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Ammonoid-calibrated sporomorph assemblages reflect a shift from hygrophytic to xerophytic elements in the late Anisian (Middle Triassic) of the Southern Alps (Italy)

Jacopo Dal Corso [a,*], Guido Roghi [b], Evelyn Kustatscher [c,d], Nereo Preto [a], Piero Gianolla [e], Stefano Manfrin [a], Paolo Mietto [a]

[a] Dipartimento di Geoscienze, Università degli Studi di Padova, via Gradenigo 6, 35131 Padova, Italy
[b] Istituto di Geoscienze e Georisorse CNR, via Gradenigo 6, 35131 Padova, Italy
[c] Museo di Scienze Naturali dell'Alto Adige, via Bottai 1, 39100 Bolzano, Italy
[d] Department für Geo- und Umweltwissenschaften, Paläontologie und Geobiologie, Ludwig-Maximilians-Universität und Bayerische Staatssammlung für Paläontologie und Geologie, Richard-Wagner-Straße 10, 80333 München, Germany
[e] Dipartimento di Fisica e Scienze della Terra, via Saragat 1, 44100 Ferrara, Italy

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ABSTRACT

An integrated sporomorph and ammonoid biostratigraphy has been carried out in three upper Anisian (Middle Triassic) stratigraphic sections in the Southern Alps (Italy). Two main sporomorph assemblages have been defined and calibrated with ammonoids. The TrSM-A assemblage is marked by the co-occurrence of *Stellapollenites thiergartii*, *Dyupetalum vicentinense*, *Cristianisporites triangulatus* and *Staropollenites antonescui*. The TrSM-B assemblage is marked by the first occurrence of *Cannanoropollis scheuringii*. The boundary between the TrSM-A and TrSM-B assemblages falls in the upper part of the *reitzi* ammonoid subzone (*Hungarites* zone; Illyrian). The TrSM-A and TrSM-B assemblages have been compared and correlated with other existing sporomorph biozonations for the northwestern Tethys, the Germanic Basin and the Barents Sea.
The first occurrence of the genus *Ovalipollis* is recorded within the assemblage TrSM-A, in the lower–middle *reitzi* ammonoid subzone.
Quantitative palynological data coupled with previously published studies show a shift from hygrophytic to xerophytic elements in the *trinodosus*–lower *reitzi* ammonoid subzones. This change in precipitation range can be recognised in other sections in the northwestern Tethys but seems to have preceded a similar shift recorded in the Boreal realm.

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1. Introduction

This paper focuses on the palynomorphs of three upper Anisian stratigraphic sections in the Southern Alps (Italy), to calibrate the sporomorph biostratigraphy with ammonoid biozonation and to study the relative abundance of different sporomorph groups to infer possible changes in the Anisian flora of the Southern Alps and, by inference, humid–arid climate shifts.

The Middle Triassic is generally considered a period of arid and warm climate, but some evidences of more humid climate intervals exist (Preto et al., 2010). Kustatscher et al. (2010) have described sporomorphs assemblages reflecting more humid climatic conditions in the middle Anisian (Middle Triassic) of the Southern Alps, constrained with ammonoid within the *balatonicus*-base of the *trinodosus* ammonoid subzones (*Balatonites*-base of *Paraceratites* ammonoid zones sensu Mietto and Manfrin, 1995). A similar Anisian hygrophytic microflora has been described also in Hungary (Brugman, 1986) and in the Barents Sea (Magerud and Rømuld, 1991; Hochuli and Vigran, 2010). However, it is difficult to understand at which extend this climatic shift in humidity can be referred to the same large-scale event or different diachronous regional shifts (Preto et al., 2010; Stefani et al., 2010), considering the lack of a solid ammonoid-calibrated and detailed sporomorph biozonation for part of the late Anisian not allowing to properly correlate the events.

This paper shows the integrated sporomorph and ammonoid biostratigraphy from the Middle Triassic (Anisian) Palus-San Marco section in the Dolomites (Southern Alps, Italy). Coeval stratigraphic sections in the Valsugana (Rio dei Carrari and Val di Centa) have been studied to test the biostratigraphic zonation in a different location within the Southern Alps. The sporomorph assemblages have been calibrated with the ammonoid biostratigraphy and compared to the Anisian sporomorph biozonations previously proposed in the Tethyan realm

* Corresponding author. Tel.: +39 049 8279174.
E-mail address: jacopo.dalcorso@unipd.it (J. Dal Corso).

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(Van der Eem, 1983; Brugman, 1986) and in the Germanic Basin (Heunisch, 1999; Kürschner and Herngreen, 2010 and references therein; Fijałkowska-Mader, 2013). A late Anisian shift from humid to arid climatic conditions is documented by the change in relative abundance of hygrophytic and xerophytic sporomorph groups and constrained by biostratigraphic correlation at least for the northwestern Tethys.

2. Geological setting and studied sections

During the Late Anisian, in the Southern Alps, a broad carbonate platform (Contrin Formation) was surrounded by deep-water basin both in the eastern Dolomites (Bivera Formation and Ambata Formation; De Zanche et al., 1993; Neri et al., 2007) and in Valsugana (Margon Dark Limestone, De Zanche and Mietto, 1989; Fig. 1). Successively, extensional tectonics broke-up the uniform carbonate platform of the Contrin Fm. resulting in a very complex palaeotopography of shallow-water and of deep-water environments (Masetti and Neri, 1980; Masetti and Trombetta, 1998; Preto et al., 2011). In the basins hemipelagic sedimentation began (Ambata and Livinallongo formations in the Dolomites and Val di Centa Marls in Valsugana), while the development of the carbonate platforms continued on structural highs (Sciliar Formation including the "Lower Edifice" sensu De Zanche et al., 1993).

2.1. The Palus-San Marco section (Dolomites)

The Palus-San Marco sedimentary succession (46°32′06″ N 12°17′08″ E; Fig. 1A) has been deposited in a basin proximal to a carbonate platform. It encompasses the upper part of the Bivera Fm., the Ambata Fm. and the upper Knollenkalke Member of the Livinallongo Fm. The

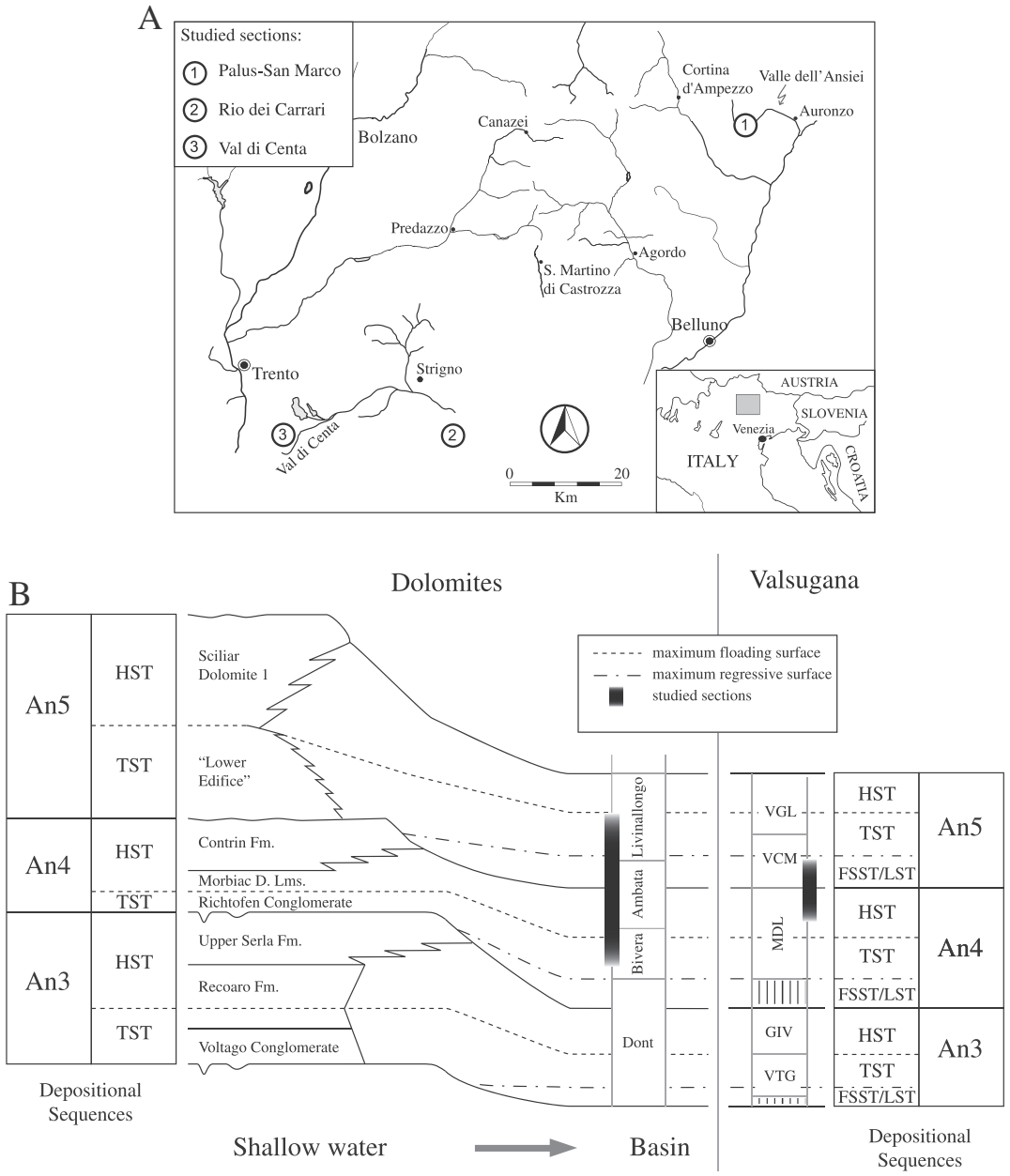

Fig. 1. A) Map of the study area and location of the sampled stratigraphic sections. B) Schematic stratigraphy and sequence stratigraphy of the studied interval in the Dolomites and Valsugana. FSST = Falling Stage Systems Tract; LST = Lowstand Systems Tract; TST = Transgressive Systems Tracts; HST = Highstand Systems Tract. VTG = Voltago Conglomerate, GIV = Giovo Formation, MDL = Margon Dark Limestone, VCM = Val di Centa Marls, VGL = Val Gola Limestone. Sequence stratigraphy and lithostratigraphy after Gianolla et al. (1998), Neri et al. (2007), Avanzini et al. (2010), Stefani et al. (2010).

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