VOLUMINA JURASSICA, 2010, VIII: 177–182

On the Oxfordian/Kimmeridgian boundary and its GSSP – current state of knowledge

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An ample report presenting the current progress in recognition of the Global Stratotype Section and Point (GSSP) for the base of the Kimmeridgian Stage has been presented in the last issue of ISJS Newsletter (Wierzbowski, 2008). It should be remembered that the Flodigarry section at Staffin Bay in Skye, northern Scotland, has been accepted both by the Kimmeridgian Working Group, and the International Subcommission on Jurassic Stratigraphy as the primary standard for the Kimmeridgian Stage with its base located at the base of the Subboreal Baylei ammonite Zone. The only problem (and the most complicated one) which is still unresolved is which of the two ammonite horizons based on successive members of the genus *Pictonia* marks the base of the Baylei Zone: the *flodigarriensis* horizon or, lying directly above, the *densicostata* horizon (Fig. 1; see also Matyja *et al*., 2006; Wierzbowski *et al*., 2006 where the horizons and the section in question are described in detail).

New biostratigraphical data from other sections (cores from Barents Sea and Norwegian Sea, the Nordvik section of northern Siberia, the Unzha River section of the Kostroma District of Russian Platform) revealed a larger correlation potential for the base of the *flodigarriensis* horizon than the base of the *densicostata* horizon, and thus its larger significance in recognition of the base of the Kimmeridgian Stage in the Subboreal and Boreal areas of Arctic, as well as northern Europe and northern Asia (Wierzbowski, Smelror, 1993; Wierzbowski *et al*., 2002; Rogov, Wierzbowski, 2009; Głowniak *et al*., 2010). This preference results from good correlation between the base of the *flodigarriensis* horizon treated as the base of the Subboreal Baylei Zone, and the base of the Boreal Bauhini Zone – marked by appearance of ammonites of *Amoeboceras* (*Plasmatites*) group such as *A.* (*P.*) *praebauhini* (Salfeld) and *A.* (*P.*) *lineatum* (Quenstedt) (see Wierzbowski, 2008) which show a wide palaeogeographical distribution and are very useful in stratigraphical correlations. The recent study of the Subboreal aulacostephanids from southern England – *i.e.* their "home area" (Wright, 2010) – evidences the incompleteness of the succession at the boundary of the Oxfordian and Kimmeridgian in these sections, but indicates the presence of the *flodigarriensis* horizon in some basinal sections of the area, such as the Wessex Basin. Thus, the previously supposed local occurrence of an index ammonite – the *Pictonia flodigarriensis* of the *flodigarriensis* horizon in northern Scotland only – used as argument against wider recognition of the base of the *flodigarriensis* horizon as a uniform boundary of the Oxfordian/ Kimmeridgian boundary, is not substantiated.

The problem still not resolved is the correlation potential of the *flodigarriensis* horizon *versus* that of the *densicostata* horizon in recognition of the uniform Oxfordian/Kimmeridgian boundary in the Submediterranean/Mediterranean and other (*e.g.* Pacific) successions of the World. Nevertheless, general opinions related to wider recognition of the Oxfordian/Kimmeridgian boundary outside the Subboreal/Boreal successions can be given. The results of studies of Subboreal and Boreal ammonites occurring in the Submediterranean succession in Europe (especially in Poland and

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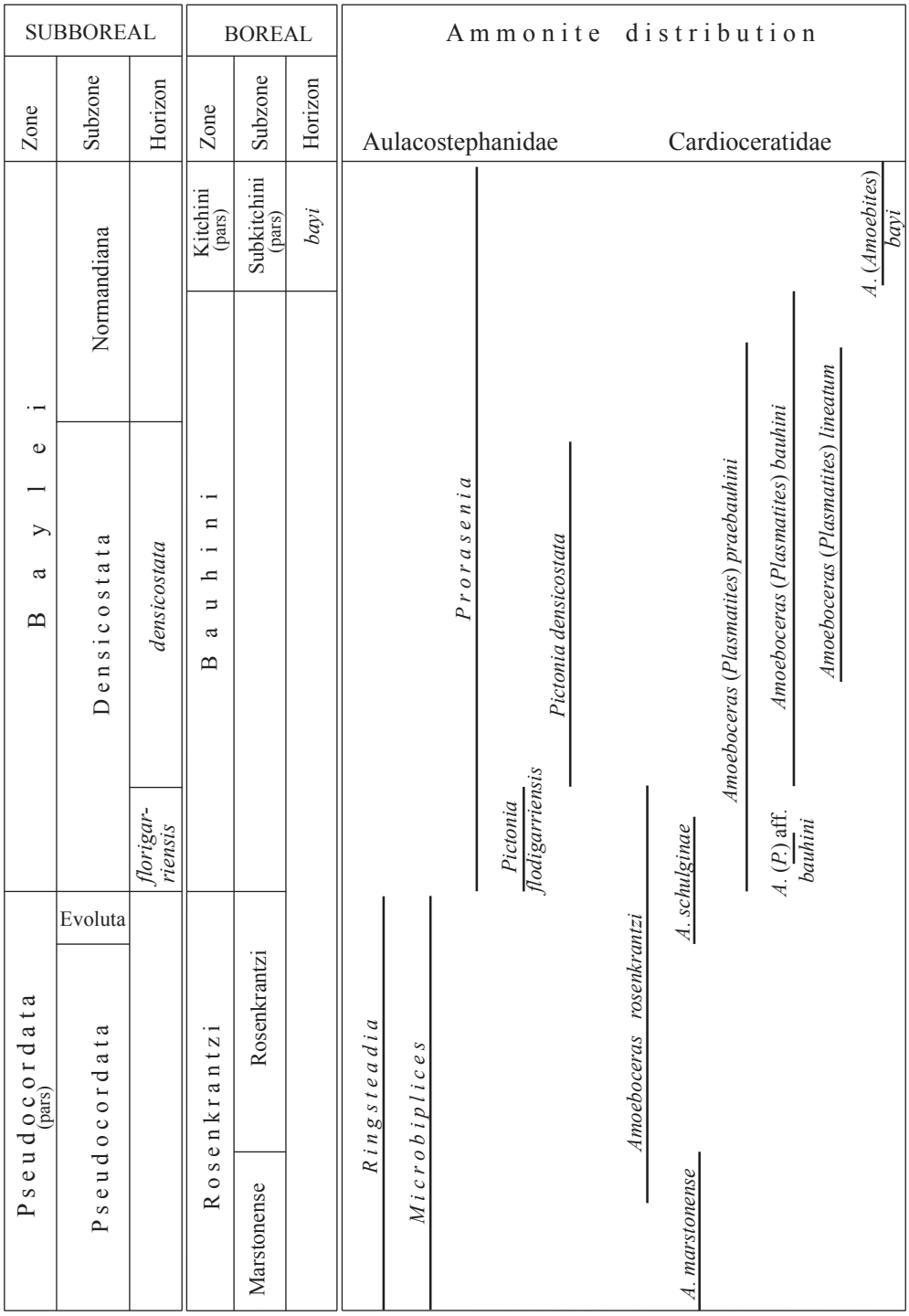

Fig. 1. Distribution of Subboreal and Boreal ammonites in the Staffin Bay Section, Skye (after Matyja *et al.*, 2006, simplified), and chronostratigraphical correlation of the Subboreal and Boreal ammonite ranges at the Oxfordian/Kimmeridgian boundary

southern Germany) suggest the following correlations of the potential Oxfordian/Kimmeridgian boundary between Subboreal/Boreal and Submediterranean zonal schemes (Fig. 2 and references given in its explanation; see also Wierzbowski, 2008; Głowniak *et al*., 2010; Wierzbowski *et al.*, 2010):

– if the base of the Baylei Zone is placed at the base of the *flodigarriensis* horizon, it will correspond to some lower part of the Bimammatum Subzone;
– if the base of the Baylei Zone is placed at the base of the *densicostata* horizon, it will correlate with some lower part of the Hauffianum Subzone, or upper part of the Bimammatum Subzone.

The problem can be solved in an unequivocal way only if one can prove which of the two Submediterranean levels has a wider correlation potential, and thus may be treated as a more convenient for the recognition of the Oxfordian/Kimmeridgian boundary: that close to the base of the Bimammatum Subzone, or that near the boundary of the Bimammatum and Hauffianum subzones. In my opinion the materials gathered so far are rather in favour of the former solution. Current results of palaeomagnetic studies seem to indicate that the base of the *flodgarriensis* horizon and lower to middle parts of the Bimammatum Subzone are to be correlated as placed close to the coeval magnetozone boundary (Przybylski *et al*., 2010; but note that some additional studies in the Flodigarry section should be undertaken to solve in detail the problem – M. Hounslow, personal commun.).

On the other hand, according to results from recent ammonite studies in Submediterranean/Mediterranean sections, the lower boundary of the Bimammatum Subzone, *i.e*. the boundary with underlying Hypselum Subzone, seems to be founded on more diversified ammonite assemblage having a larger correlation potential than that at the boundary of the Bimammatum and Hauffianum subzones. Of special importance for wider correlation is *e.g.* a change in the aspidoceratid fauna close to the boundary of the Hypselum (Semiarmatum) Subzone/Zone and the Bimammatum Subzone/Zone (see *e.g*. Oloriz *et al.*, 1999; and more recently Bonnot *et al*., 2009; Wierzbowski *et al.*, 2010). The assemblage of aspidoceratids

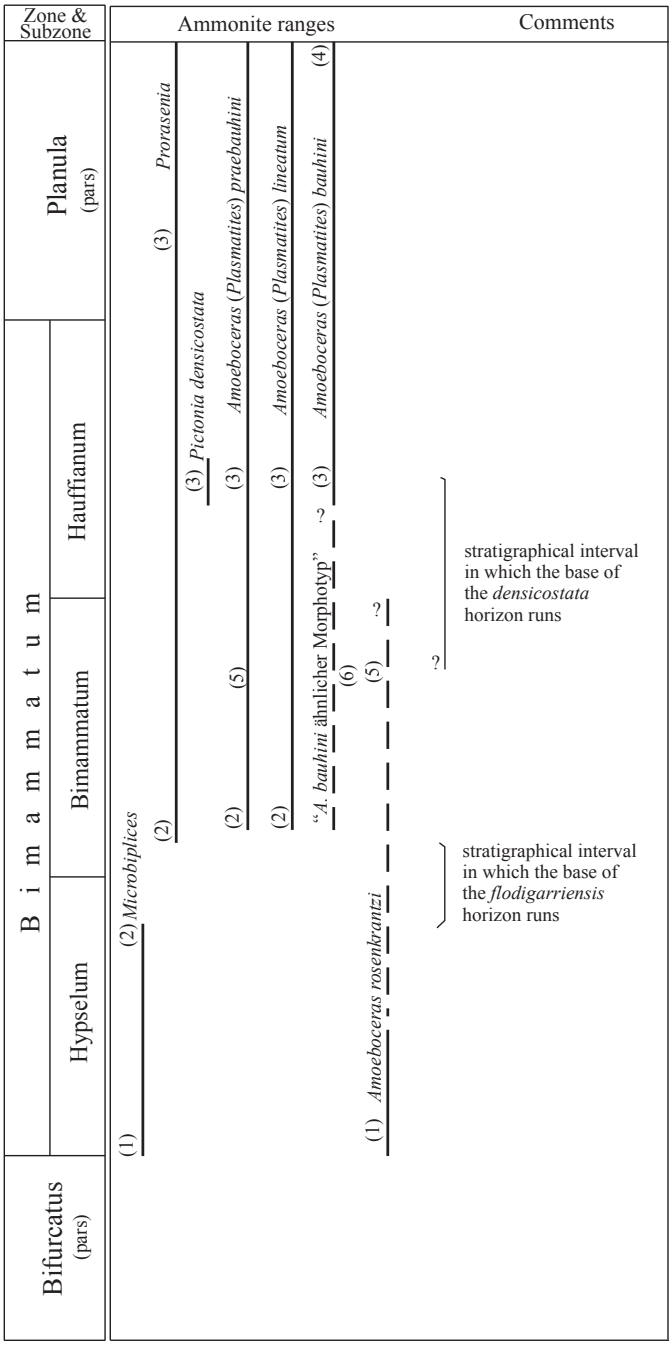

Fig. 2. Distribution of ammonites of the Subboreal/Boreal affinity in the Submediterranean succession and approximate position of the Oxfordian/Kimmeridgian boundary as based on *Pictonia* ammonite horizons

Ammonite ranges after: (1) Matyja, Wierzbowski (1994); (2) Matyja, Wierzbowski (1998); (3) Matyja, Wierzbowski (1997); (4) Matyja, Wierzbowski (2002); (5) Schweigert (2000); (6) Schweigert, Callomon (1997)

typical of the Hypselum Subzone/Zone represented by numerous *Euaspidoceras* is successively replaced in the upper part of the subzone by a new assemblage of *Clambites*, and then in the Bimammatum Subzone by *Aspidoceras* and *Physodoceras*. Although the detailed palaeontological and stratigraphical study of these ammonites in the crucial interval still needs further efforts, the results obtained so far are important for wider correlations. We need, however, new sections documenting in detail the ammonite succession from the Hypselum to Bimammatum subzones/zones in the Submediterranean/Mediterranean areas such as southern Spain, southern France, Italy or Romania.

The necessity of such studies reveals the recent stratigraphical research on Spiti Shales in Nepal by Enay (2009) who recognized: "the endemic character of Indo-SW Pacific forms (which) reduces possibilities for correlation and dating referring to the zonal standard scale established for Mediterranean Tethys and adjacent areas" (*op. cit*., p. 14). It should be remembered, however, that the forms in common with Submediterranean/Mediterranean areas, appearing there (see Enay, 2009) are mostly aspidoceratids such as *Euaspidoceras*, *Clambites*, *Aspidoceras*, *Pseudowaagenia* and *Physodoceras*...

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