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SHORT NOTES ON THE SHIMSHAL VALLEY GEOLOGY (WESTERN KARAKORUM–PAKISTAN)

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Key—words: Shimshal Valley, Karakorum, Pakistan, Stratigraphy.

Abstract. A geological reconnaissance carried out during Summer 1982 along the lower and middle Shimshal Valley allows to identify some lithostratigraphic units made up of slates (shaly and sandy deep—sea turbidites), shelf limestones and dolomites. The Upper Paleozoic age of some fossiliferous limestones is well documented. Ultrabasic dykes discordant to both bedding and cleavage intruded slates and dolomites.

Riassunto. Un itinerario geologico compiuto nell'estate 1982 lungo la parte inferiore e media della Valle Shimshal (alto bacino dell'Indo), geologicamente inesplorata, ha permesso di riconoscere delle unità litostratigrafiche costituite da torbiditi prevalentemente argillitiche di mare profondo e da calcari e dolomie di piattaforma. Alcuni calcari fossiliferi testimoniano la presenza del Paleozoico superiore. Argilliti e dolomie sono attraversate da filoni discordanti sia alla stratificazione che al clivaggio.

Introduction.

On the borderland between Pakistan and China, a natural section across the axial Karakorum batholith and the northern sedimentary (Tethyan) sequence is offered by the Upper Hunza Valley. The Karakorum Highway connecting the Indus plain with the Sinkiang Plateau along the Indus and Hunza Valleys has been opened during 1982; our preliminary program was therefore to investigate the Upper Hunza region where the geological information is mainly due to routes covered by Ivanac et al. (1956), Schneider (1957) and Desio & Martina (1972). Unfortunately no grant of permit during the 1982 was received to reach the Upper Hunza beyond the Batura bridge, still closed to foreigners.

— Casnedi R., Dipartimento di Scienze della Terra — University of Pavia (Italy) attended to the geological text. Paleontology edited by Nicora A., Dipartimento di Scienze della Terra — University of Milan (Italy).

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A secondary program was carried out along the main eastern tributary of the Hunza River, i. e. the Shimshal (or Shingshal) River, geologically unexplored.

Lithostratigraphy.

The Shimshal River up to Shimshal village is mainly cut into a very thick sequence of slates with layers of sandstones and conglomerates and volcanic dykes; the lower Shimshal Valley crosses moreover dolomites with limestone intercalations and veins of volcanics; these dolomites are very widespread on the northern watershed of the valley (Tupopdan–Karum Kush chain). The southern ridge is made up of granodiorites which form the axial Karakorum batholith.

The main sedimentary units recognized are probably the link between the Upper Hunza and the Shaksgam Valley sequences; lithostratigraphic units were already introduced by Desio & Martina (1972) in the Upper Hunza and Desio (1980) in the Shaksgam region but, failing sure correlations with these formations, some local names are brought into the sequence at present: Shimshal Slates and Karum Kush Dolomites, in addition to the already known Gircha Formation and Pasu Slates. The sequence covered from Shimshal village down to Pasu village (Hunza Valley) is therefore formed by the Shimshal Slates, Karum Kush Dolomites, Gircha Formation and Pasu Slates (Fig. 1). The Shimshal Slates appear clearly dipping below the Karum Kush Dolomites but tectonic

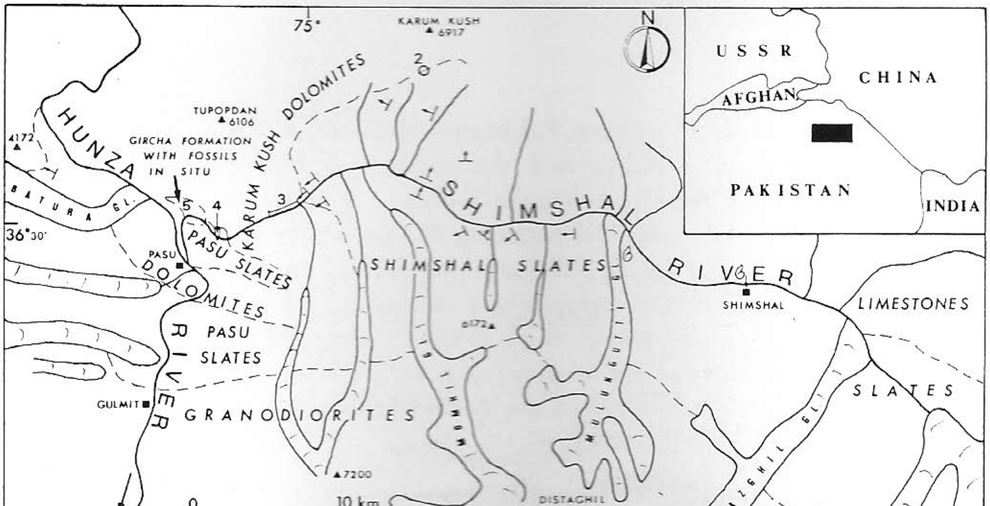

Fig. 1 – Geological sketch–map and location of the Shimshal Valley with fossils localities. Numbers 2, 4, 5 indicate pictures location; 3 the location of the partial section of the Karum Kush Dolomites.

relationships between the two formations lead to assume that the latter could represent an overthrust.

«Shimshal Slates».

This informal name is reported in absence of sure correlations with the sequence of Upper Hunza, which includes slates of similar lithology located at various levels of the stratigraphic succession.

Lithology. Black shales, slightly metamorphosed into slates, siltstones and, less frequently, fine and very fine sandstones in thin cyclical sequences show large lateral continuity of bedding. Because of the fine size, gradation is not always observable. Usually only the top Bouma interval (T_e) is represented in several repeated turbidite sequences (Mutti, Ricci Lucchi's D facies). Average bed thickness is few centimetres but thick Bouma sequences (up to 3 metres) are also present. The sequences are commonly made up of fine sandstone or siltstone grading into laminated silty shale.

The sandy fraction is constituted of well rounded quartz, largely predominant in number and size of particles, acid plagioclase, zircon and tourmaline; calcite occurs mostly as veinlets.

In the middle part of the unit, thick bedded medium size sandstones alternating with shales are present with C facies. Associated organized conglo-

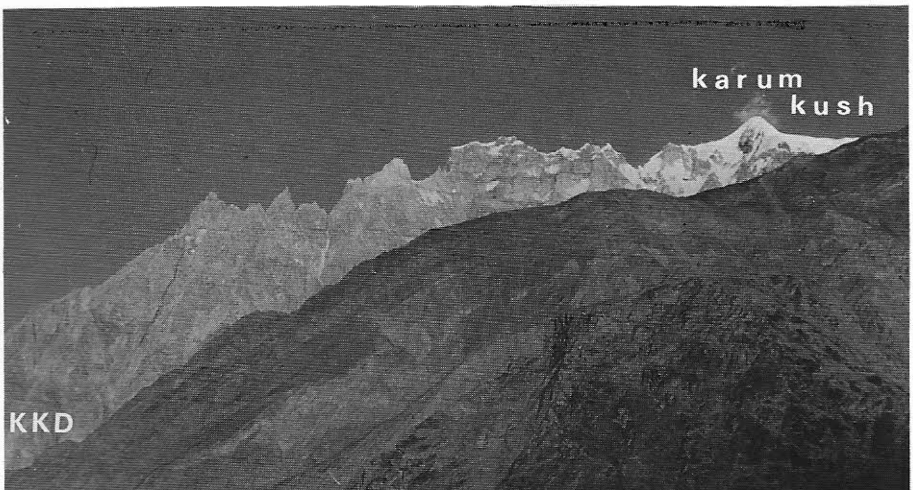

Fig. 2 – Karum Kush Dolomites (light grey on the background) and Shimshal Slates (dark grey, in front). The mutual position could be caused by a large overthrusting.

merates with very well rounded, scarcely sorted high mature pebbles of quartz and feldspars occur with a shaly matrix of 25% or less.

Environment. Deep sea. Dilute, low density turbidity currents mostly of basin plain facies associations: the occurrence of a fan progradation can be detected in the middle part of the unit with a major sand/shale ratio and the presence of channel filling conglomerates; it can be the result of the erosion of the continental (granitic–crystalline) basement. The thick layers are due to high volume turbidity currents probably moved by seismic shocks. High compaction and diagenesis are typical of a thick sedimentary pile (some thousands of metres) that cumulated rapidly.

Volcanic intrusions. The sediments are intruded by a large number of volcanic dykes discordant to both bedding and cleavage. A deep alteration of hydrothermal type transformed all the primary minerals into a thick mass made up of carbonates, clorites, sericites (white micas) and opaque minerals (mostly sulphures). Locally relics of strongly altered plagioclase are present. Some chemical analyses carried out on these dykes did not yield any petrochemical character, owing to the high degree of mobility of the major elements. In spite of that, it is possible to deduce that these rocks contain an average of 50% SiO_2 (max 52%) and high alkalies concentration.

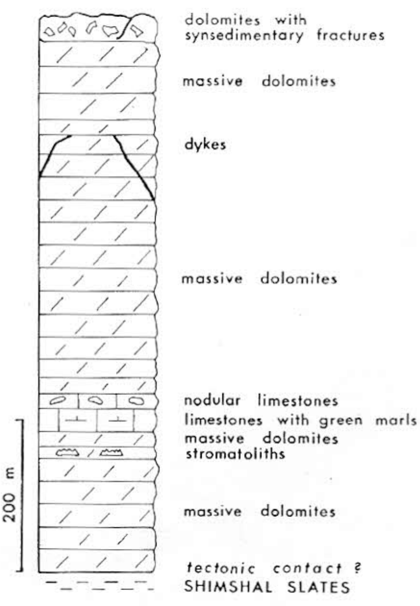

Fig. 3 – Partial section, along the Shimshal River, of the Karum Kush Dolomites, at the contact with the Shimshal Slates; this section corresponds to point 3 in Fig. 1.

Deformations. The thickness of deformed slates reaches several kilometres, but this may involve repetitions by thrusting; the sequence is folded by large upride, tight to isoclinal anticlines and synclines. Cleavage–anchimetamorphism transformed shales into slates. The western outcrops of the unit show south–western dipping beds (dip = 50°) underlying the dolomites.

Age. Fossils have not been found in this formation; rate of supply, metamorphism and environment are responsible for the lack of fossils. Owing to the probable tectonic relationships with the adjoining formations the stratigraphic position must be inferred resorting to correlations with other sections (see below): a Carboniferous age s.l. can be supposed.

Correlations. The black slates are largely widespread in the Karakorum (namely Black Mountains): see the Norin's Review (1976).
– Upper Hunza: the Misgar Slates of Desio & Martina (1972) of unknown age show similar lithology; the Pasu Tonschiefer (Schneider, 1957) could represent probably younger sedimentary terms; the Darkot Group of Permian– Carboniferous age (Ivanac et al., 1956) includes thick sequences of similar slates.
– Shaksgam Valley: a good correlation is given by the Singhiè Shales (Desio, 1980) of probable Carboniferous age.

Fig. 3b – Dolomitic–breccia in the Karum Kush Dolomites; vertical ultrabasic dyke on the right. This picture is from point 3 of Fig. 1.

– Karambar Valley: a correlation can be traced with the I mit Formation (Casnedi, 1980).
– The Shimshal Slates can be correlated also with the Horpapso Formation of Norin (1976) outcropping in western Tibet and with the Bazardar Suite of Ruzhentzev (1968, in Norin, 1976) of Carboniferous–Early Permian age.

Karum Kush Dolomites.

The lower Shimshal Valley is deeply cut in a gorge of carbonate rocks, mostly dolomites.

The base of the sequence is made of dolomites with intercalations of limestones (Fig. 3); then the dolomites are intruded by volcanic dykes (Fig. 3b) and show synsedimentary fractures cemented by secondary dolomite. The lower part of the formation was surveyed for a thickness of 750 metres. A very thick dolomite sequence follows probably up to the Tupopdan and Karum Kush peaks; it was partially crossed in a section along the Shimshal River.

Environment. Carbonate platform of shallow water; no evidence of emersion or wave action was observed.

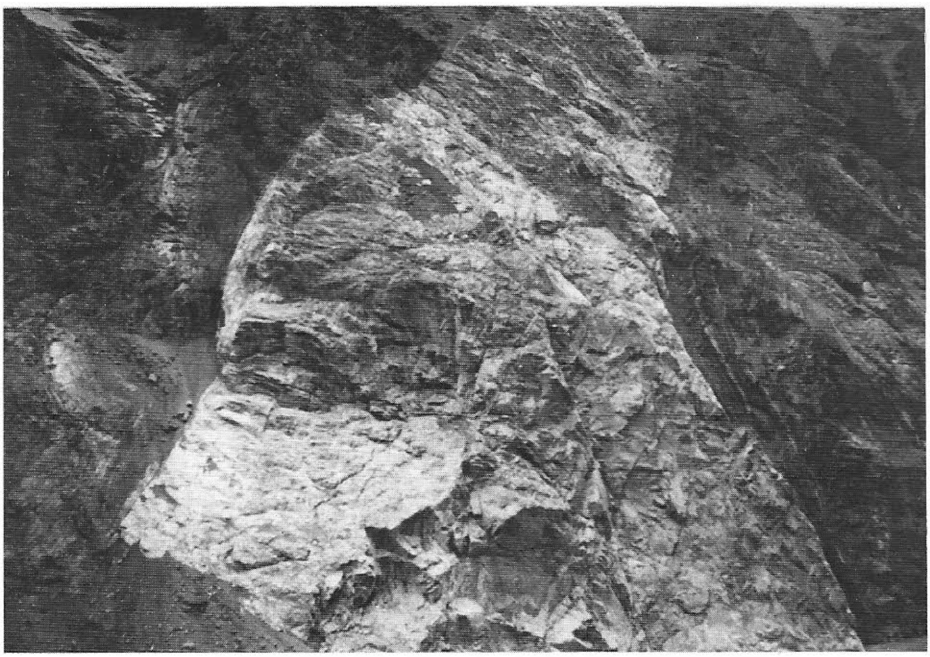

Fig. 4 – Karum Kush Dolomites (light grey) inbedded in the slates. Maximum width 70 m.

Deformation. The base of the unit shows south–west dipping probably concordant with the underlying slates. A sequence gently north–west or north –dipping up to the northern watershed (Tupopdan Peak) characterizes the main part of the unit. On the opposite (west) flank of the outcropping area close to the confluence of the Shimshal River into the Hunza, the dolomites are cut, along the former valley, by a very tight fold (Fig. 4) which causes a repetition of series: slates are involved in this deformation as well. It is not clear if these slates are correlatable with the previously described Shimshal Slates; in this case a very large synform can be the main deformation pattern of the lower Shimshal Valley with a younger dolomitic core and older slates at both the flanks. As an alternative hypothesis the slates outcropping to the south–east of the Karum Kush Dolomites can be referred to the Pasu Slates.

Age. No fossils were found in the lower Shimshal Valley.

Correlations and remarks. A Mesozoic sequence is reported by Schneider (1957) who draws a profile crossing the Shimshal Valley (see his fig. 5): the whole Mesozoic column up to the Lower Cretaceous is represented from the lower Shimshal Valley to the Tupopdan Peak. Desio (1964) indicates as Gujhal Dolomites (Triassic) the sequence of the lower Shimshal Valley. As a matter of fact, the absence of fossils, the frequence of volcanic dykes not quoted in the Gujhal Dolomites and the lithological differences make the correlation with this formation rather uncertain.

Pasu Slates.

Lithology. Slates with intercalation of limestones and quartzites. Their lithological characteristics and environment are similar to the Shimshal Slates. The age is unknown. The name has been introduced by Schneider (1957) and quoted by Desio & Martina (1972). As already reported in these works, the absence of fossils and the tectonic contacts with the surrounding formations do not allow any stratigraphic attribution.

Gircha Formation.

Lithology. Limestones and slates. An Upper Paleozoic fossil–bearing outcrop was surveyed at the beginning of the path which from Hunza brings to the Shimshal Valley (see n. 5 on Fig. 1). It is referred to the Gircha Formation widely outcropping in the Upper Hunza Valley.

Correlations. The Gircha Formation has been studied along the Hunza Valley by Desio & Martina (1972) who give a large meaning and thickness to this Permian formation, including limestones, shales and clastic intercalations. The above described Shimshal Slates could therefore belong to this formation as well. In fact Desio's Tentative Map (1964) traces a supposed belt of Permian –Carboniferous? Gircha Formation from Gircha to Shimshal, followed north–eastward by the older (Devonian?) Kilik Formation. We prefer to keep apart the Shimshal Slates owing to their peculiar lithology and deep–sea environment.

In Shaksgam Valley the Shaksgam Formation (Desio, 1980) offers similar lithology and age.

The Darkot Group, widely outcropping in the Gilgit area (Ivanac et al., 1956), includes the Gircha Formation. See moreover the large extent of the Gircha Formation westward in the Yasin and Upper Karambar Valleys (Casnedi's sketch map, 1980).

General remarks.

The Shimshal Valley is a natural cross section which exposes for the most part a huge sequence of prevailing black slates. They represent slightly metamorphosed turbidites of fan and basin plain, filling a large trench probably active during the Carboniferous. Fossils collected not in situ, coming from contiguous limestones, show an Upper Carboniferous–Permian age. Correlations

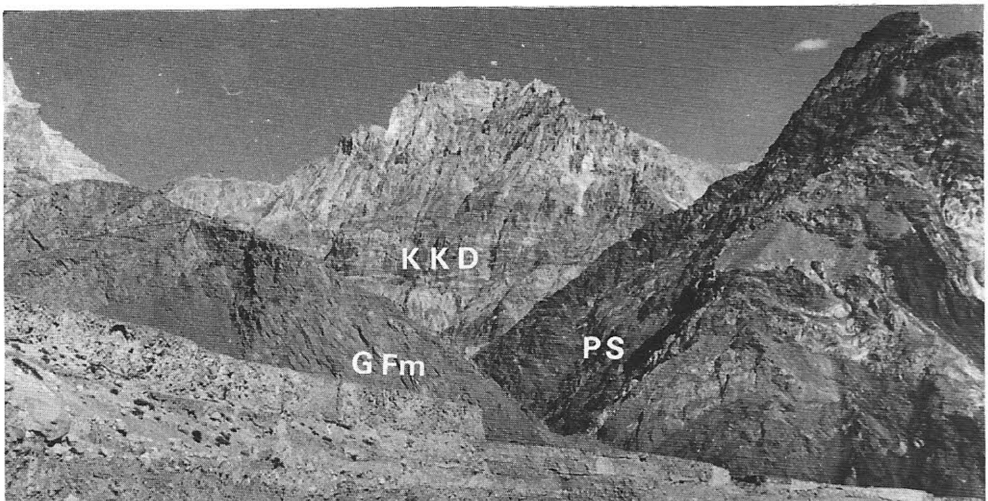

Fig. 5 – View of the confluence of the Shimshal Valley into the Hunza Valley. On the right, the Pasu Slates, on the background, the Karum Kush Dolomites, on the left, the Gircha Formation.

can be drawn with the Misgar Slates and the Darkot Group (Hunza Valley) and with the Singhiè Shales (Shaksgam Valley), confirming the existence of a deep sea, strongly subsiding during the Upper Paleozoic, largely widespread in the Hindu Kush–Karakorum.

Dolomites, slates and limestones with Upper Paleozoic fossils, characterize the deep gorge of the lower Shimshal Valley. Previous works, probably based on reconnaissances at the confluence of the Shimshal River into the Hunza, referred this sequence to the Mesozoic. The relationships of the carbonate sequence with the above mentioned black slates are still doubtful: new data from the Upper Hunza Valley are necessary in order to clarify this topic.

Paleontology

During the survey of the sequence cropping out in the lower part of the Shimshal Valley, no fossils have been found in place a part from a Bryozoan fauna (*Cystoporata*) from sample N5 collected in the Gircha Formation, along the path that from the Hunza Valley enters into the Shimshal Valley (see Fig. 1 at n. 5).

Brachiopod and Bryozoan faunas have been found in pebbles from the debris of the Shimshal River, just in the correspondance of the Shimshal village (1) or along the morena–slope of the Mulungutti Glacier (2), towards the Shimshal village (see samples list this page, foot note and the location of the fossil localities on Fig. 1).

Brachiopods.

The Brachiopod fauna consists of four specimens represented only by one valve, so identification was very difficult and only generic attributions have been done. The Brachiopods belong to the *Chonetacea* (*Rugosochonetes*? sp. and *Megachonetes*? sp.), to the *Productacea* (*Balakonia*? sp.) and to the *Spiriferacea* (*Spirifer* sp.). Only a brief description and some remarks were possible for *Rugosochonetes* sp. and *Megachonetes* sp. while the specimens of *Balakonia*? sp. and *Spirifer* sp. were too badly preserved to be figured or described.

Rugosochonetes? sp.

Pl. 57, fig. 3

Material. Sample N0; 1 pedicle valve.

Description. Small, broad, convex pedicle valve with maximum width

(1) Samples list from the Shimshal village fossiliferous locality: N 0, 1, 4, 6, 7; I–13B; KS10.
(2) Samples list from the Mulungutti morena: N 2, 3, 8, 9, 10.

slightly below the hinge. A median septum is developed for about 1/3 of the valve length as a narrow slit; diductor scars are present. Shell capillate with bifurcations; spinule apertures are numerous expecially below the cardinal margin.

Measurements: L = 8.5 mm
W = 16 mm

Remarks. The rather poor preservation makes an exact identification, even at a generic level, very difficult. The shape, ornamentation, the presence of the median septum and of the scars point to *Rugosochonetes* sp.

Age and distribution. The genus ranges from Lower to Upper Carboniferous of Europe, Asia, ?Africa, Australia, N. America.

Megachonetes? sp.

Pl. 57, fig. 1, 2.

Material. Sample N3; 1 pedicle valve.

Description. Large, semicircular, flat valve; hinge approximately widest part of shell. The ornamentation consists of fine capillae with many (one or two) bifurcations and intercalations. The shell shows weak radial plications. No spines have been observed.

Measurements: L = 37 mm
W = 52 mm

Remarks. The bad preservation, the lack of internal structures, the rather covered cardinal area make an exact identification, even at a generic level, quite difficult. On the basis of shape and ornamentation the specimen resembles *Megachonetes siblyi* (Thomas) (see Muir–Wood, 1962, pl. 12, figs. 3, 4, 7, 8) of Lower Carboniferous age.

Age and distribution. The genus has been described from the ? Middle Devonian of England; Lower to ? Upper Carboniferous of Europe (Great Britain, Ireland, France, Belgium, Germany, Russia), ? Asia, N. Africa.

Bryozoans.

A rich Bryozoan (1) fauna has been found in the collected samples. But as rocks have undergone metamorphism, Bryozoan microstructures have been alterated or largely obliterated, because of this, specific identifications and,

(1) Help in the determinations of the Bryozoan fauna has been provided by Prof. June R.P. Ross of the "Western Washington University", Bellingham, Washington. Dr. R. Olivieri, University of Modena, Italy, studied the conodont fauna.

consequently, age determinations have resulted exceedingly difficult and only high level attributions were possible.

Trepostomata, Cystoporata (Ordovician–Upper Permian), *Timanodictyina* (Carboniferous–Permian), *Rhabdomesidae* (Upper Silurian–Upper Permian), *Polypora* and fenestellids (Ordovician–Permian) characterize the microfauna of the samples (see Pl. 58) with very abundant representatives. Fenestellids s.l. are present in sample KS10 where also *Spirifer* sp. has been found. *Fenestella* sp. occurs together with *Megachonetes* ? sp. in sample N3 (Pl. 57, figs. 1, 2).

Conodonts.

Most of the collected samples have been also investigated in order to study the conodont fauna (note 1 p. 472). Only two samples yielded conodonts.

In sample I–13B a specimen of *Sweetognathus whitei* (Rhodes) has been found. This species is characteristic of the upper part of the Sakmarian, upper part of the Lower Permian. In sample N2 a specimen of *Gondolella* belonging to the variability of *Gondolella rosenkranzi* Bender & Stoppel is present. This species is characteristic of the Guadalupian, lower part of the Upper Permian.

Although only generic or wider attributions have been possible, from the collected fauna only the Paleozoic has been quoted in the lower Shimshal Valley, while most of the lithological units were attributed also to the Triassic.

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PLATE 57

Fig. 1 — Pebble collected in the morena of the Mulungutti Glacier, on the side dipping towards the Shimshal village. Fenestellids and *Megachonetes*? sp. Sample N3; x 0.6.

Fig. 2 — *Megachonetes* ? sp. Sample N3; enlargement of fig. 1; x 1.2.

Fig. 3 — *Rugosochonetes* ? sp. Sample N0, from the debris of the Shimshal River, in correspondence of the Shimshal village; x 1.9.

Fig. 4 — Pebble collected in the debris of the Shimshal River, near to the Shimshal village, same position of sample N0. Timanodictyids ? and *Trepostomata.* Sample N1; x 2.5.

Fig. 5 — Pebble collected in the morena of the Mulungutti Glacier, same locality of sample N3. A rich bryozoan fauna characterized by fenestellids, timanodictyids and *Polypora*. Sample N2; x 0.75.

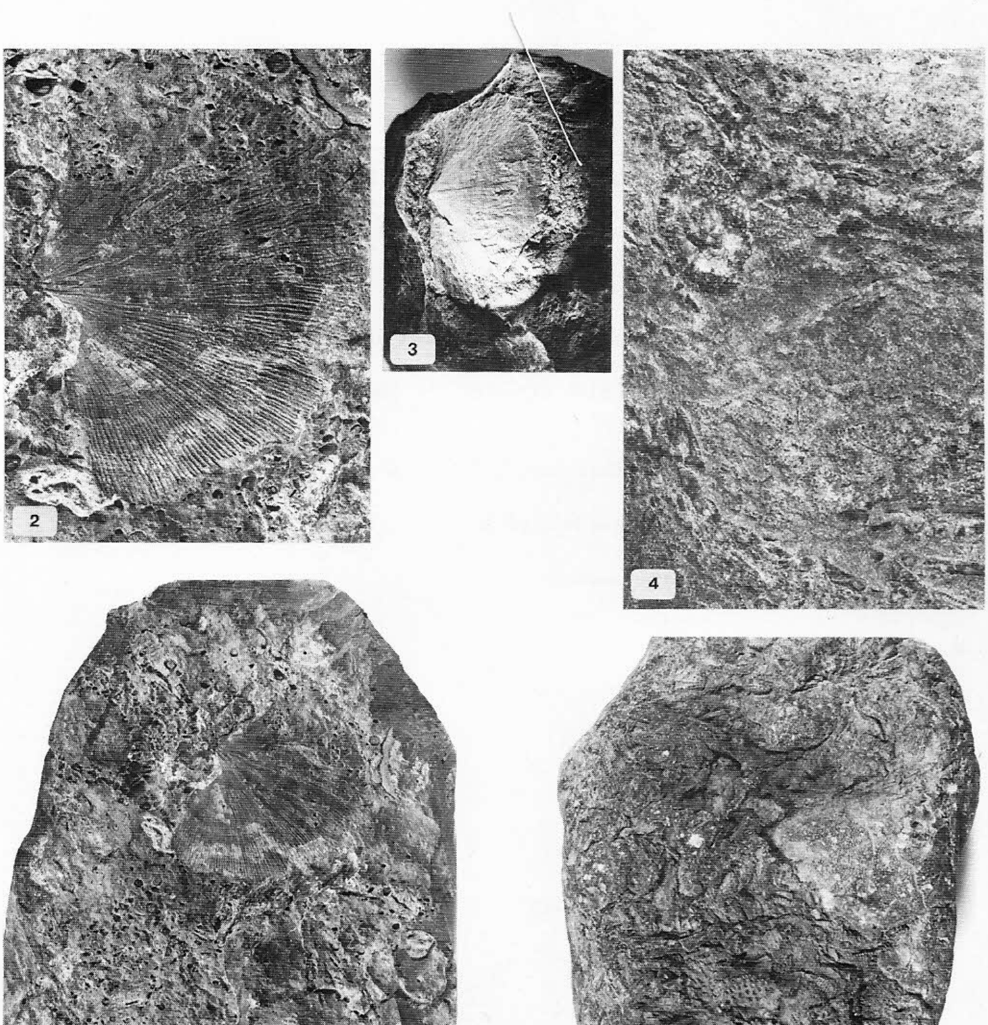
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PLATE 58

Fig. 1 — a) Trepostome and b) timanodictyid? bryozoans. Sample N1; x 5.

Fig. 2 — a) Trepostome and b) timanodictyid bryozoans. Sample N1; x 8.

Fig. 3 — a) Trepostome, b) timanodictyid, c) cystoporate bryozoans. Sample N1; x 6.

Fig. 4 — *Cystoporata*. Sample N5, Gircha Fm.; x 12.

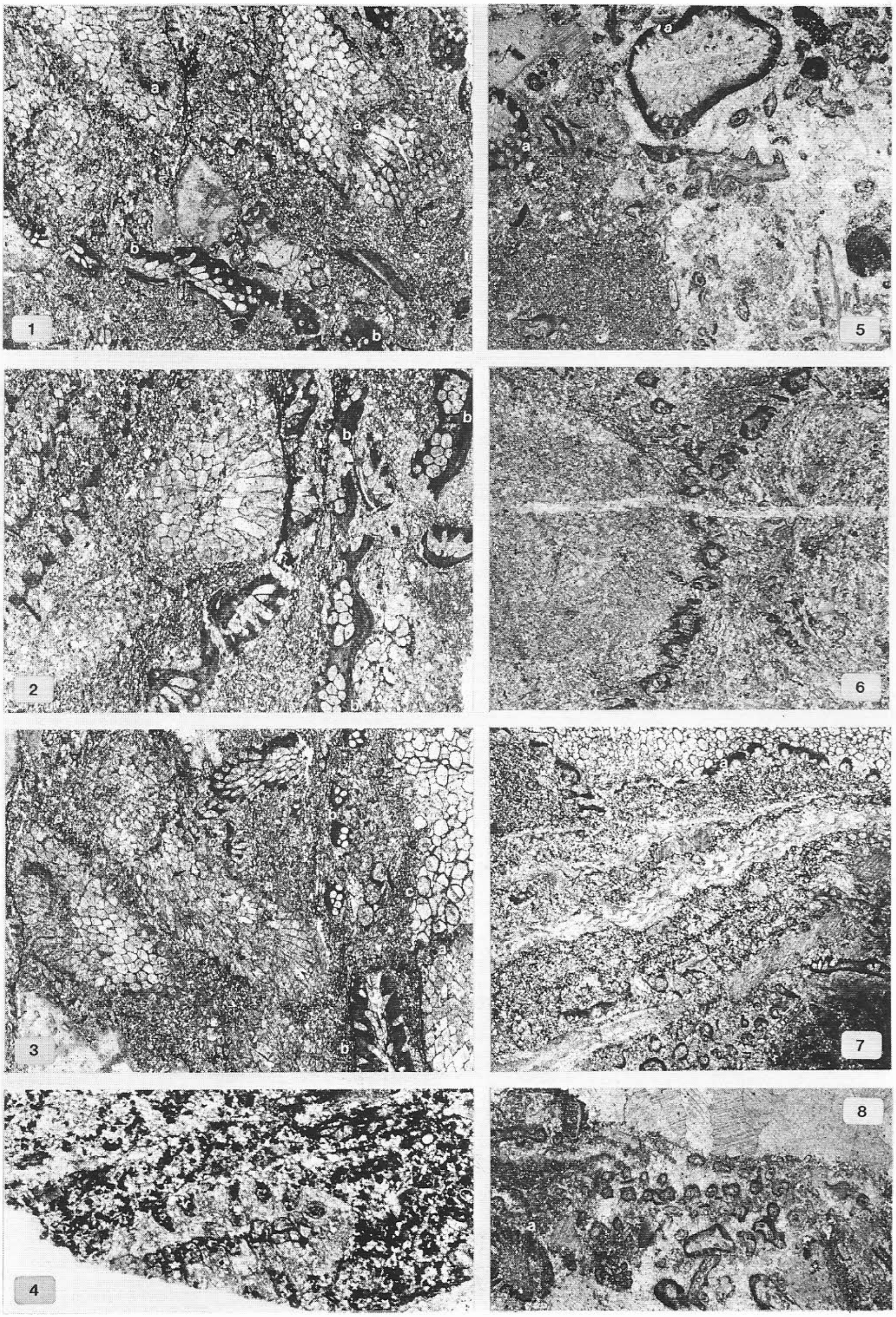
Fig. 5 — Mostly timanodictyid specimens. Sample N2; x 5.

Fig. 6 — Fenestellids s.l. Sample KS10, debris of the Shimshal river, in correspondence of the Shimshal village; x 2.

Fig. 7 — a) Cystoporate, b) fenestellids. Sample N10; x 6.

Fig. 8 — a) Rhabdomesonid ?. Sample N2; x 8.5.

All pictures are from thin sections.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