

## BIOSTRATIGRAPHIC SUBDIVISION FOR THE UPPER JURASSIC OF THE VENETIAN ALPS (NORTHERN ITALY) ON THE BASE OF AMMONITES

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"In the case of biostratigraphic units, it must be kept in mind that out of the almost limitless number and variety of overlapping biozones that could be proposed, not necessarily the first to be described and named but the most useful should be preserved. This means that workers must continually be free to propose new zones "

International Stratigraphic Guide, pag.64

### ABSTRACT

The Rosso Ammonitico Veronese is a Venetian Alp carbonate formation, studied in the last century by Catullo (1846,1853), Oppel (1862-63), Zittel (1870) and Neumayr (1873). In previous papers (Sarti, 1984,1985,1986) I subdivided for the first time the upper Jurassic part of this classical formation into 8 and 12 biozones, including two "interval-zones" ascribed, one to the Kimmeridgian s.e., the other to the Tithonian.

By means of the last research the Ammonite zonation for the upper Jurassic is the following: OXFORDIAN-Transversarium zone, Foquei zone, Bimammatum zone, Planula/Laxevolutus zone. KIMMERIDGIAN-Benettii/Loryi zone, Strombecki zone, Divisum zone, Acanthicum zone, Cavouri zone, Beckeri/Pressulum zone. TITHONIAN-Hybonotum zone, Albertinum zone, Semiforme/Verruciferum zone, Richteri zone, Admirandum/Biruncinatum zone, Volanense zone, Microcanthum zone, Vulgaris zone. CRETACEOUS-Jacobi zone.

The 15 sections studied, located in the so-called "Atesina-Platform", including Venetia and Trentino (Venetian Alps), are distributed in an area of 2560 km<sup>2</sup>; this area was a plateau in the upper Jurassic.

### RÉSUMÉ

Le Rosso Ammonitico Veronese est une formation carbonatée des Alpes Méridionales; dans le dernier siècle a été étudié par Catullo(1846,1853), Oppel(1862-63), Zittel(1870) et Neumayr(1873). Dans mes études précédentes (Sarti, 1984,1985,1986) j'ai subdivisé pour la première fois l'unité supérieure de cette formation classique, attribuable au Jurassique supérieur, en 8 et 12 biozones, incluses deux "interval-zones" appartenantes l'une au Kimmeridgien et l'autre au Tithonique.

D'après les dernières recherches, la zonation du Rosso Ammonitico Veronese pour le Jurassique supérieur est la suivante: OXFORDIEN-Transversarium zone, Foquei z., Bimammatum z., Planula/Laxevolutus z. KIMMERIDGIEN-Benettii/Loryi zone, Strombecki z., Divisum z., Acanthicum z., Cavouri z., Beckeri/Pressulum z. TITHONIQUE-Hybonotum zone, Albertinum z., Semiforme/Verruciferum z., Richteri z., Admirandum/Biruncinatum z., Volanense z., Microcanthum z., Vulgaris z. CRETACE'-Jacobi zone.

Les 15 coupes étudiées, situées dans la soi-disante "Plate-forme Atesine", comprenant la Vénétie et le Trentin (Alpes Venetiennes) sont distribuées dans une aire de 2560 Km<sup>2</sup>; cette aire était un plateau dans le Jurassique supérieur.

## INTRODUCTION

The Rosso Ammonitico Veronese is a carbonate formation very rich in ammonites, of the middle and upper Jurassic. This formation, present throughout the Venetian Alps (the so-called "Atesina-platform") can be subdivided into 3 lithostratigraphic units in continuous succession. The upper unit, attributable to the upper Jurassic, is the object of this study.

The ammonite faunas of the Venetian Alps' upper Jurassic were studied in the last century by many authors and we remember, among the most important, Catullo (1846,1853) and Benecke (1866); this last subdivided the upper unit of the Rosso Ammonitico Veronese in "Acanthicum limestone" and "Diphyia limestone", forming an embryonal biostratigraphic subdivision. We remember also the important monographic works of Oppel (1862-63), Zittel (1870) and Neumayr (1873), none of these exclusive of the Venetian Alps. After the monographie of Del Campana (1905) no other studies on ammonites of upper Jurassic were undertaken. The studies have recently recommenced (on this subject see the works of Sarti (1984,1985,1986), Benetti & Pezzoni (1985), Pavia et al.(in press). A first subdivision in biozones was performed by Sarti (1984) from middle Kimmeridgian to middle Tithonian (eight biozones), extended in further works to the present study (18 biozones from middle Oxfordian to the upper Tithonian).

## LOCATION OF THE SECTIONS

15 sections located in the "Atesina-platform" including Veneto and Trentino (Venetian Alps, Northern Italy) were studied, distributed over an area of 2560 Km<sup>2</sup>. The sections are placed at the western (Giovo Mount) and eastern (Grappa Mount 1, Grappa Mount 2) limits of the area, and in the center-western (Rust Mount, Virti di Folgaria, Roccolo di Lavarone, Col Santo on the Pasubio Mount, Col Santino on the Pasubio Mount) and center-eastern (Asiago Voltascura, Asiago Bellevue, Asiago Cortese 1, Asiago Cortese 2, Asiago Cortese 3) position. Finally two sections (Grezzana Pergola, Timarolo Mount) are located at the southern limit of the area. This area was a plateau in the upper Jurassic. In effect during Jurassic the southern Alps, in the original an uniform carbonate platform, suffered a dismemberment in blocks and a deepening in different times : the deepening

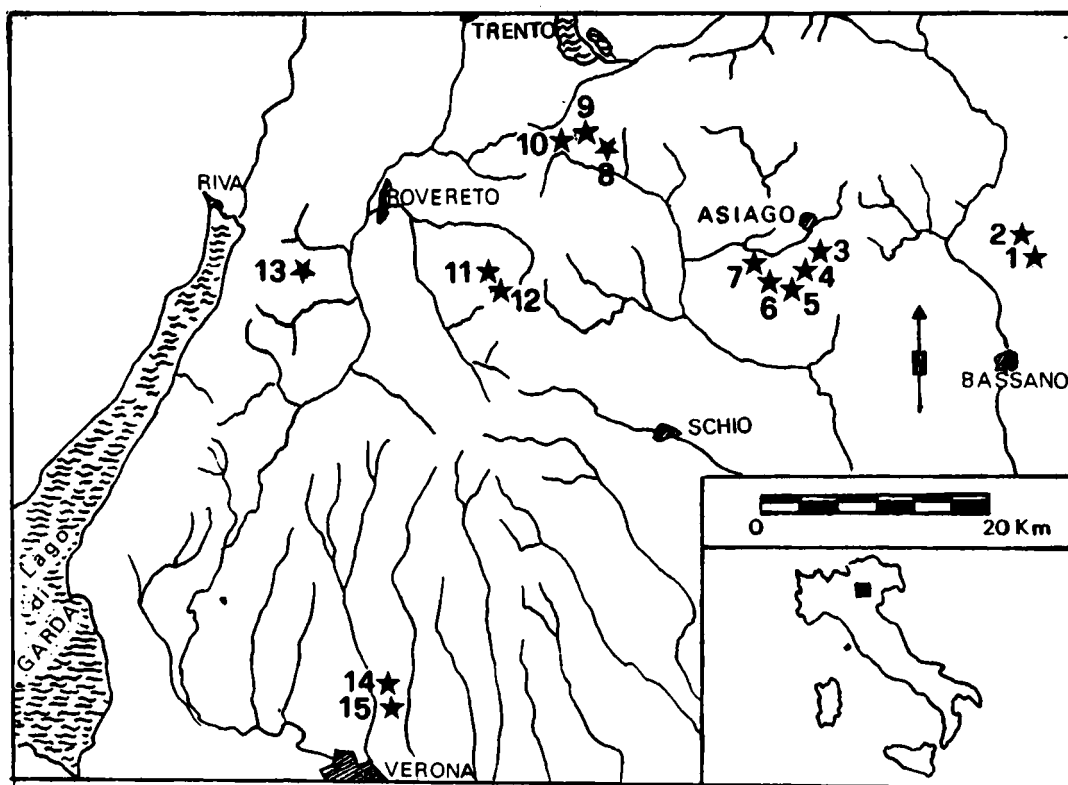


Fig.1 : Location of the sections - Localisation des coupes. 1), 2) M.Grappa; 3) Asiago-Bellevue; 4), 5), 6), Asiago-Cortese; 7) Asiago-Voltascura; 8) M.Rust; 9) Roccolo di Lavarone; 10) Virti di Folgaria; 11) M.Pasubio-Col Santo; 12) M.Pasubio-Col Santino; 13) M.Giovo; 14) M.Timarolo; 15) Grezzana-Pergola

CORDILLERAS BÉTICAS	BULGARIA	CHAINES BÉTIQUES SUD DE L'EUROPE	TRENTINO EUROPE MERID.	VENETIAN ALPS
Durangites	Microcanthum	Durangites		Vulgaris
Microcanthum		Microcanthum		Microcanthum
Burckhardticer.	Parapallasic.	Ponci		Volanense
Admir./Birunc.		Fallauxi		Admirandum/Bir.
Richteri	Rothpletzi		interval-zone2	Richteri
Verruciferum		Semiforme	Semiforme	Semiforme Verruciferum
Albertinum	Schwertschlag.	Darwini	Albertinum	Albertinum
Hybonotum	Hybonotum	Hybonotum	Hybonotum	Hybonotum
Beckeri	Beckeri	Beckeri	Beckeri	Beckeri/Pressul
Cavouri	Sesquinodosum	Eudoxus	interval-zone1	Cavouri
Compsum	interval-zone	Acanthicum	Acanthicum	Acanthicum
Divisum	Divisum	Divisum	Divisum	Divisum
Strombecki	Hypselocyclum	Hypselocyclum		Strombecki
Platynota	Oesmoides	Platynota		Benettii/Loryi
Planula		Planula	Planula	Planula laxevolutus
Bimammatum		Bimammatum	Bimammatum	Bimammatum
Bifurcatus		Bifurcatus	Martelli	Foqueti
Riasi		Transversarium	(Canaliculatum)	Transversarium

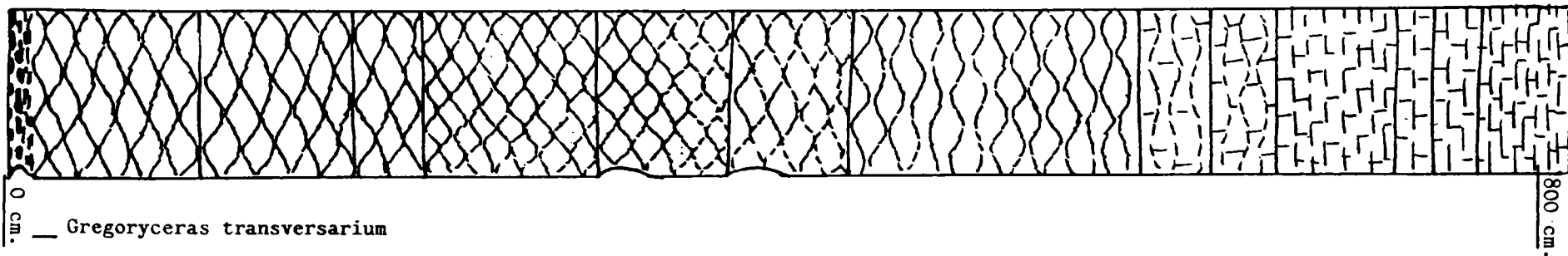
Oloriz, Sequeira, Sapunov (1977)  
Tavera (1978 -79)

Enay & Geysant  
(1975), Cariou-  
Rioul-Enay-Tin-  
tant (1971)

Sarti (1984)  
Enay-Tintant-  
Cariou (1967)

The proposed  
biozonation

Fig.2 : Some recent biozonations for the upper Jurassic in comparison with the proposed biozonation - Quelques biozonations récentes du Jurassique supérieur en comparaison avec la biozonation proposée



— Gregoryceras transversarium

— Gregoryceras foquei

— Subnebrodites planula

— Subnebrodites laxevolutus

— Physodoceras benettii

— Sowerbyceras loryi

— Taramelliceras strombecki

— Crussoliceras divisum

— Aspidoceras acanthicum

— Mesosimoceras cavouri

— Hybonotoceras beckeri

— Hybonotoceras pressulum

— Hybonotoceras hybonotum

— Virgatosimoceras albertinum

— Haploceras verruciferum

— Semiformiceras semiforme

— Richteria richteri

— Simoceras admirandum

— Simoceras volanen  
se

— Micracanthoceras  
microcanthum

Durangites vulgaris

Fig. 3 : Col Santino section (M.Pasubio, TN); stratigraphical distribution of some ammonites - Coupe de Col Santino (M.Pasubio, TN); distribution de quelques espèces d'ammonites

gave rise to platform and basins. The Atesina platform underwent a speed subsidence in middle Jurassic with the beginning of a mainly pelagic deposition substituting the precedent sublittoral deposition. For this subsidence the veneto-trentino region assumed a plateau character. The depth of the sea could have been about 800-1000 m. in the upper Jurassic.

#### LITHOSTRATIGRAPHY

The Rosso Ammonitico Veronese formation is subdivisible into 3 lithostratigraphic units in succession: the lower unit consisting of massive nodular limestones, the middle unit mainly consisting of selciferous limestones and marls, and the upper unit, well bedded or massive nodular limestones.

We distinguish two types of sections fundamentally: the first where the lower unit is in direct contact with the upper unit (section type "A", see Sarti 1985); the second where between the two is interposed the selciferous middle unit (section type "B", idem). There are some exceptions: 1) in the Pasubio Mount-Col Santo section, thick siliceous beds (10-30 cm.) are observed also along the whole upper nodular unit of Rosso Ammonitico, 2) in the Fort Luserna (TN) section the middle unit is present in the characteristic marl-calcareous facies but the nodules and beds of cherts are absent (see Sarti 1986). Generally the selciferous middle unit is partially eteropic of the lower portion of the nodular upper unit. Furtherly its extension is variable and the age can also vary between the Callovian, the Oxfordian and the first beds of Kimmeridgian. Within the selciferous limestones of the middle unit ammonites are practically absent, so that the study of the upper Jurassic faunas referring to the Oxfordian must be accomplished in the sections of the type "A".

The upper unit consists of micritic limestones, mainly nodular (nodularity is a peculiar character), its colour is from rose to whitish, whose thickness is variable from about a meter (condensed section of Giovo Mount) to about 16 meters (Grappa Mount). Normally the thickness of the unit is about 8-10 meters. These limestones can be massive or well bedded, with layers of a thickness variable between 10 and 50 cm. The limestones can be intercalated between marl layers of about 10 cm of thickness. The transition to the overhanging cretaceous formational unit, named "Biancone", occurs gradually through the so called "Diphyra-layers": moving upward

the nodular character is reduced and disappear completely in the "Biancone". The colour of the limestone gradually becomes clearer reaching the milk white of the micritic limestones of "Biancone".

#### BIOSTRATIGRAPHY

The study of faunas, overall ammonites, gathered in the section of the Rosso Ammonitico Veronese, the comparison with faunas of the Rosso Ammonitico collected in the Museums of Bologna, Firenze, Monaco di Baviera, Rovereto, Torino, Trento, Velo Veronese, Verona, and the studies on faunas made by past authors (Benecke 1866, Boden 1908, Catullo 1846,1853, Del Campana 1904,1905, Neumayr 1871,1873, Nicolis & Parona 1885, Opper 1863, Parona 1880,1881, Zittel 1870), made it possible to recognize with accuracy and to propose a biozonature for the whole upper unit of the Rosso Ammonitico Veronese, going from middle Oxfordian to upper Tithonian. With respect to the biozonature proposed by myself in 1984, the two "interval-zone" (fig.2), never before specifically distinguished because faunas had never been recognized as significant, have now been defined; further the biozonature on the whole upper Jurassic has been extended, with a higher number of recognized species.

#### OXFORDIAN :

The sediments belonging to the upper unit of the Rosso Ammonitico Veronese began to deposit in the middle Oxfordian (only sections type "A" ).

#### TRANSVERSARIUM biozone (instituted by Opper, 1863)

TAXON-RANGE-ZONE, index: Gregoryceras transversarium (Quenst.)

The base of the biozone is defined by FAD of index species. The Disco-sphinctes aeneas (Gemm.) has also been recognized, and Perisphinctes sp.gr.bocconii (Gemm.), Perisphinctes(Arisphinctes) sp.cf.helenae De Riaz, Euaspidoceras oegir (Opp.) and aff.oegir (oegir in Dorn), Euaspidoceras sp.gr.faustum (Bayl.), Phylloceratidae indet. as far as the top of the zone.

#### FOQUEI biozone (instituted by Benetti & Pezzoni, 1985)

TAXON-RANGE-ZONE, index: Gregoryceras foquei (Kilian)

The base of the biozone is defined by FAD of index species. Also at the

base of the biozone we can observe Euaspidoceras oegir (Opp.), Euaspidoceras douvillei (Coll.), Euaspidoceras sp., kranasphinctes sp., Perisphinctes (Dichotomosphinctes) sp.cf. wartae (Buck.) and gr. wartae, P.(D.) sp.gr. elisabethae De Riaz, Taramelliceras (Strebliticeras) externnodosum (Dorn), Lissoceratoides sp.cf. erato and aff. erato (D'Orb.), Phylloceras plicatum (Neum.) and other Phylloceratidae indet. have also been recognized.

BIMAMMATUM biozone (instituted by Oppel, 1863)

TAXON-RANGE-ZONE, index: Epipeltoceras bimammatum (Quenst.)

The base of the biozone is characterized by LAD of Gregoryceras foquei (Kilian) and presence of Clambites sp.aff. clambum (Opp.). Along the biozone are present also: Euaspidoceras sp., Epaspidoceras sp.cf. rueppellense D'Orb.), Orthosphinctes sp., Lissoceratoides sp.aff. erato (D'Orb.), Phylloceras plicatum (Neum.) and other Phylloceratidae indet.

This biozone is here utilized because the bimammatum is a classic index, but this must be considered provisional owing to the scarcity of the discovery of the zonal index (nobody among past authors).

PLANULA/LAXEVOLUTUS biozone (here proposed)

ASSEMBLAGE ZONE, index: Subnebrodites planula (Hehl, in Zieten)  
Subnebrodites laxevolutus (Font.)

The base of the biozone is defined by FAD of Subnebrodites : planula, laxevolutus, tonnerrense (De Lor.). Along the biozone are present also: Paraspidoceras gr.cf. lytroceroide (Gemm.), Epaspidoceras mammillanum (Quenst.) Aspidoceras sp., Lithacosphinctes sp.aff. evolutus (Quenst.), Orthosphinctes sp. Lissoceratoides sp.aff. erato (D'Orb.), Calliphyllloceras polyolcum (Benecke) and other Phylloceratidae indet. Near the top of the biozone we may observe Physodoceras benettii (Checa).

Here the above mentioned Assemblage-Zone is proposed (for its denomination the more prominent and diagnostic species were chosen, following the advice of I.G.S., 1976) for a better representation of the sudden and contemporary appearance of Subnebrodites of several species. This Assemblage-Zone of Subnebrodites appears more significant than a Taxon-Range-Zone of a Subnebrodites.

KIMMERIDGIAN :BENETTII/LORYI BIOZONE (here proposed)

CONCURRENT-RANGE-ZONE, index: Physodoceras benettii (Checa)  
Sowerbyceras loryi (Mun.Chalm.)

The base of the biozone is defined by the massive presence of Physodoceras benettii (that disappears at the upper boundary of the zone) and contemporary FAD of Sowerbyceras loryi. Further, always at the base, the Mesosimoceras ptychodes (Neum.) appears. They have been many discoveries of Orthosphinctes polygyratus (Rein.) and aff. polygyratus. Along the biozone we may observe: Orthosphinctes sp., Subnebrodites sp. aff. guilherandense (Font.), Subnebrodites sautieri (Font.), Subnebrodites sp. aff. zullianum (Nic. & Par.), Epaspidoceras mammillanum (Quenst.), Aspidoceras sp., A. sesquiodosum Font., Physodoceras altenense (D'Orb.), Calliphylloceras polyolcum (Ben.) and other Phylloceratidae indet.

The proposal of this Concurrent-Range-Zone, that substitutes the classic Platynota Taxon-Range-Zone is advised by the extreme scarcity of the Sutneria platynota (Rein.) and the copiousness of the globular forms of Physodoceras that Checa (1985) has named "Benetticeras benettii", concomitant with the appearance of the very common species Sowerbyceras loryi.

STROMBECKI Biozone (instituted by Karvé-Corvinus, 1966)

ACME-ZONE, index: Taramelliceras (Metahaploceras) strombecki (Opp.)

The base of the biozone is defined by the massive presence of the index species and LAD of Physodoceras benettii (Checa). Also at the base of the zone we can observe Physodoceras altenense (D'Orb.) and Mesosimoceras ptychodes (Neum.). Along the biozone are present also: Nebroditis spp., Mesosimoceras sp., Lytoceras polycyclum camertinum Can., Phylloceratidae.

DIVISUM Biozone (instituted by Geyer, 1961)

TAXON-RANGE-ZONE, index: Crussoliceras divisum (Quenst.)

The base of the biozone is defined by FAD of index species. Also at the base of the biozone we can observe: Crussoliceras sp., Physodoceras sp. gr. contemporaneum (Favre), Taramelliceras trachinotum (Opp.). Along the biozone are present also: Aspidoceras binodum (Opp.), A. sp. cf. longispinum (Sow.), Aspidoceras longispinum subsp. indet. "A" and "C", A. polysarcum (Font.)



Aspidoceras sp., Pseudowaagenia micropla (Opp.), Physodoceras sp.cf.altenense (D'Orb.), Physodoceras sp., Mesosimoceras teres (Neum.), M.herbichi (Hau.), Mesosimoceras teres herbichoides Oloriz, M.benianum (Catullo in Canavari), Mesosimoceras sp., M.fucinii (Can.), Nebroditis cafisii, Nebroditis agrigentinus (Gemm.), N.heimi (Favre), N.sp.aff.planocyclum (Gemm.), Nebroditis sp.cf.favaraensis (Gemm.), N.sp.cf.peltoideus (Gemm.), Nebroditis hospes (Neum.), Streblites sp., S.tenuilobatus (Opp.), Idoceras sp.cf.balderum (Opp.), Taramelliceras pseudoflexuosum (Favre), T.pugile morf.pugiloide (Can.), Crussoliceras sp., C.sp.cf.crussoliense (Font.), "Katrolliceras"serra-opima Oloriz. Near the top of the zone Aspidoceras acanthicum (Opp.), A.sp.aff.acanthicum, Simosphinctes rachistrophum (Gemm.), and Taramelliceras subcallicerum (Gemm.) have also been recognized.

Phylloceras sp., P.isotypum (Ben.), P.consanguineum Gemm., Sowerbyceras loryi (Mun.Chalm.), Calliphylloceras polyolcum (Ben.), Holcophylloceras mediterraneum (Neum.), Lytoceras montanum (Opp.), L.polycyclum camertinum Can., Limidae indet., has also been recognized.

#### ACANTHICUM Biozone (instituted by Kilian, 1895)

ACME-ZONE, index: Aspidoceras acanthicum (Opp.)

The base of the biozone is defined by LAD of Crussoliceras divisum (Quenst.) and generally of the Crussoliceras, and by massive presence of Aspidoceras acanthicum acanthicum (Opp.), extended over all the biozone. Also at the base of the zone we can observe Taramelliceras compsum compsum (opp.). Along the biozone are present also: Aspidoceras sp.cf.longispinum (Sow.), Aspidoceras longispinum subsp.ind."B", "C" and "D", A.polysarcum (Font.), Aspidoceras sp., Pseudowaagenia sp.gr.acanthomphalum (Zitt.), and near the top, Aspidoceras rafaelli (opp.), A.sp.gr.acanthicum (Opp.), Pseudowaagenia haynaldi (Herb.), Pachysphinctes sp.

Further, Nebroditis peltoideus (Gemm.), N.agrigentinus (gemm.), N.heimi (Favre), Nebroditis cf.favaraensis (Gemm.), N.favaraensis subsp.ind., Mesosimoceras sp., Taramelliceras subcallicerum (Gemm.), T.erycinum (Gemm.), Taramelliceras compsum compsum (Opp.), T.mikoi (herb.), T.pugiloide trans. pugile (Neum.), Progeronia sp., Phylloceras isotypum (Ben.), P.consanguineum (Gemm.), Calliphylloceras benacense (cat.), Sowerbyceras loryi (Mun.Chalm.), Holcophylloceras mediterraneum (Neum.), Lytoceras orsinii Gemm., L.montanum (Opp.), Lytoceras polycyclum camertinum Can., Linguithyris sp.aff.curviconcha (Zeuschn.), Limidae indet. **are present.**

CAVOURI Biozone (instituted by Oloriz, 1978)TAXON-RANGE-ZONE, index: Mesosimoceras cavouri (Gemm.)

The base of the biozone is defined by FAD of index species. Further, the base is contradistinguished by FAD of Mesosimoceras risgoviense (Schn.), and LAD of Aspidoceras acanthicum acanthicum (Opp.). Also at the base we can observe Orthaspidoceras lallierianum liparum (Opp.), Nebroditis contortus (Neum.), Taramelliceras pseudoflexuosum (Fav.); along the biozone are present also: Aspidoceras rafaëli (Opp.), Pseudowaagenia acanthomphala (Zitt.), P.sp.aff.acanthomphala, Taramelliceras compsum compsum (Opp.), Taramelliceras compsum holbeini (Opp.), Pachysphinctes sp., Perisphinctidae indet., Phylloceratidae and Lytoceratidae similar to precedent zone. Near the top of the biozone : Taramelliceras pugile pugile (Neum.).

BECKERI/PRESSULUM Biozone (here proposed)ASSEMBLAGE-ZONE, index: Hybonotoceras beckeri (Neum.)  
Hybonotoceras pressulum (Neum.)

As Oloriz (1979) properly remarks, the classic Beckeri Taxon-Range-Zone must be properly defined as the biozone of Kimmeridgian Hybonotoceras: beckeri, pressulum, harpephorum, extraspinatum, verestoicum, knopi, striatulum, attenuatum, mundulum pars.

Similarly for the Planula/Laxeolus zone it seems more significant to define an Assemblage-Zone (\*) based on Kimmeridgian Hybonotoceras.

The base of the biozone is therefore defined by FAD of Hybonotoceras: beckeri beckeri (Neum.), pressulum pressulum (Neum.), beckeri harpephorum (Neum.), pressulum verestoicum (Herb.). Furtherly Pseudowaagenia acanthomphalum (Zitt.), P.sp.aff.acanthomphalum, Aspidoceras longispinum (Sow.) subsp.ind., A.longispinum intercostatum (Buck.); Aspidoceras appenninicum Zitt., Aspidoceras sp.aff.binodiferum Waag., Physodoceras contemporaneum (Fav.), Taramelliceras compsum (Opp.) subsp.ind., T.pugile (Neum.)s.s., Taramelliceras pugiloide trans.pugile (Neum.), Hemihaploceras nobile (Neum.), Lingulaticeras sp., Lingulaticeras crenosum (Quenst.), Subplanites

(\*) that is defined as : " a body of strata whose content of fossils of a certain kind, taken in its entirety, constitutes a natural assemblage or association that distinguishes it in biostratigraphic character from adjacent strata " ( I.G.S., pag.50)

sp.aff.reisi (Sch.), Subplanites sp.aff.delgadoi (Choffat in Del Campana)  
Subplanites sp., Discosphinctoides geron (Zittel in Del Campana), "Progeronia"  
ombonii (Del Camp.), Pachysphinctes sp.aff.adelus (Gemm.), Virgalithacoceras  
sp., Virgalithacoceras sp.cf.tantalus (Herb.), Biplisphinctes cimbricus  
(Neum.), B.sp.aff.cimbricus, Torquatisphinctes sp., Discosphinctoides  
sp.aff. "1" (Oloriz, 1978), Phylloceras consanguineum Gemm., P.isotypum  
(Ben.), Holcophylloceras mediterraneum (Neum.), Calliphylloceras benacense  
(Cat.), Sowerbyceras loryi (Mun.Chalm.), Lytoceras montanum (Opp.), L.poly-  
cyclum camertinum Can., Linguithyris sp.aff.curviconcha (Zeuschn.), Cyclolam-  
pas sp. Near the top of the biozone: Virgalithacoceras riedense (Schneid),  
Subplanites sp.aff.rueppellianus (Quenst.), "Pseudokatrolicer" sp.aff.  
negrii (Del Camp.).

#### TITHONIAN :

HYBONOTUM Biozone (instituted by Ooppel, 1863)

TAXON-RANGE-ZONE, index: Hybonoticer hybonotum (Opp.)

The base of the biozone is defined by FAD of Hybonoticer hybonotum  
hybonotum (Opp.) and FAD of Hybonoticer hybonotum autharis (Opp.).  
Also at the base we can observe: Perisphinctidae indet., Lithacoceras  
sp., L.ulmensis (Opp.), "Pseudokatrolicer" sp. Along the biozone are  
present also: Aspidoceras sp., A.rafaeli (Opp.), A.sp.aff.iphiceroides  
(Waag.), Aspidoceras sp.aff.zeuschneri (Zitt.), A.sp.gr.longispinum (Sow.),  
Aspidoceras rogoznicense (Zeuschn.), Physodoceras avellanum (Zitt.), P.sp.aff  
avellanum, P.pipini (Opp.), P.contemporaneum (Fav.), Physodoceras cyclotum  
(Opp.) near the top of the biozone, Virgalithacoceras sp., Taramelliceras  
compsum cf.holbeini (Opp.), Fontansiella valentina (Font.), Pseudolissoce-  
ras rasile (Opp.), Haploceras sp., H.elimatum (Opp.), Calliphylloceras  
polyolcum (Ben.), Holcophylloceras mediterraneum (Neum.), Phylloceras  
isotypum (Ben.), Lytoceras montanum (Opp.), Protetragonites quadrisulcatus  
(D'Orb.).

ALBERTINUM Biozone (instituted by Oloriz, 1978)

TAXON-RANGE-ZONE, index: Virgatosimoceras albertinum (Cat.)

The base of the biozone is defined by FAD of index species. Also at the  
base of the biozone we can observe Semiformiceras darwini (Neum.), Subplani-

toides sp. Along the biozone are present also: Aspidoceras sp., A. rogoznicensis (Zeuschn.), Physodoceras avellanum (Zitt.), P. neoburgense (Opp.), Physodoceras cyclotum (Opp.), Virgatosimoceras rothpletzi rothpletzi (Schneid), Subplanites sp., S. contiguus (Cat. in Zitt.), Franconites (Franconites) sp., Lithacoceras sp., L. sp. cf. gracile D. & E., "Pseudokatrolliceras" sp. aff. exornatum (Cat.), "P. achiardii (Del Camp.), Torquatisphinctes sp., Subdichotomoceras pseudocolubrinum (Kil.), Perisphinctidae indet., Neochetoceras sp. cf. paternoi (Di Stef.), Haplocera elimatum (Opp.), H. sp. cf. staszycii (Zeuschn.), H. verruciferum (M) Zitt., Phylloceratidae and Lytoceratidae similar to precedent zone, echinoidea indet., near the top of the biozone: Haploceras verruciferum (m) Zitt.

SEMIFORME/VERRUCIFERUM Biozone (here proposed)

CONCURRENT-RANGE-ZONE, index: Semiformiceras semiforme (Opp.)  
Haploceras verruciferum Zitt.

The base of the biozone is defined by FAD of Semiformiceras semiforme and by the presence of a lot of Haploceras verruciferum, formerly sometimes reported in the upper part of the previous zone. Also present: Semiformiceras sp., S. sp. cf. darwini baeticum (E. & G.), Pseudolissoceras planiusculum (Zitt.), P. sp. aff. planiusculum, Haploceras sp., H. verruciferum (M) and (m) (Zitt.), Haploceras elimatum (Opp.), H. staszycii (Zeuschn.), H. tithonium (Opp.), H. caracteis caracteis (Zeuschn.), Simoceras aesinense Mgh., S. vicientinum Sant., Subdichotomoceras pseudocolubrinum (Kil.), Parapallasiceras sp., P. pseudocontiguum (D. & E.), P. sp. aff. pseudocontiguum, Pseudodiscosphinctes rhodaniforme (Dum. in Del Camp.), P. fortisii (Del Camp.), P. geron (Zitt.), Pseudodiscosphinctes chalmasi (Kil.), "Pseudokatrolliceras" sp., "Pseudokatrolliceras" negrii (Del Camp.), "P. sp. cf. exornatum (Cat.), Dorsoplanitoides bassanii (Del Camp.), D. sp. aff. bassanii, Virgatosphinctes sp. aff. evolutus Leanza, Pachysphinctes sp., Perisphinctidae indet., Aspidoceras rafaelli (Opp.), Pseudohimalaytes steinmanni (Haupt), Phylloceras sp. cf. serum (Opp.), Ptychophylloceras ptychoicum (Quenst.), Holcophylloceras mediterraneum (Neum.), Calliphylloceras kochi (Opp.), Lytoceras montanum (Opp.), L. orsinii Gemm., Protetragonites quadrisulcatus (D'Orb.), Cardiolampas sp., Tithonia sp., Nucleata planulata (Zeuschn.), Pygope janitor (Pict.), Limidae indet.

The proposal of this Concurrent-Range-Zone comes from two considerations:

1) a Verruciferum Taxon-Range-Zone is not propositional because Haploceras verruciferum is scarcely present also in the Albertinum zone, 2) a Semiforme Taxon-Range-Zone is possible, but Semiformiceras semiforme is rare on "Atesina-platform" (in proportion of about 8 : 1 with respect to the Haploceras verruciferum). Therefore Semiforme/Verruciferum Concurrent-Range-Zone appears very practical and profitable.

RICHTERI Biozone (instituted by Oloriz, 1978)

ACME-ZONE, index: Richteria richteri (Opp.)

The base of the biozone is here defined by FAD of index species and LAD of Semiformiceras semiforme (Opp.) and Haploceras verruciferum Zitt. Data in (not Italian) literature show the presence of the species index also in the upper part of the underlying zone. The rarity of the index has made it advisable for the moment not to consider this zone as a Taxon-Range-Zone in the Venetian Alps, at least until numerous findings could define the range with more certainty.

At the base of the biozone we have the last findings of Pseudodiscosphinctes geron (Zitt.). Along the biozone are present also: Subdichotomoceras pseudocolubrinum (Kil.), Parapallasiceras sp., Pseudodiscosphinctes sp. ind. "1" and "2", Lemencia sp. aff. ciliata (Schneid), Virgatosphinctes sp. aff. evolutus Leanza, Haploceras elimatum (Opp.), H. tithonium (Opp.), Haploceras staszycii (Zeuschn.), Pseudolissoceras sp., Phylloceras sp., Ptychophylloceras ptychoicum (Quenst.), Holcophylloceras sp., Lytoceras orsinii Gemm., Lytoceras sutile (Opp.), Protetragonites quadrisulcatus (D'Orb.), Triangope triangulus (Valenc.), Tithonia sp., Echinoidea indet.

ADMIRANDUM/BIRUNCINATUM Biozone (instituted by Oloriz, 1978)

TAXON-RANGE-ZONE, index: Simoceras admirandum Zitt.  
Simoceras biruncinatum (Quenst.)

The base of the biozone is defined by FAD of Simoceras admirandum/biruncinatum. Although this is a Taxon-Range-Zone we could again define it with a double name, while awaiting a more attentive study to demonstrate that admirandum and biruncinatum are extreme terms of the same species. Also at the base of the biozone we can observe: Subdichotomoceras pseudocolubrinum (Kil.), Pseudodiscosphinctes sp. ind. "2". At the middle of the biozone we have Simoceras catrianum Zitt., Simoceras admirandum/biruncinatum as far

as the top of the biozone. Along The biozone are present also : Pseudodiscosphinctes sp.ind. "1", Lemencia sp.aff.pergrata (Schneid), Haploceras elimatum (opp.), Pseudolissoceras sp., Hocophylloceras mediterraneum (Neum.), Calliphylloceras kochi (Opp.), Ptychophylloceras ptychoicum (Quenst) Cardiolampas sp., Tithonia sp.

VOLANENSE Biozone (here proposed)

TAXON-RANGE-ZONE, index: Simoceras volanense (Opp.)

The base of the biozone is defined by FAD of index species. Along the biozone are present also: Pseudosimoceras sp., Cf.Burckhardticerias, Pseudodiscosphinctes sp.cf.fortisii (Del Camp.), Aulacosphinctes sp., Haploceras elimatum (Opp.), H.tithonium (Opp.), H.carachteis carachteis (Zeuschn.), Ptychophylloceras ptychoicum (Quenst.), Holcophylloceras mediterraneum (Neum.), Calliphylloceras sp., Lytoceras sutile (Opp.), L.montanum (opp.), Protetragnites quadrisulcatus (D'Orb.), Triangope triangulus, echinoidea indet.

MICROCANTHUM Biozone (instituted by Barthel 1966)

TAXON-RANGE-ZONE, index: Micracanthoceras microcanthum (Opp.)

The base of the biozone is defined by FAD of index species. Also at the base of the biozone we can observe: Hemisimoceras sp., cf.Pseudosubplanites, Olorizicerias sp., O.sp.aff.magnum Tav. Along the biozone are present also: Corongoceras sp., C.flexuosum Tav., "C". exagonus Tav., Paraulacosphinctes transitorius (Opp.), Aulacosphinctes sp., A.sp.cf.eudichotomus (Zitt.), Moravisphinctes sp., M.fischeri (Kil.), Micracanthoceras sp., Himalaytinae indet., Haploceras sp., H.carachteis subelimatum (Font.), Haploceras carachteis carachteis (Zeuschn.), H.elimatum (Opp.), H.tithonium (Opp.), Calliphylloceras sp., Holcophylloceras mediterraneum (Neum.), Ptychophylloceras ptychoicum (Quenst.), Lytoceras sutile (Opp.), Protetragnites quadrisulcatus (D'Orb.), Triangope triangulus (Valenc.), Pygope sp., Pygope catulloi (Pictet), echinoidea indet. Near the top of the biozone : Durangites spp.

VULGARIS Biozone (here proposed)TAXON-RANGE-ZONE, index: Durangites vulgaris Burckhardt

The base of the biozone is defined by FAD of index species. Along the biozone are present also: Durangites spp., D.sp.aff.vulgaris, D.sutneroides Tav., Corongoceras sp., Micracanthoceras sp., Proniceras sp., cf. Pseudosubplanites, Haploceras sp.cf. tithonium (Opp.), H.elimatum (Opp.), H.carachteis subelimatum (Font.), H.carachteis carachteis (Zeuschn.), Ptychophylloceras ptychoicum (Quenst.), Holcophylloceras mediterraneum (Neum.), Protetragonites quadrisulcatus (D'Orb.), Triangope triangulus (Valenc.), Pygope sp., Pygope catulloi (Pictet), Cardiolampas sp., Metaporinus convexus (Cat.).

CRETACEOUSJACOBI Biozone (instituted by Le Hegerat, 1968)TAXON-RANGE-ZONE, index: Berriasella jacobi Mazenot

The studies about this biozone can be considered as preliminaries owing to the scarcity of the faunas now recognized. The base of the biozone is now defined from the appearance of Spiticeras spp. and Berriasella sp.gr. jacobi. Further Haploceras carachteis subelimatum (Font.), H.elimatum (Opp.), Ptychophylloceras ptychoicum (Quenst.), Triangope triangulus (Valenc) are also present.

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The reference section for all the new biozones here proposed (Planula|Laxevo lutum zone, Benettii|Loryi zone, Beckeri|Pressulum zone, Semiforme|Verruciferum zone, Volanense zone, Vulgaris zone) is : COL SANTINO on the PASUBIO Mount, 1° 17' 38" Longitude (Longitude of Roma M.Mario referred to Greenwich E.D.1940 : 12° 27' 08" ,40) , 45° 49' 38" Latitude, Trento Province, North Italy.

The reference section, type "A", is continuous and very rich in fossils, mainly ammonites; it is situated in a locality easily reached and, being situated in a natural park, is under legal protection.

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