Triassic *Lingularia* (Brachiopoda) from Moya, Cuenca (SE Iberian Ranges, Spain)

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Introduction: **Lingulide** brachiopods

- **Lingulide** brachiopods have been important **infaunal** constituents of marine and marginal-marine depositional systems since the **Early Cambrian to recent times**.
- This long span time may be attributed to their **tolerance** to
  - 1.- **adverse salinity** conditions (from brackish to moderately hipersaline)
  - 2.- **oxigen-deficient** settings.
  - 3.- **variable to temperature**.
  - 4.- **Constraints to low sediment-grain size** (Their absence in silty and muddy intertidal settings likely reflects this aspect).
- Modern lingulide **larvae** are able to enter a state of **developmental stasis** until they approach a suitable substrates. This prolong larval life span and **enables distribution over wide geographic areas**
- The Lingulide lifestyle has facilitated their **colonization** from **basinal to intertidal marine** (proximal offshore, offshore transition to deltaic, estuarine and intertidal) environments.

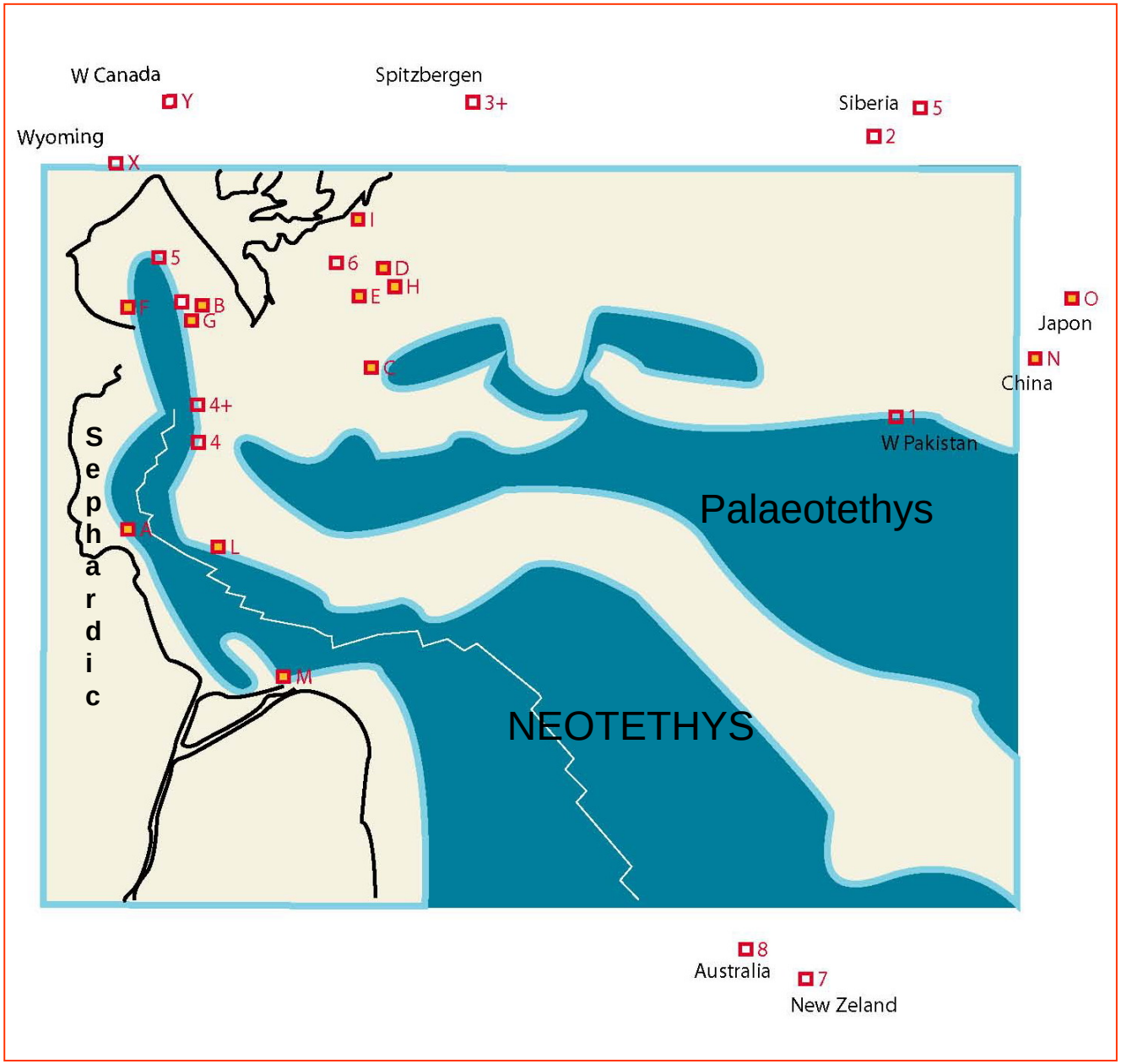
Introduction: **Lingula**

- ***Lingula*** is often considered a **"living-fossil**" based on its supposed lengthy morphological conservation owing to its **absence** of **evolution**, and its remarkable survival for more than 550 M.Y.
- ***Lingula tenuissima*** BRONN was originally described from the Buntsanstein and the Wellenkalk in the Germanic Triassic (Bronn, 1837). It occurs in the Lower to Upper Triassic (Carnian) of the Germanic and Alpine domains
- This conclusion is **based on the typical apparently unchanged "linguliform" shape of the shell.** However the taxa of the family Lingulidae show morphological evolutionary changes. Consequently, traditional opinion that *Lingula* is a "living-fossil" should be rejected. Diagnoses of the Family Lingulidae and of itsthree genera are herewith emended:
- **EMIG C.C. (2003).- Proof that *Lingula* (Brachiopoda) is not a living-fossil**, and emended diagnoses of the Family Lingulidae.- Carnets de Géologie / Notebooks on Geology, Maintenon, Letter2003/01 (**CG2003_L01_CCE**)
- Fossil Lingulide specimens are commonly referred to the genus ***Lingula***. On the contrary, the genus ***Lingularia*** *(*Biernat and Emig,1993) was introduced to the **Mesozoic forms** by their morphological differences.

Global distribution of ***Lingularia*** **(*Lingula*)** during Early to UpperTriassic

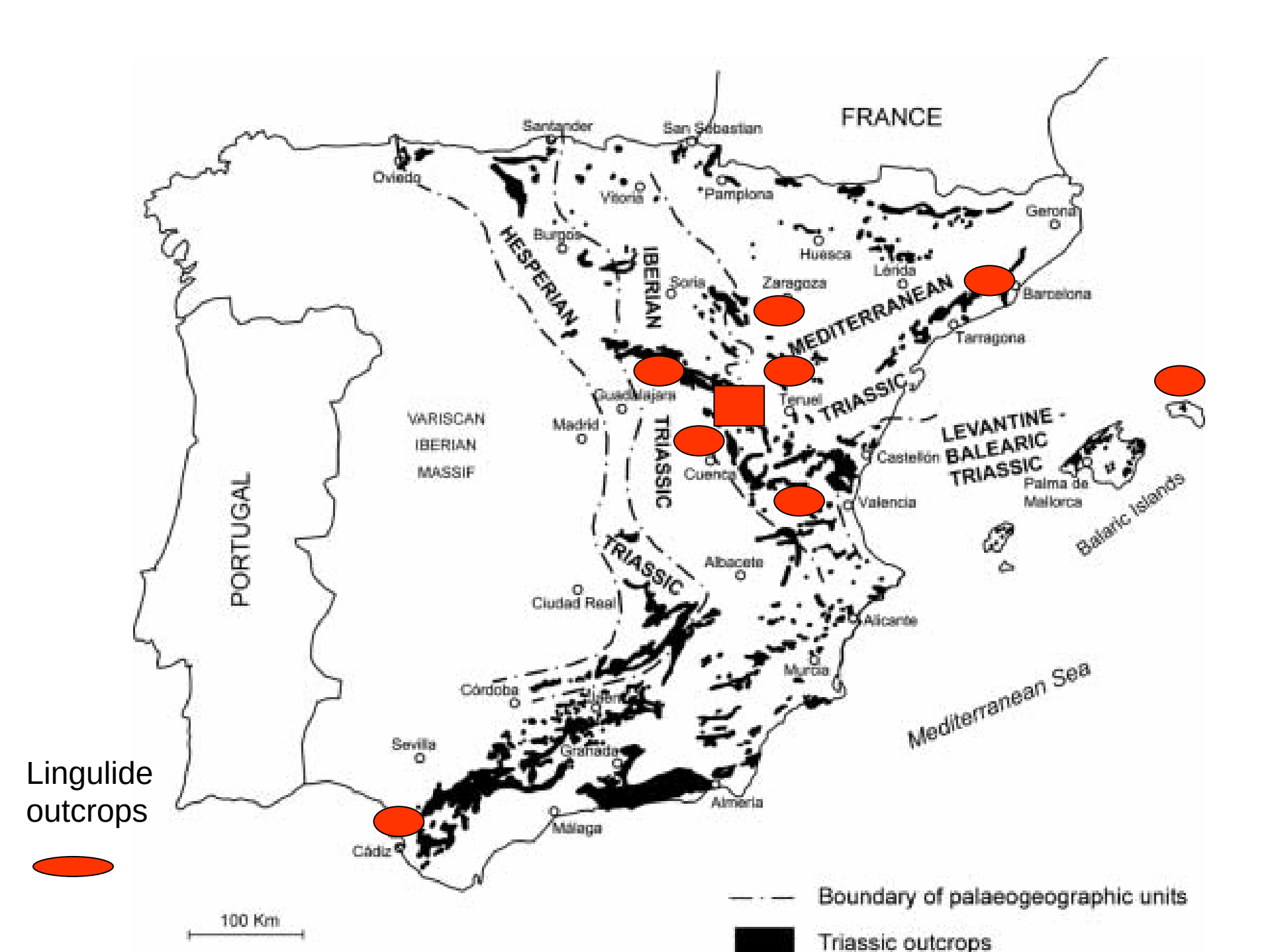
1	*siberica*	Spain (Aragon)	Biernat & Emig, 1993
1	*new sp*	Spain	Calzada & Magrans, 1997
1	*Lingularia similis*	Spain	Márquez-Alliaga et al., 1999
1	*tenuissima*	Spain (Catalonia)	Virgili C. 1958
1	*tenuissima*	Spain (Cuenca)	Arche et al, 1986
2	*tenuissima*	Germany (Franken)	Heller F. 1952
2	*Lingula keuperea*	Germany	Zenker, 1834
2	*Lingula calcaria*	Germany	Zenker, 1834
2	*tenuisima*	Germany	Bronn, 1830, 1835
2	*Lingula zenkeri*	Germany	v. Alberti, 1864
3	*tenuissima*	Switzerland	Sulser H. 1999
3	*Lingula christomani*	Switzerland	Skuphos, 1893
3	*Lingula fischeri*	Switzerland	Suess, 1854
3	*tenuissima*	Vosges (France)	Emig et al., 1978; Gall & Grauvogel-Stamm, 2005
3	*tenuissima*	Jura (France)	Sulser H. 1999
4	*tenuissima*	E England (UK)	Rose G. N. & P. E. Kent, 1955
4	*tenuissima*	Netherland	?
5	*tenuisima*	Germany (Schleswig)	Assmann, 1915
5	*tenuissima*	Poland	Senkowiczowa 1965, 1970, 1998.
6	*tenuissima*	Austria	Siblík M. 1988
6	*tenuissima*	N Slovaquia	Purkynova, unpublished data (2005)
6	*tenuissima*	N Slovaquia	Kozur & Mock, 1993
7	*tenuissima*	Hungary	Hass et al., 1988; Pálfy 2003; Pálfy & Török 1992
8	*tenuissima*	Bulgaria	Entcheva, 1972
9	*tenuissima*	Bosnia	?
11	*tenuissima*	Greece	?
12	*tenuissima*	S Alps (Italy)	Assereto et al, 1973
12	*borealis*	S Alps (Italy)	Broglio Loriga et al., 1980
13	*tenuisima*	S Tunisia (Jeffara)	Biely A. & Rakús M. 1991
13	*Lingula*	Libya	Hecht et al. 1964
14	*tenuisima*	Israel	?
15	*Lingula sp.*	Iran	Hirsch & Sussli, 1973
16	*borealis = similis?*	Pakistan (Salt range)	Rowell, 1970
16	*Lingula*	Pakistan (Salt range)	Xu & Grant, 1992
17	*Lingula*	NW Australia	Gorter, 1978
17	*L. occidentaustralis*	NW Australia	Archbold (1981)
18	*Lingula aoraki*	New Zealand	Campbell (1987); Hori (2004)
19	*borealis*	W Wyoming (N America)	Newell & Kummel, 1942
19	*similis*	Wyoming	Rowell, 1970, 1942
19	*similis*	Wyoming	Dagys, 1965
19	*Lingula*	Nevada, Utah, Idaho	Boyer et al., 2004
20	*Lingularia*	W Canada	Zonneveld et al.,
21	*borealis*	Est Greenland	Spath, 1935
22	*similis*	Spitsbergen	Biernat & Emig, 1993
22	*polaris = similis*	Spitsbergen	Lundgren, 1883
22	*arctica = similis*	Spitsbergen	Wittenburg, 1910
23	*Lingula polaris*	Bear Island (Norway)	Böhm (1903)
24	*similis*	N Siberia (Russia)	Dagys, 1965
24	*siberica*	N Siberia (Russia)	Biernat & Emig, 1993
24	*borealis*	N Siberia (Russia)	Xu
25	*borealis & tenuissima*	E Siberia (Russia)	Bittner 1899; Bragin (1991)
26	*Lingula sp.*	Japan	Murata, 1973
26	*borealis*	Japan	Bando, 1964
26	*Lingularia aff. lindströmi*	Japan	Hori, 2004; Yanagita et al., 1995;
26	*similis*	Japan	Nakazawa, 1958
27	*Lingula subcircularis*	South China	Xu & Grant, 1992
27	*tenuisima*	China	Chen et al., 2006

Lingulide Middle Triassic palaeogeographical distribution



Spanish Triassic Paleogeographical units: *Lingularia* record outcrops

- In the Iberian Peninsula, several units have been described based on palaeogeographic differences among its Triassic deposits.
- The most recent classification scheme is that described by López-Gómez et al. (1998, 2002)Who differentiates the following palaeogeographic units:
- ***Hesperian Triassic****.* This unit is characterized by a lack of carbonate materials.
- ***Iberian Triassic****.* The characteristic feature of this unit is the presence of a carbonate
- Muschelkalk **(Ladinian) facies**.
- ***Mediterranean Triassic****:* Characterized by the presence of two carbonate levels of Muschelkalk facies of Anisian and Ladinian age, respectively, and separated by an intercalation comprised of coastal facies (red clays, sandstones and gypsums)
- ***Levantine-Balearic Triassic****.* This unit shows the presence of a single, thick carbonate level of **Middle Anisian–Upper Ladinian age**.



Lingulide outcrops

Spanish "*Lingula" vs. Lingularia record*:

Spain belongs to the western part of the Sephardic Province, southern Tethys Realm, during the marine transgression of the Middle Triassic several lingulide populations were fossilized.

Different taxa of Lingula were used in the sistematic determination

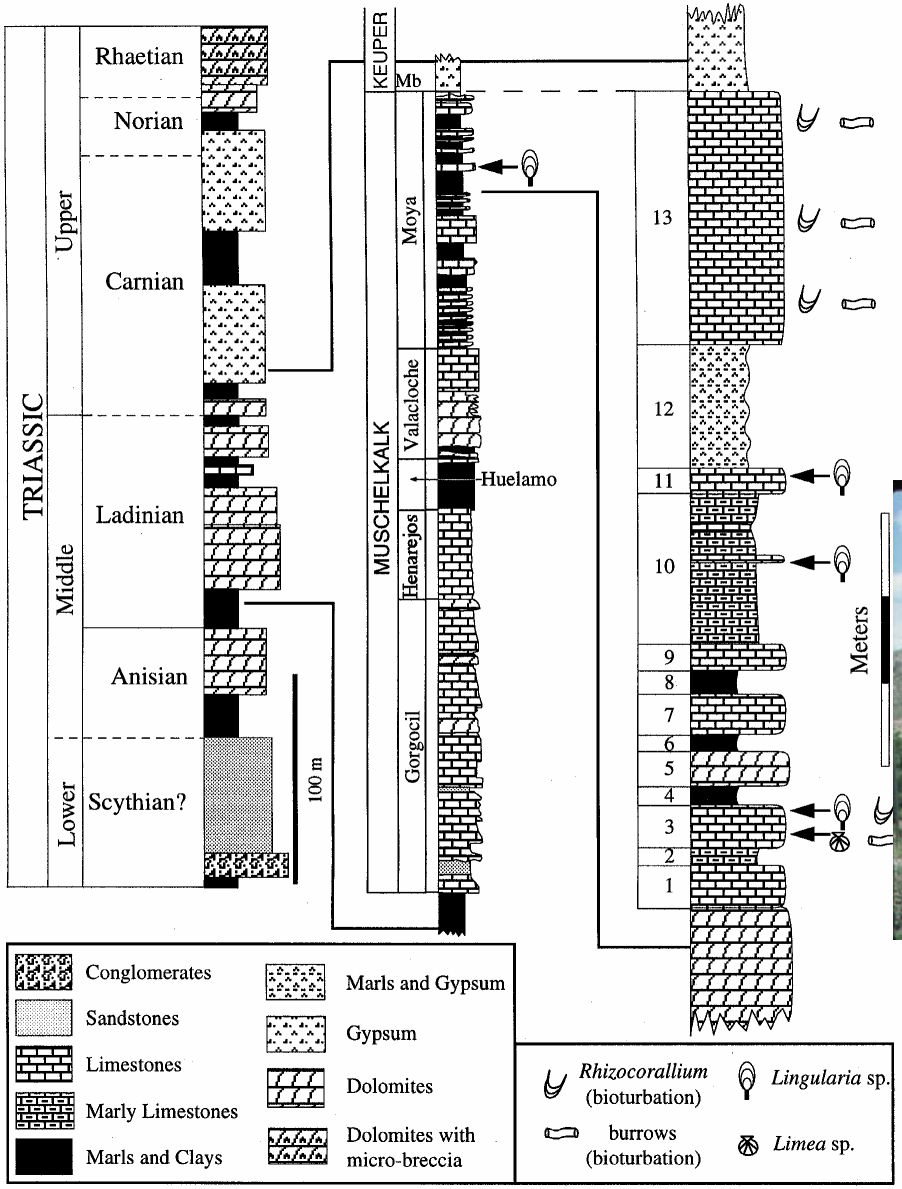
- Almera (1899), in his work from the Catalonian Range, cited ***Lingula* cf. t*enuisima* BRONN** in the Muschelkalk of Barcelona. It could be the oldest citation of Triassic lingulid of Spain.
- From the Aragonian area of the Iberic range Wurm (1911, p.123 Taf VII, Fig 5) made a good description of ***Lingula polariformis* sp. nov. aff. *polaris* LUNDGREN** and *Lingula* sp. placed in the uppermost layers of the Muschelkalk down the Keuper of Monterde and El Frasno (Zaragoza).
- Schmidt (1935)made a description of ***Lingula tenuissima* var. *zenkeri* ALBERTI** from the Langobard (Midle Triassic) of Villora (Valencia), recorder in layers placed in the uppermost part of the Muschelkalk.
- ***Lingula tenuisima* BRONN** from the uppermost part of the Muschelkalk of Pauls and Begues (Barcelona) is described by Virgili 1958
- Local Triassic studies of the Iberic Range were made by Hinkelbein (1969) and Márquez-Aliaga (1977). *Lingula tenuissima* BRONN from Albarracin (Teruel), Henarejos (Cuenca) and ***Lingula keuperea* ZENKER** from Jalance, Chelva, Macastre and Villora (Valencia) recorded in the uppermost part of the Muschelkalk, have been described.
- The genus **"*Lingula*"** is cited and located in: Henarejos (Cuenca) (Lopez *et al* 1987 and Márquez-Aliaga and López 1989), Menorca (Baleares) (Llompart *et al* 1987), Monterde (Zaragoza) (Garcia-Royo *et al*, 1989), Riba de Santiuste and Fuencaliente de Medina (Guadalajara) (Márquez-Aliaga and Garcia-Gil, 1991); Boyar (Cadiz) (Martin-Algarra et al, 1995) and Barranco del Contador (Teruel) (Arche et al. 1995).

Spanish *Lingularia* record: Geographical setting

Several hundred specimens collected in Jalance (Valencia) have been studied by Márquez-Aliaga *et al* (1999) to identify the genus and species of these specimens on the basis of morphological characteristics.

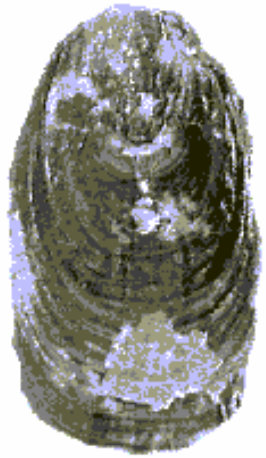
The genus ***Lingularia*** (*Lingularia* cf. *smirnovae BIERNAT & EMIG, 1993)* was by first time cited in Spain in 1999 and it is widely ranging from de Carboniferous to Cretaceous

Jalance Section



Lingularia* cf. *smirnovae (Cuenca y Valencia)

1



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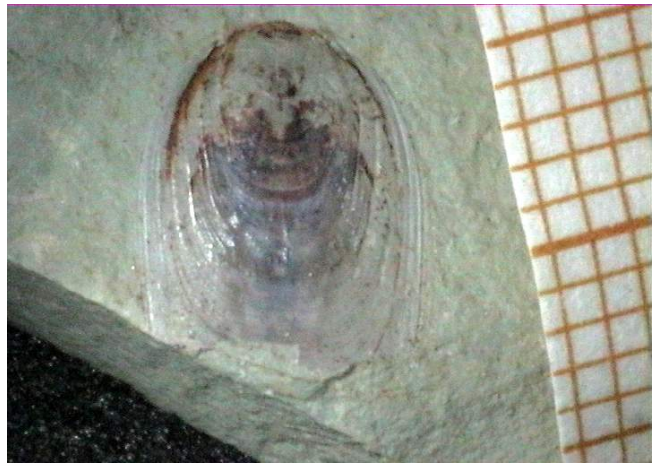
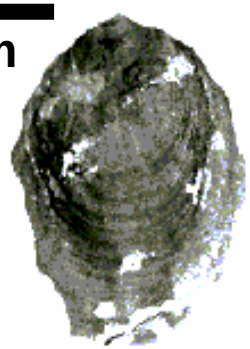


3

4

5 mm



6

7

8

Moya oucrop

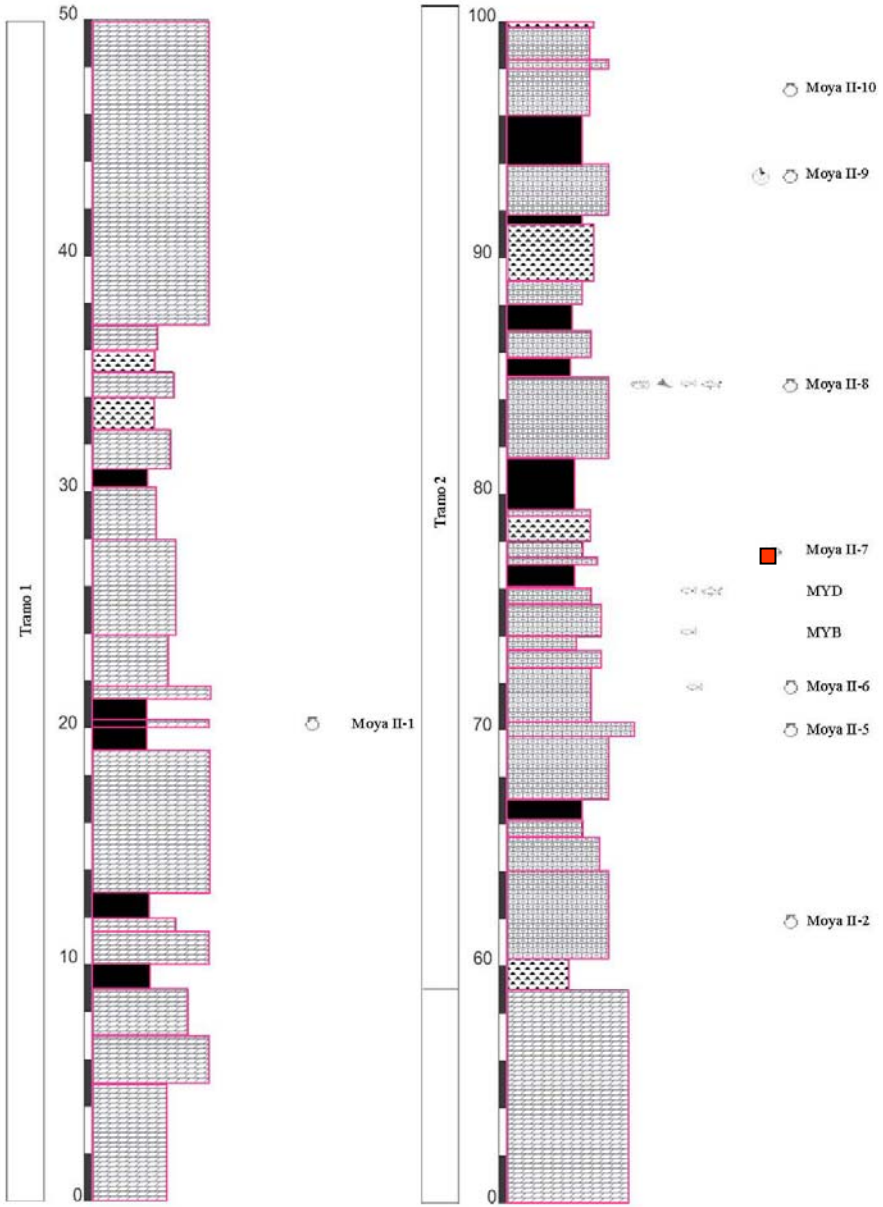
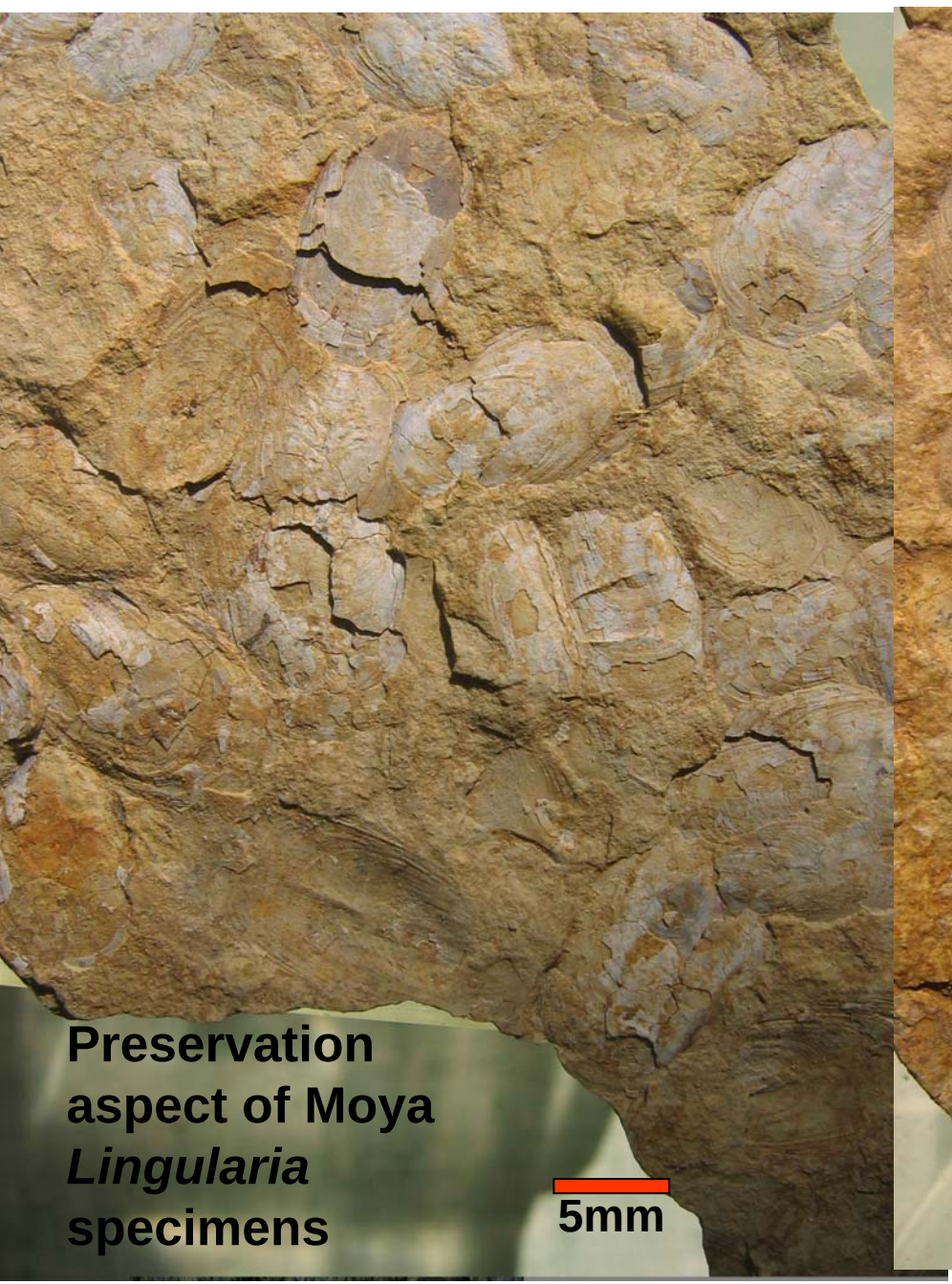


Figura Columna de la sección de Moya. López-Gomez (com. pers.)


Preservation aspect of Moya *Lingularia* specimens
5mm


5mm

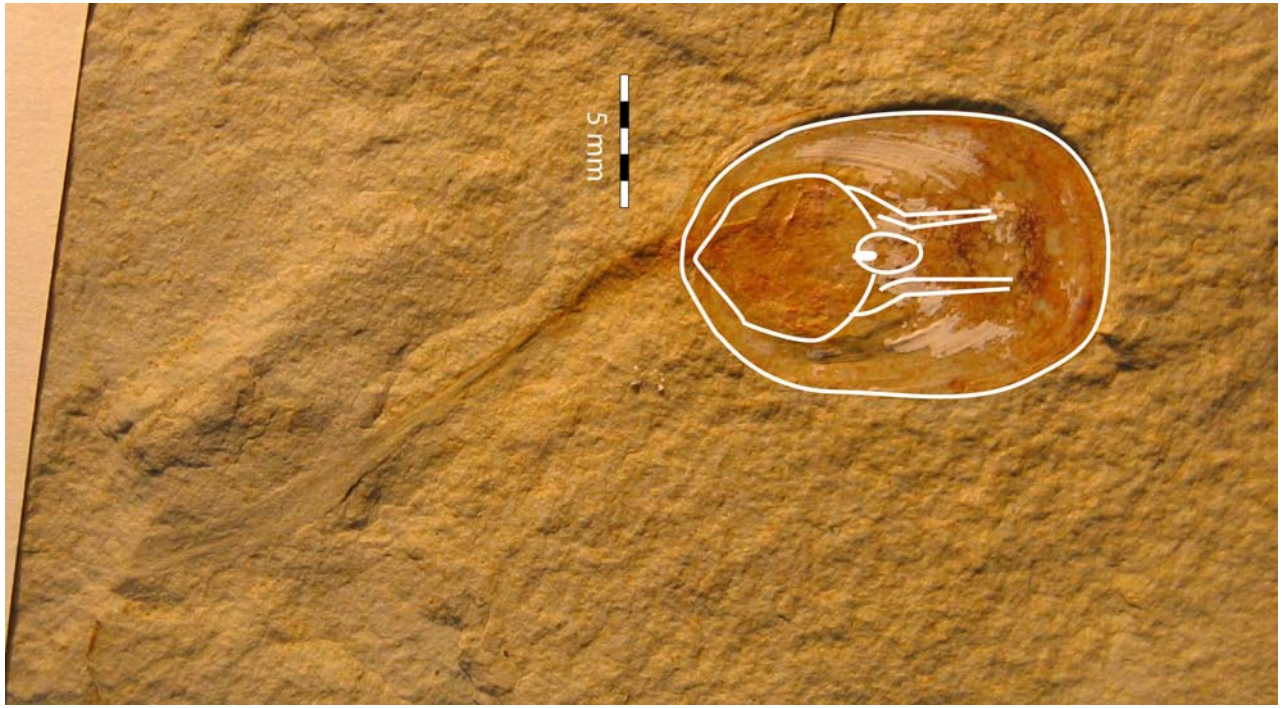
A taphonomy point of view / and its implication in lingulide paleobiology

The interpretation of *Lingula* as a disaster taxon (e.g., Schubert and Bottjer, 1995) **is not consistent** with our knowledge of on Lingulides ecological requirements (Emig, 1983, 1986).

a.- **Recent** s**hells are removed from their burrows** before or **soon after death**. These are **deposited** on the surface **as single valves** and undergo quick mechanical disintegration.

b.- Recent lingulide brachiopods have a **very low fossilization potential** and we have suggestions that **high sedimentation rates are needed to preserve them.**

c.- **the lingulides fossil record may be affected by a taphonomic megabias** -their decrease in diversity and ecologic importance after the Paleozoic may be, in part, a taphonomic artifact.



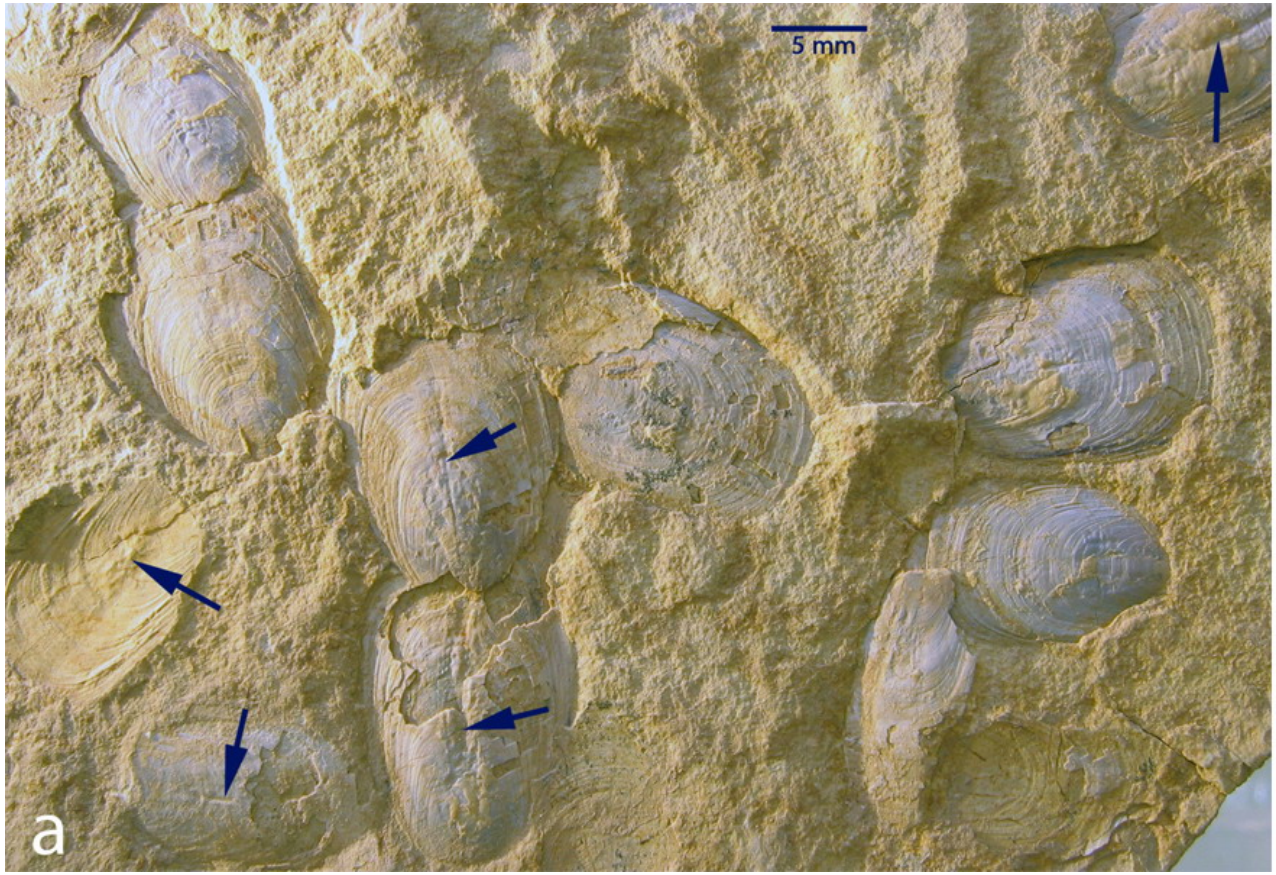
Species	n.i.	W/L range	W/L mean	L range	L mean	W range	W mean
Lingularia from Moya	18	0.56 - 0.79	0.65	5.7 - 17.9	9.1	3.7 – 11.9	5.9
Lingularia cf. *smirnovae* (*)	43	0.62 - 0.75	0.67	5.7 - 15.4	10.5	4.0 - 10.2	7.2

Range and mean value of the W/L ratios of the valves, width (W), length (L) in the *Lingularia* species. (*) data from Márquez-Aliaga *et al*.(1999); n.i. = number of individuals.

Moya specimens:

a. Flat-lying valves of *Lingularia*, some showing compression deformation (arrows) ;

b. Pedicle attached to the ventral valve of a specimen ■



Conclusions

- The studied **specimens from Moya appears similar** to those previously described in Jalance and Henarejos and reported to *Lingularia*. One specimen has been fossalized with its pedicle, that is an exceptional feature among the lingulids. From the anatomical impressions visible on the dorsal side, one may suggested that these specimen may be related **to *Lingularia* cf *smirnovae***.
- In the outcrop, **the lingulides are in free-lying and separated valves**, sometimes accumulated on several layers of valves. There is **no particular orientation** except that all valves are on the same face. These valves show no anatomical scars (except the single specimen cited above). **Many valves present deformations**, mainly in the central line. Such features should not be **interpreted as** shell characteristics, they represent **bioestratinomic** bias.
- **The fossilization** of the outcrop could be the **result of a strong drop of salinity under 20 psu** during at least one or two weeks, **which leads to a mass mortality**, **with some lingulides still in position of life, high sedimentation rates are needed to preserve them.** The chitinophosphatic valves are susceptible to dissolution and chemical degradation as well as mechanical decay, **their importance in benthic fossil communities is only related to taphonomic conditions** (Emig, 1986; Kowalewski, 1996).
- We are working with **the good preserved *Lingularia* Moya associations** in order to get a **new paleobiological Mesozoic Lingulidae** point of view.