PERMIAN OCEANIC-ROCKS OF MINO TERRANE, CENTRAL JAPAN PART IV. SUPPLEMENTS AND CONCLUDING REMARKS

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Abstract This paper is a supplement regarding the occurrence of *Tubiphytes* from the bioclastic limestone facies and coeval chert facies of the Funabuseyama Permian oceanic-rocks of the Mino terrane, and reconstructs their depositional setting. The paper also emphasizes the boundstone-forming role of *Tubiphytes* and associated filamentous blue-green algae in the bioclastic limestone facies.

A considerable amount of *Tubiphytes* occurs in the middle Funabuseyama Formation (bioclastic limestone facies) as in site growths as well as skeletal debris. *Tubiphytes* has acted an encrusting and binding agent and formed the boundstone together with *Girvanella*-like filamentous blue-green algae; the first recognition of the Permian reefal facies in Japan.

Tubiphytes was identified also in limestone lithoclasts of the limestone-breccia of the Hashikadani Formation (chert facies), which is lithologically indistinguishable from that of the Amanokawara Formation (limestone-breccia facies). The limestone-breccias of these two formations furnish evidence for a lateral continuity of the coeval bioclastic limestone facies and chert facies.

All lines of evidence indicate that the three oceanic-rock units have originally passed laterally into one another and formed an oceanic-rock complex on and around a possible seamount in an open-ocean setting.

Shallow-marine sediments on the top of the seamount are represented by deposits in a lagoonal mud flat, fringing belt of barrier bars and shoals, and marginal terrace with algal reefal mounds. The limestone-breccia and bioclastic limestone of the Amanokawara Formation formed talus deposits and sandy mud on the foreslope. The lower flank to foot of the seamount and surrounding ocean floor were covered by the radiolarian chert of the Hashikadani Formation with some displaced shallow-marine carbonates.

Introduction

Stratigraphy, petrography, and biostratigraphy of Permian oceanic-rocks of the Mino terrane were examined in the Funabuseyama area (Fig. 1) and described in a series of papers (SANO, 1988a·b, 1989). As concluding remarks, the paper reconstructs the overall depositional setting of those Permian rocks, which represent an accreted mass of sediments originally deposited on and around a possible basaltic seamount in an open-ocean realm.

Prior to the reconstruction, supplementary de-

scriptions should be given on the problematic alga *Tubiphytes* and filamentous blue-green algae. SANO (1989) has reported their occurrence from the Amanokawara Formation of limestone-breccia facies and has considered them as characteristic biota of a marginal terrace of the Funabuseyama carbonate buildup. Re-examination revealed, however, that considerable amounts of *Tubiphytes* and filamentous blue-green algae occur not only in the bioclastic limestone of the Funabuseyama Formation (SANO, 1988b), which represents lagoonal facies with sand bar or shoal facies, but also in limestone lithoclasts of the limestone-breccia embedded in the reworked dolomite of the Hashikadani Formation of radiolarian chert facies (SANO, 1988a). *Tubiphytes* in the Funabuseyama

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Fig. 1. Map showing localities of representative Permian oceanic-rock allochthons of Mino terrane. Locality names of Permian oceanic-rock allochthons, Kuzuu, Hachiman, Funabuseyama, Uokanayama, Ibukiyama, Ryozensan, and Fujiwaradake are abbreviated as K, Ha, Fn, U, I, R, and Fj, respectively. Abbreviations HD, SR, A, R, MTL, ISTL, and TTL stand for Hida metamorphic terrane, Sangun-Renge belt of Sangun metamorphic terrane, Akiyoshi terrane, Ryoke metamorphic terrane, Median tectonic line, Itoigawa-Shizuoka tectonic line, and Tanakura tectonic line. Tectonic division is drawn after TAIRA and TASHIRO (1987) and SANO and KANMERA (1988).

Formation often occurs accompanied by filamentous blue-green algae. Both of those calcareous algae acted as encrusting and binding agents and substantially resulted in construction of boundstones in forms of encrusting sheets or layers and possible reefal mounds. To be emphasized is that the *Tubiphytes*-blue-green algae boundstone is herein described as the first discovery of Permian reefal facies in Japan; no organic reefal facies have been yet recognized in Permian limestones of Japan. Further, the *Tubiphytes*-yielding limestone-breccia of the Hashikadani and Amanokawara Formations plays an important role as a lateral link between the coeval Funabuseyama and Hashikadani Formations.

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Supplementary description

In order to complete reconstruction of the depositional setting of the examined Permian oceanic-rocks, brief notes on a problematic alga *Tubiphytes* MASLOV and filamentous blue-green algae yielded from the Funabuseyama and Hashikadani Formations should be supplemented to the descriptions by the author (SANO, 1988a·b).

Tubiphytes and filamentous blue-green algae from Funabuseyama Formation

Dasycladacean algae, mollusks, fusulines, and crinoids are characteristic and dominant skeletal components in the bioclastic limestone of the Funabuseyama Formation (SANO, 1988b). Herein, through re-examination of the Funabuseyama bioclastic limestone, with additional thin-sections, it was noticed that *Tubiphytes* and filamentous blue-green algae, both represented by two forms, were important not only as noticeable bioclastic debris but also as encrusting and binding agents. Both of those calcareous algae often occur in an intimate association with each other, playing a role of construction of in site organic growths in forms of *Tubiphytes*-blue-green algae boundstone layers (Plates I-3, II) and blue-green algae lamellar encrusting sheets or layers (Plate I-4).

Tubiphytes sometimes occurs in forms of bulbous to domal, upward-growth, encrusting and binding the substrate (Plates II, III-1 to 4). The

irregular intergrowth structure anastomosing with filamentous blue-green algae (Plate II) must have been rigid enough to be semi-resistant to resistant against wave and current actions. So far as re-examined, the boundstone layers and encrustations consist only of small-sized encrusting organisms, almost lacking in large frame-building taxa, and are in a few centimeters thick and a limited extent; not so thick and extensive as coral-algal and coral-stromatolite boundstones known in other ages. It is, however, inferred that the *Tubiphytes*-filamentous blue-green algae boundstone layers have probably resulted in construction of reefal mounds with gentle slopes.

Filamentous blue-green algae found from the Funabuseyama limestone are of *Girvanella*-type, including at least two forms. One comprises long and narrow cylindrical tubes closely aligned to form lamellar layers or bundles, which encrust and bind the substrate (Plate II; also refer to Plate I-4). The other consists of short and narrow, twisted tubes which are closely intertwined (Plate I-3; see also Plate III-1, 2 of SANO, 1989). Its dense growths bind and stabilize the sediments, forming thin veneers of algal mats or sheets.

Tubiphytes and filamentous blue-green algae occur also as isolated bioclasts of the Funabuseyama limestone. *Tubiphytes* fragments are often found in crinoid-fusuline peloidal lime-grainstone (Plate I-1) and wackestone (Plate I-2). Sand- to silt-sized peloids in the lime-grainstone and wackestone are the reworked particles stripped off from algal sheets or mats of filamentous blue-green algae. The peloidal particles in the grainstone are almost completely micritized and rounded by abrasion, but those in the wackestone have tubular structures.

Tubiphytes and filamentous blue-green algae in the Funabuseyama Formation occur most frequently in its middle member (lower Middle Permian *Parafusulina kaerimizensis* Zone; Figs. 4 and 5 of SANO, 1988b), which consists chiefly of the crinoid-fusuline lime-wackestone and intraclastic bioclastic lime-grainstone. Those calcareous algae are, however, scarce, discernible only in the crinoid-rich wackestone in the upper Funabuseyama Formation (upper Middle Permian *Neoschwagerina margaritae*-*Yabeina globosa* Zone). No *Tubiphytes* and filamentous blue-green algae occur

in the lower Funabuseyama Formation (upper Lower Permian *Pseudofusulina ambigua* Zone) which chiefly comprises the bedded, black to dark grey, highly carbonaceous, dasycladacean algae- and mollusks-rich lime-wackestones. Only a very small amount of abraded *Tubiphytes* is scattered in the intermittent beds of the laminated lime-packstone which has accumulated through redeposition by storms or spring tides from sand bars or shoals.

In Permian limestones of Japan, all of which are the shallow-marine deposits, no any kinds of reefal limestones have been known. The boundstone of the Funabuseyama Formation is of the first discovery of Permian organic reefal facies in Japan. The biota of the above-described boundstone much differs from that of the Carboniferous organic reefs well known in the limestone of the Akiyoshi (e.g., OTA, 1968) and other terranes. HATTORI (1982) has stated that the Permian limestones associated with greenstones in the Mino terrane are of a coral reef type. However, no any wave-resistant, organic frameworks constructed by corals have been identified from the representative Permian limestones of the Mino terrane shown in Fig. 1, all of which are associated with greenstones and of shallow-marine facies. Fragmented corals actually occur in the Funabuseyama bioclastic limestones, but are very rare and only scattered (SANO, 1988b).

It is well known that the Permian carbonate buildups are almost completely lacking in large-sized frame-builders, including colonial corals, thick algal growths of red algae, and stromatolite-forming blue-green algae. On the other hand, encrusting and binding agency of *Tubiphytes* has been suggested in the shelf margin boundstone of the lower Permian Troglkofel buildups, southern Alps, representing stratigraphic reefs in a down-slope shelf edge (FLÜGEL, 1981) and also in the shelf edge boundstone of the Wolfcampian Delaware Basin, New Mexico (MALEK-ASLANI, 1970). Thus, it is accepted that *Tubiphytes* was an encruster in a shelf edge with a relatively high water-energy condition (WILSON, 1975).

***Tubiphytes* from Hashikadani Formation**

Through the re-examination, a small amount of *Tubiphytes* was identified also from limestone lithoclasts of the limestone-breccia intercalated in

Fig. 2. Schematic profile illustrating reconstructed depositional settings of oceanic-rock complex (not to scale), with simplified lithologic columns of three oceanic-rock units of Funabuseyama allochthon. Funabuseyama, Amanokawara, and Hashikadani Formations are abbreviated as F, A, and H, respectively. After SANO (1988a·b, 1989).

the thick dolomite succession of the middle Hashikadani Formation (see Figs. 8 and 10B of SANO, 1988a). Although no fossils reliable for age determination have been found from the dolomite and limestone-breccia, the *Pseudoalbaillella lomentaria* Assemblage of middle Early Permian age has been confirmed in the red chert about 10m below the limestone-breccia (SANO, 1988a).

The limestone-breccia of the Hashikadani Formation (Plate III-5 ; see also Plate I-6 of SANO, 1988a) is lithologically indistinguishable from much of the Amanokawara limestone-breccia (Plates III-3, 4, IV-1, 2 of SANO, 1989). The limestone lithoclasts of the Hashikadani limestone-breccia include *Tubiphytes*-bearing filamentous

blue-green algae-rich lime-grain/packstone, *Tubiphytes*-crinoid packstone, *Tubiphytes*-bearing algal packstone, sponge spicule-rich lime-mudstone, and peloidal lime-mudstone. Besides these lithoclasts, fragmented fusulines, crinoids, and *Tubiphytes* occur isolated. These lithoclasts and skeletal fragments are dense-packed, bounded by stylolite seams where Fe-oxides are condensed. The matrix is totally lacking or extremely sparse. The dense-packed, matrix-free or very rare fabric of the Hashikadani limestone-breccia is much similar to that of the type B limestone-breccia of the Amanokawara Formation (SANO, 1989). It is doubtless that most of the Hashikadani limestone-breccia have been reworked from the Amanoka-

wara Formation, bioclastic limestones of which are characterized by *Tubiphytes* and filamentous blue-green algae (SANO, 1989). Thus, the nearly coeval, deep-water radiolarian chert facies (Hashikadani Formation) and shallow-marine carbonate facies (Funabuseyama and Amanokawara Formations) are linked by the *Tubiphytes*-bearing limestone-breccia of the Hashikadani and Amanokawara Formations (Fig. 2).

Reconstruction of depositional setting : concluding remark

For consideration of the depositional setting, to be emphasized are contemporaneity of the Funabuseyama and Hashikadani Formations, lateral linkage of the *Tubiphytes*-bearing limestone-breccia between the shallow-marine carbonate and deep-water radiolarian chert facies, and close association of greenstones with the sedimentary successions of the Amanokawara and Hashikadani Formations.

Fusuline and radiolarian biostratigraphic evidence (SANO, 1988a·b) indicates that the Funabuseyama and Hashikadani Formations are nearly time-equivalent to each other ; the former ranging in age from the late Early to late Middle Permian and the latter from the middle Early to late Late Permian (Fig. 2). Incidentally, no Upper Permian section has been confirmed in the Funabuseyama Formation, top of which is invariably cut by a fault. However, in the Nabeyama limestone of the Kuzuu area (Fig. 1), which belongs to the eastern extension of the Mino terrane and is biostratigraphically comparable with the Funabuseyama Formation, the Late Permian fusulines occur in limestone clasts in the basal conglomerate of the Adayama Formation directly overlying the Middle Permian section of the Nabeyama limestone (KOBAYASHI, 1979). The completely eroded out Upper Permian section is inferred to have been laid down above the Middle Permian Nabeyama Limestone (KOBAYASHI, 1979). Thus, the Funabuseyama Formation is also assumed originally to have included the Upper Permian section, which has been missing at present ; completely eroded away or tectonically detached.

As described in the supplement, the *Tubiphytes*-bearing limestone-breccia of the Hashikadani Formation is lithologically analogous to that of the

Amanokawara Formation ; close similarity in lithology and fabric of their limestone lithoclasts. In addition, the limestone-breccias of both formations are nearly synchronous, belonging to the upper Lower Permian *Pseudofusulina ambigua* Zone and middle Lower Permian *Pseudoalbaillella lomentaria* Zone or upper Lower Permian *P. scalprata m. rhombothoracata* Zone. Thus, it is evident that the Hashikadani limestone-breccia has been provided from a part of the Amanokawara Formation which has accumulated in the bank-margin and upper foreslope of the carbonate buildup. As already stated by SANO (1988a), the thick succession and thin intercalations of dolomite rocks of the Hashikadani Formation, described as doloarenite and dololithite, have been formed by displacement of dolomitized sediments, reworked from the buildup into the deep-water basin where the radiolarian chert has accumulated.

The above-emphasized two imply that the three oceanic-rock units originally have formed a laterally continuous sedimentary complex and have passed laterally into one another, although thrust faults separate these units at present. The lateral link among the Funabuseyama, Amanokawara, and Hashikadani Formations is represented by the *Tubiphytes*-bearing limestone-breccia of the Amanokawara and Hashikadani Formations. The Hashikadani doloarenite and dololithite also indicate the lateral continuity. The reworked carbonates play an important role as the lateral link between the coeval shallow-water carbonate facies and deep-water chert facies.

The pedestal of the Funabuseyama bioclastic limestone is yet uncertain, although the Amanokawara and Hashikadani Formations are underlain by a thick succession of basaltic lavas and volcanoclastics, respectively (SANO, 1988a, 1989). However, as inferred by SANO (1988b), basaltic rocks are most likely to underlie the Funabuseyama bioclastic limestone sequence, for a few intercalations of basaltic volcanoclastics occur in its bottom part. Thus, all sedimentary sequences of the three oceanic-rock units are interpreted as a sedimentary cap and robe which have rested upon a basaltic pedestal, possibly a seamount in an open-ocean realm without contamination of island arc- or continent-derived matter.

The overall stratigraphical, sedimentological,

and paleontological results permit the author to draw a schematic sedimentary profile depicting the depositional setting of the examined Permian rocks as shown in Fig. 2, as a concluding remark of the papers in serials (SANO, 1988a·b, 1989). Brief notes were added below.

The limestones of the Funabuseyama Formation are interpreted as the sediments in a lagoonal mud flat and a seawardly fringing belt of barrier sand bars and shoals (Fig. 2). All were at very shallow water-depths.

The lower Funabuseyama Formation represents the lagoonal mud flat deposits. Its accumulation in a lagoonal environment is indicated by the black, organic matter-rich, lime-wackestone and mudstone with an impoverished fauna characterized by a great number of individuals of a single or a few species, including dense-crowded mollusks, dasycladacean algae, and staffelid fusulines. These features suggest restricted water-circulation and reducing conditions of bottom sediments. The crowded occurrence of a large-sized and thick-shelled allatoconchid bivalve (*Shikamaia akasakaensis* OZAKI) represents probable local patch reefs in the very shallow subtidal zone. In addition, an encrusting and binding green alga *Vermiporella* also has formed possible algal sheets (refer to Plate IV-1, 2 of SANO, 1988b) in intertidal flats.

The middle member of the Funabuseyama Formation is inferred to have accumulated in agitated-water areas ranging from a belt of barrier bars and shoals to a marginal terrace (Fig. 2). It consists of a thick pile of structureless limestones containing coarse skeletal debris of varied, shallow-water, benthic organisms, including fusulines, crinoids, mollusks, green algae, together with intraclastic and peloidal grains (SANO, 1988b). Dominated are lime-wackestone and grainstone. The grainstone is rich in abraded intraclasts and peloids besides skeletal debris, and has isopachous acicular calcite (primarily aragonite) cement (see Plate V-3 of SANO, 1988b), indicative of accumulation of the grainstone in water-agitated sand bars and shoals.

The limestones of the middle member are dolomitized to varied degree. This suggests that they include sediments in barrier bars which have been subaerially exposed and under the influence of meteoric water, where the dolomitization has

occurred in a mixing zone of fresh water and seawater.

The lateral transition from the lagoonal mud flat facies into the fringing barrier bar and shoal facies has been yet uncertain. However, rich in abraded fusulines, crinoids, and intraclasts, some intermittent beds of the laminated lime-packstone in the lower member are interpreted as wash-over fan or flood tidal delta sediments, which have accumulated by storms or spring tides.

As above-supplemented, the middle Funabuseyama Formation contains considerable amounts of *Tubiphytes*- and *Girvanella*-like filamentous blue-green algae-rich lime-wackestones and grainstones and of *Tubiphytes*-filamentous blue-green algae boundstone. These rocks are probably attributable to deposits on the marginal terrace of the carbonate buildup, although it is difficult to identify these rocks in the field and to delineate their areal distribution.

The Amanokawara limestone-breccia and associated bioclastic limestone represent the synsedimentary marine talus and muddy sand deposits on the marginal terrace to foreslope, respectively (Fig. 2; refer also to Fig. 5 of SANO, 1989). The limestone-breccia containing *Tubiphytes* and filamentous blue-green algae indicates its derivation from the marginal terrace.

Covering the lower flank of the carbonate-capped basaltic seamount and surrounding deep-water ocean floor was the Hashikadani radiolarian chert coeval to the Funabuseyama bioclastic limestone. The *Tubiphytes*-bearing limestone-breccia and dolomitized carbonates have been displaced from the foreslope of the carbonate bank by sediment-gravity flows, including debris flows and turbidity flows (SANO, 1988a).

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SANO, H., 1989 : Permian oceanic-rocks of Mino terrane, central Japan. Part IV. Supplements and concluding remarks. *Jour. Geol. Soc. Japan*, **95**, 595-602. (佐野弘好, 1989 : 美濃帯のペルム系海洋性岩石群—その 4. 補遺および結語—. 地質雑, **95**, 595-602.)

舟伏山地域の美濃帯のペルム系海洋性岩石群全体の堆積環境を復元した。これに先立ち、石灰岩相およびチャート相中に見いだされた *Tubiphytes* と藍藻について記述を加えた。

石灰岩相中では *Tubiphytes* と藍藻は生砕物として産するほか、密接に伴って boundstone や被覆性薄層を形成している。これらは小規模ながら、日本のペルム系石灰岩では初めて確認された礁性堆積物として重要である。

チャート相では *Tubiphytes* は石灰岩角レキ岩に産する。この事実は浅海石灰岩相とチャート相が同時異相であることを意味する。

標題のペルム系海洋性岩石群は大洋性海山頂部・周囲を覆って堆積し、本来は側方に連続していた堆積体であった。海山頂部にはラグーン・砂洲・礁性の高まりを含む縁辺テラスがあり、浅海石灰岩が堆積した。石灰岩バンク前面の斜面は崖錐性石灰岩角レキ岩の堆積で特徴づけられる。海山下部斜面から周囲の大洋底では放散虫チャートが堆積し、浅海域から炭酸塩岩の流入・再堆積もあった。

Explanation of Plates

- Plate I Thin-section photomicrographs of limestones of middle Funabuseyama Formation. All localities are shown in Fig. 2 of SANO (1988b). Refer to Table 1 of SANO (1988b) for associated fusulines. All scale bars represent 1 cm. Plane light.
1. Strongly abraded *Tubiphytes obscurus* MASOLV scattered in bioclastic (mainly crinoids) peloidal lime-grainstone. Sample 549, yielding *Cancellina* sp. cf. *C. nipponica* (OZAWA) and schwagerinids.
 2. *T. obscurus*-bearing fusuline-crinoid lime-wacke/packstone. Note syntaxial overgrowth of calcite (1) around crinoid oscicle and open-space fabric (2). Sample 544. *Cancellina* sp. and schwagerinids are associated.
 3. *Tubiphytes* boundstone crowded with *T. obscurus* and *T. carinthiacus* (FLÜGEL). Interstices are filled with micritic algal peloids, filamentous blue-green algae, and small amounts of crinoid debris and are partly cemented by microspars. Sample 420, yielding *Parafusulina yabei* HANZAWA.

4. Algal limestone associated with *Tubiphytes*-bearing limestones. Crowded dark-colored clots (center of view) are probably of filamentous blue-green algae origin (micritized). Sample 339, containing *Parafusulina* sp. cf. *P. kaerimizensis* (OZAWA). See Fig. 5 of SANO (1988b) for stratigraphic position.

Plate II Thin-section photomicrographs of *Tubiphytes*-bearing algal boundstone (Fig. 1) and its close-up views (Figs. 2 and 3). Lower part of middle Funabuseyama Formation. Sample 398 from 10 m west of loc. 400 along Hashikadani Gully, denoted in Fig. 2 of Sano (1988b). *Parafusulina* sp. cf. *P. kaerimizensis* (OZAWA) yielded from loc. 400. Plane light.

1. Boundstone layer composed of *Tubiphytes* (1), blue-green algae (2), and sheet bryozoa (3), formed on fine-grained lime-grainstone substratum (4) consisting of filamentous blue-green algae and algal peloids. Scale bar = 1 cm.
2. Close-up view of *Tubiphytes* encrusted by *Girvanella*-like filamentous blue-green algae. Note convex head of *Tubiphytes* (1), facing to stratigraphic top, encrusting filamentous blue-green algae (2), and void-filling fabric of sparry calcite (3). 4—overlying sheet bryozoa. Center left of Fig. 1 is enlarged. Scale bar = 1 mm.
3. Close-up view of undulating bundles or layers (1) and dense-grown layers (2) of *Girvanella*-like filamentous blue-green algae. Note that filamentous blue-green algae in lower center of view (1) consist of long and narrow, closely aligned, cylindrical tubes with micritic walls, and that those in upper part of view (2) are almost micritized. Center right margin of Fig. 1 is enlarged. Scale bar = 1 mm.

Plate III Thin-section photomicrographs of encrusting *Tubiphytes* in Funabuseyama Formation and *Tubiphytes*-bearing limestone-breccia of Hashikadani Formation. Plane light.

1. Encrustation by *Tubiphytes* on crinoid ossicle and fusulines in crinoid-fusuline lime-wacke/packstone of middle Funabuseyama Formation. Convex form of encrusting *Tubiphytes* (1) faces to stratigraphic top. Crinoid ossicle encrusted by *Tubiphytes* is partly micritized by algal boring (2). Sample 371. *Cancellina nipponica* and schwagerinids are associated. Locality is shown in Fig. 2 of SANO (1988b). See Fig. 5 of SANO (1988b) for stratigraphic position. Scale bar = 1 cm.
2. Close-up view of *Tubiphytes* encrustation (1) on crinoid ossicle in Fig. 1. Note thin layer of endolithic algae (2) immediately above crinoid ossicle, whose upper surface is irregularly bored. Scale bar = 1 mm.
3. Close-up view of cauliflower-shaped growth of *Tubiphytes* on fusuline debris in Fig. 1. Scale bar = 1 mm.
4. Stacked colony of *Tubiphytes* (1) seen in lime-wackestone of middle Funabuseyama Formation. Note segmented columnar growth at top (2), probably facing to stratigraphic top. Sample 321. *Neofusulinella lantenoisi* DEPRAT is associated. See Fig. 2 of SANO (1988b) for locality. Scale bar = 1 mm.
5. *Tubiphytes*-yielding limestone-breccia of Hashikadani Formation. Limestone lithoclasts are dense-packed and bounded with Fe-oxide concentrated stylolitic seams. 1—*Tubiphytes*-bearing filamentous blue-green algae-rich limestone, 2—crinoid-bearing lime-wackestone, 3—*Tubiphytes*-bearing lime-wackestone, 4—crystalline dolomite, 5—filamentous blue-green algae-bearing peloidal limestone. Also see Amanokawara limestone-breccia shown in Plates III-3 and IV-4 of SANO (1989) for comparison. Sample 341-5. Locality is shown in Fig. 3 of SANO (1988a). See Figs. 9 and 10B of SANO (1988a) for stratigraphic position. Scale bar = 1 cm.