SNS WORKSHOP ON MIOCENE / PLIOCENE BOUNDARY

Held in Bucharest, Romania, during the 10th RCMNS Congress on September 6, 1995 (Geological Museum, Room 3)

Conveners: M.B. Cita, SNS Chairman and R.H. Benson, WG on Miocene / Pliocene boundary

Report by M.B. Cita

Due to the limited time allocated by the Congress organizers, to the presence of most, if not all, the protagonists of the research, to the presence of numerous scientists from twelve countries (Russia, Ukraina, USA, France, Holland, Italy, Spain, Romania, Albania, Hungary, Morocco, Japan, very interested in the topic (see list of participants) a tightly organized program was proposed, and adopted.

The program was articulated in four points, as follows

1) General principles,
2) Presentation of three candidate sections,
3) New results on Miocene / Pliocene boundary deriving from ODP legs 160 and 161 (March–July, 1995)
4) Global correlation of Miocene/Pliocene boundary in marine sections and in continental sections.

1) General principles

The general principles were presented by convener **R.H. Benson,** of the Smithsonian Institution, who briefly explained the changes occurred in Stratigraphy in the last decades, the Global Sratotype Sections and point (GSSP) philosophy, the development of event stratigraphy, the availability of a high resolution stratigraphy for the time interval under discussion. In his long experience as chairman of the Ocean History Panel of the Deep Sea Drilling Project he witnesses the evolution of stratigraphic tools and concepts.

2) Presentation of three candidate sections

All the three sections presented as possible candidates for the definition of the GSSP are well known since at least twenty years, were the subject of numerous publications (not cited here), have been measured several times by different scientific groups and investigated with several stratigraphic tools. All of them were also studied by means of dedicated drillings; in order to obtain a more continuous record of fresh, unweathered sediments.

2A – First the Sicilian sections of Capo Rossello and Eraclea Minoa were presented by **Cita,** with additions by **Hilgen, Sprovieri, Suc. Cita** briefly summarized her pioneering study carried out in the early seventies immediately after the discovery of Messinian evaporites in the deep basins of the Mediterranean (DSDP Leg 13, 1970) in several sections from Sicily, and the proposal of the Capo Rossello section (Trubi marl) as stratotype for the Zanclean stage, and the base of the Zanclean coinciding with the Miocene / Pliocene boundary, and with the re-establishment of open marine conditions in the Mediterranean after the Messinian «salinity crisis». The presentation was given in August 1972 in Montreal, during the International Geological Congress, at a symposium on «Late Neogene e Epoch Boundaries» organized by **T. Saito** and **L. Burckle**. The proposal was discussed with all the protagonists of that time, including **Hollis Hedberg,** chairman of the Subcommission on Stratigraphic classification. It

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BUCAREST, SEPTEMBER 6, 1995

MIOCENE / PLIOCENE BOUNDARY WORKSHOP

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was widely adopted in the following years, but never voted formally.

Now the Rossello composite is extremely well known and is a classical example of integrated high resolution stratigraphy. Reference was made to a presentation at the RCMNS made on Sept. 5, 1995 by **Hilgen**, where the magnetostratigraphy and cyclostratigraphy – combined with biostrastigraphy – allow a time resolution of a few thousand years.

Sprovieri briefly presented the results of the drillhole at Capo Rossello investigated by **Bonaduce, Schwarzacher, Napoleone** and himself. The section cored extends from the lower part of the Monte Narbone Formation, thoughout the Trubi into the Arenazzolo, for a total thickness of approximately 150 m. The contact at the base of the Trubi is unconformable. The study is still in progress.

The proposed GSSP, located at the base of the Trubi Formation is isochronous at Capo Rossello and at Eraclea Minoia. It falls a few meters, 5 astronomic (precession) cycles, beneath the paleomagnetic reversal at the base of the Thvera Subchron, at the base of foraminiferal zone MPl 1, after the extinction horizon of *Discoaster quinqueramus*, within the range of *Triquetrorhabdulus rugosus,* predating the first appearance of *Ceratolithus acutus*.

2 B – The section of Carmona (Spain) was presented by **Suc**, with comments provided by **Sierro** and **Benson**. This section was proposed as stratotype for the Andalusian stage by **Perconig** in the late sixties. **Suc** and co–workers (**Cravatte, Vergnaud–Grazzini, Clauzon** and others) organized an expedition in order to obtain a paleomagnetic record by means of a drillhole. The difference in elevation recorded among the lithostratigraphic units and their setting suggested a nearshore deposition unsuitable for a standard reference section. Moreover, according to the micropaleontological study, the Caliza tosea unit does not cross the boundary, but is entirely Miocene. Consequently, **Suc** proposed not to consider the Carmena section as a candidate for the Miocene / Pliocene boundary any more.

2 C – The section of Bou Regreg was briefly presented by **Benson**, with reference to a more extended presentation given the day before (Sept. 5) to the RCMNS Congress. A combination of natural exposures, quarries and dedicated drillholes results in a composite section extending from the Tortonian into the Zanclean. Figure 1 (after **Benson** and **Rakic–El Bied**, in press) summarizes the Moroccan section, and the correlation with sections from Spain, the Tyrrhenian basin, and Sicily.

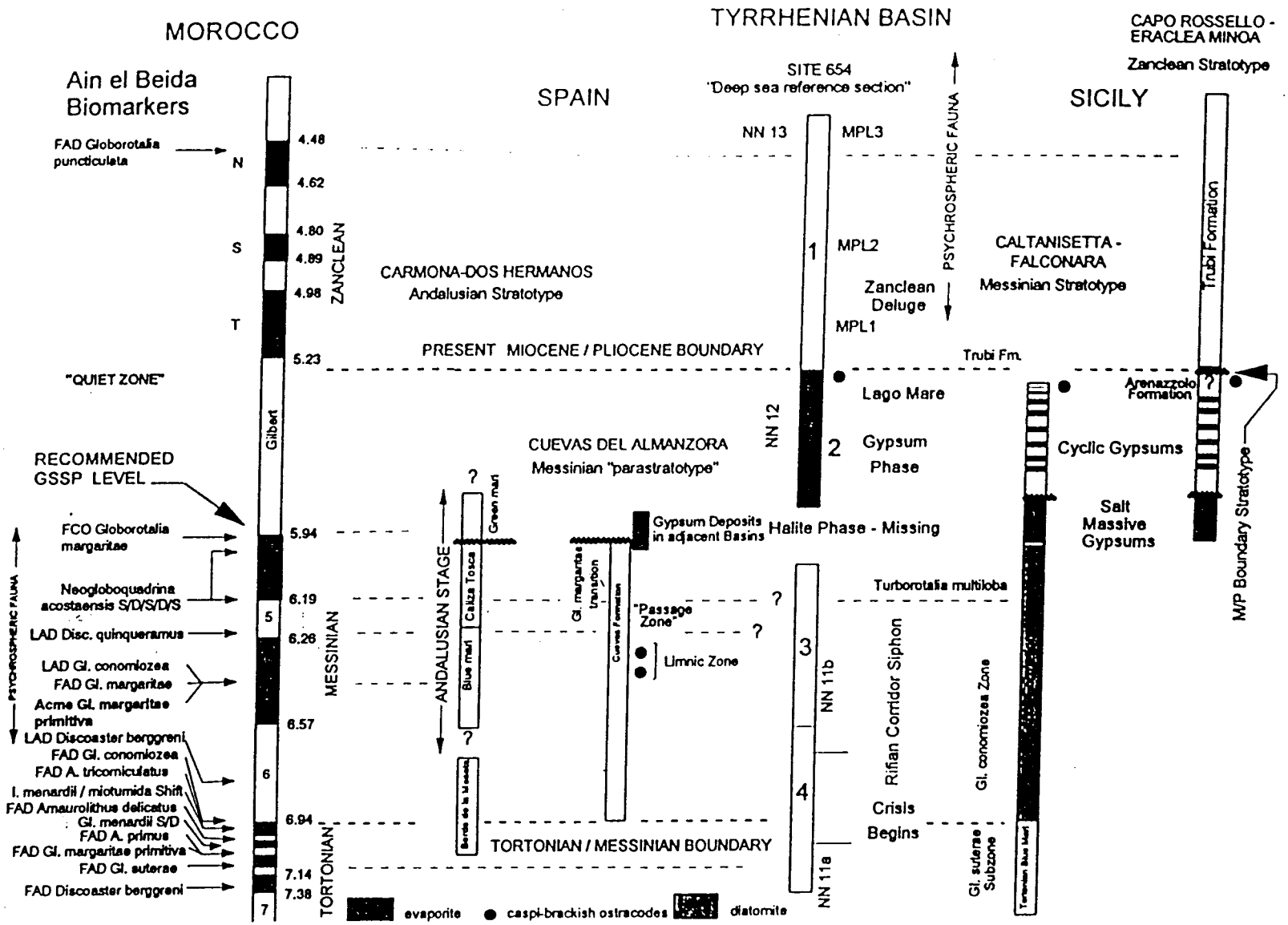
A careful study of bedding planes, cyclically repeated, is also presented and interpreted as a result of astronomical forcing.

Benson and co–workers recommend as GSSP level a point in the section which corresponds to the first common occurrence of *Globorotalia margaritae* and to the magnetic reversal between the Gilbert and Chron 5, with a numerical age of 5.94 Ma. This boundary is <u>not</u> synchronous with the boundary at Capo Rossello and/or Eraclea Minoa (5.23 Ma). The latter – according to **Benson** – falls in a "quiet zone" where no significant bioevents are identified.

A discussion followed. **Cita** presented data provided by **Rio** (who was unable to attend this congress, but is very active in this field) that deal with the distribution of calcareous nannofossils in the Indian Ocean and E equatorial Pacific. They suggest that a close check should be made in the "quiet zone" of the Bou Regreg section.

Suc presented a position paper (**Suc, Clauzon, Gauthier**, in press), where he proposes to define the GSSP in Morocco, but higher in the section, in a level that corresponds to the re–establishment of open marine conditions in the Mediterranean. He claims that in the Sicilian section a regional gap exists in the latest part of the Messinian, and that the Messinian evaporites outcropping in Sicily are not time–equivalent to those recorded in DSDP–ODP drill–sites.

Due to time constraints, the discussion could not be further continued, and the presentation of the new ODP drill–sites followed.



The Bou Regreg Section, Marocco: Proposed Global Boundary Stratotype Section and Point of the Pliocene (after Benson R.H. & Rakic-El Bied, 1995 in press)

3) New results on Miocene/Pliocene boundary deriving from ODP legs 160 and 161 (March-July,1995)

S. Iaccarino, shipboard micropaleontologist on ODP Leg 161, briefly presented the results pertinent to the Miocene/Pliocene boundary (see also her report, published at page 55). The Miocene / Pliocene boundary was identified in three drillholes, all of them cored continuously, some with multiple holes. It consistently corresponds with a marked change in lithology, with hemipelagic marls or oozes in the lowermost Pliocene, followed downhole by clays («lago-mare» facies) and evaporites. The Pliocene record was complete from a biostratigraphic point of view in the Alboran Site 978 (M/P boundary about 600 subbottom) in the Balearic Site 975 (M/P boundary about 300 m subbottom) and in the Tyrrhenian Site 974 (M/P boundary about 200 m subbottom). The paleomagnetic record is now available only for the Alboran Site, where the magnetic signal was strong, due to the terrigenous nature of the sediments, reflected by the high sedimentation rate. The base of the Pliocene is recorded beneath a normal episode identified as the Thvera event.

Cita adds some information concerning the Miocene/Pliocene boundary as recorded at ODP Site 969 on the Mediterranean Ridge. It was recorded at approximately 100 m in subbottom, and the lowermost Pliocene oozes are followed downhole by «lago-mare» muds.
A detailed multidisciplinary study of all 4 drill-holes across the Miocene/Pliocene boundary, including sedimentology, quantitative micropaleontology, isotopic geochemistry and - of course - magnetostratigraphy, is in progress. According to **Cita**, if this study will document that the boundary is isochonous in the deep-sea record, the first alternative should be supported.

4) Global correlation of Miocene / Pliocene boundary in marine sections and in continental sections.

The final point of the agenda was focused on a discussion on the correlation potential of the GSSPs under scrutiny.

First the marine realm was considered, with a lively discussion on the «luxury sections» presented. **Meulenkamp, Benson, Cita, Tsuchi, Semenenko, van Couvering** took part into the discussion. **Benson** favoured a major magnetic reversal as the preferred correlation tool; **Cita** argued that the position of a GSSP has to be known versus the geopolarity time scale, but not necessarily has to coincide with a magnetic reversal; moreover, she prefers to relate the GSSP to classical stages instead of following an idealistic approach to the best possible boundary. **Meulenkamp** stresses that we need a point in the section, but that this choice is a matter of convention. **Cita** says that all earth scientists - including geophysicists - commonly use stage names for the Cretaceous, whereas in the Neogene there is a certain reluctance to do so, but in no way are the Cretaceous stages better defined than the Neogene ones. Indeed, the stratigraphic resolution is much higher for the latters. **Meulenkamp** is in favour of keeping the currently used boundary, and so does **Tsuchi**.

The correlation potential of the two choices (near base of Thvera versus base of Gilbert) in continental sections was then briefly discussed, with reference to the distribution of mammals and micromammals in Africa, Pakistan, north America. **Van Couvering** and **Kotsakis** took part in the discussion, providing valuable information. The Turolian/Ruscinian boundary lies close to the presently accepted limit. According to **van Couvering**, many continental sections have been paleomagnetically calibrated in the last 15-20 years.

Words like «appropriate», «practical» , «classical» were used for the qualities that a GSSP should have.

The discussion had to be terminated because of an other business meeting (of RCMNS) called from 12.00 to 14.00.

The conclusion of the workshop - to be presented at the SNS business meeting later in the afternoon - was that we want to wait a little more not because we do not know where to place the GSSP, but because we have so many proxy data to analize, intepret and digest, and such a high resolution stratigraphy, that a fast vote might be disturbing.

In other words, the decision-making process of SNS is dominated by wisdom.