# New magnetostratigraphy from the Punta Grohmann section (Dolomites, NE Italy): an improvement of the Geomagnetic Polarity Time Scale around the Ladinian/Carnian boundary

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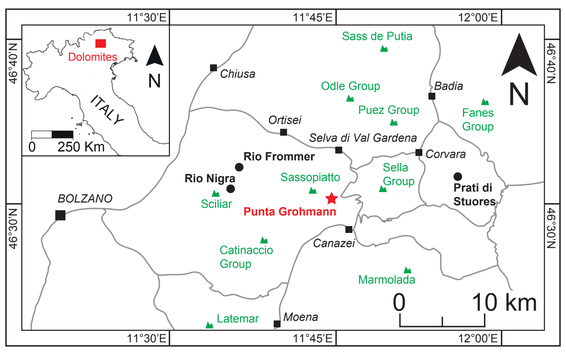
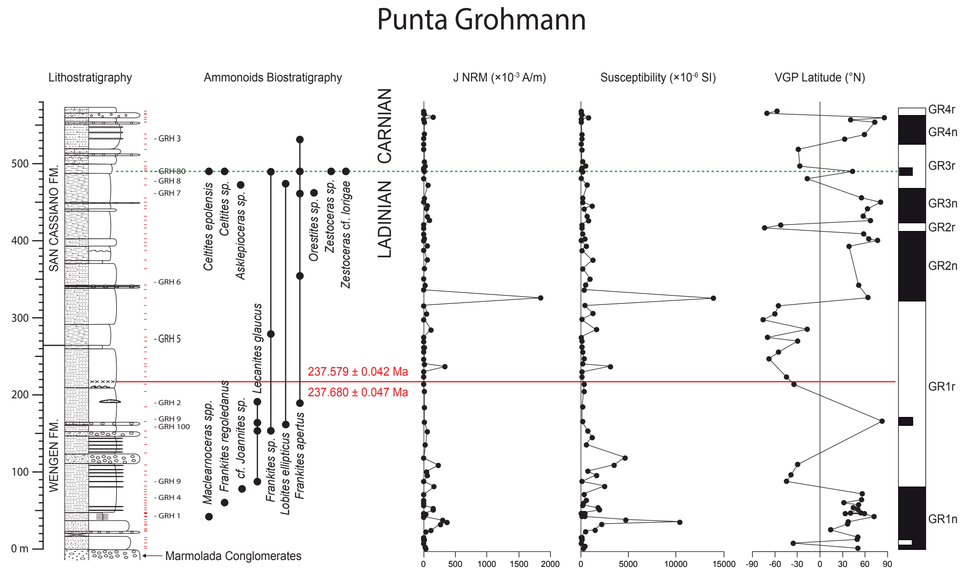
## THE LADINIAN/CARNIAN BOUNDARY

The Ladinian/Carnian boundary (LCB) is officially defined at Prati di Stuores (GSSP of the Carnian Stage; Mietto et al., 2012) with the first appearance datum of ammonoid *Daxatina canadensis* in bed SW4 (Broglio Loriga et al., 1999; Mietto et al., 2012). The age of the LCB has been recently estimated at ca. 236.8 Ma (Maron et al., 2019). In the attempt to refine the chronology of the Carnian Stage, we investigated the Ladinian-Carnian marine section of Punta Grohmann, which is time-calibrated by two U-Pb datings from the same ash-bed (237.58±0.04 Ma, 237.68±0.05 Ma; Storck et al., 2019).



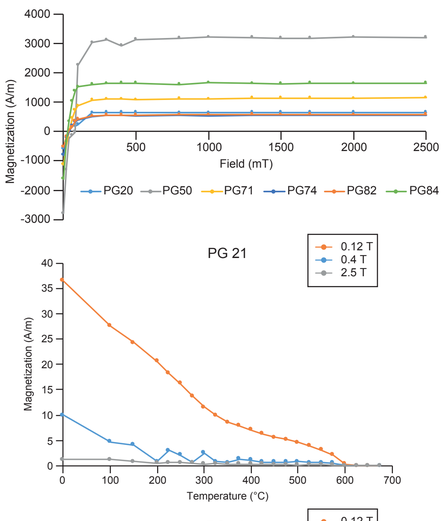

## THE PUNTA GROHMANN SECTION

The Punta Grohmann section (e.g. Gianolla et al., 1998, 2010; Mietto et al., 2012) is located in the Dolomites (Southern Alps, NE Italy), close to the Sassopiatto massif. It is a basinal sequence of ~270 m of mainly volcaniclastic sediments (Wengen Fm.) followed by ~300 m of mainly carbonatic deposits belonging to the San Cassiano Fm. The Punta Grohmann section lies above the Marmolada Conglomerates (Wengen Fm.) and is topped by the caotic breccias of the Cassian Dolomite Fm., marking the progradation of the Cassian platforms on the basinal sequences. In the lower part of the section, the ammonoid biostratigraphy is characterized by assemblages typical of the Regoledanus Subzone, while in the upper part (~490 m) the first appearance of *Zestoceras* cf. *lorigae* (Canadensis Sbz.; Mietto et al., 2012) approximates the LCB. The conodont assemblages recovered from Punta Grohmann (e.g. Russo et al., 1997) are typical of the upper Ladinian - lower Carnian interval (Gianolla et al., 2010). The U-Pb ages of 237.58±0.04 Ma and 237.68±0.05 Ma (Storck et al., 2019) are located at ~217 m.




## PALEOMAGNETISM OF PUNTA GROHMANN

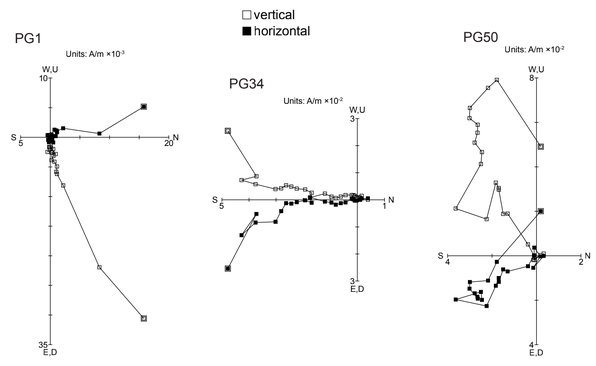
A total of 93 samples for paleomagnetism have been collected from the Punta Grohmann section, The highest values of magnetic susceptibility and NRM magnetization are generally located in the lower part of the section (within Wengen Fm.), except for a peak in both curves located in a level of the San Cassiano Fm. and probably related to locally weathered rocks. IRM acquisition and thermal demagnetization of three-axis IRM on representative samples indicate magnetite as the main carrier of the remanence in the Punta Grohmann section.

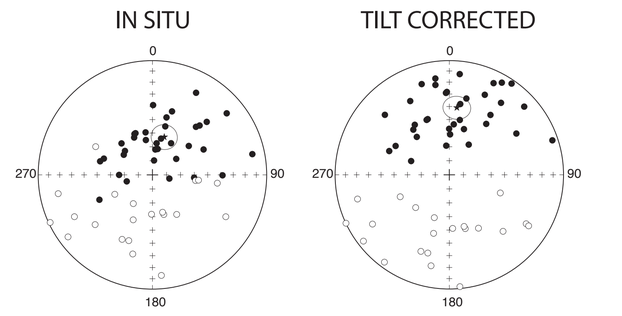








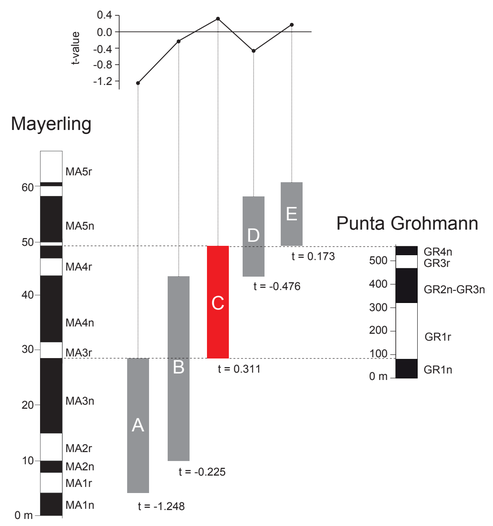

After thermal demagnetization, 56 of 93 samples revealed a ChRM component oriented north-down and south-up in *in situ* coordinates. The mean directions obtained from the ChRM components (Dec.: 6.4°E, Inc.: 40.5°, $\alpha_{95}$ = 9°) in tilt-corrected coordinates yield to a paleopole position having Lat.: 66.3°N and Long.: 176.7°E ($A_{95}$ = 6.6°). The stratigraphic sequence of the Virtual Geomagnetic Poles (VGP), calculated for each ChRM component, was used for intepreting the polarity stratigraphy. The latitude of the samples VGP defined 8 magnetozones named GR.

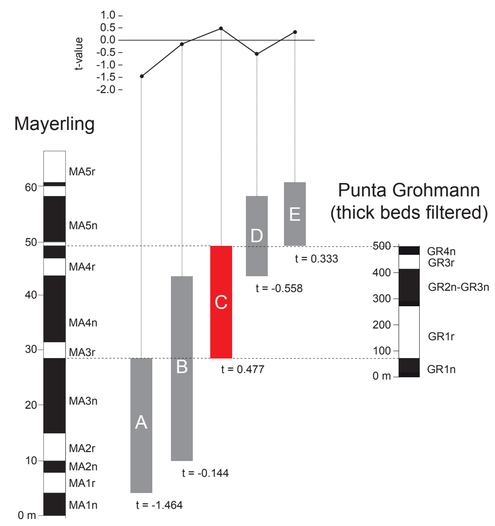
**MEAN DIRECTIONS**

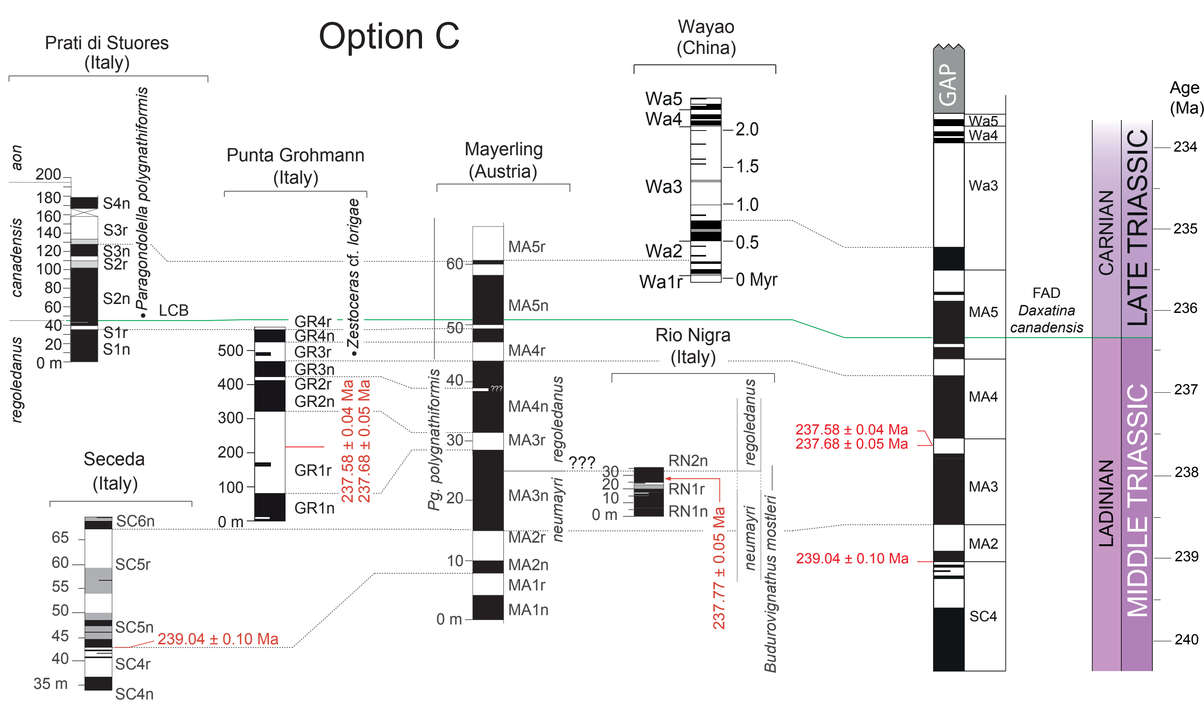
| | | In Situ | | | | Tilt-Corrected | | | |
|---|---|---|---|---|---|---|---|---|---|
| Site | N | k | $\alpha_{95}$ | Dec. | Inc. | k | $\alpha_{95}$ | Dec. | Inc. |
| **Punta Grohmann** | 56 | 5.4 | 9.1° | 17.3°E | 61.6° | 5.5 | 9.0° | 6.4°E | 40.5° |

**PALEOMAGNETIC POLE AND PALEOLATITUDE**

| Site | Lat. | Long. | k | $A_{95}$ | Paleolatitude |
|---|---|---|---|---|---|
| **Punta Grohmann** | 66.3°N | 176.7°E | 5.5 | 6.6° | 23.1°N +7.2°/-6.1° |

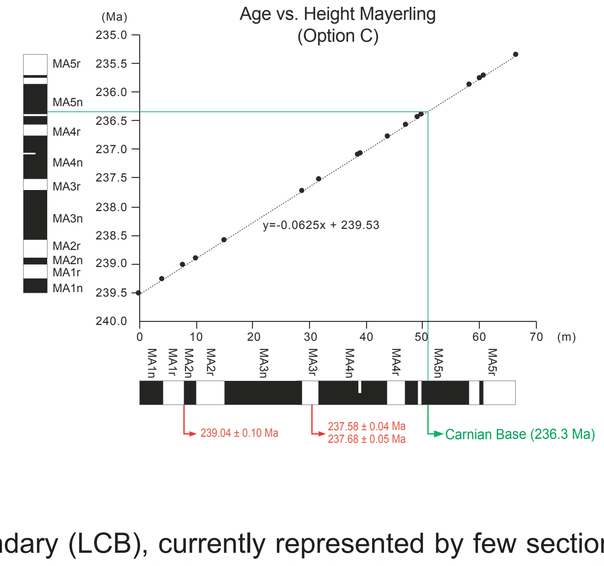



## MAGNETOSTRATIGRAPHIC CORRELATIONS

The magnetostratigraphy of the Punta Grohmann section has been correlated to the Prati di Stuores section (Mietto et al., 2012) using the ammonoid biostratigraphy to calibrate the magnetostratigraphic correlation, obtaining only one option that is in agreement with both magnetostratigraphic and biostratigraphic constraints. The correlation between Punta Grohmann and Mayerling section (Gallet et al., 1998) is based on the statistic evaluation of all the possible correaltion options obtained from sliding the Punta Grohmann magnetostratigraphy alongside Mayerling, each time comparing the thickness of the magnetozones involved (similar to Muttoni et al., 2004; Maron et al., 2015, 2019; Marini et al., 2020). The short (single and two-points) reversals in Punta Grohmann are excluded from the correlation. Among five possible options, only option C appears to be the more reliable, although with a low t-value. Inspired by the approach used on turbiditic basins by Marini et al. (2020), we excluded from the stratigraphy the thick conglomerate and slump beds, which are considered to erratically increase the accumulation rates within the section. Also in this case, option C appears to be most reliable correlation option.
Option C correlates the magnetostratigraphy of Punta Grohmann to the MA3n-MA5n.1r interval in Mayerling. Using the U-Pb ages from Punta Grohmann (Storck et al., 2019) and Seceda (239.04±0.10 Ma; Wotzlaw et al., 2018) as tie-points, we obtained an age model for the Mayerling section. The age of the LCB can be interpolated through this age model at ~236.3 Ma, about 0.5 Myr younger than previously estimated (236.8 Ma; Maron et al., 2019).




## CONCLUSIONS

The magnetostratigraphy of the Punta Grohmann section highly improved the magnetostratigraphic record around the Ladinian/Carnian boundary (LCB), currently represented by few sections (e.g. Mayerling and Prati di Stuores). The U-Pb age from Punta Grohmann provides a further chronological reference for the Middle Triassic geomagnetic polarity time scale, leading to a Ladinian/Carnian boundary age of ~236.3 Ma.

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