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# Latest Toarcian-earliest Bajocian (Jurassic) Grammoceratinae (Hildoceratidae, Ammonitina) of the western Tethys: Their palaeobiogeographic and phylogenetic significance☆

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ABSTRACT

Grammoceratinae (Hildoceratidae, Ammonitina) abound in the Toarcian strata of many western Tethyan localities, especially the Subbetic and Lusitanian basins (of southern Spain and central western Portugal, respectively). They decline through the Aalenian and disappear by the lowermost Bajocian. The genera *Asthenoceras*, *Vacekia* (subgenera *Vacekia* and *Nadorites*) and *Fontannesia* are traditionally considered as the last Grammoceratinae, with species of *Osperleioceras* occurring in the uppermost Toarcian. Grammoceratinae are common in the eastern Pacific, especially Oregon and Alaska where *Asthenoceras* is abundant. They also occur in the eastern Tethys (Thailand). Although studies of Toarcian to early Bajocian Subbetic and Lusitanian grammoceratins already exist, new material from these and other palaeogeographic areas (England, Portugal and Spain) is revised here. A new genus, *Linaresites* nov. gen. (for *Fontannesia montillanensis* Linares and Sandoval) and two new species (*Vacekia striata* Henriques, and *Asthenoceras taverai* Sandoval) are described. Another form, "*Asthenoceras*" sp. A is described and let in open nomenclature. Temporal analysis of Aalenian to early Bajocian Grammoceratinae demonstrates a progressively more evolute morphology through time, sometimes coupled with size reduction. Palaeogeographic evidence suggests that during the early Middle Jurassic, western Tethys and eastern Pacific were temporarily well connected, possibly through the Hispanic Corridor, as demonstrated by the similarity between Tethyan and eastern Pacific Grammoceratinae.



## 1. Introduction

Grammoceratinae (Hildoceratidae, Ammonitina) abound in Toarcian rocks of many western Tethyan localities where they are primary biostratigraphic tools. They become progressively scarcer in the Aalenian and disappear in the Lower Bajocian. The genera *Asthenoceras* Buckman, 1889, *Vacekia* Buckman, 1899, *Fontannesia* Buckman, 1892 and *Nadorites* Elmi and Caloo-Fortier, 1985 (here considered synonymous of *Vacekia*) are traditionally cited among the latest Toarcian-earliest Bajocian Grammoceratinae. Additionally, "species" of *Osperleioceras* Krimholz and Tazikhin, 1957, occur in the late Toarcian. Linares and Sandoval (1988, 1992) presented detailed monographic studies on some of these taxa, figuring Subbetic ammonites included in the genera *Vacekia*, *Asthenoceras* and *Fontannesia*, all assigned by these authors to the Subfamily Grammoceratinae (Hildoceratidae, Ammonitina). Grammoceratinae are also abundant in the uppermost Toarcian-Aalenian interval of the Lusitanian basin. Henriques (1992) described three new "species" of Grammoceratinae from the region: *Vacekia striata*, *V. robusta*, *Asthenoceras vacekiformis* and one *Asthenoceras* sp.

Latest Toarcian to early Bajocian Grammoceratinae are known from other regions of western Tethys, e.g., England (Buckman, 1887–1907; Callomon and Chandler, 1990), Iberian Cordillera (Ureta, 1985; Fernández-López and Gómez, 1990; Goy and Ureta, 1990), Cantabrian Cordillera (Gómez et al., 2009), Mallorca (Goy and Ureta, 1988; Alvaro et al., 1989), Italy (Vacek, 1886), Morocco (Lelièvre, 1960; Sadki, 1984, 1990, 1994, 1996), and Algeria (Elmi and Caloo-Fortier, 1985). They are common in the eastern Pacific, especially in Oregon (Imlay, 1973, 1984) and Alaska (Westermann, 1969), and present in the eastern Tethys (Thailand; Kozai et al., 2010). Here, Subbetic and Lusitanian material studied by Linares and Sandoval (1988, 1992) and Henriques (1992, 2000a) is reviewed and new data from other palaeogeographic areas added.

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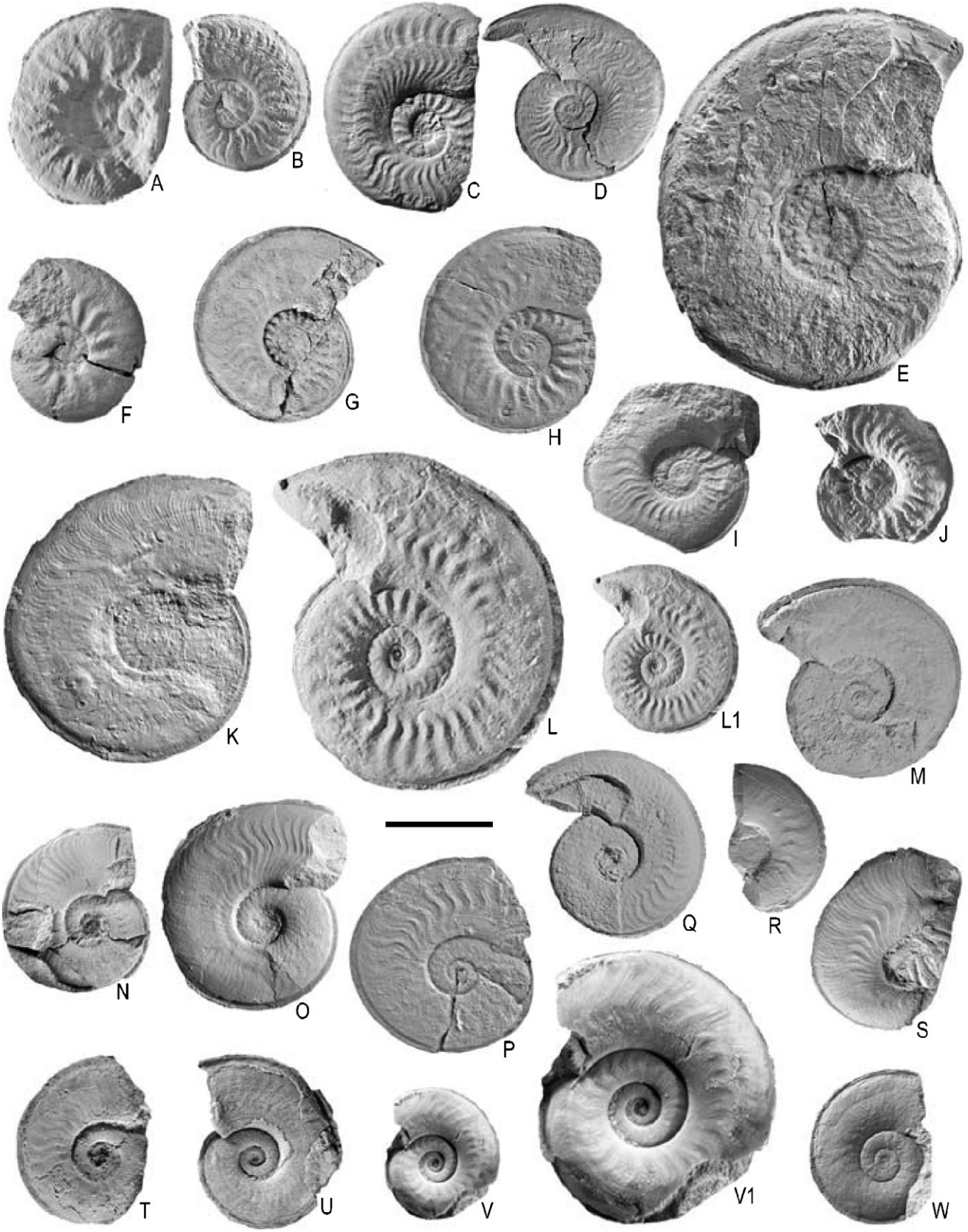


**Fig. 1. A–F**. *Vacekia sourensis* (Perrot, 1957): A, MP 1-3, Aalensis Zone, Mactra Subzone, Maria Pares, Lusitanian basin; B, M 33-28, Opalinum Zone, Comptum Subzone, Murtinheira, Lusitanian basin; C, D, CM.42.2 and CM.40.1, Aalensis Zone, Mactra Subzone, Cerro Méndez, Betic Cordillera; E, CM.69.3, Aalensis Zone, Buckmani Subzone, Cerro Méndez, Betic Cordillera; F, Rb16/3, Opalinum Subzone, Rabanera, Iberian Cordillera. **G–L1**. *Vacekia striata* nov. sp. Henriques: G, M 33-2 (holotype), H, M 33-4, L and L1, M33-5 (paratype), Opalinum Zone, Comptum Subzone, Murtinheira, Lusitanian basin; I, M25-1, Aalensis Zone and Subzone, Murtinheira, Lusitanian basin; J, SG 65-20, Opalinum Zone, Comptum Subzone, São Gião, Lusitanian basin; K, M31-7 (paratype), Opalinum Zone and Subzone, Murtinheira, Lusitanian basin. **M–T**. *Vacekia stephensi* Buckman, 1889: M, MP 100-1, Bradfordensis Zone, Maria Pares, Lusitanian basin; N, RA111-12, Bradfordensis Zone, Serra do Rabaçal, Lusitanian basin; O, SP.LR.6, Bradfordensis Zone?,