Russian GSSP Candidate Sections for the Jurassic System

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Abstract During the last decade, three Russian sections have been proposed as global stratotype section and point (GSSP) candidates for the Callovian, Oxfordian, and Tithonian Stages. A comparison of these sections with other GSSP candidate sections in relation to their fulfilment of GSSP requirements has revealed that in some respects the Russian sections are better studied. The Kimmeridgian–Tithonian (Volgian) boundary transition is especially fully investigated at the Gorodischi section, which could be used as the GSSP for the Tithonian Stage and as a secondary stratotype section and point (SSSP) for the Volgian Stage.

Keywords Russia · GSSP · Callovian · Oxfordian · Tithonian

Introduction

The Jurassic System is one of the most fully investigated systems in the whole of the Phanerozoic, but the selection of the five GSSP events and/or localities for the five remaining stages remains an important task. The Russian Platform is characterized by the wide distribution of uppermost Bathonian to Volgian deposits, and some easily accessible sections are known to represent complete successions across the stage boundaries.

Callovian Stage

The first appearance datum (FAD) of the Sub-Boreal ammonite *Kepplerites keppleri* as a key event for the identification of the base of the Callovian Stage has been accepted since 1990 (cf. Callomon and Dietl 2000). There are two

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Fig. 1 Locations of Russian GSSP candidates

well-studied candidate sections for the Callovian GSSP, but both are characterized by problems. The German GSSP candidate (Albstadt-Pfeffingen) provides a very good ammonite succession, as well as microfossil characteristics, stable isotope data derived from belemnite rostra, and a partially published succession of palaeomagnetic reversals (Callomon and Dietl 2000; Beher et al. 2010; Franz and Knott 2012). However, the section is strongly condensed, and the total thickness of the upper Bathonian and the lowermost Callovian there slightly exceeds 1 m. It should be noted also that this section has not been sampled for microfossils in the upper zone of the Bathonian.

The Russian GSSP candidate for the Callovian Stage is located near Prosek (Nizhny Novgorod area; Fig. 1), and its thickness exceeds 13 m. This section is well characterized by ammonites (Kiselev and Rogov 2007), including Boreal cardioceratids, Sub-Boreal kosmoceratids, and Mediterranean macrocephalitids, all of which are found close to the Bathonian–Callovian boundary. Unfortunately, microfossils as well as any shells are missing here (except those preserved in concretions) due to taphonomic factors, and ammonites occur mainly as crushed moulds. This section has also been carefully studied in terms of sedimentology and palaeomagnetics (Guzhikov et al. 2010). Unfortunately, neither the German nor the Russian candidate section fully meets GSSP requirements.

Oxfordian Stage

As for the base of the Callovian, the boundary event for the base of the Oxfordian Stage (the FAD of *Cardioceras*) is well defined, whereas the type section has still not been chosen. At the Redcliff Point (UK) candidate section, the ammonite succession has been studied in detail (Page et al. 2009b). The distribution of microfossils in that section was briefly mentioned without the recognition of zones (Page et al. 2009a). The succession of palaeomagnetic reversals from the section (Ogg et al. 2010) shows numerous polarity oscillations, but nearly all such reversals are based on only one or two samples. The French candidate section near

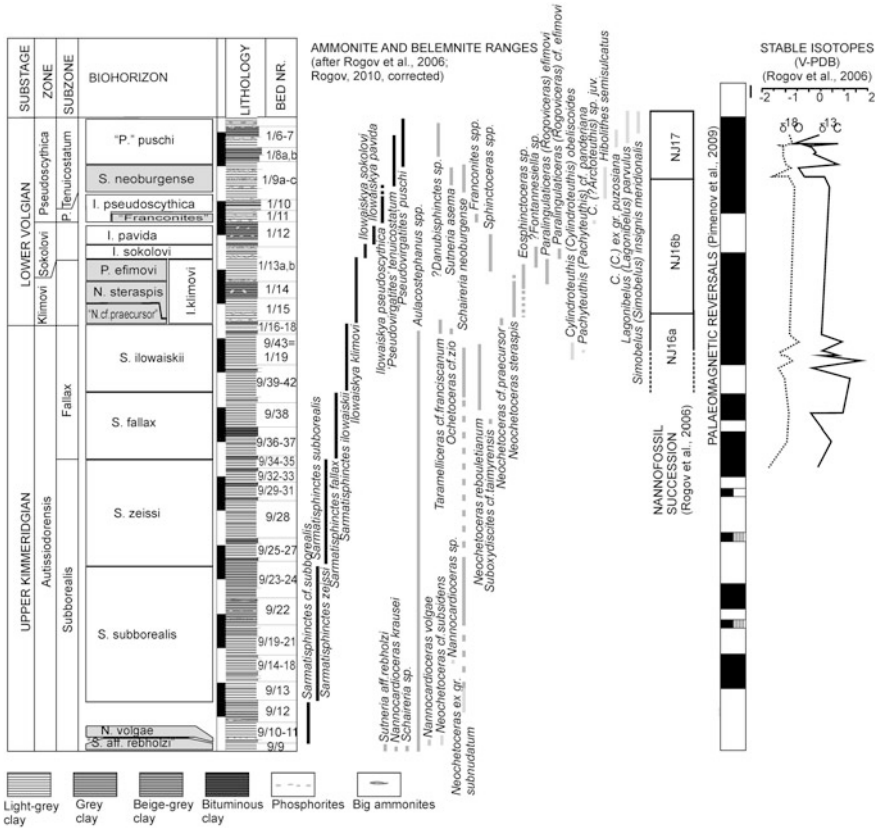

Fig. 2 The Gorodischi section: a candidate for the Tithonian GSSP and Volgian SSSP

Thuoux has been recently described (Fortwengler et al. 2012). The Callovian–Oxfordian transitional beds there also contain numerous ammonites and attain significant thickness, but the use of other markers apart from ammonites is restricted. It should also be noted that in the section, the boundary is drawn at the base of the *thuouxensis* horizon, which cannot be traced outside of France and whose base does not coincide with changes in the cardioceratid succession.

We are proposing the Dubki section (Saratov region; Fig. 1) as the Oxfordian GSSP candidate (Kiselev et al. 2013). This section is well characterized by ammonites and it is the only GSSP candidate in which zones established on the basis of foraminifers and ostracods are also recognized. This section, as well as the Redcliff Point section, also has palaeomagnetic characteristics and stable isotope data derived from molluscan shells.

Tithonian (Volgian) Stage

The position of the Tithonian Stage boundary still remains unclear, as there is no agreement concerning either the key events or the sections. Candidate sections mentioned by Ogg et al. (2012) are not described in detail, and their possible applicability is questionable. Recently, two Sub-Boreal sections have been proposed as GSSP candidates for this stage: the Gorodischi section in the Volga area, Russia (Rogov et al. 2006; Pimenov et al. 2009; Rogov 2010; Fig. 1) and Kimmeridge Bay, UK (Gallois 2011). In both of those sections, an abrupt extinction of aulacostephanid ammonites could be considered as a primary boundary marker, providing boundary traceability for the Sub-Mediterranean successions. In the Kimmeridge Bay section, only ammonites have been partially studied, and other possible boundary markers are not yet recognized.

The Gorodischi section could also be proposed as an SSSP (Cope 1996) for the Volgian Stage. The section has been studied in detail over the last decade (Fig. 2). This section provides a full succession of ammonite biohorizons across the Kimmeridgian–Volgian boundary (Rogov 2010), and is characterized by ammonites of different palaeobiogeographical affinities, providing direct correlation with both Sub-Mediterranean and Boreal zonal successions. In addition to ammonites, this section is rich in other molluscs and microfossils.

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