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THE SASS DA PUTIA CARBONATE BUILDUP (WESTERN DOLOMITES): BIOFACIES SUCCESSION AND MARGIN DEVELOPMENT DURING THE LADINIAN

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Riassunto. Il massiccio del Sass da Putia (S. Martino in Badia, Dolomiti Occidentali) è costituito da facies di piattaforma carbonatica (Dolomia dello Sciliar, Ladinico) che lungo il versante meridionale si indentano con le coeve facies bacinali (Fm. di Buchenstein, Gruppo di Wengen).

La successione stratigrafica pre-ladinica, tipica delle Dolomiti Occidentali, viene illustrata a grandi linee, mentre le facies di indentazione fra piattaforma carbonatica e sedimenti bacinali, sono oggetto di uno studio dettagliato. Sono stati riconosciuti 7 livelli, rispettivamente costituiti da (dal basso):

a - Facies prossimali (calciruditi/calcareniti gradate) della Fm. di Buchenstein (circa 10 m in affioramento).

b - 1° orizzonte di megabreccia (calcareo, 1-7 m).

c - Facies prossimali (analoghe al livello a) della Fm. di Buchenstein (circa 30 m).

d - 2° orizzonte di megabreccia (dolomitizzato, 20-40 m).

e - Unità clastiche superiori del Gruppo di Wengen (arenarie vulcanoclastiche, orizzonte conglomeratico, circa 100 m).

f - 3° orizzonte di megabreccia (calcareo, 0-20 m).

g - Ultimo orizzonte calcareo (max. 5 m) interpretato come facies di pendio più prossimali. Sopra q. 2230 m gli affioramenti sono completamente dolomitizzati.

L'analisi delle microfacies delle megabrecce ha fornito ampie informazioni sulle comunità di organismi costruttori che caratterizzavano il margine della piattaforma durante il Ladinico. La comunità di organismi presente nella parte inferiore dell'edificio carbonatico, eteropico con la Fm. di Buchenstein, sembra essere piuttosto povera e composta quasi esclusivamente da forme incrostanti (lamine di alghe blu-verdi, *Tubiphytes*, *Bacinella ordinata*, e subordinatamente Foraminiferi sessili). I Coralli sono decisamente rari (*Margarosmilia septanectens*).

I livelli di calciruditi gradate della parte superiore del livello e), e il 3° orizzonte di megabreccia, sono caratterizzati da una comunità più differenziata. Sono diffusi gli Sphinctozoi e i Coralli diventano più abbondanti, anche se le Alghe Solenoporacee sembrano le forme predominanti. Sono presenti in forma sporadica anche Idrozoi, Tabulozoi, mentre i microorganismi problematici sono piuttosto diffusi. Fra questi viene istituita la nuova specie *Bacinella elongata* sp. n.

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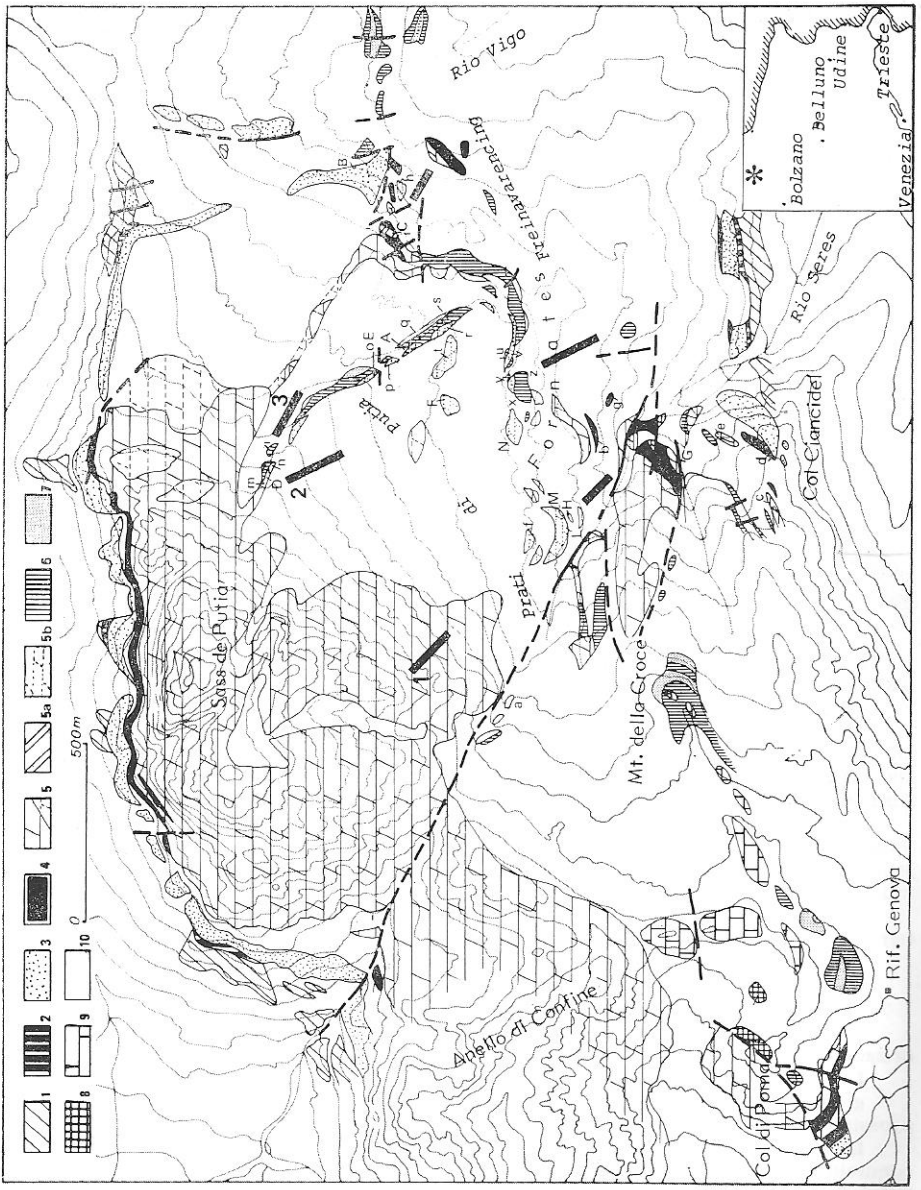

Fig. 1 - Geological sketch map of the area of Sass da Putia. 1, Werfen Fm.; 2, Richthofen Conglomerate and Morbiac Lst.; 3, Contrin Fm.; 4, Buchenstein Fm.; 5, Sciliar Dolomite (dashed lines indicate subcropping areas); 5 a, First megabreccia horizon (Level b in the text); 5 b, Third megabreccia horizon (Level f in the text); 6, Wengen Group (sandstones); 7, Wengen Group (conglomerates, level e in the text); 8, S. Cassiano Fm.; 9, Cassian Dolomite; 10, eluvium. Large numbers 1, 2, 3 refer to the sections in Fig. 3. Small and large letters refer to sample sites as follows: a, EF 39; b, EF 40-41; c, EF 42; d, EF 43; e, EF 44; f, EF 45; g, EF 46; h, EF 47; i EF 48 to 57; l, EF 58-59; m, EF 60 to 62; n, EF 63; o, EF 64; p, EF 65 to 70; q, EF 71; r, EF 72 to 75; s, EF 76; t, EF 77-78; u, EF 79; v, EF 80; z, EF 84-85; x, EF 86-87; y, EF 88; A, G 1093 to 1094; B, S 182 to 184; C, S 185 to 189; D, S 200-201; E, S 202 to 204; F, S 206-207; G, S 208; H, S 209-210; L, S 211; M, S 212; N, S 213-214. Continuous-dashed black thick lines indicate faults.

Introduction.

The analysis of the carbonate platform of Sass da Putia (S. Martino in Badia, Bz) is part of a wider research program on Ladinian-Carnian carbonate platform microfacies in Southern Alps. The area of Sass da Putia has been analyzed as there, the minute interfingering of slope facies and coeval basinal units (Buchenstein Fm. and Wengen Group) widely crops out (Fig. 1, 3). Additional informations on the geological setting will be added as the last paper concerning the stratigraphy of that area is by Mutschlechner (1933).

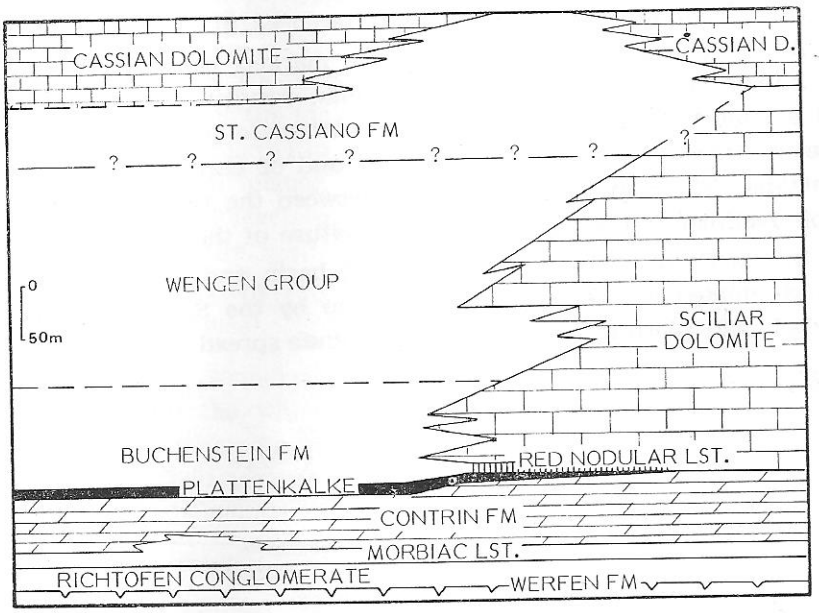

Fig. 2 - Simplified stratigraphic relationships inferred for the Sass da Putia area. Vertical scale 1 cm = 50 m.

Although the whole carbonate platform is not preserved (only the slope facies crop out), the subject displayed a great interest as: a) the outcrops are still mainly calcareous, b) the carbonate buildup seems to grow continuously during the basinal sedimentation (Buchenstein Fm., Wengen Group), giving a good control on a possible time-evolution of the biofacies, c) the analysis of the microfacies of the megabreccias supplies a general look on the characters of the margin of the carbonate platform, that frequently is fully dolomitized (Latemar Group, Mt. Coldai, Pale di San Martino) (Fois & Gaetani, 1980; Gaetani et al., 1981; Biddle, 1981).

Geological setting.

The pre-Ladinian sequence is the same of elsewhere in the Western Dolomites. The area was emergent during almost the entire Anisian and underwent numerous erosional cycles; the last one (Illyrian) is recorded by the Richthofen Conglomerate. A rapid transgression with lagoonal sediments (Morbiac Limestone) passing to a subtidal carbonate bank (Contrin Fm.) followed (Bosellini, 1968; Assereto et al., 1977; Masetti & Neri, 1980) (Fig. 2).

The Ladinian sequence generally follows the depositional trend characteristic of the areas distant from the volcanic centres (Assereto et al., 1977; Viel, 1979), showing some differences in detail.

At the beginning of the Ladinian a marked tectonic activity splits the homogeneous Contrin carbonate bank, resulting in a deeper basin and a submarine relief, on which the carbonate platform continued to develop. Hence, two sequences, basinal and of carbonate platform, are detectable. The minute interfingering between the two areas during the whole Ladinian is the most interesting feature of the Sass da Putia area.

In the Carnian the differentiation of basin and carbonate platform was eliminated as the basin was filled up by the S. Cassiano Fm. and the carbonate platform of the Cassian Dolomite spread over the whole area.

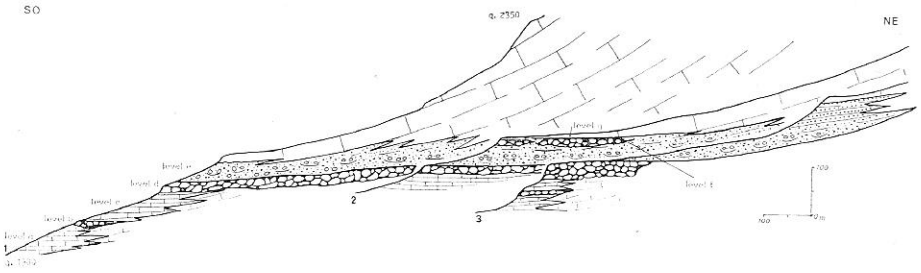

Fig. 3 - Reconstruction of the evolution of the carbonate platform of Sass da Putia showing the relationships between levels a, b, c, d, e, f, g described in the paper. Numbers 1, 2, 3 correspond to topographic profiles indicated in Fig. 1.

Basinal sequence.

The analysis of the basinal sequence is complicated by faults with E-W trend, connected to the Funes fault. For what concerns the lithostratigraphic nomenclature, that of the German Authors (Mojsisovics, 1879; Nöth, 1929) appears to me the easiest to apply at least to the Lower Ladinian, and it will be followed here.

From bottom to top the following units are recognizable:

a) Plattenkalke. This level also crops out in the area of the carbonate platform sequence. The dark, planar bedded, bituminous dolomitic limestones, are not widespread and do not exceed 10 m in thickness. The unit mainly crops out along a belt around the Sass da Putia carbonate body (northern wall of Sass da Putia, q. 2300 m; Col Ciancidel, q. 2300 m; Rio Seres, q. 1800 m) and also at Mt. Cengles. Possibly in the future it would appear more useful to consider the Plattenkalke as a unit independent from the Buchenstein Fm., as the genesis and the outcrop areas of the two lithofacies are partly different (Masetti & Neri, 1980; Gaetani et al., 1981).

b) Knollenkalke. The nodular, cherty, grey calcilutites rich in pelagic Bivalves represent the most widespread and typical basinal facies during the Early Ladinian (Rio Vigo, Rif. Genova). On Col Ciancidel, they are replaced by thin, planar bedded, dark calcarenites with millimetric lighter laminae, and levels of black chert, more similar to the Bänderkalke of the literature.

Locally towards the top, scattered horizons of Pietra Verde occur (Ciancidel, Mt. Cengles).

The following sequence presents some problems of nomenclature, because although the whole clastic succession is easily recognized as Wengen Group, the single units described in the southern areas of Dolomites by Viel (1979) are not identifiable. Thus, I have established a local subdivision which includes from bottom to top:

1) Basal Sandstones (mainly feldspatic litharenites).

2) Conglomeratic level composed of clasts of Knollenkalke (Buchensteiner Agglomerate of Mutschlechner, 1933). This mainly chaotic episode, max. 50 m thick (Rio Vigo) is of local importance. It is probable a submarine slump deposit but the lack of sedimentary structures and good outcrops makes it difficult to identify the source area.

3) Sandstones and subordinate greenish calcilutites (max. 15 m).

4) Areally limited subvolcanic bodies with plagioclase and pyroxene (max. 30 m) (« Augitporphyrite » of Mutschlechner, 1933) (Rio Vigo).

5) Volcaniclastic sandstones with a huge, laterally discontinuous conglomeratic horizon (max. 100 m) (« Wengen Agglomerate » of Mutschlechner, 1933).

Carbonate platform sequence.

This sequence crops out at the Sass da Putia, where the interfingering between platform and basinal units is preserved. The main edifice is supposed to correspond to the carbonate body outcropping in the Anello di Confine area, farther west. From bottom to top are recognizable:

a) Contrin Fm.

b) Plattenkalke (1.50 m, northern wall of Sass da Putia, q. 2300 m).

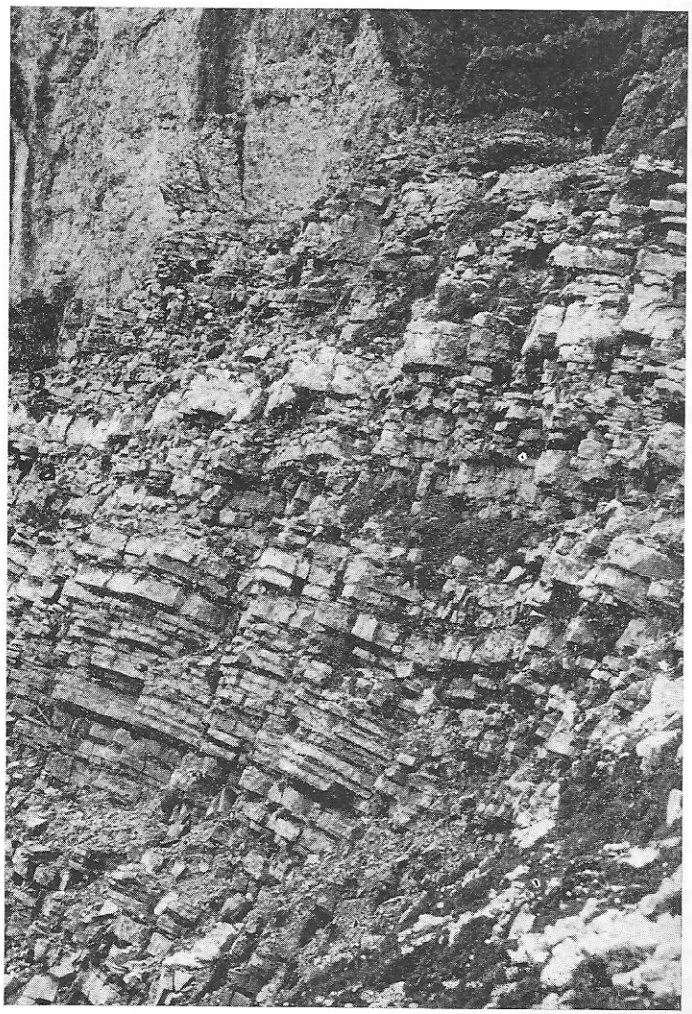

Fig. 4 - Red nodular limestones outcropping on the northern wall of Sass da Putia (q. 2300 m). Letters a and b indicate levels bearing Conodonts.

c) Red nodular limestones. Particularly interesting is, above the Plattenkalke, a level (max. 2.25 m in thickness) of reddish, nodular calcilutites bearing pelagic Bivalves and Conodonts (*Gondolella transita* Kozur & Mostler, *G. constricta* Mosher & Clark, *G. trammeri* Kozur, *G. excelsa* (Mosher), *G. mombergensis* Tatge, *Gladigondolella tethydis* (Huckriede), A. Nicora pers. comm.). This facies of Rosso Ammonitico, till now recognized only in the Marmolada area (Passo Pasche, western Dolomites) (Rossi, 1962; Gaetani et al., 1981), crops out on the northern wall of Sass da Putia at 2300 m (Fig. 4), while along the southern side it is replaced by pink, slightly nodular dolomites (Col Ciancidel, Rio Seres). The nodular calcilutites are interbedded with graded calcarenites analogous to the distal slope facies outcropping on the southeastern side of Sass da Putia (Freinavarencing). I speculate that, after the anoxic event of the Plattenkalke, a shortly lived submarine high locally developed in the area of Sass da Putia. However, the interbedded calcarenitic levels indicate that a carbonatic platform was still growing in the vicinity (a possible area would be the Anello di Confine, farther west); thus it would be more likely, instead of a true pelagic high separated from the platform, to hypothetyze a temporary lower plateau along the upper slope, on which the platform sedimentation rapidly resumed.

d) Sciliar Dolomite. Huge dolomitic body (at least 400 m thick) showing inclined bedding in its upper part, of some 20°-25° towards southeast. Because macroscopic discontinuity surfaces were not detectable, the growth of the carbonate platform is here considered at first sight to be continuous.

The interfingering between platform and basinal sediments.

Along the southeastern side of Sass da Putia (Fornates, Freinavarencing) the huge carbonate body passes, within 2 km, to a series of megabreccia horizons intercalated with more basinal sediments.

A detailed sequence from bottom to top is as follows (from q. 2025 m to q. 2230 m approximately):

a) proximal facies of Buchenstein Fm. (some 10 m);
b) calcareous megabreccia horizon (1 to 7 m);
c) proximal facies of Buchenstein Fm. (some 30 m);
d) dolomitized megabreccia horizon (20 to 40 m);
e) upper clastic unit of Wengen Group (volcaniclastic sandstones, conglomeratic horizon) (some 100 m);
f) calcareous megabreccia horizon (0 to 20 m);
g) last calcareous horizon (max. 5 m). Above q. 2240 m the outcrops are fully dolomitized.

Levels a), b), c), d) crop out from Col di Poma westward to Freinavarencing northeastward, but the best exposure is at the latter site. Level e) crops out at Mt. della Croce, Col Ciancidel, Fornates, Prati di Putia. Level f) shows the best exposure at Fornates and Prati di Putia. Level g) crops out in the area of Prati di Putia from q. 2050 m to q. 2230 m northeastward.

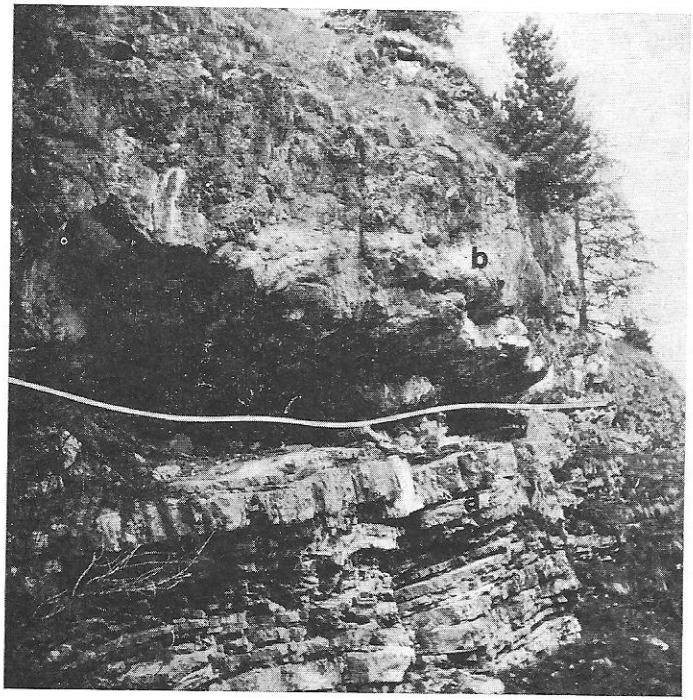

Fig. 5 - Freinavarencing section, lower part. a) Calciruditic/calcarenitic sequence of proximal Buchenstein; b) first calcareous megabreccia level (level b in the text). White line marks the erosional base of the megabreccia.

LEVELS A) AND C).

This part of the sequence has been studied in detail at Freinavarencing (Fig. 5): there a complete succession including the first two megabreccia horizons (levels b and d) crops out (see appendix and Fig. 6). Four groups of lithologies have been identified; in order of abundance are present:

— 1) planar and lenticular bedded, graded calcirudites and calcarenites, often showing erosional base (max. 10-15 cm in thickness). The

calcarenites are mainly intraclastic/peloidal packstones, rarely grainstones (microbioclastic peloidal calcisilt, Standard microfacies 2) (Wilson, 1975; Flügel, 1978); feldspar extraclasts are frequent, mainly below the first megabreccia horizon. The bioclastic fraction is often unidentifiable; the recognizable bioclasts record a monotonous assemblage (*Tubiphytes obscurus* Maslov, *T. carinthiacus* (Flügel E.), Spongiostromata laminae, *Bacinella ordinata* Pantic, Echinoderm fragments). Pelagic Bivalves and Radiolarians are subordinate but locally reach high abundance.

The calcirudites are intrabioclastic rudstones (Pl. 44, fig. 1) (classification of Dunham, 1962 modified by Embry and Klovan, 1971); the intraclasts are composed of different microfacies:

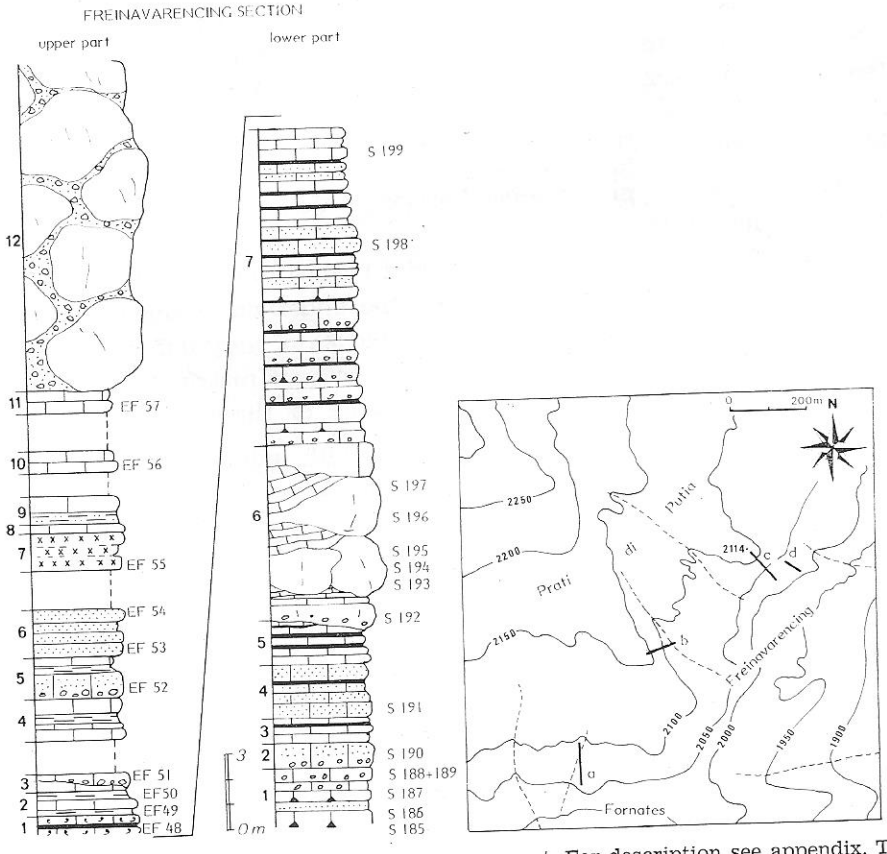

Fig. 6 - Freinavarencing section, lower and upper part. For description see appendix. The map indicates the location of the sections: a, side above Fornates; b, SE Prati di Putia; c, Freinavarencing, upper part; d, Freinavarencing, lower part.

a) frequent intraclastic/peloidal packstones with rare bioclasts (*Diplotremina astrofimbriata* Kristan-Tollmann, *Variostoma* sp.);

b) bindstones with prevailing Spongiostromata followed by *Tubiphytes obscurus* and *T. carinthiacus*, *Bacinella ordinata*.

Clast contacts are often stylolitic; diffuse matrix, composed of minute intraclasts and peloids with local clusters of pelagic Bivalves and Radiolarians. Frequent bands of chert.

— 2) Grey-brown, planar bedded, cherty lutites rich in Radiolarians and pelagic Bivalves; nodules and lists of chert are frequent.

— 3) Dark, red-greenish lutites rich in badly preserved specimens of *Daonella* cf. *tyrolensis* Mojsisovics (two decimeter thick horizons in level c).

— 4) Two volcaniclastic horizons (tuffite and cinerite) in level c). The tuffite contains abundant plagioclase and K-feldspar crystals and frequent biotite in a probably devitrified ground mass.

LEVELS B) AND D).

Only the lower megabreccia horizon is described, as the upper one is fully dolomitized.

The calcareous megabreccia (level b) constitutes a lenticular body, 1 to 7 m thick, which strongly erodes the underlying sequence of proximal Buchenstein (Fig. 5). It consists of blocks of very different size (dm to m), partially amalgamated and almost without matrix, thus often not easily identifiable. The blocks are composed of three microfacies:

1) prevalent wackestones/packstones with minute intraclasts and rare bioclasts (fragment of *Tubiphytes* and *Bacinella ordinata*);

2) subordinate wackestones/packstones with pelagic Bivalves and Radiolarians;

3) rare Scleractinians framestones (*Margarosmilia septanectens* (Loretz) (Pl. 44, fig. 2). The corallites are often encrusted by Spongiostromata and Porostromata laminae, rare sessil Forams, and *Bacinella ordinata* Pantic (Pl. 44, fig. 3).

Interpretation.

The sequence described up to now reflects the synchronous deposition of basinal and carbonate platform sediments, along the distal part of the platform slope (Standard Facies 3) (Wilson, 1975; Flügel E., 1978).

Deposition of basinal autochthonous sediments (cherty lutites) was episodically interrupted by turbidity currents carrying carbonate debris from the platform. According to the megabreccias and carbonate debris microfacies, the source area was probably a carbonate platform below the wave base (lacking of washed microfacies and presence of delicate organisms); although geometrically not preserved, the existence of a slope is testified by the presence of the turbiditic calcareous deposits. The microfacies of the megabreccias suggest a poorly developed margin consisting of laterally discontinuous organic mounds: the « reef community » was rather poor, mainly constituted by encrusting forms (*Tubiphytes, Bacinella ordinata*, blue-green algal laminae) with subordinated Scleractinians patches. It would outline again the model described for the Lower Edifice of the Latemar Group (Gaetani et al., 1981).

Concerning the megabreccias, it is possible to suppose two origins: a) submarine slumps wider than the turbiditic events, forming deposits separated from the main carbonate body; b) distal facies connected to the platform slope, according to the classical model (Wilson, 1975; Flügel, 1978), thus testifying a prograding of the carbonate platform.

The second hypothesis is supported by the lateral continuous outcropping of the megabreccias along the whole southern side of Sass da Putia, almost at the same stratigraphic position.

LEVEL E).

It consists of a thick (max. 150 m), mainly clastic unit, referable to the upper part of the Wengen Group. The sequence, whose bottom is not exposed, is mainly composed of volcaniclastic sandstones, with a huge, lenticular, conglomeratic horizon (max. 70 m) (« Wengener Agglomerate » of Mutschlechner, 1933) intercalated in the medium part.

The conglomeratic horizon forms an almost continuous belt along the southern side of Sass da Putia, from Mt. della Croce westward, to Contrines eastward, between q. 2000 m and q. 2100 m; however, in detail it is very irregular, consisting of lenticular beds intercalated and laterally substituted by paraconglomerates and volcaniclastic sandstones. The matrix percent is variable and generally it increases towards the top of the sequence. The clast size varies from 10-50 cm at the base, to a few centimeters in the upper part; locally (Col Ciancidel, Mt. della Croce) at the base of the sequence, large blocks composed of stratified portions of Knollenkalke, or strongly dolomitized carbonate platform boulders, are embedded in the clastics.

The clasts of the conglomeratic horizon consist to 80% of pink-grey

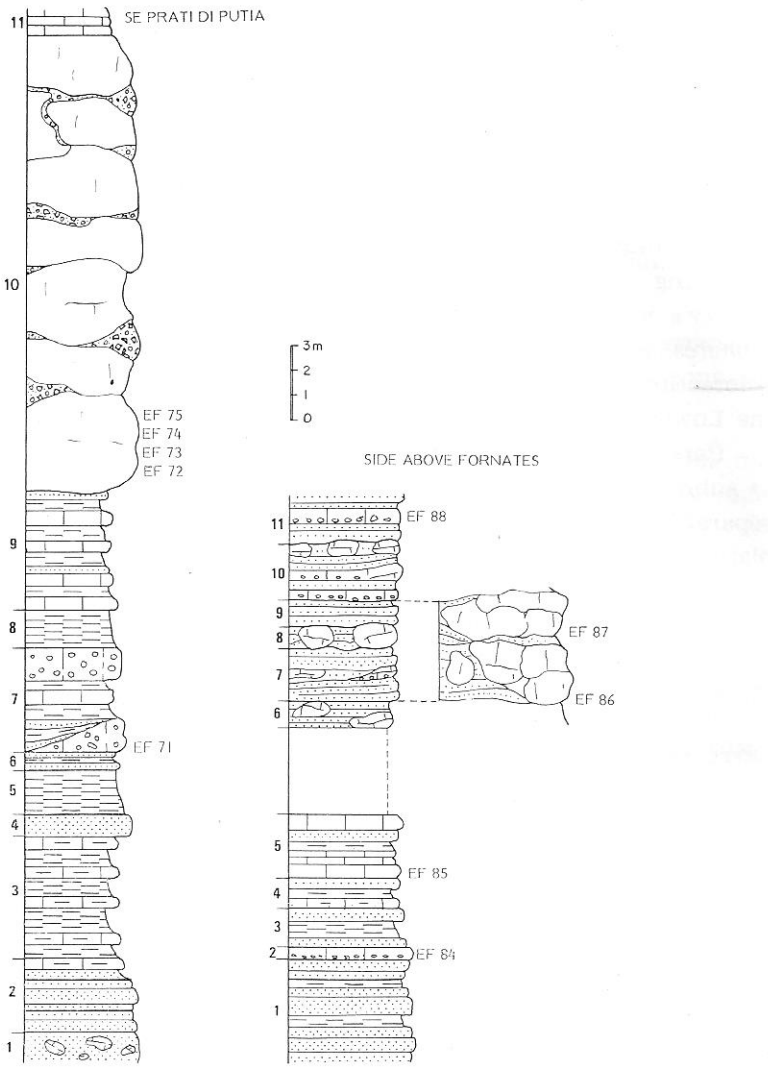

Fig. 7 - Sequences at the transition Wengen Group (level e in the text)/third megabreccia horizon (level f in the text). For description see appendix, for the location of the sections, see Fig. 6.

calcilutites rich in pelagic Bivalves and Radiolarians, evidently referable to the Knollenkalke, and calcarenitic fragments, analogous to the facies of proximal Buchenstein (levels a and c). Identifiable bioclasts (*Tubiphytes, Ladinella porata* Ott, benthic Forams i.e. *Diplotremina astrofimbriata* Kristan-Tollmann and Lagenids) recall the previously described

microfacies. Fragments of the carbonate platform microfacies, always strongly recrystallized, are very rare. Small clasts of volcanic rocks with pyroxene phenochrysts are rather common. Into the upper part of the sequence several decimetric, graded, calcarenitic/calciruditic levels are present. The microfacies are analogous to those of levels a) and c); some differences are detectable concerning the bioclastic fraction which is more abundant and differentiated mainly into the boundstones (Solenoporaceans, possibly calcareous Sponges always strongly recrystallized, along with the organisms described in levels a) and c).

Interpretation.

The composition of the conglomeratic horizon (mainly clasts of Knollenkalke and calcarenitic fragments) whose sedimentary characteristics testify a rapid deposition, allows to exclude the carbonate platform as the main source area for the submarine slumps. Moreover, if the slumps were triggered by erosion along submarine canyons cutting the platform slope, one would expect to find also large amounts of carbonate platform debris, which are lacking. Also, no synsedimentary faults which could produce outcrops of Knollenkalke at the sea floor, have been detected. Therefore, a submarine high, southward of the Sass da Putia, where the basinal sequence of the Knollenkalke outcropped, would be a more likely, albeit hypothetical source.

The graded calciruditic/calcarenitic layers interbedded into the upper part of level e) represent turbiditic deposits from a growing carbonate body.

WENGEN GROUP AND CARBONATE PLATFORM RELATIONSHIPS.

Contacts between the carbonate platform and the lower units of the Wengen Group are not exposed in the field. Infact along the southern side of Sass da Putia, where the interfingering sequence is best exposed, after the second megabreccia horizon (level d) the sequence is covered; after some fifty meters it continues with the upper volcaniclastic sandstones of Wengen Group (level e). However no data are detectable, indicating evident sedimentary gaps in the platform growth during that time. Concerning the subvolcanic bodies of Rio Vigo, because of its own genesis (they are sills), they could not interfere with the carbonate body development. Moreover, the calcarenitic fraction (clasts similar to the facies of proximal Buchenstein) found in the conglomeratic horizon of the upper Wengen Group (level e) could derive from the erosion of previous

facies of interfingering between the carbonate platform and the lower units of Wengen Group.

The continuity in the growth of the carbonate platform during the deposition of the conglomeratic horizon of level e), is impossible to demonstrate. The geometrical relationships between the two units only indicate a retreat of the carbonate flank: the clastics of the upper units of the Wengen Group wedge towards the inner part of the carbonate platform (outcrops of Prati di Putia till q. 2230 m), covering for some 1 km the underlying dolomitic sequence. Also, the later progradation of the platform (third megabreccia horizon, level f) does not immediately recover the previous extent: the front of the third megabreccia horizon was infact stepped back by some 200 m compared with the previous position (level d).

The temporary extent of basinal facies could be ascribed to: a) breacking off in the carbonate platform evolution (sinking would best justify the prograding of clastics onto the carbonate body); b) high sedimentation rate of the basinal clastics, resulting in a temporary water pollution and mostly with partial infilling of the basin. Field data support the second hypothesis, also because evidence of the drowning of the platform is lacking.

However, the retreat of the carbonate platform is temporary, while the shallow depth of the basin favours a rapid recovery of the carbonate sedimentation resulting in a prograding of the carbonate edifice. This evolution is testified by the turbiditic carbonate horizons of the upper part of Wengen Group.

LEVEL F).

The full recovery, or better the last prograding of the carbonate platform recorded at Sass da Putia, takes place rapidly: in some 20-30 m from the last conglomeratic layer the third megabreccia horizon becomes evident and widespread (see appendix and Fig. 7). This level has been identified by Mutschlechner (1933) as « Schlernkalk ».

GEOMETRICAL SETTING. The third megabreccia horizon crops out almost continuously along the whole southeastern side of Sass da Putia. The prograding of the platform follows almost everywhere the same trend (with the exception of the western area, q. 2050 m, left side of Rio Seres): above the last conglomeratic layers, a sequence of volcaniclastic sandstones with interbedded graded, planar bedded calciruditic levels, develops. Towards the top the calciruditic horizons evolve to lenticular,

areally limited, carbonate boulders (max. 1/2 m thick) displaying erosional basal contacts, which rapidly pass to true megabreccias. That last horizon, because of its emplacement, shows strongly variable thicknesses. Infact it forms a) massive banks (max. 30 m thick, far eastern and western outcrops of Prati di Putia, q. 2050/2100 m), as well as b) lenticular bodies (max. 1 m thick) laterally passing to smaller boulder suites, interbedded into the clastic sequence (above Fornates).

MICROFACIES. Macroscopically the megabreccias consist of boulders, sometimes more than 1 m in diameter, forming a rigid frame almost without matrix. In order of abundance, the microfacies are as follows:

a) different kind of bindstones, whose substratum always consists of minute intraclastic packstones.

a. 1) Mainly Porostromata bindstones (a fairly well differentiated community with prevalent laminae type b (Pl. 44, fig. 7) (Fois & Gaetani, 1980) along with *Bacinella elongata* sp. n. (Pl. 44, fig. 4, 5, 6) and rarer specimens of *Cladogirvanella cipitensis* Ott, Spongiostromata, *Tubiphytes obscurus* Maslov and subordinately *Ladinella porata* Ott. Some sessil forms could be interpreted as encrusting Sphinctozoans but they are always strongly recrystallized. Occasionally recrystallized isolated specimens, possibly Hydrozoans of *Spongiomorphidae* Group, along with Scleractinians, are present. Locally Solenoporaceans are present, which however generally build more exclusive bafflestones/framestones.

a. 2) Solenoporacean bafflestone/framestone [*Parachaetetes maslovi* Flügel (Pl. 44, fig. 8), *Solenopora* aff. *zlambachensis* Flügel (Pl. 44, fig. 9)] which locally build patches till 1 m in size, are embedded into the megabreccias. Solenoporaceans are rarely associated to a differentiated community; occasionally small specimens of *Tubiphytes obscurus* are present. Sometimes rare specimens of Tabulozoans (Pl. 45, fig. 1), generally encrusted by the Solenoporaceans, are detectable.

a. 3) Sphinctozoan bafflestones/bindstones [*Dictyocoelia manon manon* (Münster) (Pl. 45, fig. 2, 3) and rarer not identifiable forms]. Specimens of *Tubiphytes obscurus* (Pl. 45, fig. 4) and subordinate *Ladinella porata* are present.

a. 4) Scleractinian framestones. Also if not abundant, *Margarosmilia septanectens* (Loretz) (Pl. 45, fig. 5) along with thamnasterioid colonies (Pl. 45, fig. 6) are identifiable.

b) Packstones/wackestones with minute intraclasts and peloids. Local attempts of binding by blue-green algal laminae.

c) Rare breccias. Clasts show smoothered contacts (probably they were soft when sedimented); they consist of fragments of the microfacies previously described.

Interpretation.

Because of the more or less constant stratigraphic position, it is likely that also the third megabreccia horizon testifies a prograding of the platform, instead of isolated rock-slides into the basinal sequence. The connection to the carbonate body is testified by the western bank

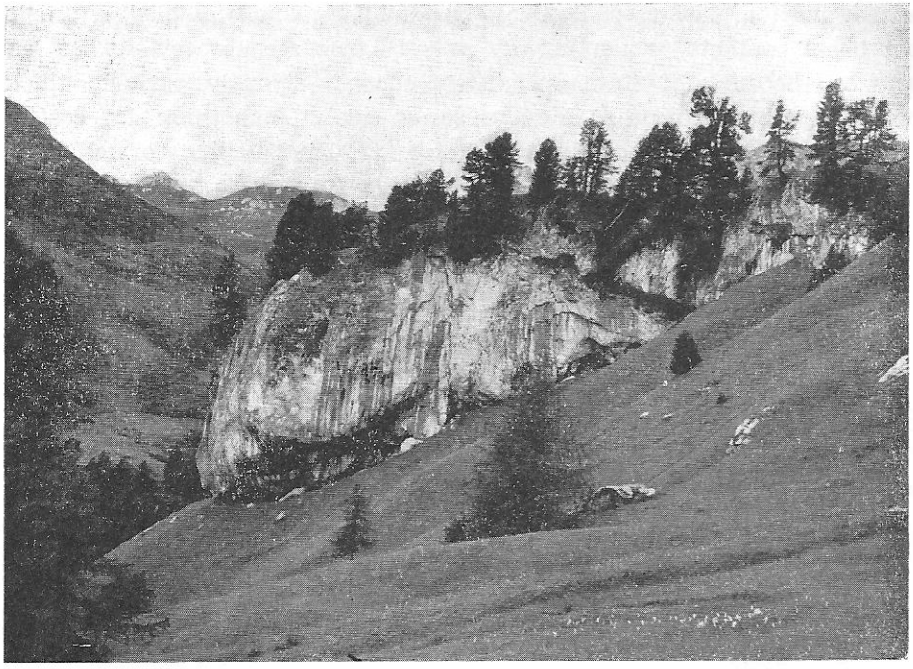

Fig. 8 - Third megabreccia horizon (left side of Rio Seres, q. 2050 m) showing a thick carbonate tongue, welded to the carbonate buildup.

(q. 2050 m, left side of Rio Seres, Fig. 8) which forms a thick tongue welded to the carbonate buildup. Only the lower part of the bank consists of breccias (max. 5-10 m), rapidly passing upwards into generally recrystallized calcilutites; the latter consist of fine graded sediments, locally bound by encrusting blue-green algal laminae and rich in fragments of the reef community (particularly Solenoporaceans), which can be interpreted as deposits of the upper slope. Moreover at this site, the underlying clastic sequence, particularly the conglomeratic horizon, is less thick than in the eastern area. These evidences could suggest an higher area in the palaeotopographic setting of the carbonate buildup more favourable to the carbonate deposition, because more protected from the clastic pollution of Wengen Group.

The central area (side above Fornates) (Fig. 9, 10) is characterized by the lacking of continuous megabreccias bodies and by a huge thickness of clastics of the Wengen Group; it could represent a depressed area in the palaeotopographic setting of the buildup, during the clastics deposition, and furtherly a distal zone of the slope, where carbonate slidings were dispersed into the basinal sequence.

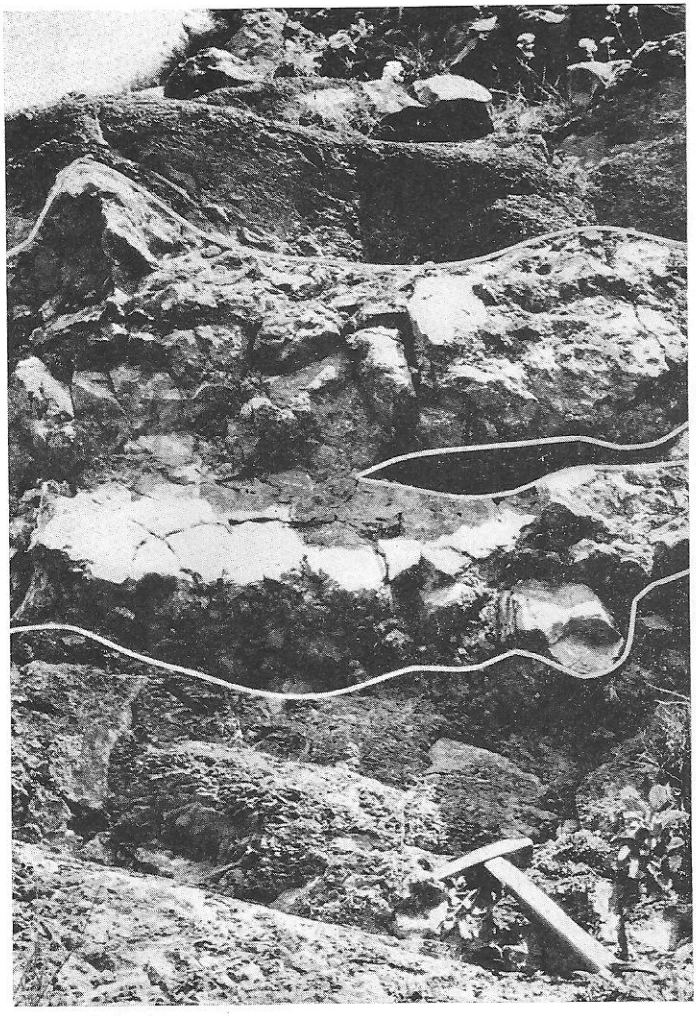

Fig. 9 - Third megabreccia horizon (side above Fornates): discontinuous calciruditic/calcarenitic bodies interfingering within the thick sequence of Wengen Group. White line marks the carbonate levels.

In the northeastern zone (NE limit of Prati di Putia) the megabreccias are lacking and the transition between paraconglomerates/sandstones/graded calcirudites (still eroding Radiolarians lutites, Pl. 45, fig. 9) / minute intraclastic packstones (see level g), is recorded. The lack of megabreccias could be explained by the palaeotopographic setting of the buildup; the northern outcrops are the nearest to the buildup core, where erosion dominated over accumulation of rock debris. Following those

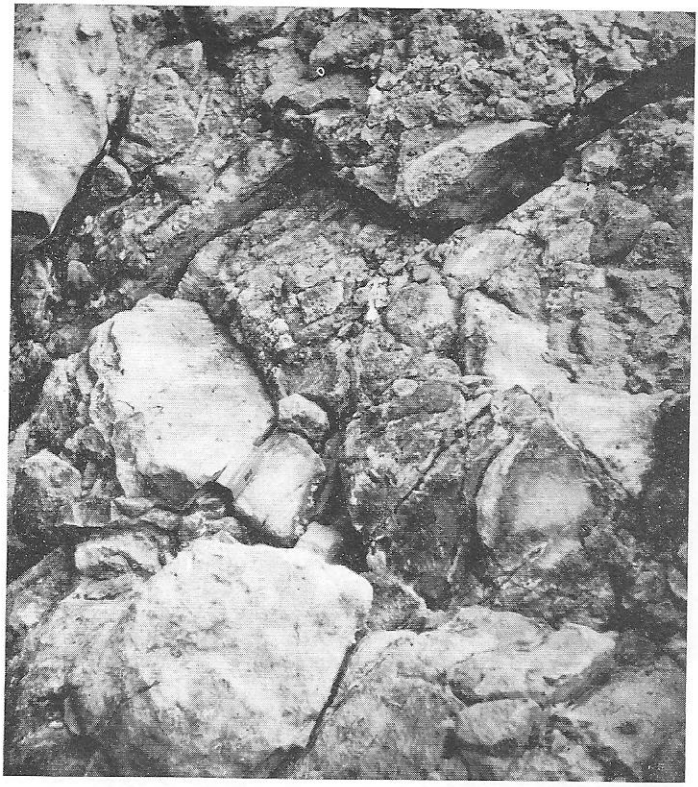

Fig. 10 - Close up view of the third megabreccia horizon (side above Fornates).

outcrops southeastwards, a transition to the southern megabreccias bodies is detectable.

The microfacies of the megabreccias present a more differentiated assemblage in comparison to the carbonate levels already described, above all the boundstones. On the base of this data, I assume that the platform margin was colonized by a fairly differentiated reef community (mainly blue-green algal laminae and *Tubiphytes* along with Sphinctozoans, Solenoporaceans and subordinate Scleractinian patches). Scattered specimens of many other organisms, i.e. possibly Hydrozoans of the *Spongiomorphidae* Group always strongly recrystallized, Tabulozoans, very rare Bryozoans, benthic (*Duostominidae*, Lagenids, Textulariids) and sessil (Calcitornellids) Forams, obviously along with Bivalves, Gastropods and Echinoderm fragments, are present. Among the microproblematics, besides specimens of *Tubiphytes* (*T. obscurus* and more rarely *T. carinthiacus*) and *Bacinella elongata* sp. n., *Ladinella porata* be-

comes particularly frequent and seems to prefer protected areas associated to encrusting blue-green algal laminae. Concerning the other groups, Sphinctozoans, Solenoporaceans and Scleractinians generally tend to be mutually exclusive. However, palaeoecological reconstructions remain speculative as it was impossible to study the facies distribution of the margin in the field.

I conclude that for the upper part of the buildup too, a margin below the wave base could be inferred, consisting of patches with a more differentiated, but still mainly encrusting, community.

LEVEL G).

It represents the last calcareous outcrop, as the upper part of the carbonate body forming the Sass da Putia is fully dolomitized.

Level g) is described apart from the third megabreccia horizon (level f) because it shows diverse textural characteristic deriving from a different genesis. It consists of fine calcarenites and calcilutites, locally poorly bedded, which crop out in the whole area of Prati di Putia from q. 2050 m westward, to 2230 m northeastward.

MICROFACIES. The microfacies are as follows:

a) prevalent minute intrabioclastic packstones;

b) subordinate, rather chaotic, never graded, rudstones/floatstones containing clasts composed in turn of intraclastic packstones as well as fragments of *Tubiphytes* and blue-green Algae bindstones. Locally clasts with abraded contacts (like soft clasts) are present, along with isolated bioclasts embedded into the surrounding sediment (corallites, fragments of *Dictyocoelia* sp., Solenoporaceans, *Bacinella elongata* sp. n., fragments of *Tubiphytes* and Gastropods, particularly abundant in comparison with the previous microfacies).

Locally, attempts of binding by blue-green algal laminae, small *Tubiphytes* and rarer specimens of *Ladinella porata* (Pl. 45, fig. 7) are detectable, often eroded by following seams of fine intraclastic packstones (Pl. 45, fig. 8).

Interpretation.

The level could be interpreted as the proximal slope where fine carbonate debris continuously sedimented; fragments of the upper slope and margin are sometimes embedded in it. The abundance of Gastropod fragments (generally abundant in the back reef microfacies and as reef

dwellers) is an evidence for a proximal facies of the platform slope.

These microfacies are very similar to those described at Mt. Coldai in the Eastern Dolomites (upper part of the slope, Sciliar Dolomite) (Fois & Gaetani, 1980). Thus the proximal part of the slope seems to be composed of rather poor microfacies, while carbonate muds and fine sands appear to be prevalent. These characteristics could be explained if one considers that in this part of the slope erosion was more active than deposition, as indicated by the large scale, inclined bedding surfaces that often cut at a sharp angles the palaeosurface of the slope. In detail the palaeosurfaces could correspond to the areas of detachment of the megabreccia slidings.

The attempt of binding by blue-green algal laminae is very interesting and places this part of the slope into the photic zone.

Chronostratigraphy.

The carbonate platform community does not lend itself easily as a tool for stratigraphic subdivision. Generally, organisms recorded have a wide stratigraphic range, most of them extending throughout the all Ladinian; moreover, many species are commonly found also in the Carnian or even in younger deposits (Sphinctozoans, Hydrozoans, Scleractinians). Because the back reef facies is lacking, no Dasycladacean Algae probably the best stratigraphic indicators among the platform biota had been found.

However, a rather detailed history of the platform growth and progradation can be obtained from the basinal assemblages intercalated within the platform debris.

A first evidence is given by Conodonts from the red nodular limestones outcropping at the base of the platform, along the northern wall of Sass da Putia. The species identified (*Gondolella transita, G. constricta, G. trammeri, G. excelsa, G. mombergensis, Gladigondolella tethydis*) indicate an Early Ladinian age (A. Nicora pers. comm.).

A second element, higher in the sequence (level e) at Freinavarencing) is a level with specimens of *Daonella* cf. *tyrolensis* Mojsisovics interbedded into the facies of proximal Buchenstein above the first megabreccia horizon. This species indicates an Early Ladinian/early Late Ladinian age because it was always found below *Daonella lommeli* (Wissmann) (M. Gaetani, pers. comm.).

Finally fragments of *Daonella lommeli* (Wissmann) found not in place but probably belonging to the conglomeratic horizon of level e) (loc. Fornates), indicate a Late Ladinian age for this unit; moreover, they permit to correlate it with the volcaniclastic sandstones containing *D. lom-*

meli and *Protrachyceras* cf. *archaelaus* Mojsisovics, which crop out westward beyond a fault in loc. Contrines.

In summary the carbonate platform above the Contrin bank, begins to grow during the Early Ladinian, and a large part of it, surely from the third megabreccia upwards, belongs to the Late Ladinian (1).

Conclusions.

a) BIOFACIES SUCCESSION. The analysis of the microfacies of the megabreccias provides ample informations on the frame-building communities which characterized the platform margin during the Ladinian.

The organic community of the lower part of the buildup, coeval with the Buchenstein Fm., seems to be rather depauperate and almost exclusively represented by encrusting forms (blue-green algal laminae, *Tubiphytes*, *Bacinella ordinata* and subordinate sessil Forams). Scleractinians are definitely rare (*Margarosmilia septanectens*).

The upper graded calciruditic horizons of level e) and the next megabreccia horizon (level f), supply a more differentiated community. Sphinctozoans (*Dictyocoelia manon manon*) are widespread and Scleractinians (*Margarosmilia septanectens* and unidentifiable thamnasterioid forms) become more abundant. However, Solenoporaceans (*Parachaetetes maslovi* and *Solenopora* aff. *zlambachensis*) seem to be the most diffused organisms. Other forms sporadically are added to the community (Hydrozoans of the *Spongiomorphidae* group, Tabulozoans, very rare Bryozoans); the microproblematics *Ladinella porata* and *Bacinella elongata* sp. n. are rather frequent. Elements already present in the older community are *Tubiphytes obscurus* and more rarely *T. carinthiacus*, along with the blue-green algal laminae (Porostromata and Spongiostromata).

Considering the data from other coeval carbonate platforms (Latemar Group, Mt. Coldai) (Gaetani et al., 1981; Fois & Gaetani, 1980) a persistent succession of the « reef communities » during the Ladinian is further supported. It reflects the passage from mainly encrusting forms

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(1) *Nomenclatural note.* The carbonate buildup of Sass da Putia is here attributed to the Sciliar Dolomite. The platform appears to grow continuously during the deposition of the basinal sequence of Buchenstein Fm. and Wengen Group, thus constituting a single lithosome; it is then the case b) recognized for the Dolomites in Fois and Gaetani (1980, p. 491) and Assereto et al. (1977). Moreover, an upper carbonate platform tongue, showing a different prograding direction (from W and S) and interfingering with the S. Cassiano Fm, is recognizable between Col di Poma and Punta delle Dodici. This upper edifice is referable to the Cassian Dolomite.

(basal Lower Ladinian) to more diverse communities occupying more differentiated ecological niches (upper part of Lower Ladinian/Upper Ladinian), announcing the forthcoming greater diversity of the Upper Triassic [the Carnian community is, however, different from the Norian-Rhaetian one (Fürsich & Wendt, 1977; Schäfer, 1979; Senowbari-Daryan, 1980; Flügel, 1981)].

In comparison to the other Ladinian carbonate platforms (i.e. Mt. Coldai, Latemar Group) a slight delay of the carbonate buildup development is detectable at Sass da Putia. However, it would be more likely to ascribe it to local temporary adverse, palaeoecological conditions. (In the area of Sass da Putia a relatively too deep pelagic high, temporary developed at the base of the Lower Ladinian, prevented the reef community bloom).

b) PLATFORM MARGIN EVOLUTION. In the area of Sass da Putia the evolutionary model identified for many Ladinian carbonate platforms in the Dolomites, seems to be confirmed. Geometrical relationships and microfacies indicate a differentiation in basinal areas and carbonate platforms after the uniform sedimentation of the Contrin Fm., starting with a rather sharp initial downwarping.

Turbiditic deposits intercalated into the Buchenstein Fm., suggest the presence of a slope. along which the carbonate debris of the platform sedimented. The lacking of huge megabreccia horizons could be ascribed to an initially rather gentle slope, which prevented large-scale failure. On the base of the microfacies of the first megabreccia horizons, a margin (below wave base) served as sediment source. It was characterized by mounds with prevalent encrusting forms. This topography is very similar to the « lower Edifice » of the Latemar Group (Gaetani et al., 1981).

The geometrical setting of the upper part of the carbonate buildup, coeval with the clastic sequence of the Wengen Group, is well exposed, because neither covered by detritus nor by further growth of the carbonate body. The original inclined surfaces of the slope (some 20°) are still preserved. The occasional higher dips would correspond to erosional surfaces, possibly the detachment niches of the surrounding megabreccias. These observations along with the microfacies of the third megabreccia horizon, would indicate a margin still developed below the wave base but with a more pronounced edge, because of organisms able to build a more rigid framework (probably similar to model 2 of Wilson (1975) « ramp knoll reef »).

The proximal part of the slope mainly consists of fine carbonate detritus (fine intrabioclastic packstones), as already detected concerning the slope of Mt. Coldai.

For concluding it would be furtherly supported the hypothesis of the physiography of the margin was at least partially influenced by the evolution of the reef community.

Paleontological description

Bacinella elongata sp. n.

Pl. 44, fig. 4, 5, 6

MATERIAL. Specimens in thin section, S 212 b, S 207 c, EF 86, EF 78, EF 77.

HOLOTYPE. Sample S 212 b. Pl. 44, fig. 4.

PARATYPES. Samples S 212 b, S 207 c, EF 86, EF 78, EF 77. Pl. 44, fig. 5, 6.

LOCUS TYPICUS. Southeastern side of Sass da Putia, between Rio Seres westward to Rio Vigo eastward (S. Martino in Badia, Bz, Western Dolomites).

STRATUM TYPICUM. Sciliar Dolomite, third megabreccia horizon.

REPOSITORY. Museum of Inst. of Paleontology, Milan University, thin section collection n° 269, 270, 271, 272, 273 ss.

DERIVATIO NOMINIS. In order to describe the elongate tubular pattern.

DESCRIPTION. The problematic Alga consists of encrusting masses some 10 mm in width which tend to grow vertically, developping quite irregular cells (poligonal, rounded in transverse section), arranged in vertical series. The cells display a thin micritic wall shared with the adiacent ones. Irregularly spaced, thin micritic transverse partitions are present.

DIMENSIONS (in mm):
Φ of cells 0.12-0.14
thickness of cell wall 0.04-0.06
whole dimension: masses some 13 mm wide and 2.5 mm high.

COMPARISONS. *B. elongata* sp. n. differs from *B. irregularis* Radoicic having a more regular growth and distribution of the cells; from *B. or-*

dinata Pantic displaying a well defined vertical growth and arrangement of series of cells.

AGE. Late Ladinian.

Appendix

Freinavarencing section.

LOWER PART (Fig. 6 a). The sequence crops out along the side called Freinavarencing from q. 2020 m (Fig. 1, 6). Dipping N 180/10. From bottom to top the sequence develops as follows:

— BASE: grey, planar bedded calcilutites, rich in Radiolarians and pelagic Bivalves, with nodular chert.

BUCHENSTEIN FM.

1) Sequence of calcilutites, calcarenites and sandy calcarenites, in grey-light brown, planar centimetric (5-15) beds. In detail the following lithologies are present:
   a) dark grey calcilutites with Radiolarians and pelagic Bivalves; millimetric laminae and levels of black chert (S 185, S 187);
   b) sandy calcarenites with clasts of volcanics, quartz and plagioclase embedded in an intraclastic packstone with rare Lagenids (S 186);
   c) graded calcarenites constituted by intrabicclastic packstones. Very rare extraclasts of quartz and K-feldspar, frequent silicization mainly of Echinoderm fragments (S 188, S 189) (2.3 m);
2) graded calcarenites with lenticular shape (S 190) (0.85 m);
3) fine graded calcarenites in centimetric beds with lists of dark chert. They are intrabioclastic packstones (fragments of *Tubiphytes obscurus* and *T. carinthiacus*, Ostracods) with very rare extraclasts of biotite (S 191) (1 m);
4) medium to coarse graded calcarenites in beds of some 40-50 cm. Thin beds of dark chert. The uppermost beds strongly canalyze the underlying cherty bed (2.1 m);
5) alternation of cherty lutites and fine calcarenitic beds, 2-5 cm thick, locally with lists of black chert (1.65 m).

SCILIAR DOLOMITE.

6) Single, 1 m thick, strongly lenticular, calciruditic bed (intraclastic rudstone with rare fragments of *T. carinthiacus*) (S 192) some 2/3 planar, cherty beds canalized by a megabreccia. This one becomes laterally thinner locally passing to well bedded calcarenites; clast sizes are strongly variable; three litholcgies are represented: a) pelagic calcilutites (with Radiolarians and pelagic Bivalves); b) calcarenites (intraclastic/peloidal rudstones-packstones locally laminated and graded) (S 193-194-195-196); c) boundstones (Scleractinian framestones, *Margarosmilia septanectens* (Loretz) with the corallites encrusted by Porostromata and Spongiostromata laminae and the problematic *Bacinella ordinata* Pantic) (Pl. 44, fig. 3) (S 197) (7.5 m).

BUCHENSTEIN FM.

7) Fine to coarse calcarenites in decimetric, planar beds with levels of chert (intraclastic packstones/grainstones with pelagic Bivalves and fragments of *Bacinella ordinata*) (S 198 at + 8 m; S 199 at + 12 m) (12.60 m).

Total thickness 28.00 m.

UPPER PART (Fig. 6 b). This part of the sequence has been measured some 50 m westward in respect to the lower part, which was covered upwards. However, the correlation is almost visual.

— BASE: single coarse calcarenitic bed, 50 cm thick, with which ended the lower part of the sequence.

BUCHENSTEIN FM.

1) Calcarenites with densely packed pelagic Bivalves, in cm/dm beds, with local finer levels; they are intraclastic/peloidal packstones with local clusters of small Radiolarians and pelagic Bivalves disposed in parallel laminae. Levels of black chert (EF 48) (0.65 m);
2) black lutites full of badly preserved specimens of *Daonella* alternating with dm beds of calcarenites (intraclastic packstones/grainstones with Crinoids and pelagic Bivalves) (EF 49,50) (0.45 m);
3) graded, planar bedded (dm) packed calcarenites eroded by a thick (50 cm) calciruditic horizon (rudstone with heterogeneous clasts: a) fine intraclastic packstone with rare bioclasts; b) rare Spongiostromata bindstones) (EF 51) (0.67 m);
— covered 1.60 m;
4) alternations of coarse and fine calcarenites with interbedded pelitic levels (1.30 m);
5) single, graded coarse breccia (rudstone with heterogeneous clasts: a) intraclastic packstones; b) subordinated bindstones with Spongiostromata, *Tubiphytes* and *Bacinella ordinata*) (EF 52), thickness 1 m. 20 cm of calcarenitic beds and dark pelites with badly preserved specimens of *Daonella* cf. *tyrolensis* Mojsisovics follow (1.20 m);
6) volcaniclastic sandy beds rich in biotite and quartz (tuffite with abundant K-feldspar phenocrysts, biotite and quartz); at the base (EF 53), at the top (EF 54) (2.00 m);
— covered 1.50 m;
7) pink grey siltites with parallel lamination, probably a cineritic layer (EF 55) (1.50 m);
8) fine recrystallized calcarenites (0.35 m);
9) foliated dolomitic marls passing upwards to fine calcarenites (1.20 m);
— covered 1 m;
10) planar, packed decimetric beds of coarse calcarenites passing upwards to fine calcarenites alternated to pelitic beds (grainstone with fragments of Spongiostromata/*Tubiphytes* bindstones as well as single intraclasts and bioclasts, i.e. fragments of *Tubiphytes* and *Bacinella ordinata* (EF 56) at the base (1 m);
— covered 2.00 m;
11) decimetric planar beds of fine calcarenites deformed by the load of the overhanging megabreccia (recrystallized wackestone/packstone with Radiolarians passing upwards to an intraclastic packstone) (EF 57) (1 m);
12) fully dolomitized megabreccia body (15 m).

After some meters of detritus the sequence goes on with some 20 m of another dolomitized megabreccia.

Total thickness 31.00 m.

The following two sections describe the transition from the basinal sediments of the Wengen Group to the third megabreccia horizon (Sciliar Dolomite).

Fornates section.

The sequence has been measured along the side above loc. Fornates at q. 2050 m upwards (Fig. 1, 7). Till q. 2030 m the conglomeratic horizon of level e) crops out, followed by foliated sandstones alternating with pelitic levels. Dip N 350/10.

1) Volcaniclastic sandstones alternating with pelitic beds (4.00 m);
2) slightly graded calcarenitic level with Crinoid stems (intrabioclastic rudstone with Crinoids, rare Solenoporacean fragments and diffuse micritic elements, probably fragments of Porostromata and *Tubiphytes;* patches of wackestone with Radiolarians and pelagic Bivalves) (EF 84) (0.30 m);
3) planar, centimetric beds of calcareous sandstones passing upwards to pelites/siltites in mm beds; the last bed consists in dark foliated sandstone (1.90 m);
4) alternation of marly limestones/siltites/fine, foliated sandstones (1.20 m);
5) alternation of slightly graded calcarenites (EF 85) and pelitic beds (intraclastic packstone with diffuse bioclasts, i.e. Crinoids, rare Lagenids, Radiolarians and pelagic Bivalves). An interval of dark sandstones follows (70 cm) and then another graded calcarenitic horizon (2.00 m);

— covered 4.50 m;

6) decimetric micritic blocks embedded in dark sandstones (1 m);
7) volcaniclastic sandstones with inside a lenticular calcarenitic level (60 cm) (1.80 m); laterally the sandstones are eroded by a lenticular megabreccia body (max. 2 m thick) (EF 86) (intraclastic packstone, locally bindstones colonized by Spongiostromata laminae, *Bacinella elongata* sp. n. and recrystallized specimens of *Ladinella porata*);
8) calcareous breccia (diameter of blocks of some 70 cm) wrapped by sandstones (1.00 m);
laterally the level passes to a megabreccia body some 2.00 m thick which is welded to the underlying megabreccia of level 7); it is also heteropic with level 9) (EF 87) (intraclastic/peloidal packstone with a zone rich in *Tubiphytes obscurus*);
9) foliated volcaniclastic sandstones in irregular beds (0.80 m);
10) alternation of calcarenites in beds of 20 cm, laterally passing to breccias, and sandstones which envelop the calcareous levels. The level ends with a megabreccia horizon (2.00 m);
11) alternation of sandstones in beds of 30 cm and graded calcarenites in beds of 15 cm; in the calcarenites (EF 88), rudstone with heterogeneous clasts: intraclastic packstones, Spongiostromata bindstones, Radiolarians and pelagic Bivalves packstone, single Crinoid fragments (2.10 m).

Total thickness 22.60 m.

Prati di Putia section.

The sequence has been measured along the southeastern side of Prati di Putia from q. 2090 m upwards (Fig. 1, 7).

WENGEN GROUP.

1) Paraconglomerates with heterogeneous clasts: calcilutites with pelagic Bivalves, intrabioclastic calcarenites (1.20 m);
2) foliated volcaniclastic sandstones (m 2.00);

3) alternation of marls and calcareous siltites with dark grey pelites (5.50 m);
4) bank of coarse sandstone with quartz, biotites and carbonate fragments (1.00 m);
5) dark, slightly calcareous pelites (2.00 m);
6) alternation of siltites and pelites with plant remains (0.80 m);
7) sequence constituted by: bank of fine calcirudites (1.50 m thick) (EF 71) (rudstone with heterogeneous clasts: intraclastic packstones, packstones with pelagic Bivalves, single bioclasts, mainly Crinoids, fragments of volcanics); this bank laterally passes to fine sandstones, and it is slightly graded. Pelitic intercalation (50 cm). Calcarenitic level (40 cm). Pelitic intercalation (10 cm). Calcarenitic level (1.50 m) (4.00 m);
8) foliated dark pelites (1.50 m);
9) alternation of planar bedded calcarenites (beds of some 20 cm) and planar laminated siltites and pelites (4.50 m).

SCILIAR DOLOMITE.

10) Megabreccia body with blocks of some 1 m in diameter mainly constituted by boundstones (Solenoporaceans and encrusting blue-green algal laminae are macroscopically recognizable) embedded in calcarenitic matrix (EF 72, 73, 74, 75) (recrystallized *Parachaetetes* sp. framestone; intraclastic packstone locally binded by Spongiostromata laminae) (20 m);
11) pink grey calcilutites with encrusting laminae (see level f, p. 578) (2.00 m).

Total thickness 42.00 m.

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PLATE 44

Fig. 1 - Intrabioclastic rudstone. At the low right fragments of ? Porifers. Proximal Buchenstein, Freinavarencing section. EF 51; 3.3 ×.

Fig. 2 - Scleractinian framestone (*Margarosmilia septanectens* (Loretz). First megabreccia horizon, Freinavarencing section. S 197; 2.6 ×.

Fig. 3 - *Bacinella ordinata* Pantic, encrusting a corallite of *Margarosmilia septanectens* (Loretz). First megabreccia horizon, Freinavarencing section. S 197; 7 ×.

Fig. 4 - *Bacinella elongata* sp. n., holotype. Third megabreccia horizon, left side of Rio Seres, about q. 2050 m. S 212 b; 5 ×.

Fig. 5 - *Bacinella elongata* sp. n., transversal section. Third megabreccia horizon, left side of Rio Seres, about q. 2050 m. S 212 b; 8 ×.

Fig. 6 - Recrystallized Porostromata (blue-green Algae) laminae, intergrowing with *Bacinella elongata* sp. n. Prati di Putia. EF 77; 3 ×.

Fig. 7 - Recrystallized Porostromata laminae. Northwestern side of Prati di Putia. EF 69; 3 ×.

Fig. 8 - Recrystallized specimens of Solenoporaceans (*Parachaetetes maslovi* Flügel). Third megabreccia horizon, side above Fornates. S 214; 2 ×.

Fig. 9 - Solenoporacean bafflestone (*Solenopora* aff. *zlambachensis* Flügel). Third megabreccia horizon, northwestern side of Prati di Putia. EF 70; 2.7 ×.

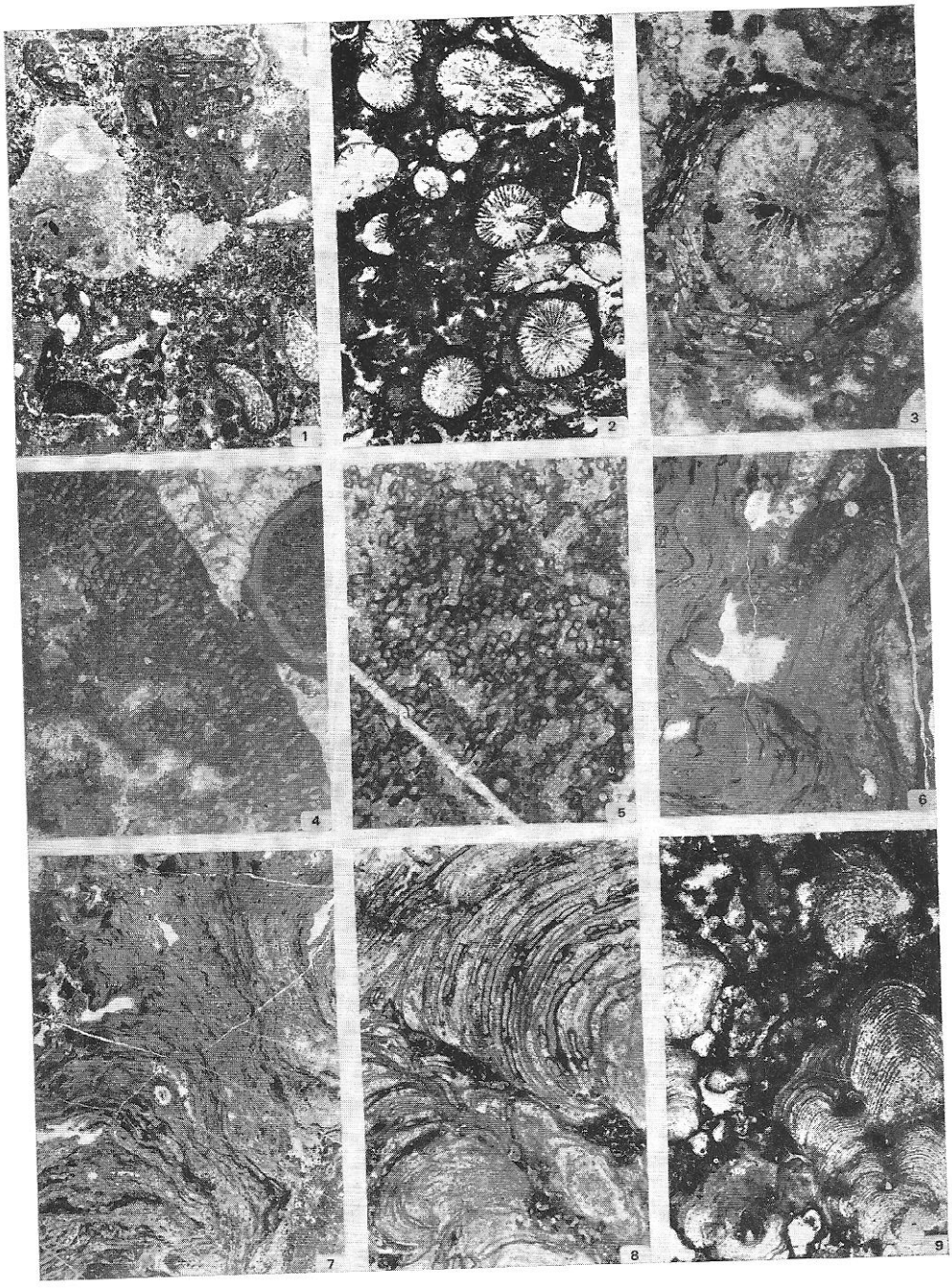
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PLATE 45

Fig. 1 - Specimens of Tabulozoans, encrusting Solenoporaceans (lower left). Third megabreccia horizon, northwestern side of Prati di Putia. EF 70 a; 3.1 ×.

Fig. 2 - Longitudinal/tangential section of *Dictyocoelia manon manon* (Münster) encrusted by *Tubiphytes obscurus* Maslov. Third megabreccia horizon, northwestern side of Prati di Putia. EF 66 c; 3.2 ×.

Fig. 3 - Longitudinal section of *Dictyocoelia manon manon* (Münster) encrusted by specimens of *Tubiphytes obscurus* Maslov. Third megabreccia horizon, northwestern side of Prati di Putia. EF 66; 3.3 ×.

Fig. 4 - *Tubiphytes obscurus* Maslov. Third megabreccia horizon, northwestern side of Prati di Putia. EF 66 b; 3.3 ×.

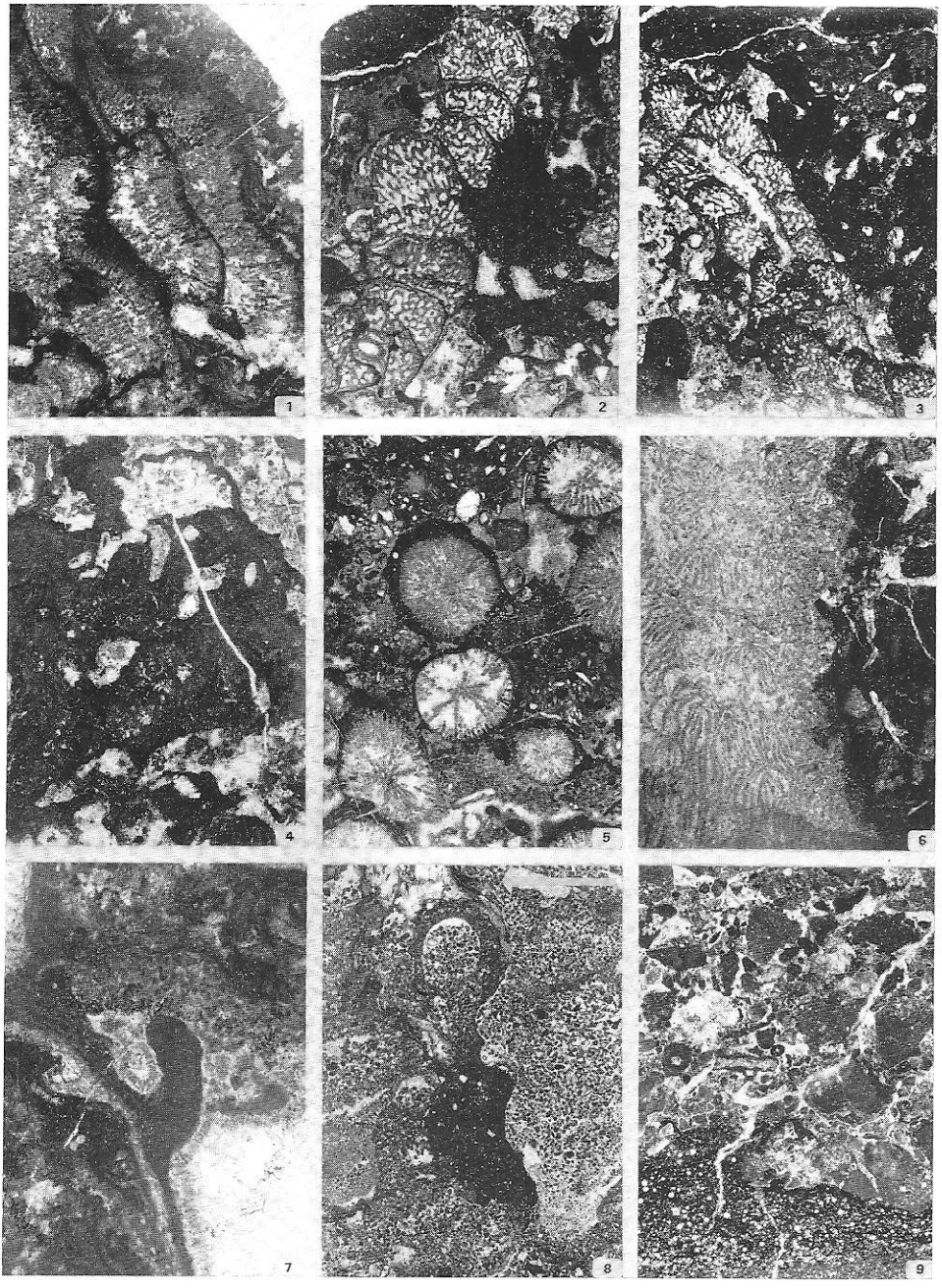
Fig. 5 - Scleractinian framestone (*Margarosmilia septanectens* (Loretz). Third megabreccia horizon, side above Fornates. S 214 b; 4 ×.

Fig. 6 - Recrystallized thamnasterioid Scleractinian colony. Northern margin of Prati di Putia, third megabreccia horizon. EF 62; 1.8 ×.

Fig. 7 - *Ladinella porata* Ott. Third megabreccia horizon, Prati di Putia. S 207 a; 9 ×.

Fig. 8 - Blue-green algal laminae eroded by fine intraclastic packstone. Level g), northern margin of Prati di Putia. EF 63; 3.3. ×. Arrow indicates the top.

Fig. 9 - Intrabioclastic, graded packstone eroding a Radiolarian wackestone-packstone. NE limit of Prati di Putia, where the megabreccias are lacking. EF 60; 3.3 ×.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