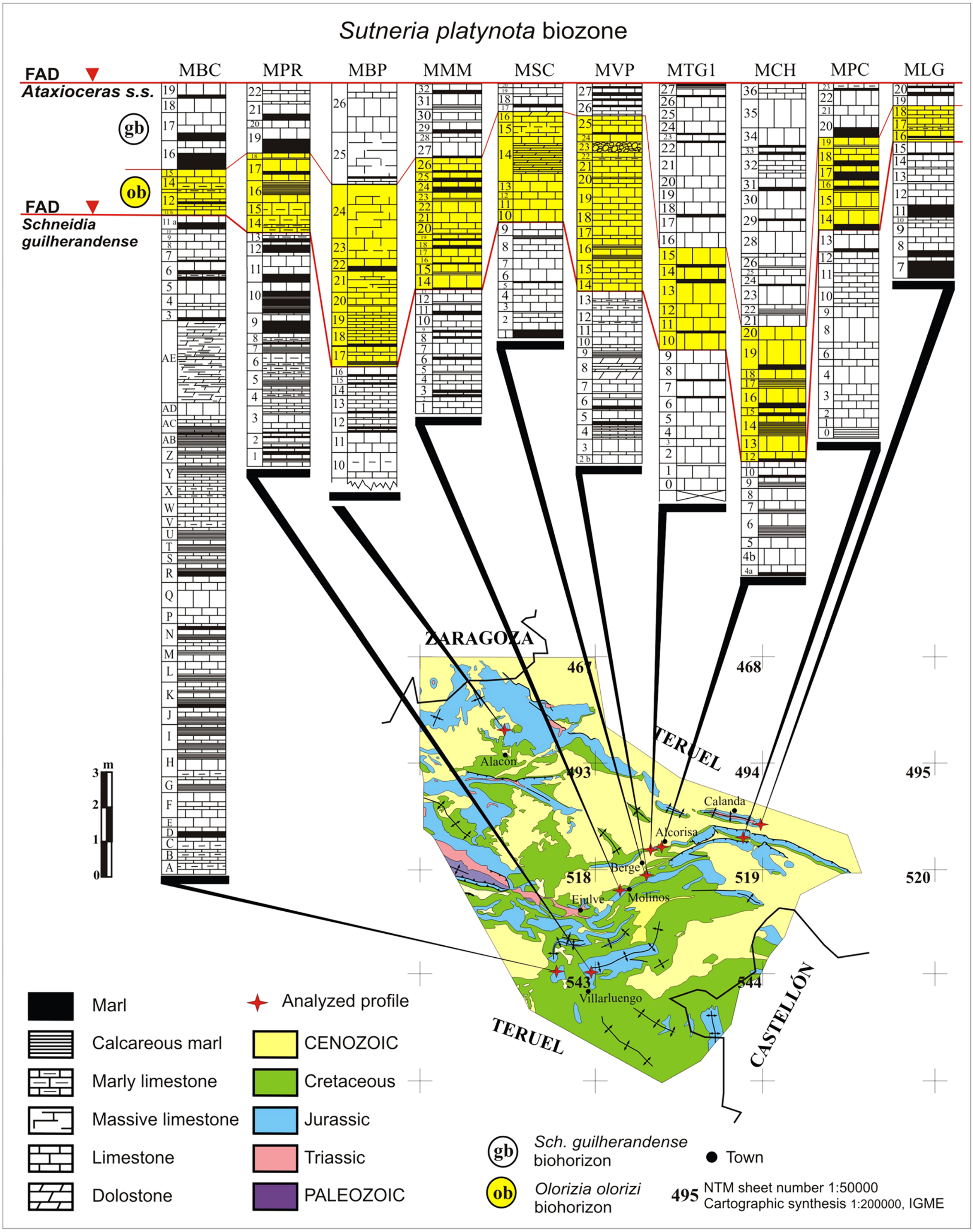
3 Material and methods

The collection of ataxioceratins obtained by Moliner (2009) has been examined. Particular attention has been paid to the 80 specimens he included in the genus *Olorizia* [m, M]; recently, field sampling has also been carried out in the strata where the rarer morphotype of *Olorizia* and the new species were previously recorded, with negative results.

Bibliography on the Lower Kimmeridgian ataxioceratins which ataxioceratoid or subpolyplocoid ribbing, included in the dimorphic genera *Olorizia*, *Schneidia*, *Ataxioceras*, *Parataxioceras* and *Geyericeras* were revised to contextualize the new taxonomical proposals.

Micro and macroconchs of *Olorizia olorizi* have been photographed to fill in the lack of images since the definition of the taxon.

Priority is given to the use of FADs in biostratigraphic proposals for the definition of biozone and biohorizon or faunal horzonts, often used in biostratigraphy (e.g. Callomon, 1984) and, although although included, but not as a formal chronostratigraphic unit in the International Stratigraphic Guide, has a certain practical value in ataxioceratins studies (e.g. Atrops, 1982; Moliner, 2009Moliner & Olóriz, 2010).


Sutneria platynota biozone
FAD
Ataxioceras s.s.
gb
ob
FAD
Schneidia guilherandense
MBC
MPR
MBP
MMM
MSC
MVP
MTG1
MCH
MPC
MLG
3 m
2
1
0
ZARAGOZA
TERUEL
TERUEL
CASTELLÓN
467
468
493
494
495
518
519
520
543
544
Alacón
Calanda
Alcorisa
Berge
Ejulve
Molinos
Villarluengo
Marl
Calcareous marl
Marly limestone
Massive limestone
Limestone
Dolostone
Analyzed profile
CENOZOIC
Cretaceous
Jurassic
Triassic
PALEOZOIC
gb *Sch. guilherandense* biohorizon
ob *Olorizia olorizi* biohorizon
Town
495 NTM sheet number 1:50000
Cartographic synthesis 1:200000, IGME

◂**Fig. 2** Geological situation. Stars indicate location of the studied sections. Biostratigraphic correlation of materials deposited during the Platynota Chron (Lower Kimmeridgian) and, in yellow, those corresponding to the *Olorizia olorizi* biohorizon in the sections of Montoro de Mezquita (MBC), Villarluengo (MPR), Alacón (MBP), Molinos (MMM), Berge (MSC and MVP), Alcorisa (MTG1 and MCH), Foz-Calanda (MPC) and Calanda (MLG)

As proposed by Callomon (1984), among others, differential spelling has been applied to identify biostratigraphic units and for the index species (in lower case and italics) and their chronostratigraphic equivalents (initials in capital letters and normal font) for both the index species and the age of the chronostratigraphic unit.

4 Remarks on Early Kimmeridgian Ataxioceratinae with double-connected ribs

It has already been indicated that ataxioceratins ammonites thrived mainly on epicontinental platforms of the Tethys Ocean and showed a tendency to reach double-connected ribs (Fig. 4) from several lineages of the genera *Ardescia* and *Lithacosphinctes* during the Early Kimmeridgian.

Olorizia [m, M] Moliner (2009) is characterised by large adult size of microconchs and moderate size of macroconchs, with moderate to low coiling, costulation with widespread development of unrelated subpolyplocoid ribs with a high density of costulation and, to a lesser extent, ataxioceratoid elements. Its stratigraphic range is restricted to the upper part of the *Sutneria platynota* Biozone. They are considered to be derived forms of the Iberian lineage of *Ardescia* [m, M], specifically *Ardescia casasi* Moliner and represent the first known cladogenetic event in this lineage.

Ataxioceras (Parataxioceras) praehomalinum Atrops (1982) is exclusively differentiated from *Ardescia desmoides* Wegele [m] by the development of ataxioceratoid ribs at the end of the body chamber and, according to Atrops (1982, p.188), probably represents no more than a morphotype progressive from Wegele's species during the late Desmoides Subchron in SE France. The determinations of this species in the Iberian Range (Fezer & Geyer, 1988; Finkel, 1992) are reinterpreted as phenotypes of *Olorizia olorizi* Moliner [m] because it comes from *Ardescia casasi* Moliner, a species considered endemic to the Iberian Peninsula.

Schneidia Atrops (1982) was defined as one of the microconchiate subgenera of *Ataxioceras*, its record is mainly confined to the youngest part of the Platynota Zone and the earliest part of Hypselocyclum Zone. They have ribs with double connections linked to their strong rib density. They are considered to be forms derived from phenotypes included in *Ardescia* of the *desmoides* Wegele group during the Early Platynota Chron (Atrops, 1982, p.156, 265). *Schneidia* Atrops [m, M], has been reinterpreted as a dimorphic genus (Moliner, 2009; Moliner & Olóriz, 2009; Villaseñor et al., 2015) that includes macroconchs previously referred to *Ataxioceras striatellum* Schneid (Atrops, 1982, p. 232, 233).

The genus *Ataxioceras* [m, M] Fontannes (1879) is considered monophyletic and includes the dimorphic pairs with the the most progressive costulation among the Kimmeridgian Ataxioceratinae, with double connected ribs and without parabolic structures. *Ataxioceras* [m] includes the *lothari* Oppel group forms, while *Ataxioceras* [M] includes the *hypselocyclum* Fontannes group forms (Moliner, 2009; Moliner & Olóriz, 2016). *Ataxioceras* [m, M] are considered to be derived forms of the more modern phenotypes of *Ardescia* gr. *desmoides* Wegele [m, M] during the Hypselocyclum Chron.

The genus *Parataxioceras* [m, M] Schindewolf (1925) is also considered monophyletic and gathers the dimorph pairs with the most conservative morphology among the Kimmeridgian ataxioceratins. These are phenotypes with slow or very slow coiling, with a somewhat compressed to equidimensional or even slightly depressed whorl, with vigorous ribbing, which, in addition, are provided with double connected ribs and with parabolic structures from the inner whorls. *Parataxioceras* [m] includes the forms of the *oppeli* Geyer group and related ones, while *Parataxioceras* [M] includes the forms of the *cardoti* Atrops—*catenatum* Schneid group and related ones (Moliner, 2009). These forms are considered to derive from various populations of *Lithacosphinctes* Olóriz. [m, M] developed during the Hypselocyclum Chron, as those of the *inconditus* Fontannes group, since in both cases (*Lithacosphinctes* and *Parataxioceras*) relatively vigorous costulation is recognised and provided with parabolic structures from the inner whorls on shells with slow coiling (Moliner & Olóriz, 2009).

Geyericeras [m, M] Moliner & Olóriz, 2010, is characterised by the relatively small adult size of both dimorphs, a relatively high degree of involution of the inner whorls, fine and delicate costulation in microconchs and in immature macroconchs, and the appearance of subpolyplocoid ribs. It is recorded in the upper part of the *Ataxioceras lothari* biozone identified in the eastern Iberian Range. *Geyericeras* [m] shows morphological convergence with the most evolute specimens of the stratigraphically older genus *Schneidia* [m] (Moliner & Olóriz, 2009). It is considered a derived form of the Iberian lineage of *Ardescia* and represents its last known cladogenetic event.

Several authors illustrated ataxioceratins phenotypes that reached the stage of double-connected ribs, during the Early Kimmeridgian in different epicontinental platforms in central-southern Europe, associated with both the Submediterranean and Subboreal domains (e.g., Oppel, 1862; Vilanova, 1863; Dumortier & Fontannes, 1876;

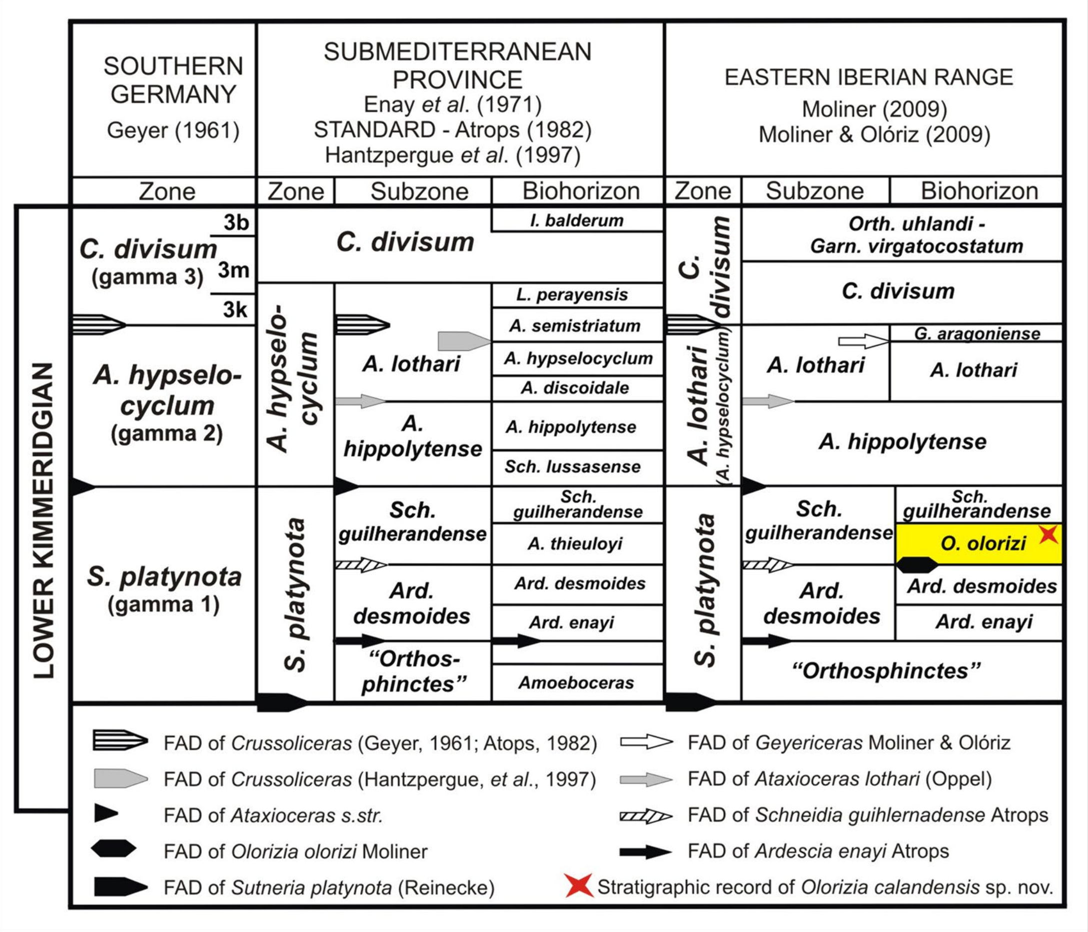


Fig. 3 Stratigraphic position of the *Olorizia olorizi* biohorizon recognised in the eastern Iberian Chain. Biostratigraphic correlation with the Secondary Standard Scheme for the Lower Kimmeridgian used in epicontinental sections of the Submediterranean Province in Europe. Taxonomic abreviations: A, *Ataxioceras*; Ard, *Ardescia*; C, *Crussoliceras*; G, *Geyericeras*; Garn, *Garnierisphinctes*; I, *Idoceras*; L, *Lithacosphinctes*; O, *Olorizia*; Orth, *Orthaspidoceras*; S, *Sutneria* and Sch, *Schneidia*

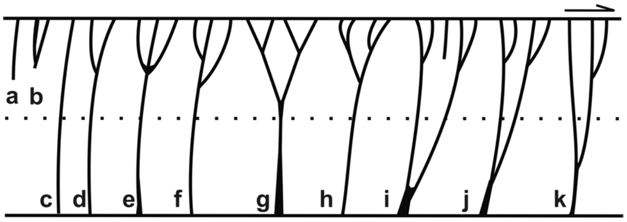


Fig. 4 Scheme of some common rib types in the genus *Olorizia*. **a** Free external or intercalatory rib. **b** Bifurcated intercalatory rib. **c** Simple rib. **d** Bifurcate rib. **e** Trifúrcate rib. **f** Polygirate rib. **g**, **h** Ataxioceratoid or polyplocoid ribs. **i**, **j** Subpolyplocoid ribs. **k** Incomplete subpolyplocoid rib. Arrow indicates position of the peristoma. The dashed line indicates half the height of the flank

Loriol, 1876; Fontannes, 1879; Quenstedt, 1888; Wegele, 1929; Schneid, 1944; Geyer, 1961; Karve-Corvinus, 1966; Schairer, 1967, 1974, 2000; Maubeuge, 1975; Ziegler, 1977; Atrops, 1982; Marques, 1983; Malinowska, 1986, Fezer & Geyer, 1988; Hantzpergue, 1989; Finkel, 1992; Rodriguez Tovar, 1993; Gradl & Schairer, 1997; Matyja & Wierzbowski, 1998; Gutowski, 1998; Caracuel et al., 1999; Gygi, 2003; Moor, 2009; Moliner, 2009; Grigore, 2011; Comment et al., 2015; Wierzbowski, 2017; Wierzbowski & Glowniak, 2018), in North West Africa (Bachnou & Atrops, 1996; Benzaggagh, 1988; Benzaggagh & Atrops, 1997), in palaeomargins of the northern Tethys, such as Iran (Parent et al., 2014; Zadesmaeil et al., 2021) and on other platforms outside of the Tethian domain, such as Cuba (Sánchez Roig, 1920, 1951) and Mexico (e.g., Cantú-Chapa, 1991, Villaseñor et al., 2015). Early Kimmeridgian ataxioceratins records are found in the Mediterranean epioceanic domain (e.g. Olóriz, 1978; Sapunov, 1977; Sarti, 1993).

Isolated records of *Ataxioceras*-like ammonites or putative *Ataxioceras* are also reported but without detailed stratigraphy from the Indo-Malgasy Province and Pacific región, such as India or Japan, (among others, Kobayashi & Fukada, 1947; Krishna et al., 1996, 2009; Sato, 1962, 1992).

However, the palaeobiological interpretation of the Early Kimmeridgian ataxioceratins as dimorphic genera (Comment et al., 2015; Fürsich et al., 2022; Hantzpergue, 1989; Moliner, 2009; Moliner & Olóriz, 2009; Villaseñor et al., 2015) continues to coexist with the partly morphological, partly phyletic interpretation established by Atrops (1982), who considered *Ardescia* as a microconchiate subgenus of the polyphyletic genus *Orthosphinctes* Schindewolf, and *Schneidia* and *Parataxioceras* as microconchiate subgenera of the genus polyphyletic *Ataxioceras* Fontannes (e.g., Kiebling & Zeiss, 1992; Gygi, 2003; Moor, 2009; Grigore, 2011; Wierzbowski, 2017; Wierzbowski & Glowniak, 2018; Zadesmaeil et al., 2021).

5 Systematic palaeontology

Class **Cephalopoda** Cuvier, 1795
Subclass **Ammonoidea** Zittel, 1885
Order **Ammonitida** Agassiz, 1847
Suborder **Ammonitina** Hyatt, 1889
Superfamily **Perisphinctoidea** Steinmann *in* Steinmann & Döderlein, 1890
Family **Ataxioceratidae** Buckman, 1921
Subfamily **Ataxioceratinae** Spath, 1930 emend. Zeiss, 1968
Génus ***Olorizia*** Moliner, 2009 [m, M]
urn:lsid:**zoobank.org:act:4A8D5EE7-8236-4F59-AEE6-9BCA12B119DC**

Type species: *Olorizia olorizi* Moliner, 2009 [m, M]

Other species in the genus: *Olorizia calandensis* sp. nov. [m, M]

Etymology: Honour to Dr. Federico Olóriz, Professor at the University of Granada (Spain), tireless researcher and teacher; for his scientific contribution to the knowledge of ammonites, biostratigraphy and fossil associations of the Upper Jurassic.

Remarks: *Olorizia* brings together phenotypes with moderate to low coiling, that develop subpolyplocoid and, to a lesser extent, ataxioceratoid ribs unrelated to a high rib density during the Platynota Chron.

Other genera of contemporary ataxioceratins, such as *Ardescia* Atrops and *Lithacosphinctes* Olóriz do not develop ribs with double connections, while *Oloriza* does.

Schneidia Atrops is more involute and has subpolyplocoid ribs linked to the strong ribbing density. *Ataxioceras* Fontannes, *Parataxioceras* Schindewolf and *Geyericeras* Moliner & Olóriz, which also develop double connections, are recorded in younger stratigraphic levels (traditional *A. hypselocyclum* Biozone).

Olorizia developed during the Platynota Chron in an area of the Morella sub-basin with restricted connection to open seas, in which post-mortem shell drift was not significant, nor were relevant alterations of the stratigraphic order such as reworking and associated effects (Moliner, 2009). In this context, the higher abundance of microconchs (4:1 ratio with respect to macroconchs) is interpreted as being due to the greater longevity of macroconchiate counterparts.

Biostratigraphy: The *Olorizia* record is restricted to the Lower Kimmeridgian, *Sutneria platynot*a Biozone, from the top of the *Ardescia desmoides* Subzone up the bottom of the *Schneidia guilherandense* Subzone.

Geographic range: *Olorizia* is considered a endemic taxon to the eastern Iberian Range and northern Maestrazgo, in the province of Teruel.

5.1 *Olorizia olorizi* Moliner, 2009 [m, M]

Urn:lsid:**zoobank.org:act:8E3E041D-14DE-4BC8-AD9B-298BDD5920F1.**

Figures 5, 6, 7b, 8, 9**.**

1988*Ataxioceras (Parataxioceras) praehomalinum* ATROPS in Fezer & Geyer, 1988, Taf. 4, fig. 1

? *pars.*1992*Ataxioceras (Parataxioceras) hippolytense* ATROPS in Finkel, p. 238, Abb. 22; *non* ? Abb. 26; *non* ? Abb. 48.

? *pars.*1992*Ataxioceras (Parataxioceras)* cf. *evolutum* ATROPS in Finkel, p. 239, Abb. 31, *non* Abb. 13.

? *pars.*1992*Ataxioceras (Ataxioceras) homalinum* SCHNEID in Finkel, p. 240, Abb. 33; *non* Abb. 21.

? *pars.*1992*Ataxioceras (Ataxioceras) discobolum* (FONTANNES) in Finkel, p. 240, Abb. 38; *non*? Abb. 25.

2009*Olorizia olorizi* MOLINER [m, M], p. 201, Lám. 4, figs. 1-5.

2009*Olorizia olorizi* MOLINER [m] in Moliner & Olóriz, p. 209, fig. 5.

Etymology: Honour to Prof. Dr. Federico Olóriz (see etymology of the genus).

Holotype: Specimen MPZ 2023/253 (formerly UGR-MTG1.12.4), internal microconchiate mould, illustrated in Fig. 6a, collected from bed number 12 in the Gallipuén

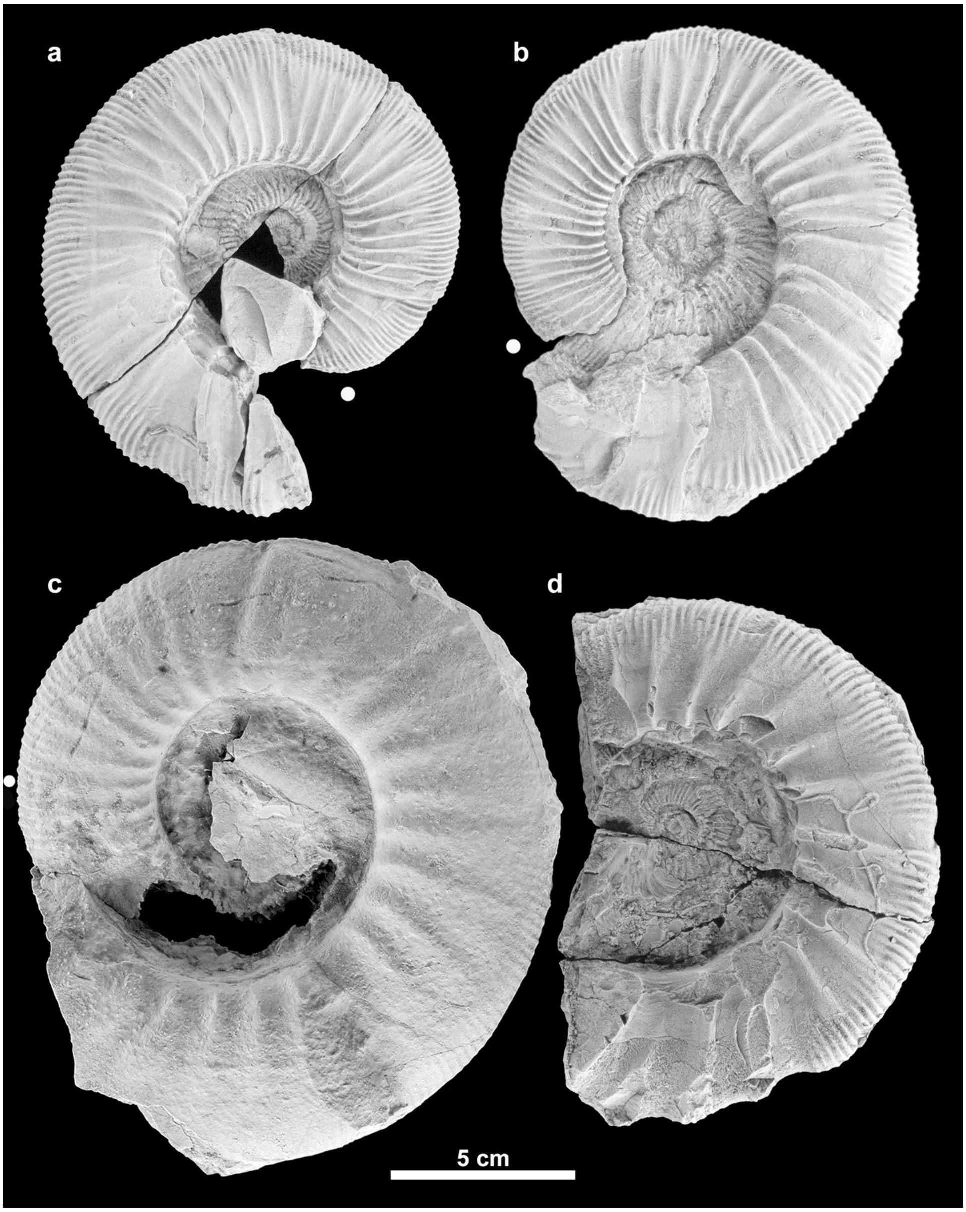


Fig. 5 *Olorizia* [m, M]. Lower Kimmerdgian, *Sutneria platynota* Biozone, *Schneidia guilherandense* Subzone, *Olorizia olorizi* biohorizon. *O. olorizi* [m] *olorizi* morphotype. **a** Specimen MPZ2023/269, **b** specimen MPZ2023/263, founds in MCH section at Alcorisa. **c** *O. olorizi* [M] *olorizi* morphotype, specimen MPZ2023/294 found in MLG section at Calanda. **d** *O. olorizi* [m] *gallipuense* morphotype, specimen MPZ 2023/308 found in MSC section at Berge. The white dot shows the start of the body chamber

section MTG1 (Province of Teruel, Spain); included in the *olorizi* morphotype.

Paratypes: [m] 39 specimens. MPZ 2023/252, MPZ 2023/254–279 (27 specimens included in the *olorizi* morphotype), MPZ 2023/304–313 (10 specimens included in the *gallipuense* morphotype), MPZ 2023/322–323 (2 specimens included in the *semihomalinum* morphotype). [M] 8 specimens. MPZ 2023/290–295 (6 specimens included in the *olorizi* morphotype), MPZ 2023/319–320 (2 specimens included in the *gallipuense* morphotype).

Complementary material, interpreted as *Olorizia* cf. *olorizi* Moliner [m, M], consists of septate internal moulds and more or less complete body chambers showing coiling degree and sculpture equivalent to those described above: [m] 17 specimens. MPZ 2023/280–289 (10 specimens, *olorizi* morphotype), MPZ 2023/314–18 (5 specimens, *gallipuense* morphotype), MPZ 2023/324–325 (2 specimens, *semihomalinum* morphotype). [M] 9 specimens. MPZ 2023/296–303 (8 specimens, *olorizi* morphotype), MPZ 2023/321 (1 specimen, *gallipuense* morphotype).

Type locally: Las Umbrías – Gallipuén area, Alcorisa (Province of Teruel, Spain). 30 T 7178666 ED50 – 30 T 4528478.3 ED50.

Type horizon: Lower Kimmeridgian, *Sutneria platynota* Biozone, uppermost part of *Ardescia desmoides* Subzone,

Fig. 6 *O. olorizi* [m] *olorizi* morphotype. Lower Kimmerdgian, *Sutneria platynota* Biozone, *Schneidia guilherandense* Subzone, *Olorizia olorizi* biohorizon. **a** Holotype, specimen MPZ2023/253 found in MTG1 section at Alcorisa. **b** Specimen MPZ2023/271 found in MSC section at Berge. **c** Specimen MPZ2023/272 found in MPC section at Foz-Calanda. **d** Specimen MPZ2023/254 found in MTG1 section at Alcorisa. The white dot shows the start of the body chamber

and base of the *Schneidia guilherandense* Subzone, *Olorizia olorizi* biohorizon (Figs. 2, 3).

Diagnosis: Microconchs with moderate to low coiling and tendency to enlarge, size up to 165 mm in diameter and compressed section; constrictions of variable number and amplitude, rare or absent parabolic structures and complex peristome provided with wide lateral lappets. Ribs are more or less dense and fine in the inner whorls, bifurcated and polygyrated with some free external ribs (residual elements); It usually includes subpolyplocoid ribs, which are sometimes incomplete and, less frequently, ataxioceratoid ribs, towards the end of the phragmocone and in the body-chamber. The ribbing index with high values, greater than or equal to 7. The rib curves decrease from small shell diameters, less than 60 mm.

Macroconchs of size less than 250 mm in diameter, section of the whorl ovate, constrictions present, rare parabolic structures in the phragmocone. Simple peristome. The ribbing of the macroconchs is similar to that of the microconchs, but with less frequent polyplocoid ribs and little development of bifurcate intercalatory ribs close ventral margin. In larger diameters, the ribbing is reduced to thick primary ribs close to the umbilical margin. The rib curves decrease from 70 mm or less.

Discussion: *Olorizia olorizi* is the index species of the *O. olorizi* biohorizon, which is the lower infrasubzonal

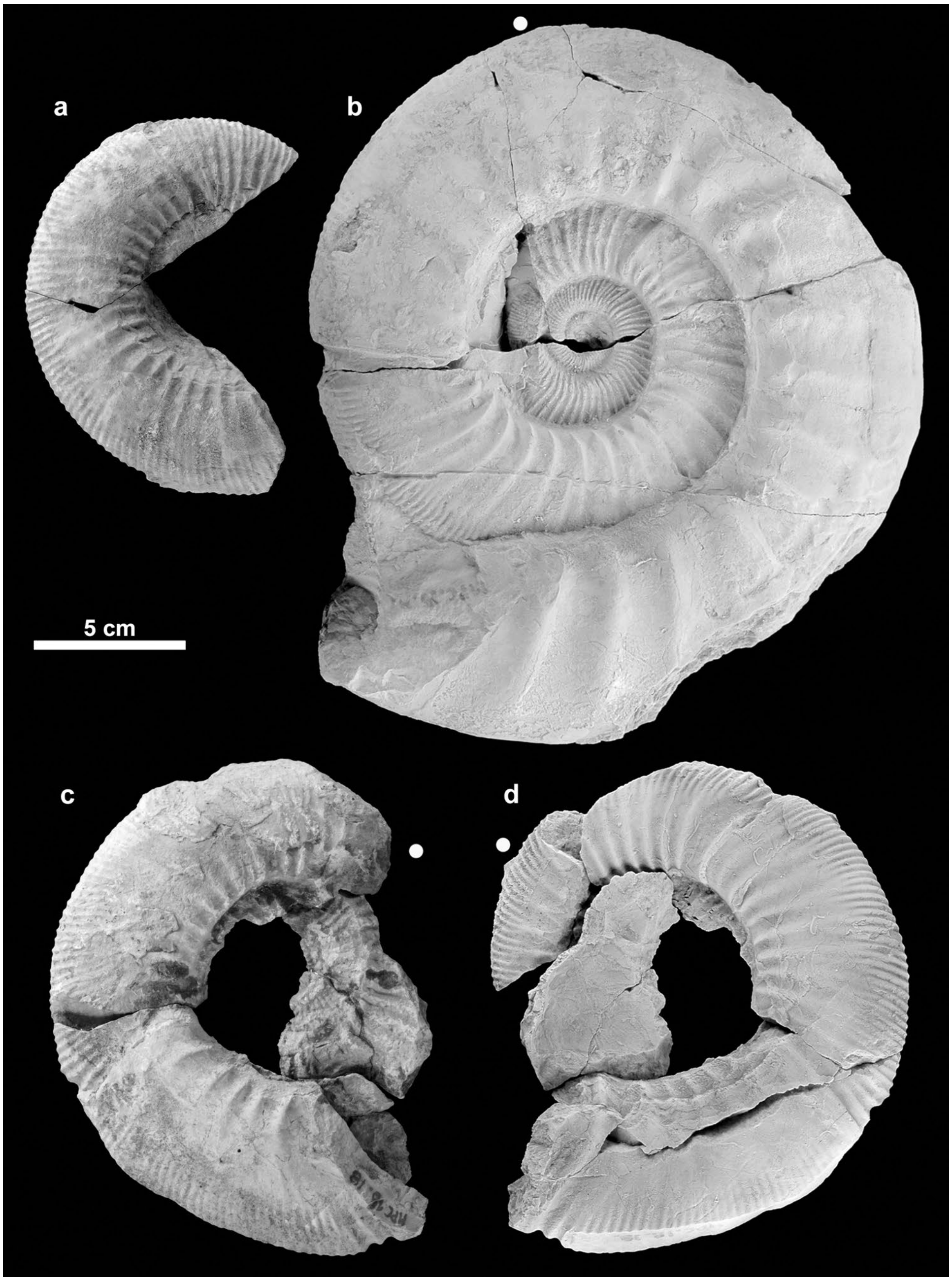


Fig. 7 *Olorizia* [m, M]. Lower Kimmerdgian, *Sutneria platynota* Biozone, *Schneidia guilherandense* Subzone, *Olorizia olorizi* biohorizon. **a** *Olorizia calandensis* [m]. Paratype, specimen MPZ2023/330 found in MVP section at Berge. **b** *O. olorizi* [M] *olorizi* morphotype, specimen MPZ2023/295 found in MPC section at Foz-Calanda. **c**, **d** *O. calandensis* [M]. Holotype, specimen MPZ2023/331 found in MPC section at Foz-Calanda. The white dot shows the start of the body chamber

unit of the *Schneidia guilerandense* Subzone in the local biostratigraphic scheme for the Iberian Chain. (Moliner, 2009; Moliner & Olóriz, 2009).

Moliner (2009) included almost all of the phenotypes interpreted as *Olorizia* in the dimorphic species *Olorizia olorizi* and, despite being large microconhs and, to a lesser extent, macroconhs, with slow coiling and a low to medium ribbing density at the end of ontogenetic development, Its intraspecific variability allowed it to recognize three morphotypes among the microconch forms and only two among the macroconchs: morphotypes *gallipuense* [m, M], *olorizi* [m, M] and *semihomalinum* [m]. The variability of *Olorizia olorizi* is manifested without stratigraphic or geographical segregation in the Aragonese Iberian Range. The two remaining specimens are gathered within the new species *Olorizia calandensis* sp. nov. [m, M].

The only specimens illustrated in the bibliography that could be included within the morphological variability recognized for *O. olorizi* were recorded in the same sector of eastern Iberian Chain, in noticeably close geographically sections, Calanda (Fezer & Geyer, 1988; Finkel, 1992) and La Ginebrosa by Finkel (1992); however, the section called Calanda by Fezer and Geyer (1988) and Finkel (1992) is not found in the municipality of

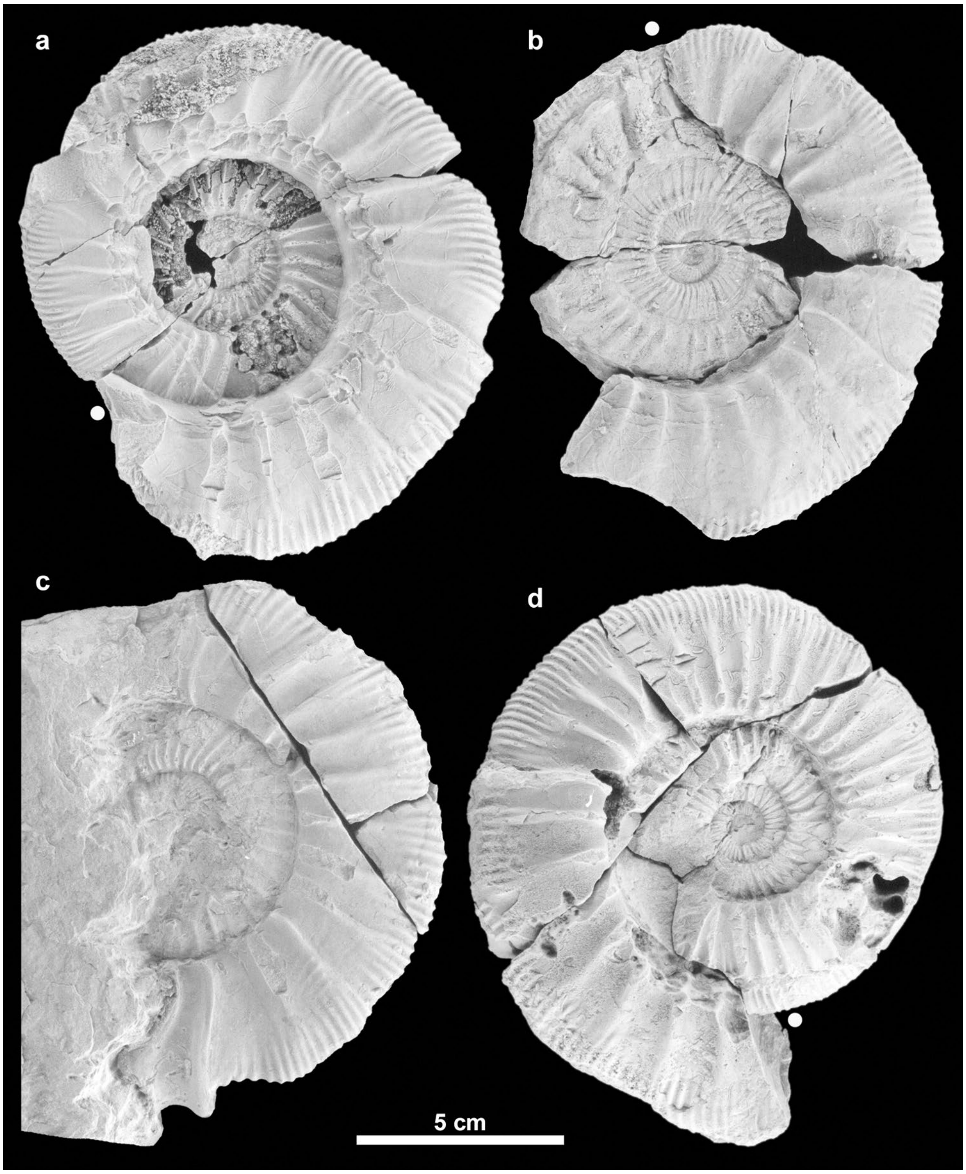


Fig. 8 *O. olorizi* [m] *gallipuense* morphotype. Lower Kimmerdgian, *Sutneria platynota* Biozone, *Schneidia guilherandense* Subzone, *Olorizia olorizi* biohorizon (specimens **a**, **c**, **d**); *Ardescia desmoides* Subzone, *Ardescia desmoides* biohorizon (specimen **b**). **a** Specimen MPZ2023/306 found in MSC section at Berge. **b**, **c** Specimens MPZ2023/304 and MPZ2023/305 found in MTG1 section at Alcorisa. **d** Specimen MPZ2023/311 found in MBP section at Alacón. The white dot shows the start of the body chamber

Calanda, but in the neighbouring locality of Foz-Calanda.. The latter author classified them among several species of *Ataxioceras* FONTANNES [m, M]. The uncertainty to reinterpret them as *Olorizia* arises from the younger stratigraphic record indicated by Finkel (*op. cit.*) for all of them, Hypselocyclum Zone; however, the list of taxa recorded in the same strata, which includes several species of *Schneidia*, and the fact that the stratigraphic sections of Calanda (Foz Calanda in this work) and La Ginebrosa are not provided, and that the samples were not taken from numbered strata, raises some doubts about the reliability of the biostratigraphy indicated by him and allows, even with some doubt, considering them synonymous with *O. olorizi*. *A. (P.) praehomalinum* is not considered because its stratigraphic record is earlier and its most direct ancestors are in *Ardescia desmoides*, whereas the ancestors of *O. olorizi* are in *Ardescia casasi*, which was interpreted as an Iberian endemism.

The analysis of the intraspecific variability of *O. olorizi* allows establishing the differential characters between the various morphotypes.

The analysis of the rib-curves of the *olorizi* [m] morphotype allowed us to determine the existence of two populations by ribbing density (Moliner, 2009). The highest cloud on the ordinate axis of the bivariate plots for the number of primary ribs per complete-whorl and per half-a-whorl, groups the most densely ribbed specimens and the lowest cloud groups the population with the lowest rib density. There are intermediate or transitional cases between the two. In addition, specimens from the less densely ribbed population show a tendency towards a slightly higher ribbing index for large shell diameters.

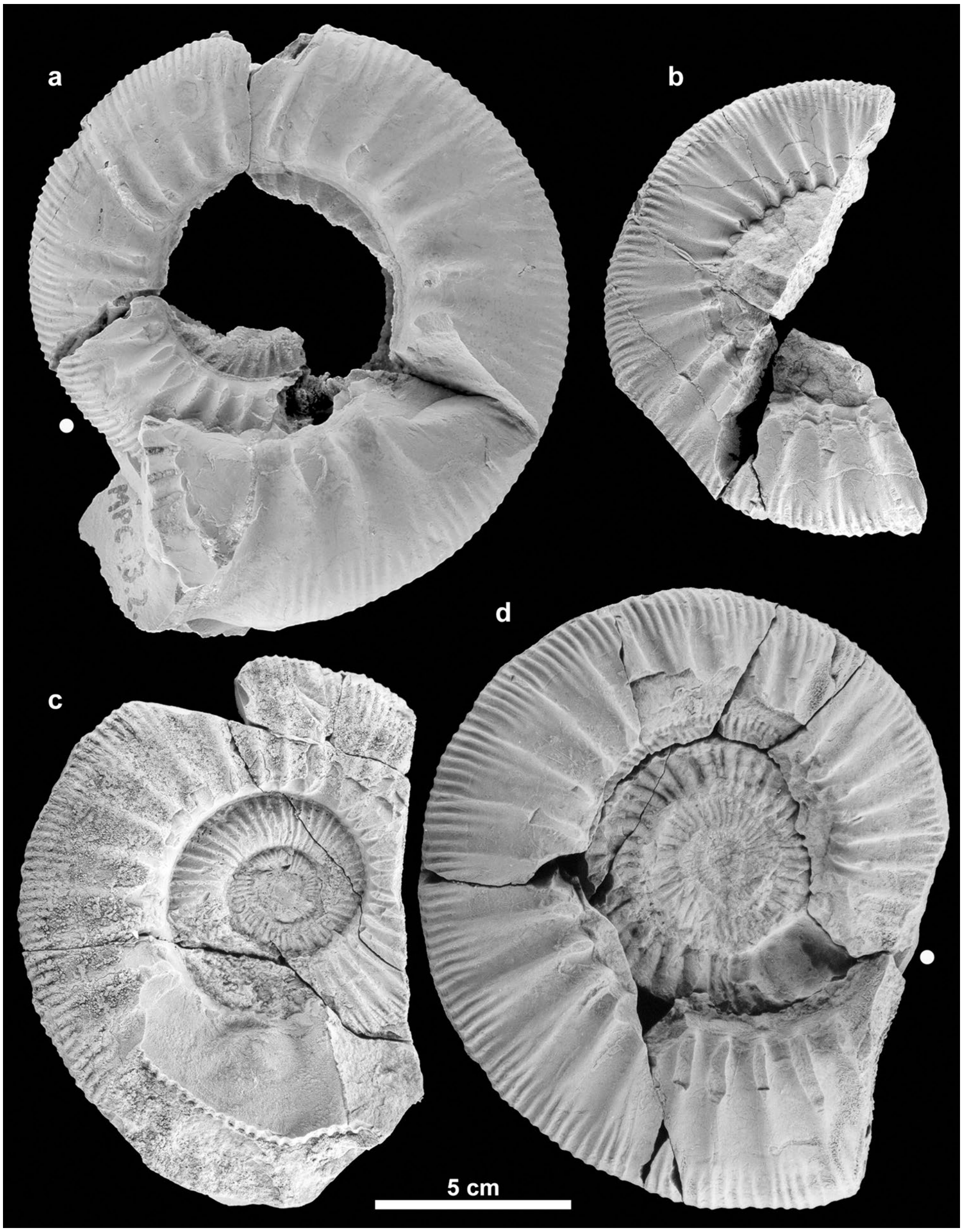


Fig. 9 *O. olorizi* [M] *gallipuense* morphotype (**a**), *O. olorizi* [m] *semihomalinum* morphotype (**b**, **c**, **d**). Lower Kimmerdgian, *Sutneria platynota* Biozone, *Schneidia guilherandense* Subzone, *Olorizia olorizi* biohorizon. **a** Specimen MPZ2023/320 found in MPC section at Foz-Calanda. **b** Specimen MPZ2023/325 found in MMM section at Molinos. **c** Specimen MPZ2023/322 found in MSC section at Berge. **d** Specimen MPZ2023/323 found in MMM section at Molinos. The white dot shows the start of the body chamber

The microconhs of the *gallipuense* morphotype are more evolute than those of the *olorizi* morphotype, also by their slower coiling, lower rib density and by having more vigorous primary ribs with greater relief at the umbilical edge. When comparing the rib-curves, a certain overlap can be seen between the *gallipuense* morphotype and the less densely ribbed population of the *olorizi* morphotype; in this case the criteria of thickness of the whorl and involution of the shell are effective for their specific differentiation. The macroconchs of the *gallipuense* morphotype are more evolute than those of the *olorizi* morphotype, have lower rib density and a higher ribbing index at equivalent diameters; in addition, the primary ribs of the *gallipuense* morphotype are more reinforced and the constrictions are more pronounced than those of the *olorizi* morphotype.

The *semihomalinum* [m] morphotype is differentiated from the rest of the morphotypes of the species by the constant spacing of the primary ribs and by its rectilinear course on the flank; furthermore, this morphotype can be free of constrictions or have a narrow, shallow constriction in the body chamber. The *olorizi* morphotype has a greater density of ribbing and its primary ribs are less rigid and thick.

Biostratigraphy: *Olorizia olorizi* ranges in the Lower Kimmeridgian, from upper part of the *S. platynota* Biozone, uppermost part of the *A. desmoides* Subzone (*A. desmoides* biohorizon) up to the lower part of the *S. guilherandense* Subzone (*O. olorizi* biohorizon).

Geographic range: The species *Olorizia olorizi* [m, M] has only been recognized in the eastern Iberian Range and northern Maestrazgo, in the NE quadrant of the province of Teruel, Spain; to date it has been registered in the sections MTG1 and MCH (Alcorisa), MSC and MVP (Berge), MPC (Foz-Calanda), MLG (Calanda), MMM (Molinos), MBC (Montoro de Mezquita), MPR (Villarluengo) and MBP (Alacón). Some specimens included in the synonymy, but originally interpreted as *Ataxioceras* (*Parataxioceras*) spp., come from the same outcrops, such as Foz-Calanda (Fezer & Geyer, 1982 and Finkel, 1991), or from very close outcrops, such as La Ginebrosa (Finkel, 1991).

5.2 *Olorizia calandensis* sp. nov. [m, M]

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Figure 7a, c, d.

2009*Olorizia* n. sp. A [m, M], in Moliner, p. 227.

Etymology: From the village of Calanda (Teruel), around which many specimens of *Olorizia* have been found.

Type material: An internal macroconchiate mould is chosen as the holotype, specimen MPZ 2023/331 (formerly UGR-MPC.18.18), illustrated in Fig. 7c.d and as a paratype, an internal microconchiate mold, MPZ 2023/330 (formerly UGR-MVP.25.2), illustrated in Fig. 7a.

Type locally: Valdelapiedra ravine, next to the Calanda reservoir in Foz Calanda (province of Teruel) 30 T 733506.1 ED50 – 30 T 4531503.9 ED50.

Type horizon: Lower Kimmeridgian, *Sutneria platynota* biozone, *Schneidia guilherandense* subzone, *Olorizia olorizi* biohorizon (Figs. 2, 3).

Diagnosis: Ataxioceratin moderately large macroconch and moderately small microconch. Coiling degree ca. 40%. Ovate whorl section. Oblique, narrow, shallow constrictions, sparse on the microconch. Ribbing slightly prorsiradiate. Bifurcated and polygyrated ribs with some external intercalatory ribs. Both dimorphs develop subpolyplocoid ribs on the larger diameters. Primary ribs tend to reinforcement on the periumbilical edge at the larger diameters of the macroconch. The sculpture tends to weaken mid-flank in the body chamber and the connections between the primary and secondary ribs are not clear in both dimorphs.

Description: The holotype, MPZ 2023/331, is a macroconch 168 mm in diameter and shows a coiling degree ca. 40% in diameters greater than 125 mm. The end of the phragmocone is at ca. 95 mm and the body chamber is almost one whorl (Table 2). Ovate whorl section with a maximum thickness at mid-height on the flank, with a narrow and rounded venter and slightly convex flanks.

There are four narrow and relatively deep constrictions in the body chamber.

Crowded ribbing on the phragmocone, progressively less accentuated. Ribs are thin, progressively thicker, somewhat prorsiradiate and slightly concave towards the peristome.

Bifurcate and polygirate ribs with some intercalatory ribs (one or two) at the beginning of the body chamber, then sculpture consists of subpolyplocoid common ribs showing the primary/secondary connection more or less close to the mid flank, but always in its inner half.

Reinforcement of ribs on the periumbilical edge is incipient towards the end of the shell, where it also occurs the sculpture smoothing and weakening of connecting points among primary and secondary ribs. The ribbing index increases to 4.

MPZ 2023/330, is an incomplete microconch measuring 129.5 mm in diameter and 40% involution, which preserves only about two-thirds of the whorl corresponding to the body chamber (Table 2).

The section is ovate with the maximum thickness close to the umbilical edge, which is rounded; the flanks

Table 2 Measurements: *Olorizia calandensis* sp. nov. [m, M]

	Dm	Ph	U	H	U/D	H/D	U/H	UR	UR/2	RI	C
MPZ 2023/330	129,5	< 90	52	46	0,40	0,36	1,13	–	18	3,7	1
[m]	121,0	–	49	41,5	0,40	0,34	1,18	–	19	3,7	–
MPZ 2023/331	168,0	95	65	47,5	0,39	0,28	1,37	33	12	6,3	4
[M]	143,0	–	57	39	0,40	0,27	1,46	-	17	4,8	–
	128,0	–	51	35	0,40	0,27	1,46	-	21	3,9	–

Maximum shell diameter measured (Dm), maximum phragmocone diameter (Ph); umbilicus size (U); whorl high (H); whorl width (W); number of umbilical ribs per complete whorl (UR), number of umbilical ribs per half – a – whorl (UR/2); ribbing index calculated as the number of peripheral ribs per ten umbilical ribs (RI), number of constrictions (C) are slightly convex and converge in the ventral region, which is broad and convex; the umbilical wall is steep. A deep, narrow constriction is seen at the beginning of the preserved body chamber fragment.

Ribs are thin and maintains its thickness all the way along the flank, somewhat prorsiradiate and slightly concave towards the peristoma. Ribs are bifurcated, with sparse free external ribs intercalated between them; the final third of the preserved body chamber shows polygyrate ribs and at least four subpolyplocoid elements with clear connections. In larger diameters, there is a smoothing of the sculpture and weakening of the connection points between the primary and secondary ribs. The ribbing index is low (3.7–129 mm in diameter).

Discussion: Both dimorphs have similar coiling degree. At equivalent diameter, the ribbing of the macroconch is denser and the ribbing index higher. The microconch develops double-connected ribs at smaller diameter.

The *semihomalinum* morphotype [m] is the closest morphologically to *Olorizia calandensis* [m] of the three morphotypes of *Olorizia olorizi*, considering the uniformity ribbing and the scarcity of constrictions; however, at equivalent diameters, *Olorizia calandensis* [m] is less evolute, with higher ribbing density, finer primary ribs and the lowest ribbing índex, (3,7 at shell diameters 121–129,5 mm in *O. calandensis vs* 4,5–5,2 at shell diameters 120,5–134 mm).

Macroconchiates of *Olorizia olorizi gallipuense* morphotype have a lower ribbing density, the primary ribss are more vigorous, the constrictions are more developed and double-connected ribs are less well achieved.

Differences with other taxa, such as *Ardescia*, *Lithacosphinctes*, *Schneidia*, *Ataxioceras*, *Parataxioceras* and *Geyericeras* have been discussed in the introduction to the genus *Olorizia*.

Olorizia calandensis sp. nov. is the youngest record of the genus in the sections in which it appears.

Associated ammonites: The enumeration of ammonites identified in the strata where *Olorizia calandensis*, MPC.18 and MVP.25, was collected is: *Ardescia celtiberica* Moliner [m], *Ardescia strangulata* Moliner [m], *Ardescia* sp. [m], *Lithacosphinctes schaireri* (Atrops) [m], *Schneidia guilherandense guilherandense* Atrops [m], *Schneidia guilherandense turolense* Moliner [m], *Schneidia collignoni* Atrops [m, M], *Schneidia* sp. [m], *Olorizia calandensis* sp. nov. [m, M], Ataxioceratinae [m, M] unspecified, *Aspidoceras* s.l., *Ochetoceras* sp., Glochiceratidae unspecified and the zonal index, *Sutneria platynota* (Reinecke).

Stratigraphic and geographic distribution: The species come from levels of the *Sutneria platynota* Biozone, *Schneidia guilherandense* Subzone, *Olorizia olorizi* biohorizon. The macroconch was found in bed number 18 in the Foz Calanda section (MPC) and the microconch, in the bed number 25 in the Berge section (MVP).

6 Conclusions

The description of the species *Olorizia calandens*is sp. nov. was made possible by the revision of the Early Kimmeridgian ataxioceratins with with double connected ribs and, especially, by the revision of the genus *Olorizia*.

The new species, like all the specimens belonging to the genus *Olorizia*, achieves one of the maximum exponents of the morphology derived from the group, the ribs with double connections at large diameters. *Olorizia calandensis* sp. nov. develops only double connected ribs of subpolyplocoid type on the body chamber, with the lower connection below half flank height.

Macroconch and microconch dimorphs have been identified.

The palaeogeography, with the formation of the Maestrazgo Basin during the Late Jurassic-Early Cretaceous rifting event that affected Iberia, coupled with the overall geographical and stratigraphic record of *Olorizia*, allows us to consider the new species as another case of endemism among the Ataxioceratinae of the eastern Iberian platform during the Early Kimmeridgian and as a product of in situ evolution.

The stratigraphic record of *Olorizia calandensis* is restricted to the middle part of the *Schneidia guilerandense* Subzone, *Olorizia olorizi* biohorizon.

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Data availability The data that support the findings of this study are available on request.

Declarations

Conflict of interest I know of no conflicts of interest associated with this publication.

Ethical statement I declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere.

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