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Toarcian GSSP candidate: the Peniche section at Ponta do Trovão

S. Elmi[1†], R. Mouterde[†] , R. B. Rocha[2] & Ch. Ruget[3]

[1] Former Toarcian Working Group Co-ordinator
[2] CIGA, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, P 2829-516 Caparica; rbr@fct.unl.pt
[3] Chipier, route de Pimotin, F 69420 Tupin et Semons; ACRuget@aol.com

Resumo

Palavras-chave: limite Pliensbaquiano/Toarciano, GSSP, cronostratigrafia, amonites, foraminíferos, Peniche, Portugal

O perfil de Ponta do Trovão em Peniche (Portugal) é apresentado como o potencial estratótipo (GSSP) do limite Pliensbaquiano/Toarciano. É descrita a sucessão litostratigráfica e apresentada a cronostratigrafia com base nas diferentes associações de amonites; a mudança nas associações de foraminíferos é feita mais tarde, apenas na base das bancadas 16 (base da subzona de Semicelatum, horizonte de Crosbeyi ?).

É apresentada uma bibliografia de conjunto de todos os trabalhos publicados com referências precisas a este limite, quer na Bacia Lusitaniana quer na Bacia do Algarve.

Résumé

Mots-clés: limite Pliensbachien/Toarcien, GSSP, chronostratigraphie, ammonites, foraminifères, Peniche, Portugal

La coupe de Peniche (Ponta do Trovão) au Portugal est présentée comme le potentiel stratotype (GSSP) pour la limite Pliensbachien/Toarcien. La succession lithostratigraphique est décrite et on présente la chronostratigraphie en ayant comme base les différentes associations d'ammonites; le changement des associations de foraminifères se fait plus tard, seulement à la base des couches 16 (base de la sous-zone à Semicelatum, horizon à Crosbeyi ?).

L'ensemble de la bibliographie de tous les travaux publiés, ayant des références à cette limite dans le Bassin Lusitanien et dans le Bassin de l'Algarve, est présenté.

Abstract

Key-words: Pliensbachian/Toarcian boundary, GSSP, chronostratigraphy, Ammonites, Foraminifera, Peniche, Portugal

The Peniche section (Ponta do Trovão) in Portugal is presented as potential stratotype (GSSP) for the Pliensbachian/Toarcian boundary. The lithostratigraphic succession is described and the chronostratigraphy, based on ammonite assemblages, is presented; the change in foraminifera assemblages occurs later, only at the base of beds 16 (base of Semicelatum Subzone, Crosbeyi ? Horizon).

An extensive bibliographical list of all scientific articles containing specific reference to this stratigraphic boundary, whether from the Lusitanian or Algarve basins, is also presented.

In Portugal, the Pliensbachian–Toarcian transition is well exposed in several localities yielding Tethyan ammonites associated with some NW European classic species. These assemblages give good markers for worldwide correlations. Moreover, the transition beds often indicate a relatively continuous sedimentation, contrarily to the frequent gap recorded in NW Europe. The best Portuguese section is located along the Atlantic coast at Ponta do Trovão, in the Peniche Peninsula (fig. 1-2), 80 km North of Lisbon.

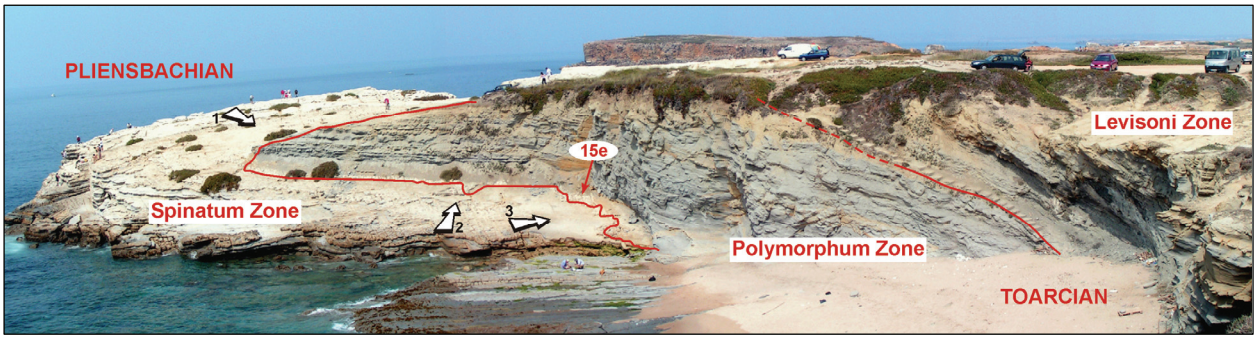

Fig. 1 – General view (from SW to NE) of the Ponta do Trovão section, Peniche Peninsula (Portugal); the 3 arrows shows the locals (and directions) where are taked the photos corresponding to the figures 3, 4 and 5; in the background, the Papoa Peninsula (photo S. Mailliot).

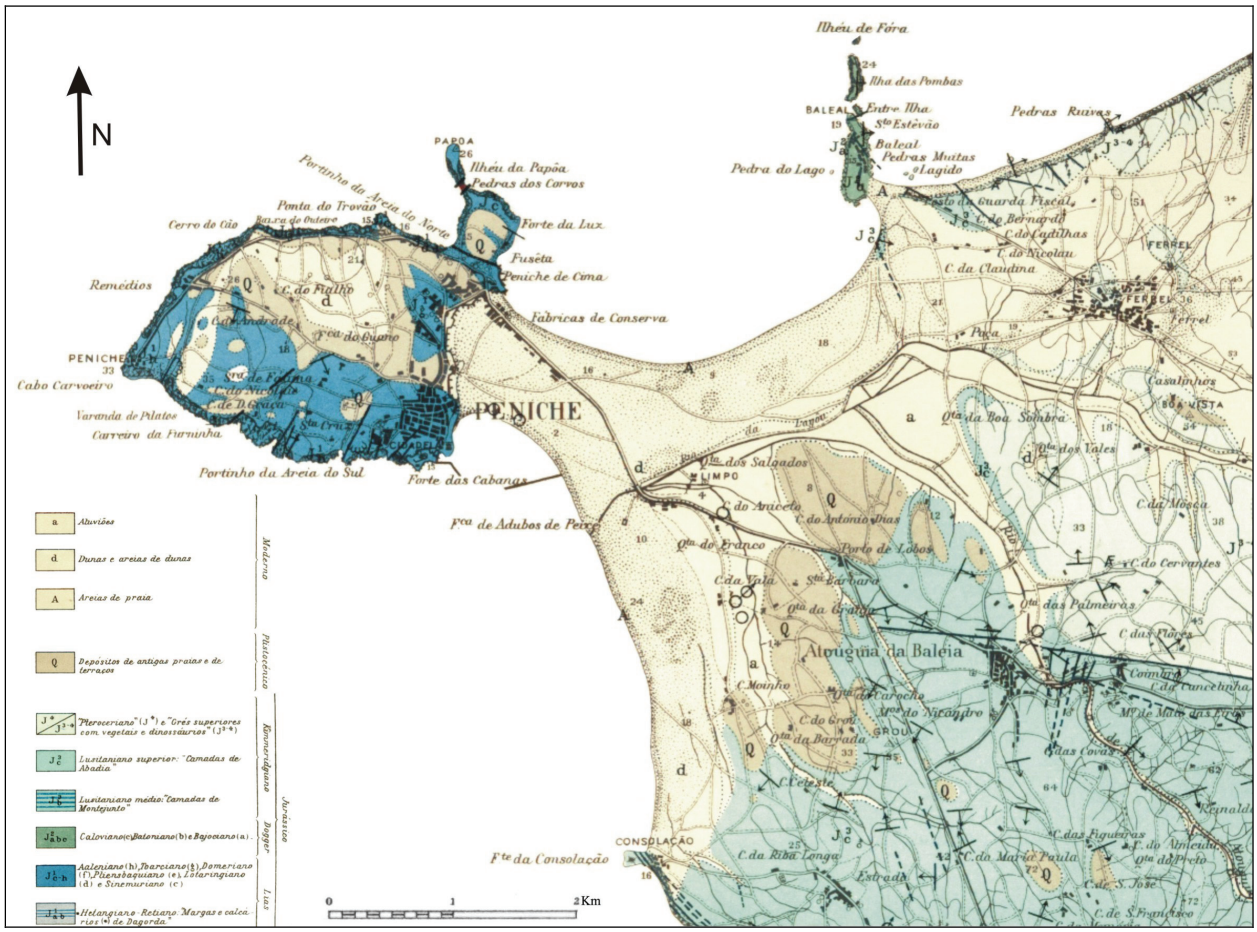

Fig. 2 – Geological map of the Peniche region (*in* FRANÇA & *al.,* 1960).

In this locality, the Upper Pliensbachian (Domerian) series consists of regular marl-limestone alternations (Lemede Formation), dipping gently to the South. The uppermost part of this formation (around 1m thick), was described by P. CHOFFAT (1880) and R. MOUTERDE (1955) as a particular unit called *Couches de passage* (Transition beds). They have yielded a continuous and diversified fossil material, which has been strongly collected. Shells are often accumulated and gathered, forming irregular heaps. Some belemnite accumulations have been interpreted as coprolites remnants. *Plicatula* and serpulids are fixed on ammonite shells or casts. The "Couches de passage" indicate a low sedimentation rate and they are capped by *hard ground* (top surface of

level 15e, MOUTERDE, 1955; D5, SOARES & *al*., 1993a; DT1, DUARTE, 1995, 1997, 2003). The last bed (15e) has yielded a characteristic association of Dactylioceratids that is classically interpreted as marking the beginning of the Toarcian. In consequence, the chronostratigraphic boundary differs from the lithologic one, the latter being situated between the "Couches de passage" (levels 15, topmost of Lemede Formation) and the base of the Cabo Carvoeiro Formation (levels 16, base of Cabo Carvoeiro, 1st member; = "Couches à Leptaena") (fig. 3-5).

The biostratigraphic boundary is located within a succession showing a progressive sedimentary evolution, without noticeable interruption. The time recording can be considered good enough to give an international reference.

The detail of the *Couches de passage* (Transition beds) succession will be shortly described (fig. 6)

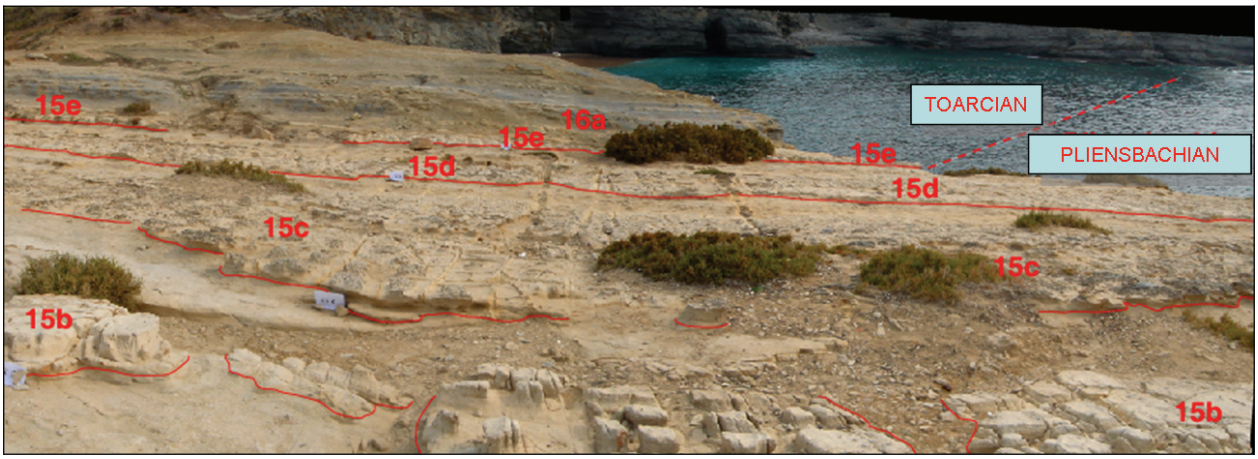

Fig. 3 – Detail of the Transition beds (levels 15, topmost of the Lemede Formation), in the Ponta do Trovão northern part.

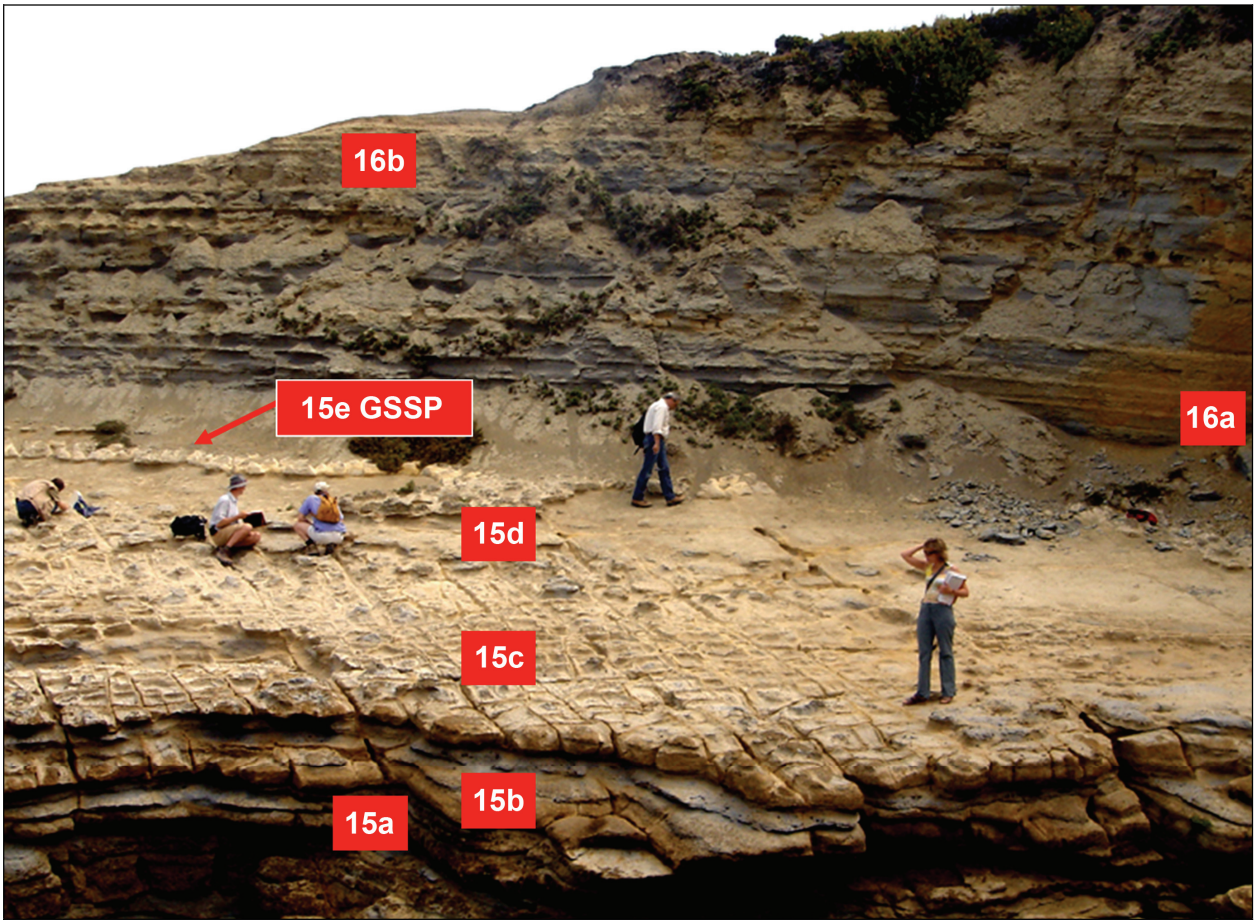

Fig. 4 – The boundary (15e-16a) between the Lemede and the Cabo Carvoeiro Formations.

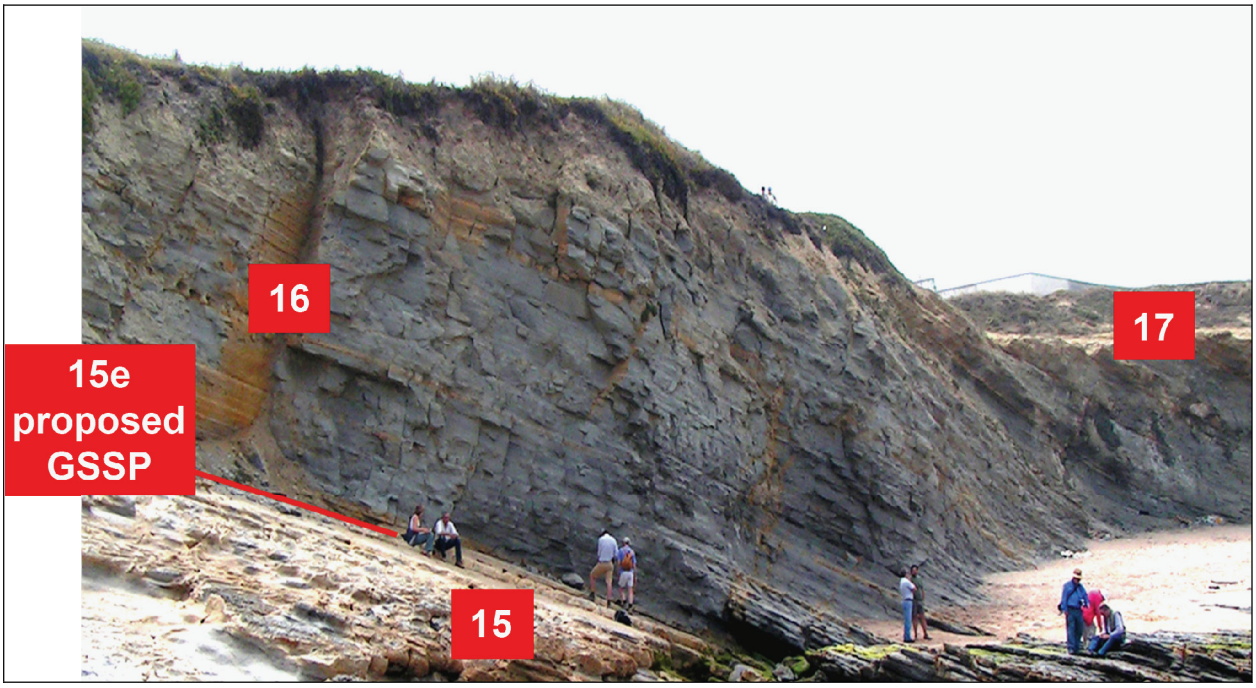

Fig. 5 – Detail of the cliff of the Cabo Carvoeiro Formation base (beds 16 and 17), above the proposed GSSP (top of level 15e).

Spinatum Zone, Emaciatum Subzone

Bed 15a (0,15 m) – *Canavaria* bed. Bioturbated micritic limestone with some lumps. *Canavaria zancleana* (FUCINI) is associated with *Emaciaticeras emaciatum* (CATULLO), *E. lotti* (FUCINI) and *Lioceratoides* aff. *ballinense* (HAAS).

Bed 15b (0,25/0,30 m) – Calcareous laminated marls with brachiopods (*Zeilleria* sp.), belemnites, gastropods and bivalves [*Plicatula (P.) spinosa* (SOWERBY) var. *pectinoides* (LAMARCK)].

Spinatum Zone, Elisa Subzone

Bed 15c (0,25/0,30 m) – *Tauromeniceras* bed. Bioturbated micritic limestone with *Tauromeniceras elisa* (FUCINI), *T. disputandum* DUBAR, *T.* gr. *nerina* (FUCINI), *Lioceratoides aradasi* (FUCINI), *L.* aff. *ballinense*, *Tiltoniceras* aff. *capillatum* (DENCKMANN), *Protogrammoceras (Paltarpites)* sp., *Spiriferina* gr. *rostrata* SCHLOTHEIM and *P. (P.) spinosa* var. *pectinoides*.

Bed 15d (0,20/0,30 m) – Marly limestones rich in belemnites and spiriferinids. *Tauromeniceras mazetieri* (DUBAR), *Neolioceratoides* aff. *hoffmanni* (GEMMELLARO), *Spiriferina* gr. *rostrata*, *Zeilleria* sp. and *P. (P.) spinosa* var. *pectinoides*.

Polymorphum Zone, Mirabile Subzone

Bed 15e (0,20m) – *Eodactylites* bed. Micritic limestone with numerous ammonites (including at top of the bed), generally corresponding to oxidized pyritic casts. Shows the first appearance of *Eodactylites* and disappearance of Arieticeratinids. *Eodactylites* are abundant and varied: *Dactylioceras (Eodactylites) simplex* (FUCINI), *D. (E.) pseudocommune* FUCINI, *D. (E.) polymorphum* FUCINI. The association *D. (O.) simplex – D. (O.) pseudocommune* can indicate a slight condensation, according to Iberian Ranges data, which requires larger confirmation. Other ammonites are also remnants of Domerian stocks such as *Tiltoniceras* aff. *capillatum* and *Neolioceratoides* aff. *ballinense*. The presence of *Protogrammoceras (Paltarpites)* cf. *paltum* (BUCKMAN) is a good indicator for correlations with the NW Europe. Brachiopods (*Spiriferina* sp., *Zeilleria* sp. and *Rhynchonella* sp.), belemnites and bivalves [*P. (P.) spinosa* var. *pectinoides*] are common. This bed marks the beginning of the Toarcian (Paltus/Mirabile Subzone of the Tenuicostatum/Polymorphum Zone).

Polymorphum Zone, Semicelatum Subzone

Bed 16a (1,70 m) – The level 16 marks the lower part of the Cabo Carvoeiro Formation. The basal two meters of this marl dominated unit contain small pyritous casts of representatives of NW european species of *Orthodactylites*: *D. (O.) crosbeyi* (SIMPSON), *D. (O.) clevelandicum* HOWARTH associated with *Protogrammoceras* (*Paltarpites*) sp. Their presence allow a tentative correlation with the Clevelandicum Horizon (or Subzone) of Britain and document the hypothesis that the absence of *Eodactylites* in many classic sections is due to a sedimentologic gap rather than to a palaeogeographic differential distribution. The same levels yield an abundant assemblage of belemnites, gastropods and brachiopods. These small faunas can be, partly, dwarf or miniaturized communities that have lived in an environment rich in organic matter and poorly oxygenated. Bioturbation is important (*Zoophycos* and ferruginous tubular burrows).

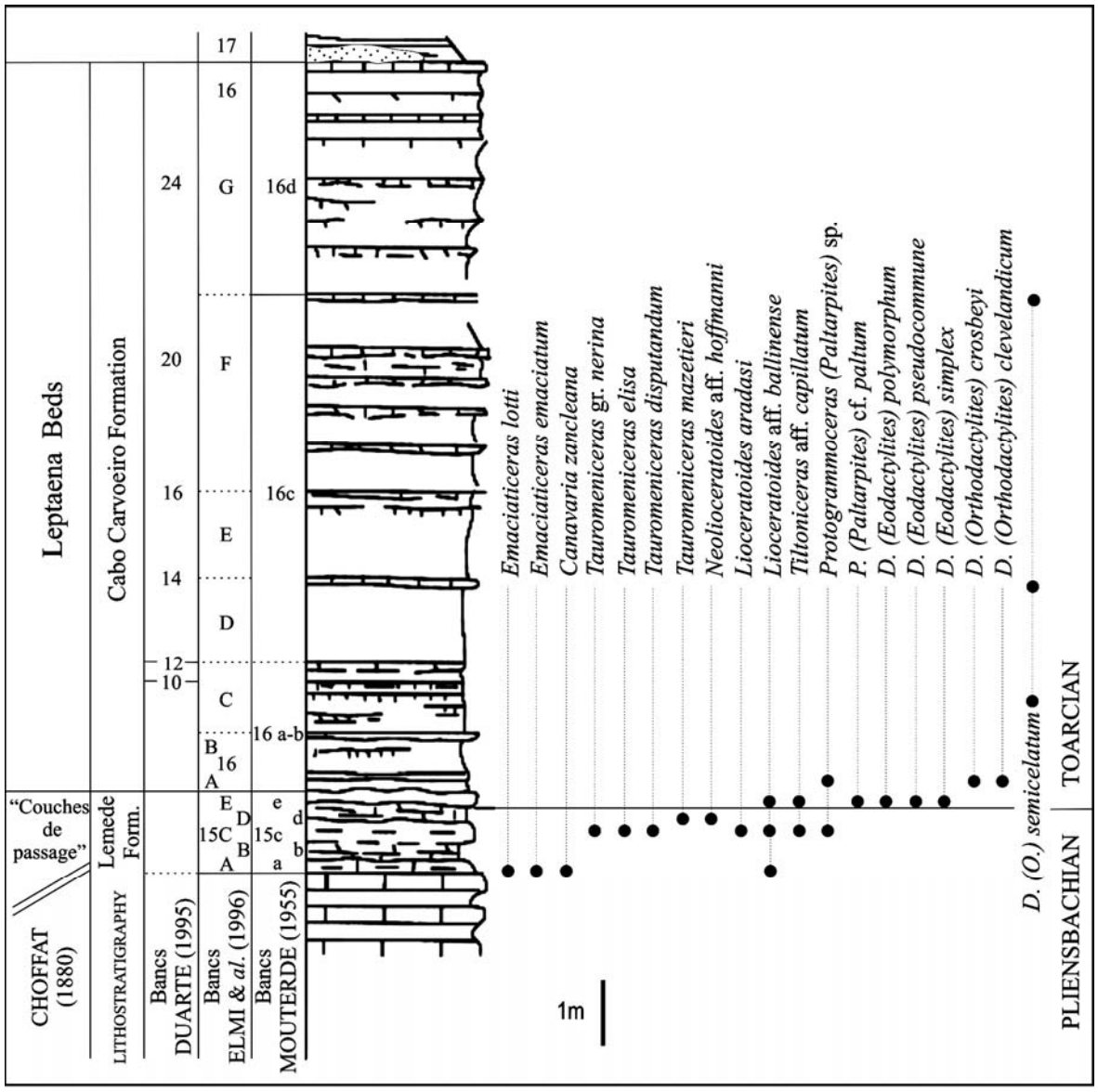

Fig. 6 – Geological section of the Pliensbachian/Toarcian boundary at Ponta do Trovão (Peniche) (after ELMI & *al*., 1996, modified).

The upper part of level 16 contains several fossiliferous beds yielding mainly *D. (O.) semicelatum* (SIMPSON). These ammonites can be disorderly disposed, probably as a result of bioturbation.

The Lower Toarcian microfaune

The microfauna of the Pliensbachian/Toarcian boundary at Peniche is very similar to the fauna found at other sites of Portugal (Sagres, Coimbra …). The assemblages here described were collected in April 1987 and come from levels 16a, 16b, 16c and 16d (*in* MOUTERDE, 1955).

The microfauna of levels 16a and 16b are clearly dominated by Domerian species. The assemblages consist of genera *Lenticulina* mg *Lenticulina*, rare morphogenera (mg) *Planularia* or *Marginulinopsis*, but the morphogenera *Falsopalmula* is present in very little number; it probably corresponds to a form gathered in other sites, not yet described in detail, but that was collected in the Polymorphum Zone: *Lenticulina preobonensis* mg *Planularia* (BOUDCHICHE & *al.,*1994). Numerous *Marginulina prima* d'ORBIGNY, *M. spinata* TERQUEM, *M. interrupta* TERQUEM, ornamented forms are found. In level 16b arenaceous forms are present, accompanied by smooth *Pseudoglandulina* and by *Pseudonodosaria multicostata* (BORNEMANN).

From level 16c upwards, a clear regression of the *Marginulina prima* group is noted. The only abundant forms are *Dentalina terquemi* d'ORBIGNY, *D. obscura* TERQUEM and *D. arbuscula* TERQUEM. In the *Lenticulina s. str*. group (meaning clearly coiled forms), a very clear difference is noted in relation to the Domerian forms; the umbilicus is higher, the keels are more acute and wider, the body chambers are more numerous. These forms remind those from the basal Toarcian that have been described in France, Spain and Morocco. Level 16d equally yields *L. preobonensis,* which confirms a

Lower Toarcian age (Polymorphum Zone). In these levels numerous Holothurian sclerites are present.

In conclusion, it can be said that from the upper part of level 16c Toarcian forms are already present, although no truly typical forms are recognized.

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Plate 1

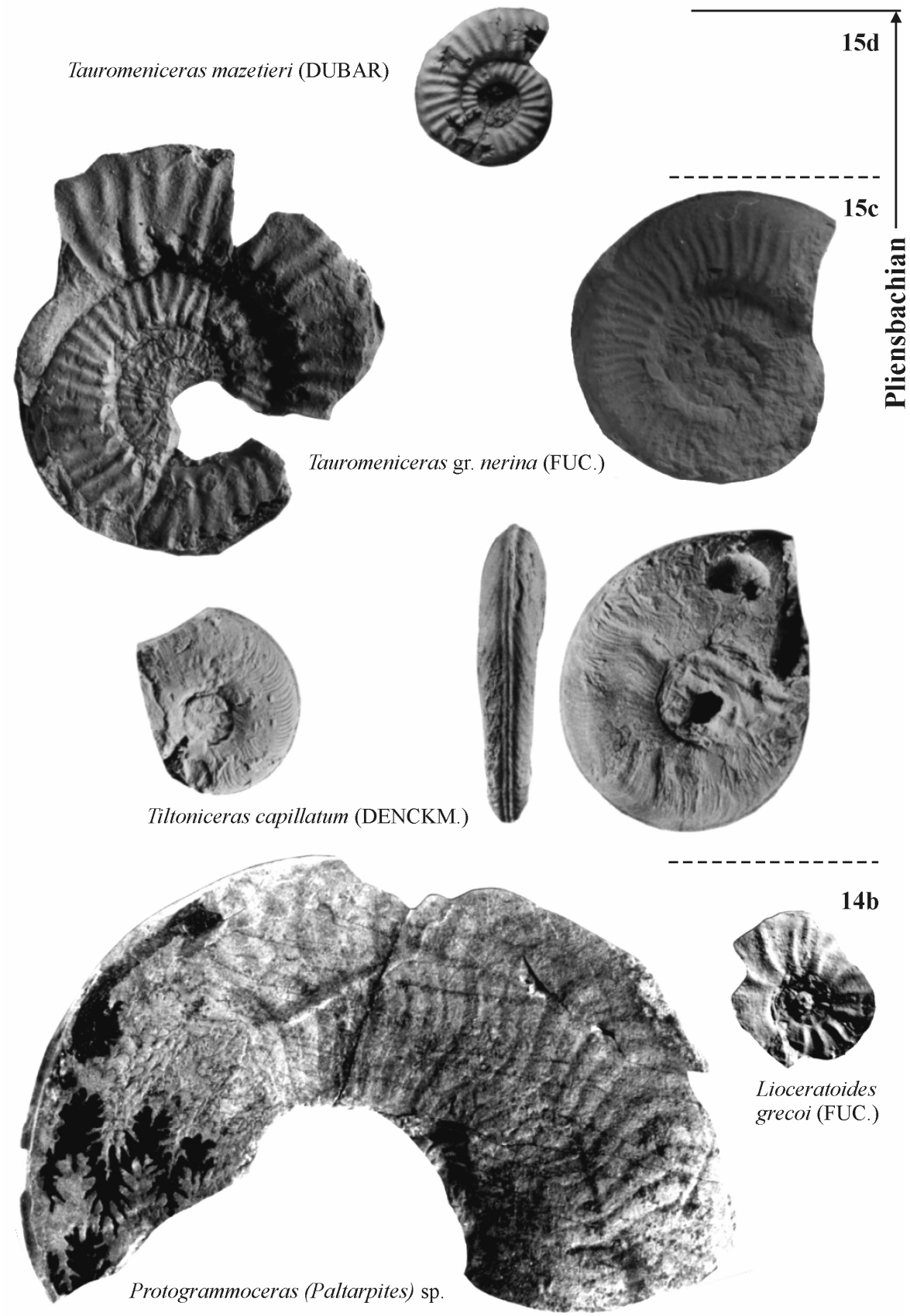

15d
15c
Pliensbachian
Tauromeniceras mazetieri (DUBAR)
Tauromeniceras gr. nerina (FUC.)
Tiltoniceras capillatum (DENCKM.)
14b
Lioceratoides grecoi (FUC.)
Protogrammoceras (Paltarpites) sp.

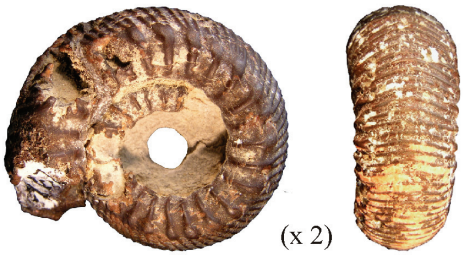
Plate 2

16b

(x 2)

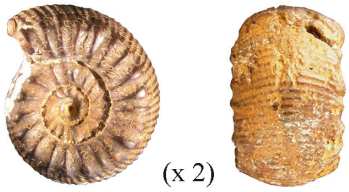
Dactylioceras (Orthodactylites) semicelatum (SIMPSON)

16a



(x 2)

D. (Orthodactylites) clevelandicum HOWARTH



(x 2)

D. (Orthodactylites) crosbeyi (SIMPSON)

15e

Tiltoniceras capillatum (DENCKM.)

D. (Eodactylites) simplex (FUC.)

Lioceratoides (?) sp.

Protogrammoceras (Paltarpites) cf. *paltum* (BUCK.)

Toarcian