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ANCIENT CONTOURITES IN THE MENILITE BEDS (OLIGOCENE) OF THE CARPATHIAN FLYSCH, POLAND

(Pl. I—II and 2 Figs.)

Konturyty w warstwach menilitowych (oligocen) jednostki skolskiej fliszu karpackiego

(Pl. I—II i 2 fig.)

A b s t r a c t. Tractionite deposits in the Menilite Beds (Oligocene) of the Skole nappe of the Carpathian Flysch show a consistent paleocurrent direction at right angle to regional paleocurrents directions in sand flow deposits and turbidites of the overlying Kliwa Sandstone. This paleogeographic context suggest that the tractionite deposits of the Menilite Beds represent ancient contourites.

INTRODUCTORY REMARKS

From an earlier study of ancient traction currents deposits from the Carpathian Flysch (Unrug, 1977) the author concluded that contourites — deposits of geostrophic currents of thermohaline circulation should be considered as a special case of tractionites — deposits of deep-sea traction currents. The traction currents may represent thermohaline circulation currents following or not following izobaths, tide induced currents (Shepard and Marshall, 1973), internal waves or currents of clear water induced by passage of turbidity currents.

The general term „tractionite" for deposits of traction currents, as opposed to turbidites — deposits of sediment-laden turbidity currents, proposed by the present author with some reservations (Unrug, 1977), received support from various sources (personal communications of Dr. E. D. McKee and Prof. H. Okada), and will be used also in this paper. The present author suggested that criteria for distinguishing ancient contourites within the broader class of tractionite deposits are lacking, and

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will be probably based upon palaeogeographical considerations rather than upon textural and structural characters of ancient sediments, which are likely to be similar in all types of tractionite deposits (Unrug 1977).

Tractionite deposits found recently in the Menilite Beds (Oligocene) of the Skole nappe of the Carpathian Flysch may represent true contourites as indicated by the paleogeographical context of their occurrence.

TRACTIONITES OF THE MENILITE BEDS

Occurrences

The tractionites occurring in the Menilite Beds are associated with the Kliwa Sandstones. The Kliwa Sandstones form sandstone lithosomes lenticular in transverse cross-section and channelized in the mudstones

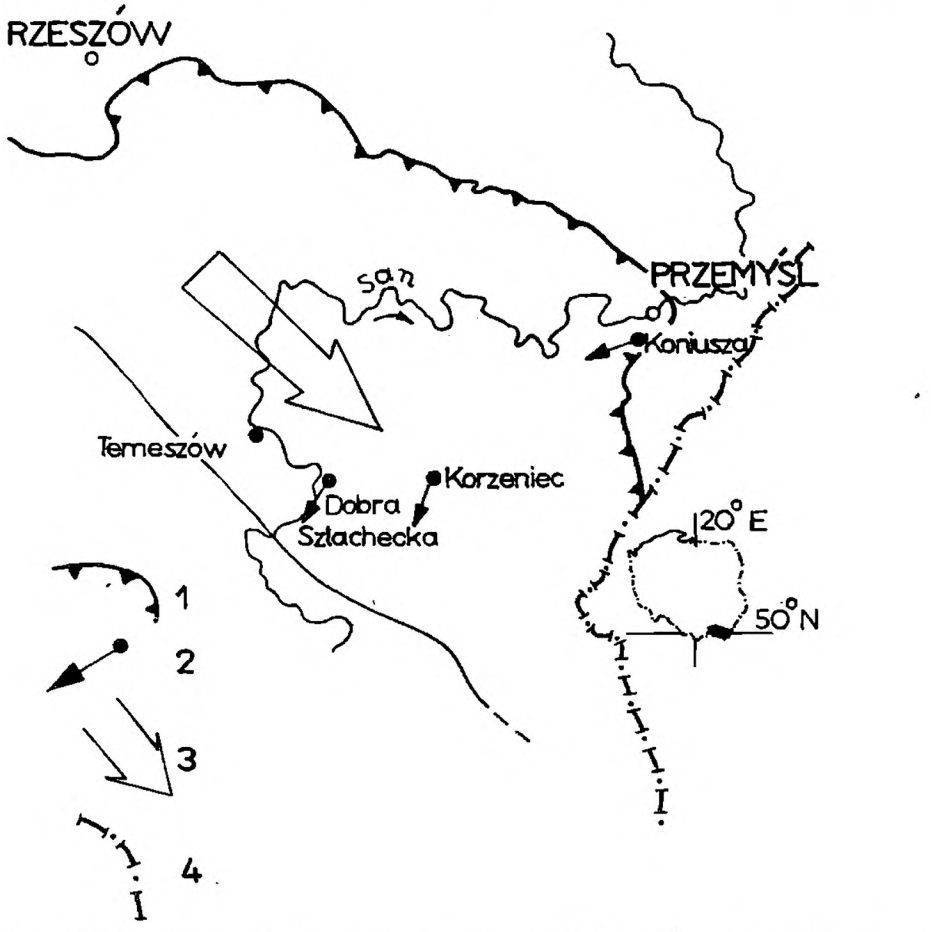

Fig. 1. Area of occurence of contourites in the Menilite beds of the Skole nappe. 1 — northern thrust front of the Skole nappe; 2 — localities studied and paleocurrent direction in contourites; 3 — regional paleocurrent direction in the Kliwa sandstones overlying contourites; 4 — state boundary

Fig. 1. Badane odsłonięcia z konturytami w łupkach menilitowych jednostki skolskiej. 1 — północna granica jednostki skolskiej; 2 — odsłonięcia konturytów w łupkach menilitowych i kierunek paleoprądu w konturytach; 3 — regionalny kierunek paleoprądów w piaskowcach kliwskich przykrywających utwory z konturytami; 4 — granica państwowa

of the Menilite Beds. The Kliwa Sandstones are represented mostly by thick-bedded sand-flows and turbidite deposits, fine- to coarse-grained, composed of well sorted and well rounded quartz grains with a significant admixture of glauconite (Ślączka and Unrug, 1966).

The tractionites occur across the whole width of the belt of exposures of the Skole nappe in the eastern part of the Polish Flysch Carpathians. The occurrence of beds interpreted here as tractionites was noted earlier (Dżułyński and Kotlarczyk, 1962; Ślączka and Unrug, 1976), but no detailed interpretations were given then.

In the present study tractionite deposits were examined at four localities (Fig. 1):

— at Koniusza near Aksmanice south of Przemyśl, in the profile exposed in the Koniusza stream within the outermost thrust slice of the Skole nappe;

— at Korzeniec in the road cut of the Bircza-Przemyśl highway;

— at Temeszów in the exposures of the left slope of the San River valley;

— at Dobra Szlachecka north of Mrzygłód in the valley of the small right bank tributary of the San River north of the village, in the profile of the southern limb of the Wara anticline, that is in the innermost part of the belt of exposures of the Skole nappe.

Descriptions

At Korzeniec, Temeszów and Dobra Szlachecka the tractionite deposits are present in the same position in the profile of the Menilite Beds above the basal chert horizon, and below the lowest lithosome of the Kliwa Sandstone.

The tractionite deposits are represented by sandstone lenses 1,5—5 cm thick, and 40—50 cm long, fine- to very fine-grained, cross-laminated, consisting of single sets of cross-laminae, occasionally of 2—3 superposed sets (Fig. 2). The sandstone lenses are embedded in dark-brown micaceous silty shales and spaced vertically at intervals of 5—20 cm. The top and base surfaces of the sandstone lenses are sharp. In all three localities the transport direction of the tractionites indicated by cross-lamination is at right angle to the transport direction of the thick-bedded Kliwa Sandstones occurring higher in the profile.

At Koniusza the tractionites occur above the basal chert horizon of the Menilite Beds but they are not covered by the thick-bedded Kliwa Sandstones which are absent in the profile of the outermost thrust slice of the Skole nappe. The basal chert horizon is overlain by dark-brown mudstones with very numerous thin beds, lenses and laminae composed of well sorted, rounded very fine sand grains. Cement is nearly absent and the sandstones are friable. The top and base surfaces of these stra-

tification units are sharp (Plate I, Figs. 1, 2). The sandstone laminae are up to a few milimetres thick, while the isolated ripples and the laminated and cross-laminated beds are up to 5 cm thick. Load deformations at the base of the isolated ripples are common. The beds have irregular top and base surfaces resulting from coalescence of ripples (Pl. II, Fig. 1).

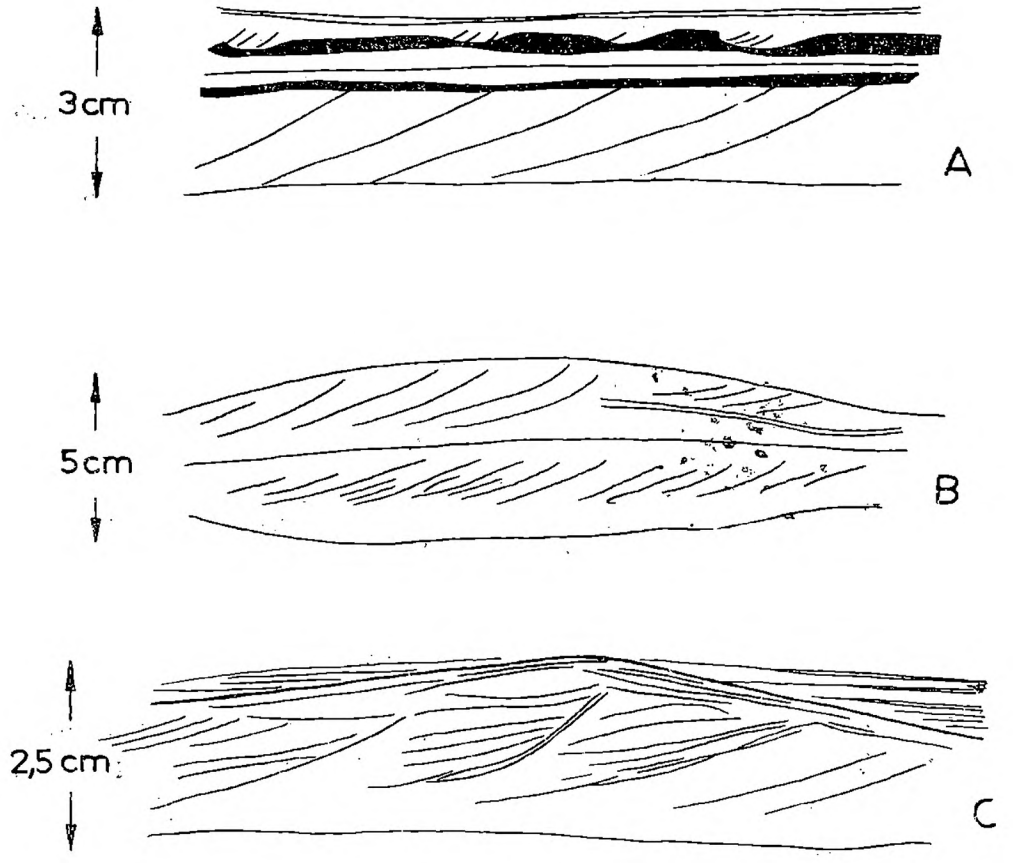

Fig 2. Types of lamination in the contourite beds. A, B — specimens from Dobra Szlachecka locality; C — Specimen from Korzeniec locality

Fig 2. Typy laminacji w soczewkowatych ławicach konturytów. A, B — okazy z Dobrej Szlacheckiej; C — okaz z Korzeńca

Cross lamination is ubiquitous and indicates a constant transport direction from ENE to WSW. The Koniusza locality is situated within the sigmoidal bend of the front of the Skole nappe. The direction of this front extending here north-south is local and obviously related with a clockwise rotation of c. 40°. An anticlockwise rotation adjusting the local strike of beds to the regional NW-SE strike is giving the azimuth of paleocurrent directions as c. 210°, a value similar to that measured at Korzeniec, and roughly perpendicular to the regional direction of transport of the thick-bedded Kliwa Sandstones.

Petrography

Thin sections of the thin sandstone lenses from Temeszów and Korzeniec were examined. Very good sorting and the presence of laminae rich in heavy minerals are characteristic features (Plate II, Figs. 1, 2). Laminae of well sorted silt are also present and sometimes they accompany the laminae enriched in heavy minerals. Laminae containing clay matrix are rare. The sandstones are composed of quartz and rare glauconite grains. The cement is opalline silica (present at Temeszów, Korzeniec and Dobra), while in the profile at Koniusza the cement content is extremely low and the sandstones are friable. Petrographically the described sandstones represent the fine grades of the sedimentary material forming the thick-bedded Kliwa Sandstones.

INTERPRETATION AND DISCUSSION

The described deposits display a combination of textural features and sedimentary structures which is considered as diagnostic for contourites (Stow and Lowell, 1979, Table II modified after Hollister and Heezen, 1972). However it should be stressed upon that these features are indicative only of transport, reworking and sorting of sand-sized sediment by bottom currents. Other criteria are needed for recognition of a particular type of traction currents and for identification of contourites within the broader class of traction currents deposits or tractionites. This statement, published already in an earlier paper (Unrug, 1977) is repeated here, since Stow and Lowell (1979, p. 279) in a review paper referred erronously traction current deposits described from the Carpathian Flysch as „candidates for the description contourites" while the present author termed them „tractionites".

Paleocurrent analysis is likely to provide the most important criteria for identification of contourites within the broader class of tractionites (Unrug, 1977; Anketell and Lowell, 1976).

In the case of tractionite deposits of the Menilite Beds described here, the highly persistent paleocurrents direction similar over the whole investigated area, and perpendicular to the regional paleocurrent direction in the sand flows and turbidites deposits of the thick-bedded Kliwa Sandstones strongly suggest currents flowing across the submarine slope. The interpretation of the decribed tractionites as fine-grained overbank turbidites is discarded because of the occurrence of the tractionites below the sand flows and turbidites deposits in the stratigraphic profile, while the interpretation as distal turbidites is discarded, as the most typical and numerous beds of tractionites are present at Koniusza, that is at

the outer margin of the sedimentary basin, which is likely to represent a submarine slope.

The dark-brown mudstones accompanying the thin-bedded lenticular tractionite sandstones are probably also tractionite (possibly contourite) deposits. There are no direct criteria for this conclusion other than the relatively coarse grains in these mudstones, as compared with the fissile clayey shales of the Menilite Beds present in other parts of the sedimentary basin. The identification of muddy contourites is difficult as stressed upon by Stow and Lowell (1979) and the association with tractionite, possibly contourite sandstones in the case described here is the most important support of the hypothesis of tractionite, possibly contourite nature of the mudstones of the Menilite Beds of the Skole nappe.

The possible source of heavy water in the sedimentary basin of the Carpathian Flysch during the deposition of the Menilite beds is not known. However, the facies of brown mudstones and shales of the Menilite beds is widespread in the whole Outer Carpathians, suggesting the existence of a large basin in which some kind of geostrophic circulation of contour currents was possible. It is highly significant that a coeval lithofacies of brown pelites with thin siltite beds — interpreted as contourites — is present also at the opposite margin of Late Alpine system of sedimentary basins in the Numidian Flysch of Sicily (Wezel, 1970; Kotlarczyk, 1976).

Specimens pertaining to this study are housed in the Geological Museum, Institute of Geological Sciences, Jagellonian University, collection symbol UJ 23 — thin sections, UJ 5D — rock samples.

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REFERENCES — WYKAZ LITERATURY

Anketell J. M., Lowell J. P. B. (1976). Upper Llandoverian Grogal sandstones and Aberystwyth Grits in the New Quay area, Central Wales: a possible upward transition from contourites to turbidites. *Geol. J.*, 11: 107—108.

Dżułyński S., Kotlarczyk J. (1962), O pogrzęźniętych pręgach falistych (riplemarkach). On load-casted ripples. *Rocz. Pol. Tow. Geol.* 32: 147—160.

Hollister C. D., Heenzen B. C. (1972), Geologic effects of ocean bottom currents: western North Atlantic. In: A. L. Gordon (Ed.) *Studies in Physical Oceanography*, 8. Gordon and Breach, New York N.Y., pp. 37—66.

Kotlarczyk J. (1976). Flisz numidyjski a warstwy menilitowe (uwagi porównawcze). *Spraw. Kom. Nauk. PAN Oddz. Kraków* 19, 1: 187—189.

Shepara F. P., Marshall N. F. (1973), Currents along floors of submarine canyons. *Bull. Am. Assoc. Petrol. Geol.*, 57: 244—264.

Ślączka A., Unrug R. (1966), Z badań nad strukturami sedymentacyjnymi i petrografią niektórych serii piaskowcowych z łupków menilitowych Karpat (Sedimentary structures and petrology of some sandstone members of the Menilite Beds, Carpathians). *Rocz. Pol. Tow. Geol.* 36: 155—180.

Stow D. A. V., Lowell J. P .B., (1979), Contourites: their recognition in modern and ancient sediments. *Earth Sci. Reviews* 14: 251—291.

Unrug R. (1977), Ancient deep-sea traction currents deposits in the Lgota beds (Albian) of the Carpathian Flysch. *Rocz. Pol. Tow. Geol.* 47: 355—370.

Wezel F. C. (1970), Numidian Flysch: an Oligocene-Early Miocene continental rise deposit off the African platform. *Nature* 228, no. 5268: 275—276.

STRESZCZENIE

W warstwach menilitowych powyżej poziomu rogowców, a pod piaskowcami kliwskimi występują wśród mułowcowych brunatnych łupków nieciągłe soczewkowate ławice, izolowane riplemarki i pojedyncze laminy piaszczyste, złożone z bardzo drobnoziarnistego materiału, bardzo dobrze wysortowanego pod względem wielkości ziarna. W ławicach i riplemarkach występuje laminacja pozioma i przekątna, podkreślona koncentracjami ziarn minerałów ciężkich (fig. 2, Pl. II, fig. 2). Najlepsze odsłonięcia tych utworów występują w miejscowości Koniusza koło Aksmanic na S od Przemyśla w brzeżnej łusce płaszczowiny Skolskiej (fig. 1, Pl. I, fig. 1 i 2, Pl. II, fig. 1). W profilu tej brzeżnej łuski piaskowce kliwskie nie występują, i cały profil warstw menilitowych zawiera tylko cienkoławicowe i soczewkowate utwory opisane wyżej. Cechy teksturalne — drobne ziarno, bardzo dobre wysortowanie, brak matrix iłowej, koncentracja ziarn minerałów ciężkich w laminach oraz struktury sedymentacyjne wskazują, że omawiane osady deponowane były przez przydenne prądy trakcyjne. Pod względem petrograficznym osady te reprezentują drobnoziarniste frakcje materiału osadowego piaskowców kliwskich.

Warstwowanie przekątne w osadach prądów trakcyjnych wskazuje kierunki paleoprądów prostopadłe do paleoprądów w wyżej leżących piaskowcach kliwskich. Pozwala to na interpretowanie opisanych trakcjonitów jako osadów geostroficznych prądów płynących po izobatach podmorskiego stoku. Osady te mogą więc być określone terminem „konturyty".

EXPLANATION OF PLATES — OBJAŚNIENIA TABLIC

Plate — Plansza I

Fig. 1. Thin beds, lenses and laminae of sand in dark-brown mudstones. Menilite Beds, exposures in the Koniusza stream at Koniusza. The diameter of coin is 29 mm. Beds are vertical, bases at right. Phot. R. Unrug

Fig. 1. Cienkie ławice, soczewki i laminy piaskowca w brunatnych mułowcach warstw menilitowych. Odsłonięcia w potoku Koniusza w Koniuszy. Średnica monety 29 mm. Warstwy pionowe, spągi z prawej strony. Fot. R. Unrug

Fig. 2. Lenses (isolated ripples) and laminae of sand in dark brown mudstones. Menilite Beds, exposures in the Koniusza stream at Koniusza. The diameter of coin is 29 mm. Beds are vertical, bases at right. Phot. R. Unrug

Fig. 2. Soczewki (izolowane riplemarki) i laminy piaskowca w brunatnych mułowcach warstw menilitowych. Odsłonięcia w potoku Koniusza w Koniuszy. Średnica monety 29 mm. Warstwy pionowe, spągi z prawej strony. Fot. R. Unrug

Plate — Plansza II

Fig. 1. Close up view of lenses and laminae of sand in dark-brown mudstone. Menilite Beds, specimen collected at Koniusza. The height of specimen is 30 mm. Phot. K. Fedorowicz

Fig. 1. Szczegóły lamin i soczewek piaskowca w brunatnych mułowcach warstw menilitowych. Wysokość okazu 30 mm. Potok Koniusza. Fot. K. Fedorowicz

Fig. 2. Photomicrograph of a lamina enriched in heavy minerals grains. Sandstone lens from Menilite Beds, Korzeniec. The white bar represents 0.2 mm. Phot. R. Unrug

Fig. 2. Mikrofotografia laminy wzbogaconej w ziarna minerałów ciężkich. Soczewka piaskowca z łupków menilitowych, Korzeniec. Biała kreska reprezentuje 0,2 mm. Fot. R. Unrug

Fig. 3. Photomicrograph of a silt lamina in very well sorted sandstone with opaline cement. Sandstone lens from Menilite Beds, Temeszów. The white bar represents 0.2 mm. Phot. R. Unrug

Fig. 3. Mikrofotografia laminy mułowca w bardzo dobrze wysortowanym piaskowcu o spoiwie opalowym. Soczewka piaskowca z łupków menilitowych, Temeszów. Biała kreska reprezentuje 0,2 mm. Fot. R. Unrug

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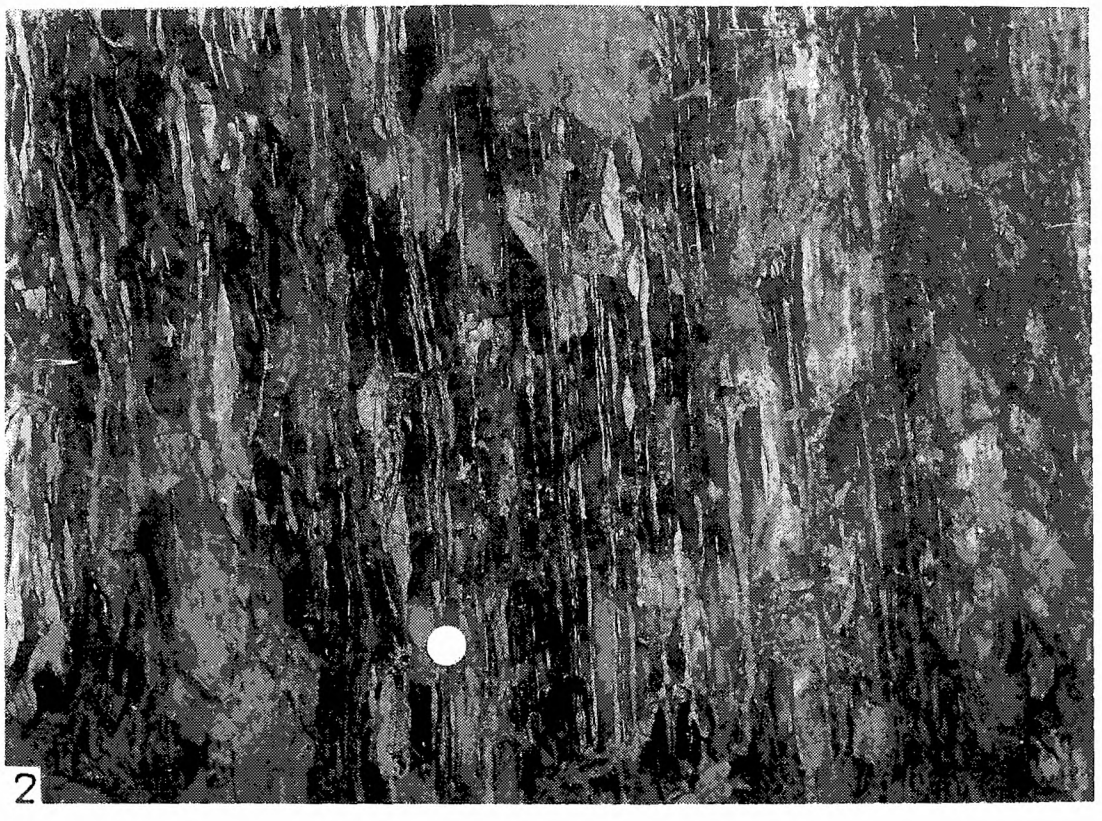

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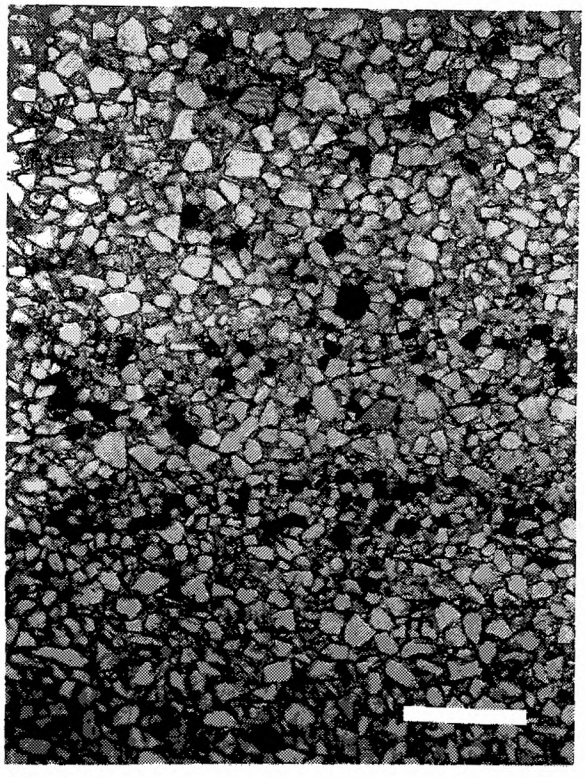

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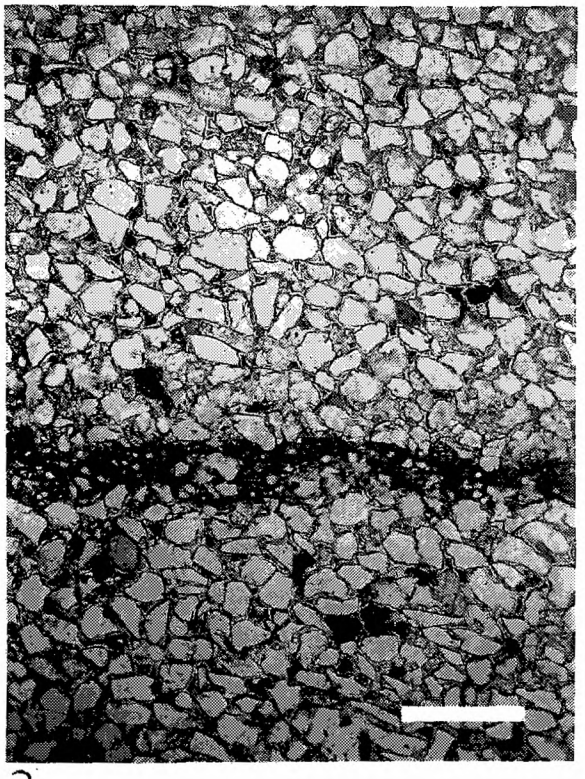

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