



Santonian Working Group

Subcommission on Cretaceous Stratigraphy, International Commission on Stratigraphy-
International Union of Geological Sciences (IUGS)

Chairman: Marcos A. Lamolda

Report on postal ballot about selection of a candidate as GSSP for the basal Santonian Stage

Dear colleagues,

November 12th 2007 was the dead-line for voting between the two candidates for the Santonian GSSP: Olazagutia and Ten Mile Creek.

The report of this chairman about it was sent to 48 persons:

E.O. Amon, J.A. Arz, H. Bailey, J.P. Bellier, P. Bengtson, V. Beniamovskii, M. Bilotte, Ch. Colom, M. Floquet, A. Gale, L.T. Gallagher, J. Gallemí, R. Gambashidze, S. Gardin, D. Gaspard, K.W. Graefe, J. Haggart, M. Hampton, T. Hasegawa, J. Ion, J. Jagt, C. Johnson, E. Kauffman, J. Kennedy, L. Kopaevich, M.A. Lamolda, J. Lees, G. López, R. Martínez, M.C. Melinte, S. Monechi, R. Mortimore, Ch. Neumann, Ch. Paul, D. Peryt, M.R. Petrizzo, J.M. Pons, I. Premoli Silva, F. Robaszynski, J. Schoenfel, P. Sikora, H. Summesberger, S. Tshimitsu, M. Wagreich, I. Walaszczyk, Ch. Wood, E. Jagt-Yazykova, V.A. Zakharov.

According to ICS statutes (point 9.3. – see www.stratigraphy.org/status.htm) we have chosen between the two candidates for the Santonian GSSP.

A total of 35 persons returned ballot-paper on time (underlined), and another two later than the dead-line (dotted underlined). Therefore, 35 valid votes have been received, which are about 73% of all possible votes.

Results

Olazagutia: 24 favorable votes

Ten Mile Creek: 6 favorable votes

Abstain: 4 votes

Negative votes for both candidates: 1 vote

The Olazagutia section received 24 votes, which is around 68% of valid delivered votes (60% minimum for a valid approval), and the amount of valid delivered votes (35) is around 73% of 48 possible votes (60% minimum for a quorum).

Thereby, the Olazagutia section has been approved as GSSP for the base Santonian by the Santonian Working Group.

A few persons produced some comment on my report and enclosed them with their respective ballot-paper. Three other comments were sent later than the dead-line.

Except for some obvious errata, comments are reproduced literally.

Dr. Haidon Bailey's comment:

“It is obvious from the data available for both sections under discussion that neither is ideal as the GSSP for the base of the Santonian.

My vote for Ten Mile Creek is purely based on the fact that this section appears to be the better of the two.

My personal preferences would be:

i) delay the vote until additional work on Ten Mile Creek is done or

ii) find an alternative site altogether.

Sorry to be so negative, but I don't see the necessity to be forced into a vote at this stage.”

Dr. Matthew Hampton's comments:

“My preference would be to postpone the vote on the candidates for the Santonian GSSP. There are still issues outstanding regarding the suitability of both sections as a GSSP which need resolving before a decision can take place.”

Dr. Jana Ion's comment:

"In Romania, in the Carpathian domain (with the continuous succession from Coniacian to Santonian) no macrofauna has been known for to mark the Coniacian-Santonian boundary. But across the successions from Coniacian to Santonian have been identified the following successive bioevents (Ion, Antonescu, Melinte, Szasz, 1997, 1998, 1999): FO of *Lucianorhabdus cayeuxii* – FO of *Globotruncana bulloides* – FO of *Calculites obscurus* and FO of the "pillow-box-like" morphotype of *Globotruncana linneiana*.

According to the Olazagutia section/data, in Romania the Coniacian-Santonian boundary: - in planktonic foraminifera terms (Ion) is located by the FO of the "pillow-box-like" morphotype of *G. linneiana*, as proxy marker; - in calcareous nannofossil term (Melinte) it falls into the *L. cayeuxii* Zone (CC 16).

It is to note that in Romania:

- the FO of *Dicarinella asymetrica* (In Carpathians and North Dobrogea) is associate with the first levels with the fauna belonging to the *Peroniceras tridorsatum* Zone and / or the *Inoceramus mantelli* Ass. Zone (Szasz & Ion 1998; Ion & Szasz 1994; Ion et al. 1997, 1998, 1999), Middle Coniacian.
- *Sigalia carpatica* is very rarely, practically it not exist for a biostratigraphy.
- The Coniacian-Santonian boundary falls into the *D. asymetrica* Zone and into the *G. bulloides* SZ respectively (Ion in op. cited)"

Dr. Jackie Lees' comments:

"Although this (Ten Mile Creek) would be a useful 2° reference section.

But note that the nannos *C. obscurus* and *L. cayeuxii* are not reliable markers in relation to this boundary and should not be advertised as such."

Dr. Mihaela C. Melinte's comment:

"I consider that the proposed section of Olazagutia (N Spain) contains all the important biostratigraphic markers recommended by the Santonian Working Group, for pointing out the Santonian GSSP. It is also a continuous section, not disturb tectonically point of view. It is accessible and could be well preserved. By contrast, the Ten Mile Creek section is a composite section, made by 4 to 6 partial sections. I think to select a composite section for a GSSP is not suitable for any stratigraphic point of view. Additionally, structural complication are present in some of the partial sections of the Ten Mile Creek. Only one of the primary markers proposed by the GSSP was recognized in the Ten Mile Creek.

Taking in account these facts, I agree that the Olazagutia section could be selected as a Santonian GSSP."

Dr. Seiichi Toshimitsu's comments:

"I think the Olazagutia section is a good one for a candidate of the GSSP section of the Santonian, but I want to abstain from the vote at this time. The reason is that the primary marker (*Inoceramus undulaticus*) and the secondary marker (*Sigalia carpatica*) do not occur from Japan and adjacent areas (NW Pacific realm), and so I cannot exactly commentate this problem now. So, if the formal GSSP section of the Santonian recommended by the Santonian Working Group will be adopted, we will be able to refer this section to our Japanese sections by means of not only fossil markers but also other tools for example isotope stratigraphy, in future research. I think, however, that we need a reference section in the northern Pacific realm for a short while, as we do not have firm markers above-mentioned and recommended by the Subcommission on Cretaceous Stratigraphy in the Japanese and Russian Far East sections, under the existing circumstances."

Comments sent later that dead-line

Dr. Ramaz Gambashidze's comments (mailed on November 16th):

"Biostratigraphic subdivision. The great number of inocerams and expensive in stratigraphical opinion representatives of cephalopods allow to establish in the Santonian sequence of Georgia the stratigraphical subdivisions local and common character. In the lower Santonian are established:

1. Strata with *Inoceramus undulaticus*. The faunistic complex consist with *Inoceramus branchoi* Wegener, *In. decipiens* Zittel, *In. undulaticus michaeli* Heinz, *Micraster rostratus* Mantell, *Nowakites savini* (Groussouvre).

2. Strata with *Inoceramus cordiformis* with *Inoceramus subquadratus* Schlueter, *In. crassus* Petrascheck, *In. subsarumensis* Renngarten, *Gaudryceras varagurense* Kossmat, *G. mite* (Hauer), *Puzosia denisoniana* Stolicka.

The mentioned ammonites foresee their stratigraphical position in the uninterrupted sequence definite the Lower Santonian age of observed strata.”

Mr. Christopher Wood's comments (after his e-mail dated on Saturday November 17th, Haydon Bailey, Andy Gale, Jim Haggart, Jim Kennedy, Rory Mortimore and Irek Walaszczyk wish to append their names to it).

“Observations on the two candidate GSSP sections

I have visited the Cantera de Margas section, Olazagutia on at least two occasions, the most recent being at the time of the Bilbao conference. I visited the section previously with Gundolf Ernst's Berlin Cretaceous Working Group, and more recently worked with one of his research students, Thomas K uchler, in preparing a paper on it and nearby Spanish sections that was published in 2002 in the Proceedings Volume of the 6th International Cretaceous Symposium, Vienna 2000. I therefore feel that I am in a position to comment on the suitability of this section as a candidate Santonian GSSP in the context of macrofossil biostratigraphy. I have never visited Ten Mile Creek, but I have discussed this section with several workers who know it well.

Use of macrofossils in defining the base of the Santonian Stage

The only macrofossils that are of any international correlative use in defining the base of the Santonian are inoceramid bivalves and ammonites. The primary marker is the FO of the inoceramid *Cladoceramus undulatoplicatus*, which appears suddenly, replacing the *Magadiceramus*-dominated inoceramid assemblage of the Upper Coniacian. In more boreal regions, notably in northern Europe and Russia, the topmost Coniacian is marked by a thin zone characterized by the occurrence and entry of the genus *Sphenoceramus* (the so-called *Sphenoceramus* Teilzone); this genus then forms a significant component of the Santonian and basal Campanian inoceramid assemblages.

An ideal Santonian GSSP section would be one in which the *Magadiceramus* and *Cladoceramus* records are well represented, together with the terminal Coniacian *Sphenoceramus* Teilzone and the sequence of *Sphenoceramus* taxa in the Santonian part of the succession. Such a section should also have a good ammonite record across the boundary interval.

So far as I know, the only successions that fulfil all these criteria are some of those in north German mineshafts (see Kennedy and Kaplan, 2000 for details and relevant references). Needless to say, the macrofossil material from these shafts is only approximately horizoned, and additional material could not be collected. These mineshaft successions cannot therefore be considered as candidate Santonian GSSP sections.

The macrofossil record in the Wal-Mart section on Ten Mile Creek

In this section (see Gale *et al.*, 2007) there is a *Magadiceramus* record (involving several taxa) over 17.5 m, with the highest occurrence only 0.4 m below the entry of *Cladoceramus*. Some additional Upper Coniacian inoceramid taxa appear just below this datum, and several specifically Santonian taxa, including *Platyceramus cycloides*, appear only 3 to 4 m above the datum. This locality is south of the geographical range of *Sphenoceramus* and therefore the key *Sphenoceramus* Teilzone is not represented. The FO of the ammonite *Texanites gallicus* in this section is located 2.4 m below the entry of *Cladoceramus*; this taxon ranges across the boundary, with its LO 3.7 m above.

The macrofossil record in the Cantera de Margas east face section, Olazagutia

In this section (see Gallemi *et al.*, 2007), the only really abundant fossils across the boundary interval are echinoids of regional but no international biostratigraphical significance. There are some lower Lower Coniacian inoceramid records, including what appear to be *Cremnoceramus deformis erectus* [the primary marker for the base of the Coniacian] and *C. waltersdorfensis hannovrensis* near the base of the section, c. 94 m below the entry of *Cladoceramus*. The only horizoned *Magadiceramus* records (incomplete, poorly preserved and specifically unidentifiable specimens) are c. 30 m below the entry of *Cladoceramus*. There is, admittedly, a good inoceramid record in the Santonian part of the section, including several biostratigraphically significant taxa in addition to *Cladoceramus*. However, with the exception of a record of *Platyceramus cycloides* c. 5 m above the boundary and within the range of *Cladoceramus*, these latter taxa

do not appear until some 25 m above the highest *Cladoceramus* record. There are no horizoned Coniacian ammonite records whatsoever. Apart from a record of the long-ranging *Tetragonites epigonus* from 1 metre above the FO of *Cladoceramus* in the now disappeared west face (Küchler 2000, fig. 2 and p. 320), the lowest, very limited and biostratigraphically not particularly significant, Santonian ammonite record in the east face starts 33 m above the datum.

In fact, it is worth considering the following comments in one of the most recently published papers on the Cantera de Margas section (Gallemi *et al.*, 2007, pp. 6, 7):

... “with fresh outcrops, conditions for extensive macrofossil sampling are not ideal [my italics], but they are good for microfossil and stable-isotope sampling.”

... “Inoceramids are rare below the boundary and abundant above it, while echinoids are abundant throughout the section to such an extent that they contribute to the lithological characteristics of the rocks.”

... “Ammonites are very rare; moreover, the few specimens collected come from far above the boundary.”

Finally, it should be emphasized that much of the earlier detailed macrofossil biostratigraphical work, including the identification of several fossiliferous horizons within the Santonian part of the succession, was by the Berlin Cretaceous Working Group in the 1980s on a continuous section on the west side of the quarry, which is no longer available as a result of quarrying activity. The Santonian ammonite record from this face, notably from high above the base of the Santonian, was much more extensive than that from the east face. There are significant differences in the *Cladoceramus* records from both sections, in that neither a higher *Cladoceramus* event horizon identified in the west face nor the level of the reported LO of the genus in this face has subsequently been recognized in the candidate east face section (see Küchler 2002, fig. 2, pp. 318–321 for details and relevant references).

Conclusions

It is clear that, purely on a macrofossil basis, the Cantera de Margas east face section, Olazagutia is unsuitable as a candidate GSSP section. In any case, the preserved candidate east face, with its metal markers, is not available for the bed-by-bed collection of biostratigraphically significant macrofossils such as inoceramid bivalves and ammonites. It is not even certain whether these metal markers will remain attached to the face on a long-term basis. There is undoubtedly a good foraminiferal and nannofloral record, but it is difficult to relate the sample horizons in the published skeletal logs to the detailed log with the stable isotope sample horizons (Lamolda and Paul, 2007, fig. 2). Incidentally, this graphic log implies that the lithostratigraphy is readily recognisable in the face, which is not the case as I remember it. Some idea of the relatively poorly exposed nature of this face can be seen in the photograph fig. 4B in Gallemi *et al.* (2007). In fact, the quarry road visible in the photograph interrupts the Upper Coniacian part of the succession at about the level which has yielded the only horizoned *Magadiceramus*.

Apart from its excellent macrofossil (and foraminiferal and nannofloral) record and good exposure, the Wal-Mart section on Ten Mile Creek has the added advantage of a conspicuous cyclostratigraphy that readily enables location within the section. In contrast to the Cantera de Margas east face section, Olazagutia, it is possible to collect inoceramids and ammonites on a bed-by-bed basis through the boundary interval. The criticism that Ten Mile Creek is a composite section affected by faults also applies to some extent to the entire succession in the Cantera de Margas as exposed at present. The only significant fault in the Wal-Mart section on Ten Mile Creek is conspicuous and its displacement is readily interpretable. The carbon stable isotope stratigraphy is at least as good as that of the Cantera de Margas section, and it is moreover directly correlatable with the southern England Chalk curve with all its various named isotope events (Jarvis *et al.*, 2006).

References:

- Gale, A.S., Kennedy, W.J., Lees, J.A., Petrizzo, M.R. and Walaszczyk, I. 2007. An integrated study (inoceramid bivalves, ammonites, calcareous nannofossils, planktonic foraminifera, stable carbon isotopes) of the Ten Mile Creek section, Lancaster, Dallas County, north Texas, a candidate Global boundary Stratotype, Section and Point for the base of the Santonian Stage. *Acta Geologica Polonica* **57**, 113–160.
- Gallemi, J., Lopez, G., Martinez, R., Pons, J.M. 2007. Macrofauna of the Cantera de Margas section, Olazagutia: Coniacian/Santonian boundary, Navarro-Cantabrian Basin, northern Spain. *Cretaceous Research* **28**, 5–17.
- Jarvis, I., Gale, A.S., Jenkyns, H.C. and Pearce, A. 2006. Secular variation in Late Cretaceous carbon isotopes: a new $\delta^{13}\text{C}$ carbonate reference curve for the Cenomanian–Campanian. (99.6–70.6 Ma). *Geological Magazine* **143**, 561–608

- Kennedy, W.J. and Kaplan, U. 2000. Ammonitenfaunen des hohen Oberconiac und Santon in Westfalen. *Geologie und Palaontologie in Westfalen*, 131 pp.
- Küchler, T. 2002. Additional macrofossil biostratigraphic data on the Upper Coniacian and Santonian of the Olazagutia, Iturmendi and Zuazu sections in the Barranca (Navarra), northern Spain. In: Wagreich, M. (Ed.), Aspects of Cretaceous Stratigraphy and Palaeobiogeography, Proceedings Volume of the 6th International Cretaceous Symposium, Vienna 2000. *Oesterreichische Akademie der Wissenschaften, Schriftenreihe der Erdwissenschaftlichen Kommissionen* **15**, 315–331.
- Lamolda, M. and Paul, C.R.C. 2007. Carbon and oxygen stable isotopes across the Coniacian/Santonian boundary at Olazagutia, northern Spain. *Cretaceous Research* **28**, 37-45.”
- (end of Wood et al.'s comments)

Dr. J. Lees' comments (after her e-mail dated on Wednesday December 12nd):

“I am aware that there has been some formal criticism concerning the wording of the ballot paper for the Santonian GSSP, which presented Olazagutia in a much better light than seems to be warranted. In that case, I feel that I was not given the full facts that would have allowed me to vote in an unbiased way, and so I would like to withdraw my vote until such a time as a ruling on the scientific validity of the ballot paper has taken place.

Consequently, my comment on 10 Mile Creeks is now also invalid.

But note that the nannos *C. obscurus*, *L. cauyeuxii* are not reliable markers, in relation to this boundary. Should not be advertised as such. This comment, however, stands as a general comment, regardless of the GSSP chosen.”

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These comments will be considered to produce the proposal of Olazagutia as GSSP for the base Santonian, which this Chairman will send to the Subcommittee on Cretaceous Stratigraphy. As well as other correspondence that this Chairman has with members in respect to clear or enlarge information on Coniacian/Santonian boundary topics.

I expect your collaboration in the next task, in order to get a proposal as complete as possible.

Merry Christmas and a Happy New Year 2008!

Granada, 14th December 2007
Marcos A. Lamolda
Chairman, Santonian Working Group