Magnetostratigraphy and biostratigraphy of Callovian-Oxfordian limestones from the Trento Plateau (Monti Lessini, northern Italy)

J. E. T. Channels, F. Massari, A. Benetti and N. Pezzoni

ABSTRACT

Callovian-Oxfordian “Ammonitico” limestones from the Trento Plateau carry a characteristic remanent magnetization indicating frequent geomagnetic polarity reversals which can be correlated to Callovian-Oxfordian ammonite zones. The characteristic magnetization component has low coercivity and blocking temperatures below 600°C, suggesting that magnetite is the carrier. The geomagnetic polarity is not constrained by field tests although sedimentological evidence for early lithification and the close stratigraphic juxtaposition of normal and reversed component directions, tend to indicate that acquisition of the magnetization occurred close to the sediment-water interface. Stratigraphic gaps and the condensed nature of the sections inhibit the correlation of polarity reversals between sections. The data suggest a reversed polarity bias for the Oxfordian and a normal polarity bias for the Callovian.

Introduction

The correlation of the geomagnetic reversal timescale (GRTS) to biozonations and hence to stage boundaries has been greatly facilitated by magnetostratigraphic study of Late Jurassic to middle Tertiary pelagic limestones exposed on land in the Mediterranean area (e.g. Alvarez et al., 1977; Channell et al., 1979, 1987; Lowrie et al., 1980, 1982; Ogg et al., 1984; Lowrie and Channell, 1984). The correlation for pre-Tithonian time has been more problematic for several reasons. Firstly, whereas the oceanic magnetic anomaly record provides the blue print for much of the Mesozoic and Cenozoic GRTS (Larson and Hilde, 1975; LaBrecque et al., 1977), Late Jurassic oceanic anomalies older than M25 have yielded an ambiguous picture of geomagnetic polarity due to low amplitudes of pre-M25 oceanic anomalies both in the Pacific (Cande et al., 1978) and Atlantic oceans (Bryan et al., 1980). Secondly, the pre-Tithonian (Callovian to Kimmeridgian) deeper-water sediments exposed on land in the southern Tethyan realm are either in siliceous (basinal) facies or highly condensed calcareous (seamount) facies. The pelagic limestones of the Maiolica and Scaglia Formations, which have provided the magnetostratigraphies for younger strata, are characteristic of the southern Tethyan continental margin only from Tithonian time. In the siliceous pre-Tithonian facies, magnetostratigraphic studies have been hampered by poor biostratigraphic control (Channell et al., 1984). In the condensed calcareous facies (Ammonitico rosso), biostratigraphies are adequate but discontinuous sedimentation rates yield a polarity pattern that cannot easily be correlated...
between sedimentary sections (Ogg et al., 1984; Steiner et al., 1985, 1986). Nevertheless, Steiner et al. (1985, 1986) give the first convincing documentation, in ammonite-rich Oxfordian limestones from Spain, of Late Jurassic reversals older than M25, indicating that the "Jurassic Quiet Zone" in the oceans is not due to constant normal geomagnetic polarity. In addition, recent aeromagnetic data from the western Pacific Ocean give the first clear indication of linedated oceanic magnetic anomalies older than M25, and this sequence of anomalies has been numbered to M38 (Handschumacher et al., 1988).

The purpose of this paper is to investigate the magnetostratigraphy of condensed calcareous (Ammonitico rosso) limestones of Callovian to Oxfordian age from the Trento Plateau (Northern Italy) in order to help establish the geomagnetic polarity pattern in this interval, and correlate it to the new oceanic anomaly data and to the ammonite biozonation.

**Lithostratigraphy**

The Trento Plateau is a paleogeographic zone which originated as a fault-bounded high on the southern Tethyan continental margin during Early Jurassic continental rifting (Bernoulli and Jenkyns, 1974; Winterer and Bosellini, 1981). The Bajocian to Lower Tithonian interval on the Trento Plateau is represented by the Ammonitico Rosso Formation which is a highly condensed red to pink nodular limestone characterized by stratigraphic gaps and sporadic preservation of the stratigraphic record, especially in the lower (Oxfordian to Bajocian) member of the formation (Massari, 1981; Clari et al., 1984).

Three sections of Callovian–Oxfordian Ammonitico Rosso limestones have been sampled in Monti Lessini. The sections, all located in the province of Verona (Fig. 1), are: "Piccola Mantova II", located in the town park of Boscocchieanovia; "Valle delle Sfingi", in the locality Buse di Sotto, 2.9 km north of Velo Veronese; and "Covolo di Campolivano", 2.4 km north of Velo Veronese. The sampled sections can be subdivided into three members bounded by stratigraphic discontinuities. Ammonites occur abundantly in the lower and upper member, but are almost absent in the middle member. The middle member is a limey local equivalent of the cherty limestone unit known elsewhere as Fonzaso Formation, which is gener-

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**Fig. 1. Location map of the studied sections. 1 = Piccola Mantova II. 2 = Valle delle Sfingi. 3 = Covolo di Campolivano.**
Fig. 2. Lithologic logs, polarity records (black: normal polarity, white: reversed polarity), and ammonite zones corresponding to individual ammonite finds for the three sections from Moasi Lessini. Lithologic correlations bounding Members A, B and C are shown.
ally barren of ammonites throughout the Trento Ridge area.

The lower member (A in Fig.2) consists of a sequence of massive pink limestones, rich in cyanobacterial oncoids and stromatolites, and bounded by stratigraphic discontinuities at the base and probably also at the top. It overlies pink nodular limestones of Bathonian age bearing rare ammonites. High condensation of this sequence is indicated by the local occurrence of mixed ammonite faunas, and abundance of reworked bioclasts and intraformational lithoclasts characterized by pervasive iron staining, microperforated rims and common polycyclic onchoidal overgrowths. The evidence for early lithification and reworking suggests that in addition to larger stratigraphic gaps commonly marked by stromatolite-draped hard-grounds with Fe/Mn crusts, many small-scale gaps probably exist. Thin-section examination shows a predominance of packstones/wackestones, with abundant "proto-globigerines", *Globochaete alpina* Lombard, nodosarids, spirillinids, calcispheres, sparse radiolaria, abundant thin-shelled bivalves, small gastropods, fragments of echinoderms, rare small quartz grains and rare phosphatic bio-clasts.

The intermediate member (B in Fig.2) shows marked differences in thickness. It is reduced to some centimetres in the Valle delle Sfingi section, and has maximum thickness (3.13 m) in the Piccola Mantova II section. It is characterized by thin-bedded pink burrowed limestones commonly displaying wavy stratification (flaser-bedding). Some whitish layers showing planar geometry are interbedded with the flaser-bedded facies and locally display a planar lamination and/or small-scale cross-lamination partly obliterated by the bioturbation. In thin section, these layers appear as microcoquinoid grainstones to grainstone/packstones, almost exclusively made up of thin-shelled bivalves. Cryptalgal fabrics, as well as evidence of early lithification are lacking in this member. The flaser bedding suggests that sediments remained in a soft state during the burial and consequently suffered stronger effects of burial diagenesis with respect to the nodular facies. The different diagenetic history may explain the extreme scarcity of ammonite remains in this member, and their occurrence as deformed molds. In thin section, the flaser-bedded facies shows a packstone to packstone/grainstone fabric dominated by thin-shelled bivalves in the lower part of the member and calcitized radiolarians in the upper part. The other components are the same as those occurring in Member A. Exhumed nodules and/or iron-stained lithoclasts and bioclasts occur in the lowermost part of member B and result from mechanical reworking of the uppermost layers of the underlying member. The microcoquinoid layers show evidence of emplacement by traction currents. In the Boscochievanova area, they locally display hummocky cross-bedding, which is commonly regarded as a structure typical of storm-layers.

The upper member (C in Fig.2) is similar to Member A in outcrop appearance. It is a massive facies, commonly stromatolitic, and typically consists of packstones very rich in "proto-globigerines" as well as iron-stained and bio-eroded residual lithoclasts and bioclasts, pointing to strong condensation. The components are the same as those occurring in the lower member, except for the absence of thin-shelled bivalves, and local presence of aptychi and rhyncholites.

**Biostratigraphy**

Nannofossils in these sediments are rare and poorly preserved due to pervasive recrystallization of micrite to microspar, a feature which is widespread in the Ammonitico Rosso limestones of the Trento Ridge area, possibly due to early diagenetic changes of fabric. The only marker species recognized was *Pseudoconus enigma* (uppermost Bajocian to Lower Callovian) which was observed at 4.28 m and 4.95 m at Piccola Mantova II (E. Erba, pers. comm., 1990). Due to the scarcity of useful nannofossil markers, the biostratigraphy is based on ammonites. We followed the ammonite zonation proposed by Mouterde et al. (1971) for the submediterranean province (Fig.3). The zonal markers are often missing, as in many other localities of the Monti Lessini, and the biozone is usually based on faunal assemblages. In the Appendix, the ammonite assemblages and corresponding biozones are given for each fossiliferous horizon or group of horizons.
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Fig. 3. Ammonite zonation proposed by Mouterde et al. (1971) for the submediterranean province.

Paleomagnetism

At Piccola Mantova II, 115 samples for paleomagnetic study were collected from 5.73 m of stratigraphic section (Fig. 2), giving an average sample spacing of 5 cm. At Valle delle Sfingi and Covolo di Camposilvano, 36 and 20 samples were collected from 1.7 m and 0.93 m of section, respectively. We discuss the magnetic properties of these sediments with reference to the Piccola Mantova II section, as this is the principal section in this study and similar behaviour is seen in all three sections.

Stepwise thermal demagnetization indicates the presence of a magnetization component with consistent direction and dual polarity that unblocks in the 300–600°C temperature range (Fig. 4). The characteristic component direction for each sample was computed from thermal demagnetization data using principal component analysis (Kirschvink, 1980). The component directions yield two approximately antiparallel groups for all three sections with some intermediate directions (Fig. 5). The virtual geomagnetic polar (VGP) latitudes, calculated from the component directions, are interpreted in terms of a sequence of normal and reversed polarity zones (Figs. 6–8).

We do not have good constraints on the age of this magnetization component. We note that the polarity of the magnetization component changes from one sample to another within a stratigraphic distance of a few centimeters with no intermediate component directions present (Fig. 4) and that the component directions are closely antiparallel (Fig. 5). The maximum blocking temperatures of the characteristic magnetization components do not exceed 600°C. Comparison of thermal demagnetization with alternating field demagnetization data for the same sample (Fig. 9) indicates that the characteristic magnetization component does not have high coercivity. The coercivity and blocking temperature spectra of the natural remanent magnetization tend to indicate that magnetite is the principal remanence carrier. We consider that the characteristic magnetization component was acquired during early diagenesis, within a few centimeters of the sediment/water interface. This is based on evidence for a low coercivity (magnetite) magnetization, close stratigraphic juxtaposition of normal and reversed magnetizations, and evidence for early diagentic lithification, particularly in Members A and C.

On the other hand, there is an interval within Member B at Piccola Mantova II (7.37–7.75 m) where the component directions are intermediate between the normal and reversed polarity directions (Figs. 5 and 6) and have higher maximum blocking temperatures and higher coercivity (Fig. 10) suggesting that hematite carries part of this component. We suppose that the intermediate directions are composite components acquired by
Fig. 4. Orthogonal projection of thermal demagnetization data from the Piccola Mantova II section, examples from Member A (a), and from Member C (b). Closed and open circles represent projection on the horizontal and vertical plane, respectively. The demagnetization temperatures are given in °C, and the meter level of the sample is indicated.
Fig. 4. Continued.
growth of authigenic hematite through its blocking volume in more than one polarity chron.

Discussion

The ammonite zones corresponding to the distinctive finds are indicated adjacent to the stratigraphic logs (Figs. 2 and 6–8), and the ammonite finds are described in the Appendix. The ammonite zonation is that proposed by Mouterde et al. (1971) for the submediterranean province (Fig. 3). The distinctive ammonite finds in these sections give an only partial age record. However, in view of the lithostratigraphic correlations (Fig. 2), we conclude that Member A is Callovian in age and spans the interval from the Macrocephalus zone to the Coronatum zone in the Covolo di Camposilvano section, and that Member C is Oxfordian spanning the interval from the Plicatilis zone to the Planula zone. We have no direct control on the age range of the intervening Member B due to the lack of ammonite finds.
Fig. 6. Virtual geomagnetic polar (VGP) latitudes, polarity interpretation and ammonite zones corresponding to individual finds for the Piccola Mantova II section.

Fig. 7. Virtual geomagnetic polar (VGP) latitudes, polarity interpretation and ammonite zones corresponding to individual finds for the Valle delle Sfingi section.

Fig. 8. Virtual geomagnetic polar (VGP) latitudes, polarity interpretation and ammonite zones corresponding to individual finds for the Covolo di Camposilvano section.

Fig. 9. Orthogonal projection of alternating field demagnetization data for a sample from Member A. Symbols as for Fig. 4a with peak alternating fields given in mT. For thermal demagnetization behavior of the same sample, see Fig. 4a.

The correlation of the magnetostratigraphic record from one section to another is ambiguous. The lack of correlation between sections, which has also been observed in limestones of the same age.
and facies from Spain (Ogg et al., 1984; Steiner et al., 1985, 1986), is probably due to the lack of continuity in the sedimentary record rather than inadequacies of the limestone samples as recorders of geomagnetic polarity.

The data are significant in view of the paucity of magnetostratigraphic data from the Callovian–Oxfordian. The only published magnetostratigraphy correlated to well-controlled Oxfordian biostratigraphy is from Steiner et al. (1985, 1986) who show 15 reversals and a reversed polarity bias in the Transversaria, Bifurcatus and Bimammatum zones of the middle and late Oxfordian. The data presented here are consistent with their interpretation; and also indicate that reversals occurred in the Callovian, but for this stage a normal polarity bias is apparent.

The correlation of these records to the oceanic magnetic anomaly data of Handschumacher et al. (1988) is not possible partly due to the lack of continuity in the land record and partly due to the lack of a distinctive thumbprint in the oceanic record. However, the indication of frequent reversals of Oxfordian–Callovian age in the Monti Lessini sections is consistent with the oceanic record. Thick stratigraphic intervals of normal polarity observed in the middle Jurassic Italian siliceous limestone sections were considered correlative to the Jurassic quiet zone in the oceans (Channell et al., 1982, 1984). These siliceous sections are devoid of ammonites, are often turbiditic and may have been deposited rapidly. Their magnetostratigraphy cannot be well correlated to stage boundaries.

Most of the paleomagnetic data from the Southern Alps have been derived from Cretaceous sediments. These data give pole positions close to the African polar wander path consistent with the view that the Southern Alps moved with Africa during Cretaceous and Tertiary time (VandenBerg and Wonders, 1976; Lowrie et al., 1980; Channell, 1986; Lowrie, 1986). However, the directional data from the three Monti Lessini sections (Table 1) yield paleomagnetic pole positions which deviate...
TABLE I

Mean characteristic magnetization directions for the three Monti Lessini sections. N refers to number of samples. k and a95 to Fisher (1953) statistics. The magnetization direction yielding the 155 Ma "African" pole of Westphal et al. (1986) is given.

<table>
<thead>
<tr>
<th>Section</th>
<th>N</th>
<th>Before tilt correction</th>
<th>After tilt correction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dec</td>
<td>Inc</td>
<td>k</td>
</tr>
<tr>
<td>P. Mantova II</td>
<td>107</td>
<td>310.3</td>
<td>38.2</td>
</tr>
<tr>
<td>V. delle Stinigi</td>
<td>36</td>
<td>308.2</td>
<td>43.0</td>
</tr>
<tr>
<td>C. Campostellavane</td>
<td>5</td>
<td>312.0</td>
<td>48.6</td>
</tr>
</tbody>
</table>

Direction which yields the 155 Ma "African" pole: 330° 45′

significantly from African apparent polar wander path (APWP). The data can be reconciled to the 155 Ma point on the African APWP of Westphal et al. (1986) by anticlockwise rotation of 15°-25° of this part of the Trento Plateau.

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Appendix

"Piccola Mantova II" section

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<th></th>
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<tbody>
<tr>
<td>4.40</td>
<td>Indosphenites (I.) patina (Neumayr), Indosphenites (Elatmites) praehaequealis Mangold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.42</td>
<td>Indosphenites (I.) rusticus Spath</td>
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</tbody>
</table>

Zone: Gratiss zone, Patina subzone (Callovian).

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<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>4.47</td>
<td>Psychophylloceras (P.) euphyllum (Neumayr)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.48</td>
<td>Calliphylloceras disputabile (Zittel)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Zone: uncertain, due to the large stratigraphic range of the species.

Zone: (?) Transversarium zone (Oxfordian).

8.11-8.30 — Some large Passendorferia s. str. and Paraplagoceras s. str. [probably P. (P.) submeriani Zeiss]

8.38 — Lystoceras orsitii Gemmellaro, Tarxammelliceras (T.) pseudotruchotostum

8.55 — Gregoryceras (G.) transversarium (Quenstedt)

8.58 — Lisoscleratoïdes sp., Gregoryceras (G.) transversarium (Quenstedt)

8.63 — Gregoryceras (G.) transversarium (Quenstedt)

Zone: Transversarium zone (Oxfordian).

8.68 — Lystoceras orsitii Gemmellaro

8.79 — Passendorferia (P.) upsonoides (Enay), Gregoryceras (G.) jouquei (Kilian)

8.90 — Severbyceras tortusculatum (d’Orbigny)

8.99 — Calliphylloceras manfredi (Oppel), Severbyceras tortusculatum (d’Orbigny)

9.06 — Proscaphites sp.

Zone: Bifurcatus zone (Oxfordian). Although the marker is absent, according to Melendez (1984)
Passendorferia (P.) uplonoides is typical of this zone.

9.41 — Tarantelliceras (T.) costatumpinque (Quenstedt)

Zone: (?)Bimammatum zone (Oxfordian).

9.44 — Sowerbyceras loryi (Munier-Chalmas)
9.45 — Sowerbyceras loryi (Munier-Chalmas), Orthosphinctes sp., Aspidoceras (A.) binodum (Quenstedt)
9.48 — Trimarginites sp.
9.60 — Tarantelliceras (Strebliliceras) tegulatum (Quenstedt)
9.73 — Benetticeras beneti Checa

Zone: Planula zone (Oxfordian). This is substantiated by the presence of Benetticeras beneti, which, according to Checa (1985), is typical of the Planula zone, and of Sowerbyceras loryi (Benetti and Pezzoni, 1985). The latter species extends also into the Hauffianum subzone of the Bimammatum zone, but the lower boundary of the Planula zone can nevertheless be identified by means of a correlation to the nearby “Piccola Mantova I” section (Massari et al., 1988), where Subnebrodites sp. is quite common.

9.94-10.00 — Among several corroded and undeterminable forms, Sowerbycerus loryi, Holchophylloceras mediterraneum, Aspidoceras aff. binodum have been recognized in the topmost nodular horizons of the section. Although these species are poorly indicative, a Kimmeridgian age can be established by means of a correlation with nearby sections.

“Valle delle Sfingi” section

0.08 — Homoeoplanulites (H.) halensis (Neumayr), Homoeoplanulites (H.) farculus (Neumayr), Indosphinctes (I.) choffati (Parona and Bonarelli), Indosphinctes (I.) patina (Neumayr), Indosphinctes (Elaitmites) prahcequensis Magnold

Zone: Gracilis zone, mixing of ammonites belonging to the Koenigi and Patina subzones (Callovian).

0.48 — Phyloceras kunthi Neumayr (not stratigraphically significant)
0.03 — Psychophylloceras (P.) euphyllum (Neumayr)
0.05 — Calliphylloceras disputabile (Zittel)
0.06 — Euaspidoceras (E.) acuticostatum (Young & Bird)
0.14 — Periphioceras (?Otophylloceras) anguliculus Enay, Passendorferia (P.) teut (Enay), Euaspidoceras (E.) sp.
0.16 — Tornquistes (Pachytorniquites) oxfordense (Tornquist), Tornquistes (T.) helvetiae (Tornquist)
0.26 — Sowerbyceras tortisulcatum (d’Orbigny), Passendorferia (P.) teut (Enay), Gregorycerus sp.
0.30 — Gregorycerus (G.) romani (De Grossoivre)
0.35 — Gregorycerus (G.) transversarium (Quenstedt)

Zone: Plicatilis zone, Antecedens subzone (Oxfordian).

0.41 — Phyloceras plicatum Neumayr, Sowerbyceras tortisulcatum (d’Orbigny), Periphioceras sp., Passendorferia (P.) ziegleri Brochicz-Lewinski
0.47 — Lissoceratoides erato (d’Orbigny), Trimarginites aralicum (Oppel), Periphioceras (Dichotomosphinctes) elisabethae (De Riaz), Passendorferia (Enayites) hirnemadortfensis (Moesch), Euaspidoceras cf. riazi (Collot), Parapipunceroceras (P.) submerian Zeiss, Gregorycerus (G.) transversarium (Quenstedt), Gregorycerus (G.) sp.
0.53 — Euaspidoceras (E.) oegir (Oppel), Gregorycerus (G.) fouquei (Kilian)
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30 i

0.56 — Sowerbyceras tortisulcatum (d'Orbigny), Euaspidoceras (E.) oegir (Oppel)

0.61 — Perisphinctes (Dichotomosphinctes) elisabethae (De Riaz), Gregoryceras (G.) fouquei (Kilian)

Zone: Transversarium zone (Oxfordian).

0.66 — Passendorferia (P.) aff. uptonoides (Enay), Euaspidoceras (E.) oegir (Oppel), Gregoryceras (G.) fouquei (Kilian)

0.67 — Perisphinctes sp.

0.70 — Euaspidoceras (E.) oegir (Oppel), Gregoryceras (G.) fouquei (Kilian)

Zone: Transversarium zone (Oxfordian), probably Schilli subzone. The assemblage can be attributed to the Schilli subzone due to nearby occurrence of Passendorferia cf. torcalensis (Kilian), P. ziegleri (Brodwicz-Lewinski) and P. aff. uptonoides (Enay) in the same horizon (Pavia et al., 1987). Of these species, the first is known in association with G. fouquei at the transition between Transversarium and Bifurcatus zones; the second displays maximum abundance in the middle-upper part of the Transversarium zone, and the third is reported from the transition Transversarium-Bifurcatus and in the Bifurcatus zone.

0.86 — Taramelliceras (T.) compsum (Oppel), Nebrodites agrigentimum (Gemmellaro), Nebrodites flavescens (Gemmellaro), Nebrodites peloidens (Gemmellaro), Nebrodites rhodanensis Ziegler, Progeronia (P.) pseudolictor (Choffat), Pseudowaagenia micropla (Oppel), Orthaspidoceras garbaldi (Gemmellaro), Orthaspidoceras sp. aff. uhlandi (Oppel)

Zone: probably Divisum zone (Kimmeridgian).

"Covolo di Campostiliano" section

0.03 — Bullatimorphites (Kheraiceras) bul-

latus (d'Orbigny), Macrocephalites sp. ind.

0.04 — Macrocephalites sp. ind.

0.10 — Large specimens of Choffatia sp., non determinable owing to the bad preservation

Zone: Macrocephalus zone (Callovian).

0.17 — Homoeoplanulites (H.) furcatus (Neumayr), Homoeoplanulites (H.) balinensis (Neumayr), Homoeoplanulites (Parachoffatia) funatus (Oppel) Choffatia (C.) prorsocostata (Siemiradzki), Choffatia (Subgranosouvia) cf. recuperat (Gemmellaro)

Zone: Gracilis zone, Koenigi subzone (Callovian).

0.19 — Homoeoplanulites (Parachoffatia) funatus (Oppel), Indosphinctes (I.) brenoni Colognnon, Indosphinctes (I.) choffati (Parona and Bonarelli), Indosphinctes (I.) cesaredensis Mangold, Indosphinctes (I.) rasticus Spath, Indosphinctes (I.) subpatina Petitclerc

0.23 — Calliphylloceras disputabile (Zittel)

0.24 — Holcophylloceras zignodium (d'Orbigny), Psychophylloceras (P.) flabellatum (Neumayr), Lytoceras eudesianum (d'Orbigny), Lissoceras (L.) ferrifex (Zittel)

0.26 — Psychophylloceras (P.) empyrium (Neumayr), Hecticoceras (H.) sp. ind., Indosphinctes (I.) aff. subpatina Petitclerc

0.32 — Bullatimorphites (Bombaria) globuliforme (Gemmellaro)

0.45 — Ptychiceras sp., Reineckeia (R.) spinosa Jeannet

Zone: Gracilis zone, Patina subzone (Callovian), except for Homoeoplanulites (Parachoffatia) funatus (Oppel), which is probably reworked from the underlying Koenigi subzone.

0.81 — Choffatia (C.) waageni (Teisseyre),
Choffatia (Subgrossouvia) damori-
tieri Mangold & Elmi

Zone. Coronatum zone (Callovian). Within this
assemblage, Choffatia (S.) damortieri is typical of the
Coronatum zone, whereas Choffatia (C.)
wangeni is reported from the Coronatum and
Janson zones. A specimen of the zonal marker,
Erymnoceras coronatum, has been found in the
same horizon, about 100 m west of the section
(Benetti, 1977).

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