Towards a refined ammonite and inoceramid biostratigraphy of the Turonian–Coniacian stage boundary in the Vocontian and northern Aquitaine basins of France (Cretaceous; western Tethys)

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Ammonites and inoceramid bivalves are the biostratigraphically most important fossil groups for subdivision and correlation of the Turonian and Coniacian stages. The first occurrence (FO) of the ammonite *Forresteria (Harleites) petrocoriensis* (Coquand, 1859) has traditionally been taken as marking the base of the Coniacian. The Coniacian Working Group of the Cretaceous Subcommission on Stratigraphy recommended the FO of the inoceramid bivalve *Cremnoceramus rotundatus* (now known as *C. deformis erectus* (Meek, 1877)) as the criterion for recognizing the Turonian–Coniacian (T–C) boundary (Kauffman *et al.* 1996). However, in recent years it has become clear that the FO of this species lies well above the FO of *F. (H.) petrocoriensis* (Kennedy & Walaszczyk 2004). This has lead to an upward shift of the stage boundary and much of the previous lower Coniacian is consequently now included in the upper Turonian. The Salzgitter-Salder quarry in Lower Saxony, Germany, has been cited as a potential Global Boundary Stratotype Section and Point (GSSP) (Wood *et al.* 1984, Kauffman *et al.* 1996), partly because of its rich fossil content. The advent of event stratigraphy (e.g. Ernst *et al.* 1983, Wiese *et al.* 2004) enabled the recognition of more than ten eco-, bio-, litho- and tephro-events across the T–C boundary. However, recent work suggested that the Salzgitter-Salder section is incomplete (Sikora *et al.* 2004), and so it will not be recommended as a stratotype (I. Premoli Silva, Milano, personal communication 2007) although a proposal was nearing publication. The Pueblo section in Colorado, USA appears to be a better candidate.

There is currently a gap in the "standard" ammonite zonation at the base of the Coniacian, and the occurrence of *F. (H.) petrocoriensis* at much lower levels than previously known indicates that our knowledge of the ammonite succession around the T–C boundary is insufficient. The lack of agreement on defining the stage boundary and the difficulties to find a suitable GSSP is symptomatic of the poor stratigraphic control of previous studies. The FOs of critical inoceramid and ammonite species may even be diachronous from one place of the earth to another, as suggested by Wiese (1999) and Sikora *et al.* (2004).

A reinvestigation of critical sections in the French upper Turonian to “lower Coniacian” has yielded new ammonite and inoceramid material. Detailed field work in northern Aquitaine (Le Toulon and La Rouquette formations), including the type locality of *F. (H.) petrocoriensis*, as well as classical and new localities, was conducted in order to log the entire succession and collect ammonites and inoceramids bed-by-bed to establish their relative occurrence. Ammonites occur in sufficient numbers for biostratigraphic purposes, with rare inoceramids previously unknown from this area. The underlying Turonian is developed in rudist facies and has not yielded ammonites or inoceramids so far.

Other important sections are found in the Vocontian Basin. In the vicinity of Montélimar (Drôme), a section previously studied by Sornay (1950) and Moullade *in* Middlemiss & Moullade (1968) has yielded an upper Turonian ammonite fauna with *Parapuzosia (Austiniceras)* sp., undeterminate pachydiscids (possibly *Tongoboryceras* and *Lewesiceras*), *Prionocyclus* aff. *germari*, *Barroisiceras* sp., *Scaphites geinitzi* and *Hyphantoceras* sp. together with common inoceramids of the genus *Mytiloides*. Systematic description of the fauna is in progress and indicates the presence in France of the *Prionocyclus germari* Zone (introduced by Kaplan & Kennedy 1996 for northern Germany). On the basis of this new collection, the occurrence of the biostratigraphically important genus *Barroisiceras* is confirmed, which will facilitate correlations with, for example, Brazil, Madagascar, Japan and Austria. In the latter area, *Barroisiceras* occurs associated with *Didymotis* (Summesberger & Kennedy 1996), an inoceramid showing several abundance peaks in the uppermost Turonian *Mytiloides scupini* and *Cremnoceramus waltersdorfensis* zones (*Didymotis* events 0, I and II), which approximately equate the *P. germari* Zone.

Thus, preliminary results enable a refinement of the upper Turonian zonation used in France through the recognition of the *Prionocyclus germari* Zone. The presence of previously undescribed inoceramids associated with two successive assemblages with Barroisiceratinae suggests the possibility of an integration of ammonite data with the "standard" inoceramid biostratigraphy currently used for the T-C boundary, as well as pinpointing this stage boundary as currently conceived for the first time in France.

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