

## SCYTHIAN-ANISIAN LITHOSTRATIGRAPHIC UNITS IN THE SOUTHERN ALPS

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with 3 figures

### Summary

In this study a formally unified stratigraphic nomenclature of the Scythian-Anisian units in the Southern Alps is suggested. From bottom to top the sequence is synthetically defined as follows:

- 1) Werfen Formation (Formazione di Werfen): under this term the Servino Fm. is included;
- 2) Lower Serla Dolomite (Dolomia del Serla inferiore, Unterer Sarldolomit): this term stands for names as Formazione del Serla inferiore, Werfener Grenzdolomit, Carniola di Bovegno, Dolomia di Elto, Werfeniano superiore, Formazione di Lusnizza and other informal terms;
- 3) Braies Group (Gruppo di Braies, Pragser Schichten): it comprises the terrigenous and terrigenous-carbonatic units which lie between the Lower Serla Dolomite and the Buchenstein Formation group or carbonate platforms.

### Zusammenfassung

In der vorliegenden Arbeit wird eine einheitliche stratigraphische Nomenclatur der skythisch-anisischen Einheiten der Südalpen vorgeschlagen. Die Abfolge vom Liegenden zum Hangenden wird wie folgt definiert:

- 1) Werfener Formation (Formazione di Werfen): zu diesem Begriff zählt auch die Servino-Formation;
- 2) Unterer Sarldolomit (Dolomia del Serla inferiore): umfaßt Begriffe wie Unterer-Sarldolomit-Formation (Formazione del Serla inferiore, Werfener Grenzdolomit, Carniola di Bovegno, Dolomia di Elto, Werfeniano superiore).

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- riore, Formazione di Lusnizza und andere lokale Schichtbezeichnungen;
- 3) Prager Schichten (Gruppo di Braies): Sie umfassen die terrigenen und terrigen-karbonatischen Einheiten zwischen dem Unteren Sarldolomit und den Buchensteiner Schichten bzw. den Karbonatplattformen.

## Introduction

The current nomenclature of the Triassic lithostratigraphy in the Southern Alps is very complex and often characterized by a great number of synonyms. For the last 150 years new names have been introduced by geologists of different schools during their local studies.

The present paper is mainly intended to suggest a unitary terminology for the Scythian and Anisian lithostratigraphic units because of their extensive occurrence throughout the Southern Alps and the substantial uniformity of their general features.

The sequences will be described following a regional subdivision as commonly used in geological literature (e.g. ASSERETO in DESIO, 1973). From East to West we shall therefore discuss the following regions: Julian Alps and Tarvisio area, Carnian Alps, Vicentinian Alps, Central and Eastern Lombardy, Western Lombardy and Piedmont, Po Plain.

### The stratigraphic sequences:

#### a - Julian Alps and Tarvisio area

The most complete sequence is, from bottom to top, the following:

- 1) siltstones, sandstones, oolitic and bioclastic limestones, dolomitic limestones (Werfen Formation). This unit is gradually followed by:
- 2) limestones, dolomitic limestones, dolomites and vuggy dolomites (Lusnizza Fm.) overlain, after a gradual transition or, locally, a sharp erosional boundary, by:
- 3) limestones and brown nodular limestones (Valbruna Limestone); this unit is unconformably covered by:
- 4) red and grey conglomerates, sandstones and pelites of the Ugovizza Breccia (cf. ASSERETO & PISA in DESIO, 1973, fig. 60).

Locally some terms of the sequence are missing owing to Anisian erosional events which affected great parts of the Paleozoic-Mesozoic succession (ASSERETO & PISA, op. cit.; ROSSI, 1973). PISA et al. (1979) included the terms 3 and 4 in the Braies Group following PIA's (1937) subdivisions in the Northern Dolomites.

#### b - Carnian Alps

The sequence is similar to the one in the neighbouring Tarvisio area:

- 1) siltstones, sandstones, dolomitic limestones, oolitic and bioclastic limestones (Werfen Fm.) followed after a gradual transition by:
- 2) dolomites, vuggy dolomites, breccias and gypsum (Formazione di Lusnizza of ASSERETO & PISA, op. cit.; "Unità inferiore" di SELLI in DESIO, 1973;

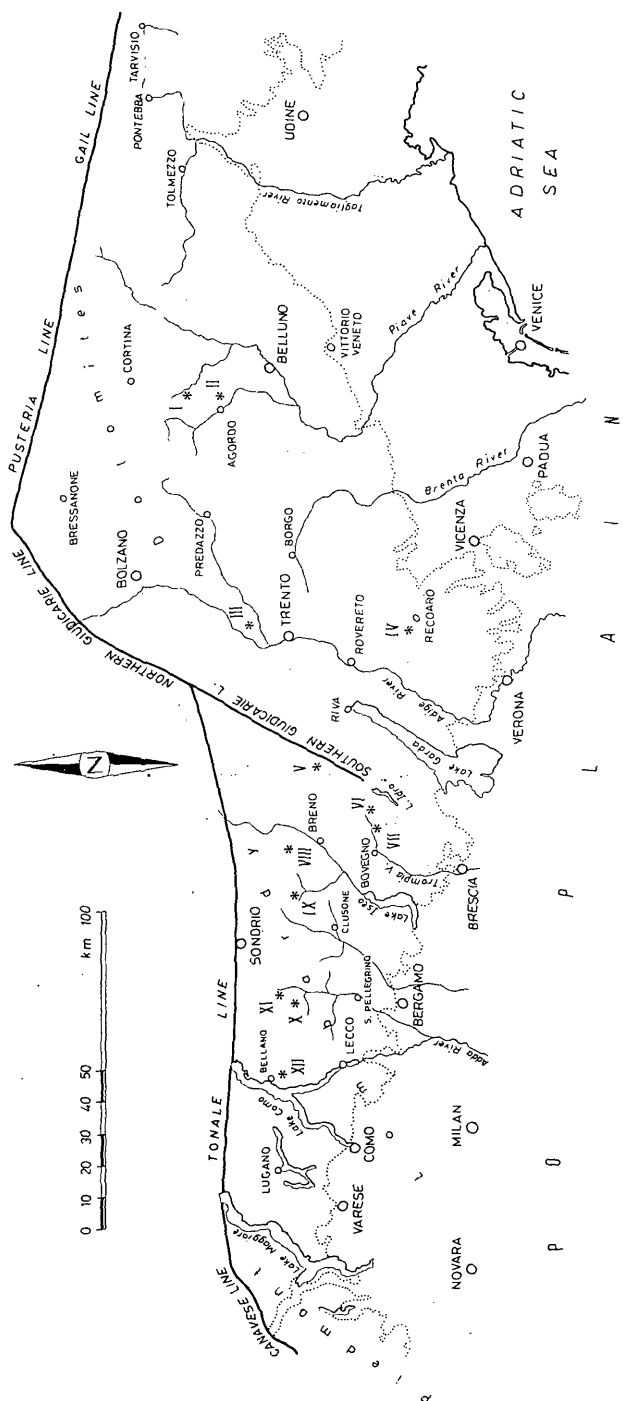


Fig. 1: Index map of the Southern Alps

I: Spiz Agnellesa section (Zoldo Valley); II: Val Cassanola section (Agordo area); III: Monte Corona section (Adige Valley); IV: Val Calda section (Recoaro area); V: Dosso dei Morti section (Giudicarie Valley); VI: Passo del Maniva section; VII: Val Fontanelle section (Trompia Valley); VIII: Passo dell'Erbugno section (Camonica Valley); IX: Vilminore-Pianezze road section (Scalve Valley); X: S. Brigida section (Brembana Valley); XI: Passo S. Marco section (Brembana Valley); XII: Val Muggiasca section

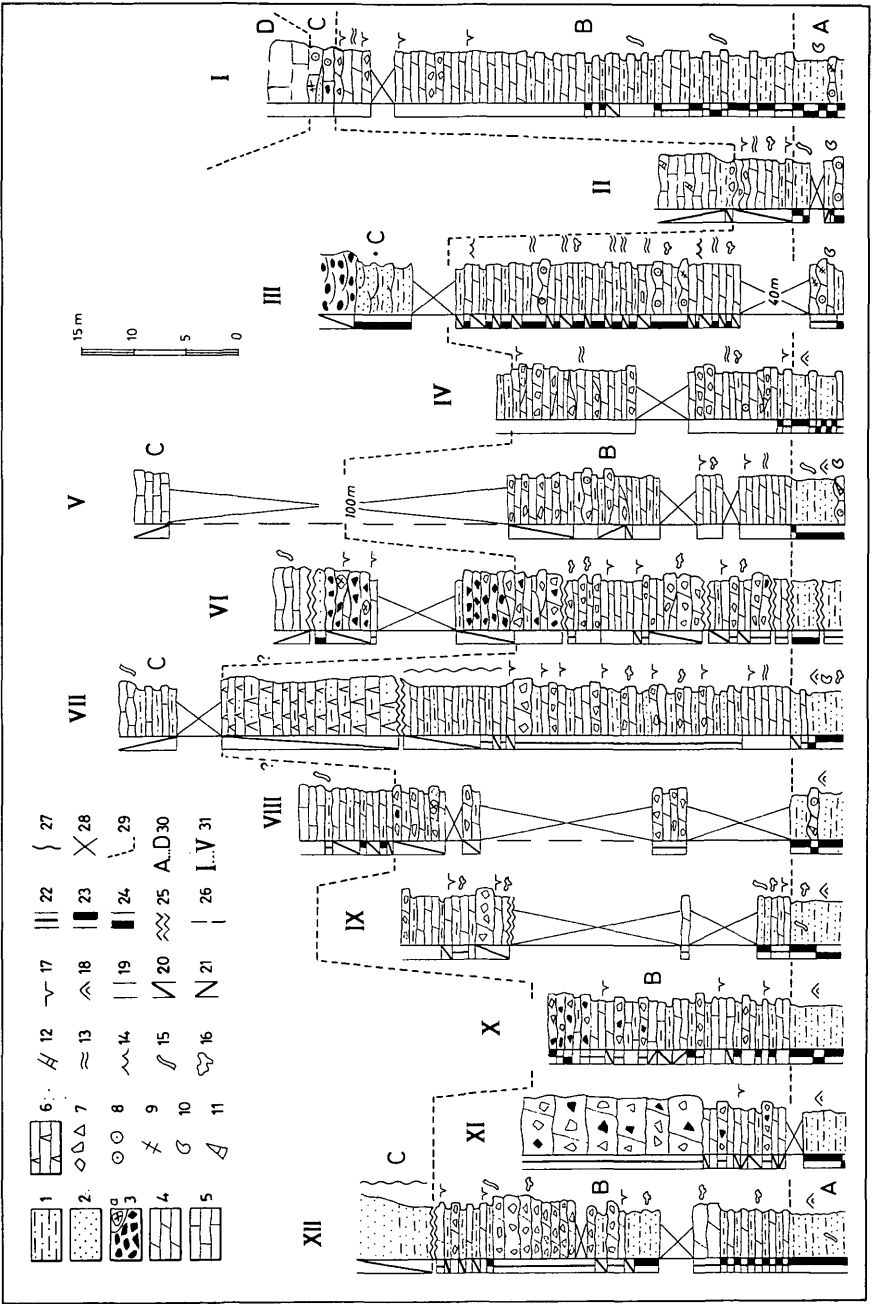


Fig. 2

Fig. 2: Stratigraphic sections

Legend: 1) pelites and fine sandstones; 2) medium to coarse sandstones; 3) extraformational breccias, a) volcanic fragments; 4) dolomites; 5) limestones; 6) gypsum arenites; 7) intraformational fragments; 8) oolites; 9) crinoids; 10) foraminifers; 11) gastropods; 12) calcareous algae; 13) planar stromatolites; 14) embryo tepees; 15) bioturbation; 16) cavities; 17) mud-cracks; 18) wave ripples; 19) grey; 20) light grey to whitish; 21) dark grey to blackish; 22) yellow; 23) green; 24) red and violet; 25) fault; 26) not measured thickness; 27) tectonically deformed beds; 28) detrital cover; 29) lithostratigraphic correlation; 30) A- Werfen Fm, B-Lower Serla Dolomite, C-Braies Group, D-Upper Serla Dolomite; 31) sections (see fig. 1)

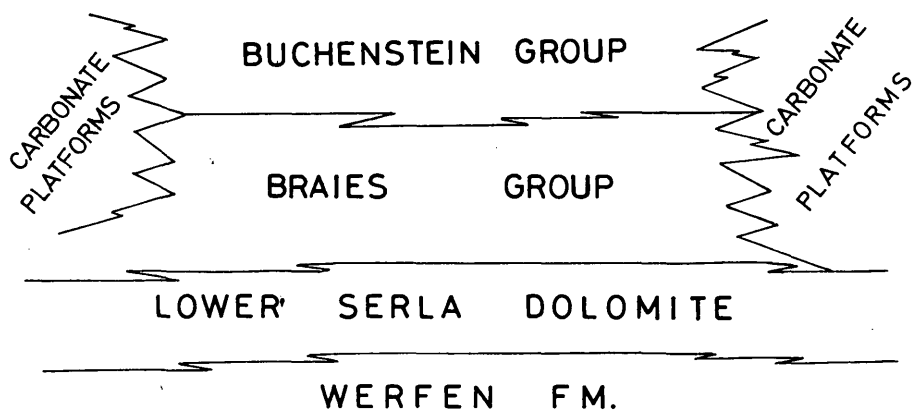


Fig. 3: Schematic relationship between the Scythian-Anisian units in the Southern Alps

Formazione di Lusnizza + "dolomie stratificate" of PISA, 1974; Lower Serla Dolomite of PISA et al., 1979; Formazione di Lusnizza + Formazione del Serla Inferiore of JADOUL & NICORA, 1979). The subsequent transition, gradual (PISA, 1972) or locally erosional (FARABEGOLI & LEVANTI, 1982), is characterized by:

3) dolomites and dolomitic limestones (Serla dolomite in PISA, 1974; Upper Serla Fm. in JADOUL & NICORA op. cit.), calcarenites, siltstones, sandstones and conglomerates (Braies beds in PISA et al., op. cit.; Braies Group in FARABEGOLI & LEVANTI, 1982).

#### c - Dolomites

The first description of the complete sequence in the Braies area was given by PIA (1937); BECHSTÄDT & BRANDNER (1970) confirmed the main outlines. A similar sequence was then recognized in the Southeastern Dolomites (FARABEGOLI et al., 1977; PISA et al., op. cit.) and in the Cadore area (ASSERETO et al., 1977; MARINELLI, 1980).

From bottom to top following units are recognizable (see columns I and II in fig. 2):

- 1) sandstones, siltstones, dolomitic limestones, oolitic and bioclastic limestones (Werfen Fm.). Through gradual transition the unit is overlain by:
- 2) dolomites, silty dolomites, siltstones, marls (Lower Serla Dolomite), which are covered, after a sharp erosional boundary or gradual transition, by:
- 3) siltstones, marls, calcarenites and conglomerates (Braies Group) or massive dolomites and dolomitic limestones (Upper Serla Dolomite).

In the Central Dolomites the Lower Serla Dolomite was eroded due to Anisian tectonic events which caused the uplift of the Badioto-Gardenese Ridge. On the Western margin of the ridge (neighbourhood of Trento) the sequence (see col. III in fig. 2) shows features similar to those to be observed in the Southeastern Dolomites: the transition from the Werfen Fm. to the Lower Serla Dolomite is gradual, while the subsequent one to the siltstones, sandstones, conglomerates, limestones and dolomites (Braies Group) is gradual or sharp).

#### d - Vicentinian Alps

In the Recoaro area (see col. IV in fig. 2) the sequence consists of:

- 1) sandstones, siltstones, limestones and dolomites (Werfen Fm.) which are gradually overlain by:
- 2) dolomicrites, vuggy dolomites, pelites, sandstones, intraformational breccias ("Rauchwacken oder Zellendolomit" in BITTNER, 1883; "Werfener Grenzdolomit" in TORNQUIST, 1901; Lower Serla Fm. in DE ZANCHE et al., 1980). Again after a gradual transition follows:
- 3) "Gracilis Formation" consisting of alternating siltstones, sandstones, marls, silty and sandy limestones, calcarenites, dolomites, gypsum and locally breccias containing intra- and extraformational clasts (Val Leogra Breccia in DE ZANCHE et al., 1981). According to the original definition of PIA, the unit should be classed with the Braies Group.

#### e - Central and Eastern Lombardy

On the whole the sequence (see col. VI-XII in fig. 2) is rather uniform. From bottom to top it consists of:

- 1) green and red sandstones and pelites, sometimes oolitic calcarenites and dolomicrites of the Servino Fm. (cf. ASSERETO & CASATI, 1965, cum bibl.; CASSINIS, 1968). A gradual transition leads to:
- 2) dolomicrites, often vuggy dolomites and dolomitic limestones, pelites, prevailing intraformational breccias of the Carniola di Bovegno Fm (cf. ASSERETO & CASATI, op. cit.; MICHELETTI, 1970; FARABEGOLI & DE ZANCHE, 1980). In the Camonica Valley two lenses of gypsum (Castelfranco) and anhydrite (Volpino) are known (ASSERETO & CASATI, op. cit.). In the Fontanelle Valley (Trompia Valley) the uppermost part of the unit also consists of a gypsum arenitic lithozone, little more than 15 m thick. Through gradual transition the Carniola di Bovegno Fm. is overlain by:
- 3) pelites, silty micrites, sandstones, conglomerates, breccias containing prevailing extraformational clasts, followed upwards by:
- 4) dark silty limestones (Angolo Limestone).

The terms 3 and 4 in this case also clearly belong to the Braies Group. Besides it is possible that the gypsum arenites of the Fontanelle Valley, generally classified as part of the Carniola di Bovegno Fm., may belong to the same group.

#### f - Western Lombardy - Piedmont

In this area the stratigraphic and paleogeographic setting is different from the one known in the central and eastern parts of the Southern Alps (cf. LEHNER, 1952; BERNOULLI, 1964; GIANOTTI, 1968). Generally the sequence is not complete since, in our opinion, the Servino Fm. and the Carniola di Bovegno Fm. seem to have been eroded. In geological literature only one remark (FRAUENFELDER, 1961) about facies and fossils belonging to the Servino Fm. is to be found; further field research, however, is necessary.

#### g - Northeastern Po Plain

The data from some AGIP oil wells (cf. DE ZANCHE & FARABEGOLI, 1981) have made it possible to recognize a sequence completely comparable with those outcropping in the Dolomites, in the Recoaro area and in the Central-Eastern Lombardy. From bottom to top it consists of:

- 1) siltstones, sandstones, limestones and dolomites (Werfen Fm);
- 2) dolomicrites and calcarenites (Lower Serla Dolomite);
- 3) pelites, sandstones and conglomerates (Braies Group).

#### Conclusive remarks

The above synthetic regional review makes it possible to define the Scythian-Anisian lithostratigraphic interval in the Southern Alps as follows:

A) According to the regressive trend of a tectono-sedimentary cycle (cf. FARABEGOLI & VIEL, 1981), the siltstones, sandstones, limestones and dolo-

mites of the Werfen Fm. and the Servino Fm. are overlain by prevailing dolomites, dolomitic breccias and gypsum of the Lower Serla Dolomite and of the Carniola di Bovegno Fm.

The top of the regressive trend is clearly definable only where it is marked by an erosional surface (see col. I and II in fig. 2). On the margin of the emerged areas the regressive trend has produced terrigenous-carbonatic sediments interpreted as belonging either to the underlying units (see col. VI-XII in fig. 2; cf. former papers) or to the overlying ones (e.g. GAETANI, 1969, fig. 2).

B) The following transgressive phase is characterized by variously arranged terrigenous and terrigenous-carbonatic sediments (Braies Group) or by carbonate platforms (Upper Serla Dolomite).

The uniformity of the sequence is emphasized by the constant presence of terrigenous and terrigenous-carbonatic sediments at its top, in the central part of the Southern Alps too (see col. VI-XII in fig. 2). This fact has not been recognized before, as the terrigenous facies, which undoubtedly belong to the Braies Group, have not been defined yet (cf. PISA et al., 1979).

C) We therefore suggest the following unified sequence to be used formally for the Southern Alps (see fig. 3):

- 1) Werfen Formation (Formazione di Werfen, Werfener Formation)
- 2) Lower Serla Dolomite (Dolomia del Serla inferiore, Unterer Sarldolomit)
- 3) Braies Group (Gruppo di Braies, Pragser Schichten)

We also want to draw attention to the fact that sequences belonging to the Braies Group very frequently occur in the Southern Alps. In detail, according to PIA (1937), this unit includes the basinal, lagoonal, peritidal and continental terrigenous and terrigenous-carbonatic facies which lie between the Lower Serla Dolomite and the Buchenstein Group. This seems to be the only lithostratigraphic term which may unify the nomenclature.

The above proposal substantiates the general necessity of correlating the various Triassic sequences in many regions of the Southern Alps described since the last century by e.g. HAUER (1858), BITTNER (1883) and more recently by TREVISAN (1939). Therefore, the terms we suggest for the Scythian-Anisian interval seem to be very useful, since they belong either to lithostratigraphic units defined in detail at the beginning (Lower Serla Dolomite and Braies Group) or to units which, moreover, were the very first to be used for lithostratigraphic correlations all over the Southern Alps (Werfen Fm.).

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