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Composition and exchange capacity of deep sea sediments

part 2

D. Eisma

Report of work carried out in 1969/70

on sediment cores used by

E.K. Duursma, IAEA, (Monaco),

for sorption experiments

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Contents

I. Summary

Grainsize, content of organic matter, Cl, Ca, Mg, Fe, Na and K were determined in 19 new cores and samples. X-ray analysis as well as base exchange capacity and specific surface were carried out on all cores and samples. Also x-ray analysis was carried out

on the coarser size fractions of samples that contain many grains, mostly aggregates and concretions, which could not be identified under the microscope. The data are listed in seven tables.

II. Introduction

As stated in part I (1968) the purpose of this study was to determine the composition and base exchange capacity of sediment samples collected by various institutions and sent to the Monaco laboratory of the IAEA to be used in sorption experiments by E.K. Duursma. It involved determination of grainsize, mineralogical composition, content of heavy metals (in cooperation with H.A. Das, Reactor Centrum Petten) and base exchange capacity. Moreover a number of extracts were made with solutions of increasing acidity in order to determine the strength whereby several elements are bound to the sediment particles.

In part I the results of some analyses made on 41 cores or sediment samples were discussed. Since then the work on these samples was completed while also nineteen other cores or samples were analysed. The results are given here. Most analyses were made at the Netherlands Institute for Sea Research, Texel (formerly Den Helder). The X-ray analyses and the determinations of base exchange capacity and specific surface were carried out in collaboration with H.W. van der Marel (STIBOKA, Wageningen, temporarily at NIOZ, Texel). The results of heavy metal analyses, being done at the Reactor Centrum, Petten, will be reported seperately with H.A. Das.

III. Analytical Techniques

a. Determination of grainsize, content of organic matter, Cl, Ca, Mg and Fe, and microscope analyses were carried out as described in the first report.

b. The acid extracts were made on the 19 new cores and samples with 0.1 N HCl and 12.0 N HCl; the intermediate extractions, as made on the other samples and discussed in the first report were omitted, since they did not give more information.

c. The X-ray analyses were redone on better equipment and with a presumably better technique of identification and estimation of the relative amounts present of each mineral. Therefore the percentages given in Table V differ from those in Table VII of part I. Minerals were identified following Biscaye (1965) or with standard samples. For the quantitative estimation calciumcarbonate was determined chemically (as Ca), giving a fixed percentage, whereas the well-cristallized minerals such as quartz, mica, chlorite, feldspar and kaolonite were determined within rather narrow limits with standards. The amounts of the less well cristallized minerals (intermediates, montmorillonite) were estimated within the limits thus obtained. Opal was estimated directly from the diagram by measuring the surface under the opal "bulge". This was found to be more reliable than heating to 950^{o} C and measuring the cristoballite peak.

d. For determination of base exchange capacity the sample was weighed and mixed with coarse clean sand. After percolation with alcohol to remove sea salts it was 4 x percolated with 1 N NaCl so that all exchange positions were filled with Na. This was followed by percolation with 1 N NH_4Cl whereby Na was exchanged for NH_4. Determination of Na in the NH_4Cl-percolate gave the total base exchange capacity of the sample (in meq/100 gr.) Specific surface was determined with the method of Dyal and Hendricks (1950).

IV. Results

a. Grainsize and microscope investigations

The results of sieve analysis and microscope study of the fractions 25μ are given in Table II, the results of sieve and pipette analysis in Table III. For each sample the median diameter (d_{50}) and a measure of sorting (σ) were determined from the frequency distributions following Inman (1952). As was also found in the first 41 samples there is a relation between d_{50} and sorting (fig. 1): the finer sediments tend to be better sorted than the coarser sediments. The bad sorting of the coarser samples is due to the presence of organic skeltons and fragments of variable size and of coarser mineral grains in the predominantly fine silt and clay.

b. organic matter

Organic matter content is given in Table IV and varies between 0.85% and 19.4%, the C/N ratio lying between 5.9 and 63.8.

c. Clay mineral composition

The composition of the fraction <2 μ and 2-25 μ as determined by X-ray diffraction is given in Table V. Sample XXVII was too small to be separated into size fractions large enough to be analysed in the diffractometer so that only an analysis of the total sample was made, Mineral identification gave difficulties only in a few cases. The Red Sea sample (XL) contains much amorphous Fe, probably as hydroxyde, some limonite ($Fe(OH)_3$) and a carbonate where Ca probably has been replaced to some extent by Fe and Mn. In samples LVII and LVIII the percentage intermediates/swelling illite also includes some montmorillonite which could not be separated quantitatively from the other swelling minerals. Significant amounts of opal were only found in XXVII.

d. X-ray analysis of coarser fractions

Besides mineral grains that could be identified under the microscope and recognizable organic skeletons and fragments, a large number of grains occur in the coarser size fractions that could not be determined in this way. Therefore X-ray analysis was done on the size fractions of samples containing comparatively large amounts of unidentified grains (Table V).

These can be listed as follows:

1) dark brown/grey black grains and orange grains. They occur in small numbers in nearly all samples except those which are nearly pure carbonate. They are too few however to give recognizable peaks in the diffractograms. Usually they are somewhat magnetic and probably consist of Fe, Mn and Ti oxydes.

2) brown grey and dark grey flakes. They are brittle agglomerates, more or less disc-shaped and consisting of small particles ($<30\mu$), mostly quartz and feldspars as far as could be ascertained. Since they do not distintegrate in HCl, they are probably cemented by SiO_2. In large numbers they are present in cores IV (Chukchi Sea 54 m) and XXIV (Gulf of Guinee 3520 m). X-ray analysis indicates

that the coarser size fractions of core IV contain mainly quartz with some feldspars and mica, those of core XXIV a large amount of calcite (foraminifera, vid. Table II), quartz and a comparatively high percentage of kaolinite, which is also abundant in the clay fraction. This suggests that these aggregates are formed in situ either by solution of SiO_2 from the sediment and redeposition, or by deposition directly from the interstitial water or from seawater. Harder (1965) and Harder und Menschel (1967) have shown that deposition of SiO_2 occurs when hydrozydes of Al, Fe, Mn of Mg are present. The possible presence of such hydrozydes is indicated by the occurrence in both cores of orange-brown grains as mentioned under 1). There remains the question however why flakes of this kind are not found in other cores under similar conditions.

3) yellowish grey/brown yellow/brown/dark grey brittle aggregates. These are irregularly shaped opaque grains that do not disintegrate with HCl but can be broken by exerting some pressure with a needle. They occur in cores VI, VII, VII, (Laptev Sea - Chukchi Sea 26-50 m), X (Atlantic Ocean 5384 m), XXV (Gulf of Trieste 30 m) and XL (Red Sea 2080 m) but only in VIII and XL in comparatively large amounts. X-ray analysis of VIII shows a strong predominance of quartz, indicating that these grains are quartz aggregates stained by some oxydes. XL contains, besides large amounts of carbonates, a high percentage of amorphous Fe and Mn hydroxydes, indicated by a typically high back ground in the X-ray diagram and confirmed by chemical analysis (12.3% Fe and 14.4% Mn).

4) soft or somewhat brittle orange yellow brown grains. They are round, sometimes angular, tube-like or spool-shaped and occur in cores I, II III (mediterranean 2720 m) and in core XXX (Pacific Ocean 5879 m).

In core II the rounder aggregates sometimes can be seen to be formed around a foraminifer as a nucleus. The tube-like forms look like worm tubes.

5) brown concretions. They are usually round, elliptic or disc-shaped and of larger size than the grains or aggregates mentioned under 1-4. Concretions as those occurring in core XLIV are described by Winterhalter (1966) and consist of hydrous Fe and Mn oxydes. The concretions found north of the Amazon in core XLVII are rather loose, but cohesive enough to withstand the strong water stream during wet-sieving. Since the fraction $> 250\ \mu$ contains only organic carbonates besides concretions the composition of the concretions is indicated by the composition given in Table V minus the carbonates: they contain around 10% chamoisite (as found also by Porrenga 1967 on the Orinico shelf), a large number of swelling illite, some quartz and a trace of kaolinite. Since the composition of the concretions, apart from the chamoisite, is rather similar to the composition of the finest size fractions (but with a marked predominance of swelling illite in the concretions) it can be assumed that the formation of chamoisite in the presence of organic matter (as indicated by Porrenga 1967) has led to the cementing of the original sediment.

6) micronodules (predominantly hydrous Mn and Fe oxydes) occur in cores X (Atlantic Ocean 5384 m), XXIX, XXX, XXXV (all Pacific Ocean 5200-5900 m) and XXXIV (Pacific Ocean 965 m).

7) glauconite occurs in cores XLVI (Cape Good Hope 200 m) and L (Melkbos Strand).

8) yellow white/dull white grains. They are of variable shape, usually roundish, sometimes flakes, and occur in cores XII (Bahamas, Tongue the Ocean), XXII (Atlantic Ocean 2440 m), XXXI (Antarctic Ocean 7648 ...

XXXIII (Indian Ocean 3047 m) and LV (Indian Ocean 4227 m). The coarse size fractions of core XII consist wholly of carbonate, those of cores XXII and LV comparatively large amounts of carbonate (XXII: 65%; LV: 30%; as not enough sample was available, the coarse fractions of XXXI and XXXIII were not analysed). These data indicate that the dull-white grains in core XII and probably also in the other cores are cemented carbonate.

e. Base exchange capacity.

The data on base exchange capacity are given in Table VI, together with those on specific surface. Since for the specific surface determination ethyleneglycol is used, which is adsorbed on the internal surfaces as well as on the external surfaces, the specific surface is more or less related to the base exchange capacity. The relation found is rather good (fig. 2) and agrees with similar relationships found in soils by Van der Marel (1966) except for cores X and XL. Cores X contains much manganese in the form of micronodules, core XL much amorphous iron (probably as hydroxyde). A large surface area of these amorphous substances may account for a large specific surface of the sediment without a correspondingly high base exchange capacity.

In the first report a measure was calculated for the base exchange capacity of the sediment:

$$q = K \sum P.f$$

where K is the percentage $< 2\mu$, P = relative peak height (in the X-ray diagram) in %, and f is a conversion factor for the base exchange capacity of each mineral. For kaolinite f has been assumed to be 10, for illite and chlorite 25, for montmorillonite 100 (Grim 1958), and for all other minerals 0. It was assumed that 1) the clay mineral particles in the sediment are not larger than 2μ, and 2) that the base exchange capacity of the grains > 2μ is negligeable. In fig. 3 the relation between q and the experimentally found base exchange capacity is given. The relation is, surprisingly, rather good except for core X, which indicates that q indeed can be used as a (rough) relative measure. However, quantitatively q is 2-4 times too low compared to the experimental data. Using the data of Table V of this report (giving percentages, not peak heights) and taking P to be the average percentage of a mineral in the size fractions < 2μ en 2-25μ respectively, and K the % < 2μ and the % 2-25μ we can calculate

$$q' = K_{<2\mu} \sum P_{<2\mu} . f + K_{2-25\mu} \sum P_{2-25\mu} . f$$

and

$$q'' = K_{<2\mu} \sum P_{<2\mu} . f$$

where for f the same values are used as given above. In Table VI the values of q' and q" calculated for each core or sample are given and in fig. 3 they are put against the experimentally found base exchange capacity. The relation is much worse than for q, which may be due to the different way of determining P, to the presence of X-ray amorphous substances and grains > 25μ which have a base exchange capacity > 0, or to the average values of f being too low.

f. Acid extracts

The amount of Ca, Mg and Fe found in the acid extracts (0.1 N HCl and conc. HCl) are given in Table VII. In nearly all samples all Ca is dissolved in 0.1 N HCl and present as $CaCO_3$. Only in samples XLIII, XLIV and LII some difficulty soluble Ca is present in small amounts. Mg is partly present in an easily soluble form (carbonate) and in 11 samples also as difficultly soluble Mg. The latter amounts are not related to base exchange capacity and the % 2μ as was found previously. Fe is present in all samples in both easily and difficultly soluble form. There is a general increase of the iron extracted with 0.1 N HCl and conc. HCl with increasing base exchange capacity (or increasing specific surface), but this relation is not as clear as in the previous 41 samples. Most of the samples XLII - LVIII however contain (Fe, Mn) concretions and/or brown and orange grains. It was shown in the first report that solution of Fe from such grains obscures a possible relation between the amount of exchangeable iron extracted and base exchange capacity.

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Table I

list of sediments (samples XLII - LX)

Number of sediment core	Sample numbers	Length of core	Details on colour moisture etc.	Area and depth	Location	Donor
XLII	-	-	grey,moist	Baltic Sea 220 m	57°22'N 19°58'E	ARANDA, Finland, Dr. Winterhalter
XLIII	-	-	grey,moist	Baltic Sea 220 m	ibid.	ibid.
XLIV	-	-	Fe-Mn concentrations brown	Baltic Sea 89 m	61°28'N 19°48'E	ibid.
XLV	grab	-	sandy,moist	Cape Good Hope 55 m	33°44'S 18°20'E	Th.B. DAVIE, 15/III/67, MG/GR/21 Dr. Dingle, S.Africa
XLVI	grab	-	sandy,moist	Cape Good Hope 200 m	43°02'S 18°00'E	CALYPSO, 16/III/68 Comm.J.Yves Cousteau, Monaco
XLVII	grab	-	sandy,moist	Amazone delta 110 m	02°27'N 48°00'W	CALYPSO, april 1968 Comm.J.Yves Cousteau, Monaco
XLVIII	grab	-	sandy,moist	North of Amazone 170 m	06°13'N 52°03'N	ibid.
XLIX	grab		grey, dry	North Atlantic 375 m	75°51'N 14°30'W	ANTON DOHRN, 287/10 Dr. K. Vollbrecht, Hamburg 26
L	grab	-	sandy, green- black,moist	Beach westcoast S.Africa (Melk-bosch strand)		jan. 1968 Dr. Dingle, Cape Town
LI	grab	-	muddy,moist	Dutch Waddensea 1 m	53°30'N 5°20'E	EPHYRA, July 1968 Dr. D. Eisma, Den Helder

LII	grab	-	grey,moist	North Dawed Inlet S.E. Alaska 80 m	$57^{o}31'$N $133^{o}00'$W	MAYBESO, station 5 Dr. T. Loder, College, Alaska
LIII	652-696	225 cm	grey,moist	Indian Ocean 2679 m	$00^{o}45'$N $74^{o}07'$E	OCEANOGRAPHER 52-G May-OPR-476 Dr. W.S.Moore, Stoney Brook, 2/VII/67
LIV	697-716	100 cm	grey,moist	Indian Ocean 3994 m	$05^{o}39'$N $82^{o}13'$E	ibid. 120-G day OPR-476 4 july 1967
LV	717-745	145 cm	grey,moist	Indian Ocean 4227 m	$05^{o}29'$N $92^{o}35'$E	ibid. 177-G day-OPR-476 1 july 1967
LVI	grab	-	grey,moist	VAR-river close to Nice	$43^{o}40'$N $07^{o}12'$E	july 1968 Dr. E.K. Duursma, Monaco
LVII	grab	-	grey,moist	Bombay harbour 11 m	$18^{o}59'$N $72^{o}52'$E	15 october 1968, nr. 53 Dr. B.Patel, Bombay
LVIII	grab	-	grey,moist	Bombay harbour 11 m	$18^{o}60'$N $72^{o}57'$E	ibid. Nr. 63
LIX	grab	-	black,suspension	Europort harbour Netherlands 15 m	$51^{o}58'$N $04^{o}04'$E	GEOPOTES, 21/V/69 Ir. J. Ringers, Rotterdam
LX	grab	-	grey,moist	Off Ivory Coast 60 m	$04^{o}35'$N $06^{o}45'$W	REINE-POKOU 17/X/69 Dr. L. Martin, Abidjan

Table II

Sample nr.	size fraction	% weight	Composition
IX	>250µ	0.31	mineral grains, some orange-brown grains
	63-250u	1.25	mainly orange-brown grains, many mineral grains, some black grains
	25- 63µ	4.67	as 63-250u, rather many mica grains
XIII	> 250u	0.9	foraminifera, mollusks, fragments, many light-coloured fibres
	63-250u	15.9	many fragments of foraminifera and mollusks mica, light-weight black particles (organ matter?)
	25- 63u	30.3	many minerial grains, mica, black particles some fragments of foram. and mollusks
XLII	> 250u	13.2	mineral grains, some fine gravel, brittle orange-brown concretions
	63-250µ	12.1	mainly mineral grains, some orange-brown grains, some black particles
	25- 63µ	8.1	as 63-250µ
XLIII	> 250u	0.27	foraminifera + fragments
	63-250u	1.10	many light brown grains, many dark orange-brown grains, some foraminifera and fragments
	25- 63u	5.58	as 63-250µ, no foraminifera
XLIV	>250µ	-	concretions of Fe-Mn
	63-250u	-	mainly Fe-Mn concretions, some mollusks, fragments and mineral grains
	25- 63u	-	mineral grains, some concretions

Table II (continued)

Sample nr.	size fraction	% weight	Composition
XLV	> 250µ	8.3	mollusks, foraminifera + fragments, ostracods, a few mineral grains
	63-250u	87.4	mineral grains, limestone fragments, some black grains
	25- 63µ	0.5	as 63-250u, some sponge needless
XLVI	> 250u	45.7	mainly black grains, many (greenish) mineral grains, some fragments of mollusks and Bryozoa
	63-250µ	49.7	as 250u, some foraminifera
	25- 63u	0.7	mineral grains, some fragments of foraminifera
XLVII	> 250µ	72.1	mineral grains, fragments of Bryozoa, mollusks, some foraminifera
	63-250u	24.4	as > 250µ, many fragments of Bryozoa
	25- 63u	1.2	as 63-250µ, many sponge needles
XLVIII	> 250µ	23.1	loose light- and dark-brown concretions (some very loose), foraminifera + fragments, mollusk fragments
	63-250µ	61.5	mineral grains, foraminifera + fragments, mollusk fragments, some dark brown concretions, some orange-brown grains
	25- 63u	4.3	mainly mineral grains, some mica, many orange-brown grains, some mollusk fragments
XLIX	> 250u	23.11	concretions, some mineral grains, foraminifera, some mollusk fragments, ostracods
	63-250u	21.78	mainly minerals, remainder as > 250u
	25- 63µ	12.89	as 63-250µ, some sponge needles

Table II (continued)

Sample nr.	size fraction	% weight	Composition
L	> 250u	1.45	foraminifera + fragments, some ostracods, mollusk fragments, a few brittle aggregates, some dull black grains
	63-250µ	36.12	foraminifera + fragments, many dull black grains, some mica
	25- 63µ	11.86	foraminifera + fragments, dull black grains, small brown flakes
LI	> 250µ	0.93	mineral grains, mollusk fragments, some foraminifera, mica
	63-250µ	86.76	mineral grains, much mica, foraminifera + fragments, black grains
	25- 63µ	5.32	mineral grains, black grains, brown-orange flakes
LII	> 63µ	4.67	chiefly mica, mineral grains
	25- 63u	26.39	chiefly mica, mineral grains
LIII, 652	> 250u	7.92	foraminifera + fragments (chiefly filled with sediment)
	63-250u	9.84	" "
	25- 63u	8.82	" " (a few mica)
653	> 250u	5.57	foraminifera + fragments
	63-250µ	8.26	" "
	25- 63u	11.16	" " , some mica, black fibers, small brownish flakes (organic?)
656	> 250u	2.10	foraminifera + fragments
	63-250u	2.96	" " , black grains, black fibers
	25- 63u	13.33	as 63-250µ, some mica

Table II (continued)

Sample nr.	size fraction	% weight	Composition
661	> 250u	-	foraminifera + fragments, black concretions
	63-250µ	-	as > 250u, some mica
	25- 63u	-	foraminifera + fragments, many mica grains, black fibers and pieces, some mineral grains, few concretions
666	> 250µ	2.37	foraminifera + fragments
	63-250u	5.21	" " , some orange-brown grains, some black fibers
	25- 63u	7.10	many mica grains, foraminifera + fragments, black fibers, some dull-white grains
671	> 250u	2.34	foraminifera + fragments, a few black grains, orange-brown coating on some foraminifera
	63-250µ	4.20	as > 250µ, some black fibers
	25- 63µ	4.40	as 63-250µ, many black fibers, some mica
676	> 250u	3.52	foraminifera + fragments, some brown and black grains
	63-250u	5.63	mainly fragments of foraminifera, some brown grains
	25- 63u	38.73	as 63-250µ, some mineral grains, many mica
686	> 250u	3.3	foraminifera + fragments, some with brown coating
	63-250µ	3.4	" " , some mineral grains and mica, some black particles (organic?)
	25- 63u	6.8	mainly mineral grains, fragments of foraminifera, mica

Table II (continued)

Sample nr.		size Fraction	% weight	Composition
	691	> 250u	1.70	foraminifera + fragments
		63-250u	3.02	" " , some orange-brown grains, same black fibers
		25- 63u	12.20	foraminifera + fragments, some black fibe
	696	> 250u	0.49	foraminifera
		63-250u	0.70	foraminifera + fragments, some mica, brown grains
		25- 63u	5.21	as 63-250µ
LIV	697	> 250u	1.26	foraminifera + fragments
		63-250µ	0.52	as > 250µ
		25- 63u	1.41	as > 250µ
	701	> 250µ	0.26	foraminifera + fragments, some orange and black grains
		63-250u	3.15	as > 250u, some mica
		25- 63µ	12.16	as 63-250µ, many mica grains
	706	> 250u	0.72	foraminifera, some ostracods
		63-250µ	10.05	foraminifera + fragments, much mica, black fibers
		25- 63u	19.09	as 63-250u
	711	> 250u	3.57	foraminifera + fragments
		63-250µ	6.25	" " , some mica, black fibers, a few orange grains
		25- 63µ	5.36	as 63-250µ (more mica)
	716	> 250µ	1.9	foraminifera + fragments
		63-250u	2.6	" " , some sponge needles, mica, mineral grains, black fibers
		25- 63µ	2.7	as 63-250µ (more mineral grains)

Table II (continued)

Sample nr.		size fraction	% weight	Composition
LV	706	> 250u	0.27	foraminifera, some loose aggregates, light-brown (worm?) tubes, some brittle aggregates
		63-250u	2.83	mineral grains, foraminifera, much mica, dull-white grains
		25- 63µ	10.06	as 63-250u, but no foraminifera
	721	> 250µ	0.4	foraminifera, a dark brown grain, an ostracod, some mica
		63-250µ	5.3	mineral grains, many mica grains
		25- 63µ	31.3	as 63-250u
	726	> 250u	0.7	foraminifera + fragments, some mineral grains, brown grains
		63-250µ	1.4	mineral grains, much mica, some dark particles (organic?), some brown grains, fragments of foraminifera
		25- 63µ	8.2	as 63-250µ, more mica
	731	> 250µ	1.1	foraminifera + fragments, some brown grains
		63-250µ	1.1	" " , mica
		25- 63µ	9.0	many mineral grains, mica, some black grains
	736	> 250µ	1.2	foraminifera + fragments, some mineral grains
		63-250u	2.4	as >250µ, much mica, some dark-brown grains
		25- 63u	10.6	many mineral grains, mica, some dark grains
	741	> 250u	0.13	foraminifera + fragments
		63-250µ	1.72	many mineral grains, mica, dull-white and beige grains, black fibers
		25- 63µ	5.83	as 63-250u, more mica

Table II (continued)

Sample nr.	size fraction	% weight	Composition
745	> 250u	1.0	foraminifera + fragments, a few mica, black grains
	63-250μ	4.0	mineral grains, many mica grains, fragments of foraminifera, some black grains
	25- 63u	11.6	as 63-250μ
LVI (VAR)	> 250u	0.70	mineral grains, many mica grains (some in fan-like groups), some fragments of foraminifera
	63-250μ	42.95	mainly mica, some orange and black grains, some minerals grains
	25- 63μ	28.87	as 63-250u, more mineral grains
LVII	> 250u	0.21	some mineral grains, foraminifera, a black grain
	63-250u	1.39	mineral grains, mica, black grains, some brown-orange grains, colourless fibers
	25- 63μ	1.94	mainly dull beige grains and black grains
LVIII	63-250u	0.26	mineral grains, some fragments of foraminifera, orange-brown grains
	25- 63μ	1.92	dull beige grains, some orange-brown grains

<u>Table III Grainsize</u>

core	sample nr.	<2µ	2-16µ	16-25µ	25-63µ	63-250µ	>250µ	d_{50}	σ µ
IX	-	<1.0	51.0	41.7	4.7	1.3	0.3	15	7
XIII	-	3.2	12.6	37.1	30.3	15.9	0.9	22	17
XLII	-	3.9	31.7	31.0	8.1	12.1	13.2	20	175
XLIII	-	<1.0	47.9	44.1	5.6	1.1	0.3	17	9
XLV	-	3.4	<1.0	<1.0	0.5	87.4	8.3	160	60
XLVI	-	<1.0	<1.0	1.9	0.7	49.7	45.7	240	>60
XLVII	-	3.1	<1.0	<1.0	1.2	24.4	72.1	280	>45
XLVIII	-	<1.0	6.2	4.9	4.3	61.5	23.1	175	>95
XLIX	-	5.9	5.7	30.6	12.9	21.8	23.1	48	>110
L	-	5.7	17.3	17.5	21.9	36.1	1.5	36	58
LI	-	3.0	<1.0	5.7	5.3	84.8	0.9	158	61
LII	-	3.8	14.9	50.1	26.4	4.8(>63µ)	-	22	14
LIII	652	<1.0	54.7	18.9	8.8	9.8	7.9	15	61
	653	6.8	20.4	47.7	11.2	8.3	5.6	20	35
	656	12.9	19.3	49.4	13.3	3.0	2.1	20	24
	661	6.0	12.0	72.9	2.5	4.1	2.4	19	12
	666	6.7	40.0	38.6	7.1	5.2	2.4	17	14
	671	4.8	31.1	46.8	4.4	4.2	2.3	18	14
	676	<1.0	18.1	34.1	38.7	5.6	3.5	24	36
	686	<1.0	25.3	61.1	6.8	3.4	3.3	20	9
	691	6.3	18.9	57.9	12.2	3.0	1.7	20	15
	696	<1.0	30.1	63.5	5.2	0.7	0.5	20	12
LIV	697	<1.0	59.1	47.7	1.4	0.5	1.3	14	7
	701	7.6	30.6	46.1	12.2	3.2	0.3	19	17
	706	<1.0	24.8	45.3	19.1	10.1	0.7	20	24
	711	12.8	25.7	46.2	5.4	6.3	3.6	19	20
	716	6.8	40.7	46.7	2.7	2.6	1.9	18	14
LV	717	4.7	34.6	47.5	10.1	2.8	0.3	18	10
	721	<1.0	8.1	55.1	31.3	5.0	0.4	23	32
	726	4.2	4.1	81.4	8.2	1.4	0.7	21	4
	731	<1.0	14.6	74.2	9.0	1.1	1.1	20	6
	736	4.9	9.7	72.3	10.6	2.4	1.2	20	6
	741	4.6	18.6	69.2	5.8	1.7	0.1	19	11
	745	4.5	9.0	69.9	11.6	4.0	1.0	21	10

Table III Grainsize (continued)

core	sample nr.	<2u	2-16μ	16-25μ	25-63μ	63-250u	>250μ	d_{50}	μ
LVI (Var)	-	3.8	11.5	12.2	28.9	42.9	0.7	54	115
LVII	-	<1.0	56.1	40.4	1.9	1.4	0.2	15	6
LVIII	-	6.7	33.5	57.6	1.9	0.3 (>63u)	-	17	8
LIX	-	7.1	27.6		15.9	47.9	1.5	62	140
LX	-	11.2	58.2		22.9	6.6	1.1	18	40

Table IV

Core	Sample nr.	%N	%C	C/N
IX	-	-	-	-
XIII	-	0.123	2.75	22.3
XLII	-	0.117	1.065	9.1
XLIII	-	0.457	11.42	24.9
XLIV	-	0.203	2.07	10.1
XLV	-	0.023	0.50	21.7
XLVI	-	0.049	0.61	12.4
XLVII	-	0.055	0.68	12.3
XLVIII	-	0.043	0.55	12.7
XLIX	-	0.101	2.09	20.6
L	-	0.480	9.80	20.4
LI	-	0.039	0.75	19.2
LII	-	0.045	0.74	16.4
LIII	652	0.075	1.89	25.2
	653	0.113	1.55	13.7
	656	0.064	1.97	30.7
	661	0.065	3.43	52.7
	666	0.144	2.80	19.5
	671	0.100	2.28	22.8
	676	0.077	2.30	29.8
	686	0.077	1.80	23.3
	691	0.117	2.89	24.7
	696	0.095	4.12	43.3
LIV	697	0.128	3.19	24.9
	701	0.119	2.65	22.2
	706	0.034	2.09	61.4
	711	0.119	2.95	24.7
	716	0.144	2.61	18.1
LV	717	0.137	0.81	5.9
	721	0.118	1.09	9.2
	726	0.067	1.14	17.0

Table IV (continued)

Core	sample nr.	%N	%C	C/N
	731	0.078	0.79	10.0
	736	0.013	0.83	63.8
	741	0.106	0.98	9.2
	745	0.078	0.93	11.9
LVI (Var)	-	0.044	1.04	23.6
LVII	-	0.105	2.95	28.0
LVIII	-	0.069	3.18	46.0

Table V

number	size fraction	Int./sw. illite	mica	chlorite	montm.	kaol.	quartz	calcite	arag.	dolom.	feldspar	amfibole	remarks
I:1	<2µ	27	22	3	-	8	22	16	-	-	2	-	
	2-25µ	10	12	11	-	10	20	31	-	2	4	-	
:5	25-63µ	-	13	9	-	-	30	33	-	6	9	-	
	63-250µ	-	9	7	-	-	39	34	-	2	9	-	
	>250µ	-	2	-	-	-	46	44	2	-	6	-	
II:16	<2µ	30	16	5	-	10	13	22	2	-	2	-	
	2-25µ	17	9	4	-	9	28	31	-	-	2	-	
III:22	<2µ	29	11	2	-	8	27	21	-	-	2	-	
	2-25µ	tr	15	4		8	30	35	-	3	5	-	
IV:31	<2µ	37	15	6	-	15	22	-	-	-	5	-	
:37	2-25µ	-	14	14	-	-	55	-	-	-	17	-	
:44	25-63µ	-	19	8	-	-	45	-	-	-	28	-	
	63-250µ	-	16	6	-	-	55	-	-	-	23	-	
	>250µ	-	-	-	-	-	100	tr	-	-	-	-	
V:55	<2µ	3	35	5	-	15	28	-	-	-	14	-	
:63	2-25µ	2	14	13	-	9	46	-	-	-	19	-	
VI:81	<2µ	24	16	9	-	24	21	-	-	-	6	-	
	2-25µ	-	21	13	-	13	32	-	tr	-	21	-	
	25-63µ	-	8	11	-	-	43	-	2	1	34	3	

number	size fraction	Int./sw. illite	mica	chlorite	montm.	kaol.	quartz	calcite	arag.	dolom.	feldspar	amfibole	remarks
	63-250µ	-	11	14	-	-	42	-	-	1	31	1	
VII:85	<2µ	36	19	4	-	11	20	-	-	-	10	-	
:96	2-25µ	13	9	13	-	4	32	-	-	-	29	-	
VIII:102	<2µ	45	17	5	-	11	17	3	-	-	2	-	
:126	2-25µ	26	8	4	-	8	24	24	2	-	4	-	
	25-63µ	-	-	-	-	-	86	8	-	-	6	-	
IX	<2µ	38	13	4	-	10	21	8	-	-	6	-	
	2-25µ	17	10	4	-	7	35	19	-	-	8	-	
	25-63µ	-	8	4	-	-	44	21	4	2	17	-	
	63-250µ	-	5	-	-	-	67	19	2	2	5	-	
X:145	<2µ	39	15	5	-	17	17	tr	-	-	7	-	
:153	2-25µ	24	13	5	-	8	43	-	-	-	7	-	
XI:172	<2µ	38	5	4	-	11	9	30	-	-	3	-	
:182	2-25µ	24	8	2	-	-	14	46	3	-	3	-	
XII:197	<2µ	16	-	-	-	-	2	12	70	-	-	-	1.4% Sr
:207	2-25µ	2	-	-	-	-	7	36	55	-	-	-	1.05% Sr
	25-63µ	-	-	-	-	-	-	22	78	-	-	-	
	63-250µ	-	-	-	-	-	-	20	80	-	-	-	
XIII:	<2µ	26	15	5	-	7	25	18	-	2	2	-	

number	size fraction	Int./sw. illite	mica	chlorite	montm.	kaol.	quartz	calcite	arag.	dolom.	feldspar	amfibole	remarks
	2-25μ	13	9	3	-	5	26	35	-	5	4	-	
	25-63μ	-	9	4	-	-	29	31	-	14	13	-	
	63-250μ	-	8	-	-	-	29	25	-	11	27	-	
	>250μ	-	-	-	-	-	18	71	11	-	-	-	
XIV:	<2μ	4	40	2	-	9	25	18	2	-	tr	-	
	2-25μ	11	13	4	-	5	25	34	-	5	3	-	
XV:	<2μ	9	23	3	-	9	31	23	-	-	2	-	
	2-25μ	-	9	15	-	9	27	35	-	2	3	-	
XVI:	<2μ	32	15	4	-	11	22	15	-	-	1	-	
	2-25μ	11	13	9	-	8	26	28	-	2	3	-	
	>25μ	-	13	4	-	-	31	33	-	6	13	-	
XVII	<2μ	30	19	5	-	11	19	14	-	-	2	-	
	2-25μ	7	13	11	-	9	30	23	-	-	7	-	
XVIII	<2μ	14	38	2	-	9	27	tr	5	-	5	-	
	2-25μ	17	15	5	-	9	38	6	3	2	5	-	
XIX	<2μ	54	11	2	-	19	14	-	-	-	-	-	
	2-25μ	45	5	-	-	17	17	9	-	-	7	-	
XX	<2μ	26	-	-	-	7	-	67	-	-	-	-	

number	size fraction	Int./sw. illite	mica	chlorite	montm.	kaol.	quartz	calcite	arag.	dolom.	feldspar	amfibole	remarks
	2-25µ	9	2	3	-	3	-	83	-	-	-	-	
XXI	<2µ	50	7	3	-	9	9	20	-	-	2	-	
	2-25µ	16	13	6	-	4	15	39	-	2	5	-	
XXII:224	<2µ	50	9	3	-	11	7	20	-	-	-	-	
:229	2-25µ	17	8	5	-	7	24	24	7	4	4	-	
:224	25-63µ	-	4	3	-	-	22	66	-	1	4	-	
	>63µ	-	3	4	-	-	25	65	-	-	3	-	
:230	>63µ	-	9	11	-	-	29	43	2	2	4	-	
XXIII:236	<2µ	12	-	-	-	5	-	83	-	-	-	-	
:240	2-25µ	-	-	-	-	5	7	85	-	-	3	-	
XXIV:252	<2µ	28	7	-	-	54	11	-	-	-	-	-	
:257	2-25µ	26	8	2	-	15	46	-	-	-	3	-	
:248	25-63µ	-	4	-	-	-	22	68	-	-	6	-	
	63-250µ	-	-	-	-	16	11	68	-	-	5	-	
XXV:	<2µ	11	17	11	-	2	43	11	-	5	-	-	
	2-25µ	13	11	3	-	7	39	20	-	4	3	-	
XXVI	<2µ	26	28	5	-	9	22	7	-	2	1	-	
	2-25µ	-	7	5	-	7	30	33	-	15	3	-	

number	size fraction	Int./sw. illite	mica	chlorite	montm.	kaol.	quartz	calcite	arag.	dolom.	feldspar	amfibole	remarks
XXVII													
0-4 cm	total sample	13	4	2	-	3	21	-	-	-	20	-	37% am. SiO_2(opal)
20-24 cm	" "	10	3	2	-	-	18	-	-	-	23	-	44% " " "
40-44 cm	" "	-	6	4	-	-	28	-	-	-	25	-	37% " " "
60-64 cm	" "	11	4	4	-	-	25	-	-	-	27	-	29% " " "
84-88 cm	" "	14	4	3	-	-	25	-	-	-	27	-	27% " " "
XXIX	<2μ	20	20	4	-	13	27	2	-	-	14	-	
	2-25μ	9	19	3	-	5	51	2	-	-	11	-	
XXX:345	<2μ	19	23	8	-	16	29	-	-	-	5	-	
	2-25μ	3	36	8	-	5	36	5	-	-	7	-	
XXXI:381	<2μ	51	14	5	-	7	14	-	-	-	9	-	
:363	2-25μ	40	7	4	-	7	27	-	-	-	15	-	
:371													
:381													
XXXII:384	<2μ	8	-	-	-	-	-	92	-	-	-	-	
	2-25μ	16	-	-	-	-	4	80	-	-	-	-	
XXXIII:428	<2μ	28	21	-	-	-	-	17	34	-	-	-	4.7% Sr
:447	2-25μ	13	14	7	-	8	25	18	4	3	8	-	
XXXIV:465	<2μ	26	22	5	-	13	19	7	-	-	8	-	
[illegible]	[illegible]	[illegible]	11	13	-	9	20	-	-	-	22	-	

number	size fraction	Int./sw. illite	mica	chlorite	montm.	kaol.	quartz	calcite	arag.	dolom.	feldsp.	amfibol	remarks
XXXV:512	<2µ	-	-	-	88	5	7	-	-	-	-	-	
:530	2-25µ	-	5	-	26	-	-	-	-	-	42	27	
	25-63µ	-	7	-	33	-	9	-	-	-	35	16	
	63-250µ	-	6	-	27	-	23	-	-	-	27	16	
	>250µ	-	-	-	-	-	11	-	14	-	61	14	
XXXVI:572	<2µ	48	5	2	-	11	8	23	-	1	2	-	
	2-25µ	32	6	3	-	7	11	36	-	2	3	-	
XXXVII:589	<2µ	17	-	-	-	10	5	68	-	-	-	-	
	2-25µ	-	5	7	-	5	5	75	-	-	3	-	
XXXVIII:598	<2µ	8	6	-	-	6	4	76	-	-	-	-	
	2-25µ	-	5	-	-	4	5	86	-	-	-	-	
XXXIX:608	<2µ	4	3	-	-	5	-	88	-	-	-	-	
	2-25µ	-	3	-	-	2	2	90	-	-	3	-	
XL:615	<2µ	-	-	-	-	5	-	16	-	-	-	-	10% limonite, 50% am.Fe_2O_3,19%(Fe,Mn, Ca) CO_3
:622	2-25µ	-	-	-	-	-	-	15	-	-	-	-	8% limonite,60% am. Fe_2O_3,17% (Fe,Mn,Ca) CO_3
:638	25-63µ	-	14	-	-	-	-	46	22	-	18	-	much am. Fe_2O_3
	63-250µ	-	-	-	-	-	-	93	7	-	-	-	" " "

number	size fraction	Int./sw. illite	mica	chlorite	montm.	kaol.	quartz	calcite	arag.	dolom.	feldspar	amfibole	remarks
XLI:642	<2μ	16	8	7	-	8	-	61	-	-	-	-	
:650	2-25μ	3	3	-	-	4	3	83	-	-	4	-	
XLII:	<2μ	-	15	7	-	13	35	26	2	2	-	-	
	2-25μ	-	9	3	-	9	32	24	4	5	14	-	
	>250μ	-	4	-	-	-	39	26	4	-	27	-	
XLIII:	<2μ	-	13	8	-	9	55	2	-	-	13	-	
	2-25μ	-	15	4	-	13	49	6	-	-	13	-	
	25-63μ	-	21	6	-	-	56	-	-	-	17	-	
	63-250μ	-	9	7	-	-	64	11	-	-	9	-	
XLV:	<2μ	-	4	-	-	4	-	92	-	-	-	-	
	2-25μ	-	3	-	-	-	60	32	-	-	5	-	
	63-250μ	-	2	2	-	-	79	6	2	2	7	-	
XLVI:	<2μ	-	7	-	-	5	27	52	5	-	4	-	
	2-25μ	-	13	9	-	9	45	10	3	-	11	-	
	63-250μ	-	-	-	-	-	74	2	4	-	-	-	20% glauconite
XLVII:	<2μ	-	2	-	-	3	7	84	4	-	tr	-	
	2-25μ	-	3	-	-	4	34	40	17	-	2	-	
	63-250μ	-	8	3	-	-	45	19	6	-	19	-	
	>250μ	-	-	-	-	-	50	39	4	-	7	-	

number	size fraction	Int./sw. illite	mica	chlorite	montm.	kaol.	quartz	calcite	arag.	dolom.	feldspar	amfibole	remarks
XLVIII:	<2µ	40	9	5	-	10	20	9	2	-	5	-	
	2-25µ	32	13	4	-	8	35	1	1	-	6	-	
	25-63µ	-	7	4	-	-	59	6	1	1	19	3	
	>250µ	53	-	-	-	2	17	11	-	-	7	-	10%chamoisite; concentrations
XLIX	<2µ	-	17	9	-	30	40	2	-	-	2	-	
	2-25µ	-	17	7	-	19	35	-	-	-	22	-	
	63-250µ	-	8	6	-	8	45	-	-	-	33	-	
	>250µ	-	7	4	-	6	31	-	-	-	47	-	5% limonite; concentrations
L	<2µ	-	4	2	-	2	8	82	-	-	2	-	
	2-25µ	-	7	7	-	3	-	76	-	-	7	-	
	25-63µ	-	-	-	-	-	52	28	1	-	9	-	10% glauconite
	63-250µ	-	2	-	-	2	26	50	-	-	17	-	3% "
LI	<2µ	-	10	9	-	15	45	12	-	-	9	-	
	2-25µ	-	3	-	-	3	9	83	-	-	2	-	
	25-63µ	-	8	5	-	-	40	6	2	4	33	2	
	>250µ	-	4	-	-	-	57	22	8	-	9	-	
LII	<2µ	-	15	2	-	4	32	3	2	2	36	4	
	2-25µ	-	17	4	-	4	32	1	1	-	33	8	
	25-63µ	-	22	5	-	-	20	-	4	-	35	14	
	>63µ	-	32	14	-	-	33	2	1	-	18	-	

number	size fraction	Int./sw. illite	mica	chlorite	montm.	kaol.	quartz	calcite	arag.	dolom.	feldspar	amfibole	remarks
LIII:652	<2μ	15	8	-	-	6	15	50	-	-	6	-	
	2-25μ	-	4	-	-	4	6	82	-	-	4	-	
:653	25-63μ	-	12	-		8	20	46	2	-	12	-	
:656	25-63μ	-	13	11	-	-	28	28	2	-	18	-	
:666	25-63μ	9	12	8	-	-	19	30	2	2	18	-	
:671	25-63μ	-	7	4	-	-	23	48	2	-	14	2	2% gibbsite
:686	25-63μ	11	8	9	-	-	24	31	2	-	14	1	
:666	63-250μ	-	4	3	-	-	19	66	3	-	5	-	
:671	63-250μ	-	3	-	-	-	11	80	-	-	6	-	
:686	63-250μ	-	7	-	-	-	16	73	-	-	4	-	
:671	>250μ	-	8	6	-	-	26	56	4	-	-	-	
LIV:697	<2μ	-	9	6	56	8	11	5	-	-	5	-	
	2-25μ	-	16	2	24	11	31	-	-	-	16	-	
:701	25-63μ	-	6	6	16	-	36	20	-	-	16	-	
	63-250μ	-	8	6	6	-	18	38	-	-	24	-	
LV:717	<2μ	11	18	9	-	19	34	5	-	-	4	-	
	2-25μ	-	26	18	-	-	36	-	1	2	17	-	
:706	25-63μ	6	9	6	-	-	19	32	3	-	23	2	
:717	25-63μ	-	28	8	-	-	28	-	-	-	32	4	
:721	25-63μ	4	24	9	-	-	26	-	-	-	34	3	
:741	25-63μ	5	25	14	-	-	31	3	-	-	20	2	
:745	25-63μ	-	27	6	-	-	36	3	-	-	26	2	
:706	63-250μ	-	15	3	-	-	32	34	2	-	14	-	

number	size fraction	Int./sw. illite	mica	chlorite	montm.	kaol.	quartz	calcite	arag.	dolom.	feldspar	amfibole	remarks
:717	63-250μ	-	30	8	-	-	35	9	-	-	18	-	
:721	63-250μ	-	32	9	-	-	35	-	-	-	22	2	
:741	63-250μ	-	30	8	-	-	29	16	-	-	15	2	
LVI:	<2μ	-	15	2	-	5	38	36	-	-	4	-	
	2-25μ	-	7	3	-	9	28	48	-	-	5	-	
	63-250μ	-	12	5	-	-	30	38	-	3	12	-	
	>250μ	-	20	4	-	-	44	24	-	-	8	-	
LVII	<2μ	60	8	4	-	6	9	7	-	-	6	-	
	2-25μ	35	6	6	-	6	24	3	-	2	18	-	Int./sw.illite partly montm.
	25-63μ	-	11	-	-	6	29	20	2	2	30	-	
	63-250μ	-	-	-	-	-	91	4	-	-	5	-	
LVIII	<2μ	59	7	3	-	8	7	9	-	-	7	-	
	2-25μ	30	12	3	-	8	30	2	-	-	15	-	
	25-63μ	18	6	12	-	4	29	11	2	2	16	-	
LIX	<2μ	19	16	3	-	12	36	12	-	-	2	-	
	2-25μ	9	8	9	-	5	46	14	-	4	5	-	
	25-63μ	-	6	5	-	-	47	18	-	6	18	-	
	63-250μ	-	8	6	-	-	38	14	-	4	30	-	
LX	<2μ	15	3	-	-	52	17	13	-	-	-	-	
	[illegible]25μ	13	2	-	-	31	42	12	-	-	-	-	

Table VI

Core nr.	Sample nr.	Base exchange Capacity meq/100gr	Specific Surface m^2/gr	q meq/100gr	q' meq/100gr	q" meq/100gr
I	1	9.06	73	1.4	5.1	2.0
II	16	13.61	89	2.2	6.6	3.9
III	25	9.58	76	1.3	3.6	2.5
IV	44	20.16	112	4.6	6.7	4.4
V	62	20.16	106	5.8	4.0	1.4
VI	82	6.55	50	0.4	1.4	0.2
	83	7.55	56	-	-	-
VIII	110	25.19	129	-	7.0	3.2
	116	14.61	92	-	-	-
X	151	2.72	149	6.5	9.3	3.8
XI	178	10.58	86	3.6	5.7	3.0
XII	212	2.03	50	0.3	0.4	0.2
XIII		8.58	66	-	3.2	0.5
XIV		7.55	63	0.4	2.0	0.2
XV		8.06	66	0.8	3.8	0.9
XVI		11.10	76	3.7	7.0	3.6
XVII		11.58	83	2.7	6.8	3.9
XVIII		15.13	89	-	4.9	0.5
XX		6.55	63	0.5	2.1	0.7
XXI		16.13	122	4.0	6.3	3.3
XXII	230	18.16	89	-	6.8	4.4
XXIII	237	5.55	63	0	0.8	0.5
XXV		13.10	96	-	3.2	1.0
XXVI		5.55	53	0.3	3.1	0.4
XXIX	314	30.70	149	13.9	6.1	4.6
XXXII	398	5.55	69	0.2	2.3	0.4
XXXIV	473	10.58	73	3.8	5.4	2.2
XXXV	560/570	108.87	284	-	31.8	16.7
XXXVI	573	26.68	109	9.7	10.5	5.2
XXXVII	590	5.07	69	0.1	2.1	1.1
XXXVIII	604	4.04	79	0	1.2	1.0

Table VI (continued)

Core nr.	Sample nr.	Base exchange Capacity meq/100gr	Specific Surface m^2/gr	q meq/100gr	q' meq/100gr	q" meq/100gr
XXXIX	612	5.55	79	0.2	1.2	0.8
XL	622	6.06	162	0	0.05	0.05
XLI	649	6.55	69	0	1.1	0.7
XLII		9.06	69	-	2.4	0.03
XLIII		20.68	129	-	-	-
XLV		1.00	23	-	0.01	0.01
XLVI		9.58	66	-	0.13	0.01
XLVII		0.52	23	-	0.03	0.01
XLVIII		15.61	96	-	1.3	0.1
XLIX		7.06	53	-	1.6	0.3
L		23.19	139	-	0.9	0.04
LI		2.03	33	-	0.4	0.02
LII		7.06	42	-	1.1	0.05
LIII	676	23.35	129	-	0.3	0.04
LIV	706	15.13	89	-	-	-
	716	29.23	-	-	24.7	5.8
LV	721	10.10	63	-	4.1	0.4
	731	14.13	89	-	-	-
	745	13.61	89	-	-	-
LVI		4.55	46	-	0.6	0.04
(VAR)		5.03	-	-	-	-
LVII		46.87	188	-	10.2	0.2
LVIII		45.78	187	-	9.7	1.1

Table VII

Core	Sample nr.	%Fe 0.1NHCl	%Fe Conc.HCl	%Ca 0.1NHCl	%Ca Conc.HCl	%Mg 0.1NHCl	%Mg Conc.HCl
IX	-	1.38	3.77	5.22	5.53	0.59	0.76
XIII	-	0.84	1.45	15.95	16.31	2.16	3.74
XLII	-	1.63	2.53	9.04	9.32	1.29	1.40
XLIII	-	2.11	4.17	1.78	2.24	0.49	0.67
XLIV	-	2.36	14.19	0.21	0.42	0.11	0.58
XLV	-	0.11	0.21	5.34	5.39	0.64	0.64
XLVI	-	0.54	5.04	3.78	3.75	0.51	0.72
XLVII	-	0.09	0.32	12.73	12.83	1.74	1.75
XLVIII	-	3.22	7.20	3.01	3.32	0.37	0.44
XLIX	-	1.64	3.70	0.81	0.84	0.17	0.23
L	-	0.42	2.98	20.27	20.08	2.54	2.71
LI	-	0.12	0.32	2.62	2.76	0.33	0.36
LII	-	2.43	4.01	0.31	0.83	0.22	0.41
LIII	652	0.39	2.54	21.93	22.41	2.95	3.11
	666	1.01	3.63	11.87	11.98	1.51	1.66
LIV	697	0.78	6.02	2.25	2.24	0.37	0.57
LV	717	1.99	3.78	1.97	2.19	0.35	0.47
LVI	-	0.82	1.83	20.28	21.02	2.59	2.72
LVII	-	2.18	6.84	3.02	3.13	0.51	0.63
LVIII	-	2.03	6.99	3.04	3.16	0.50	0.66

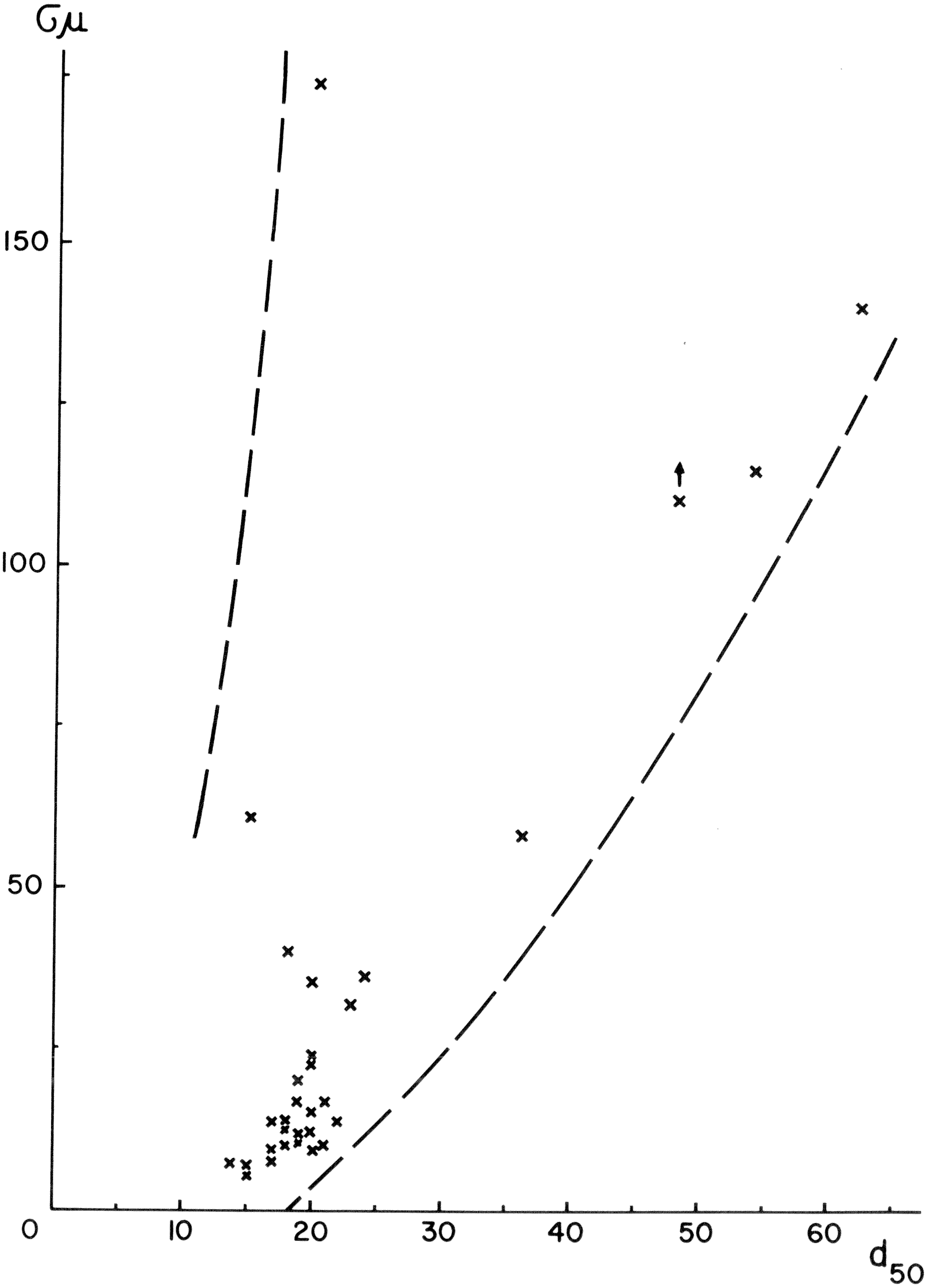

Fig. 1

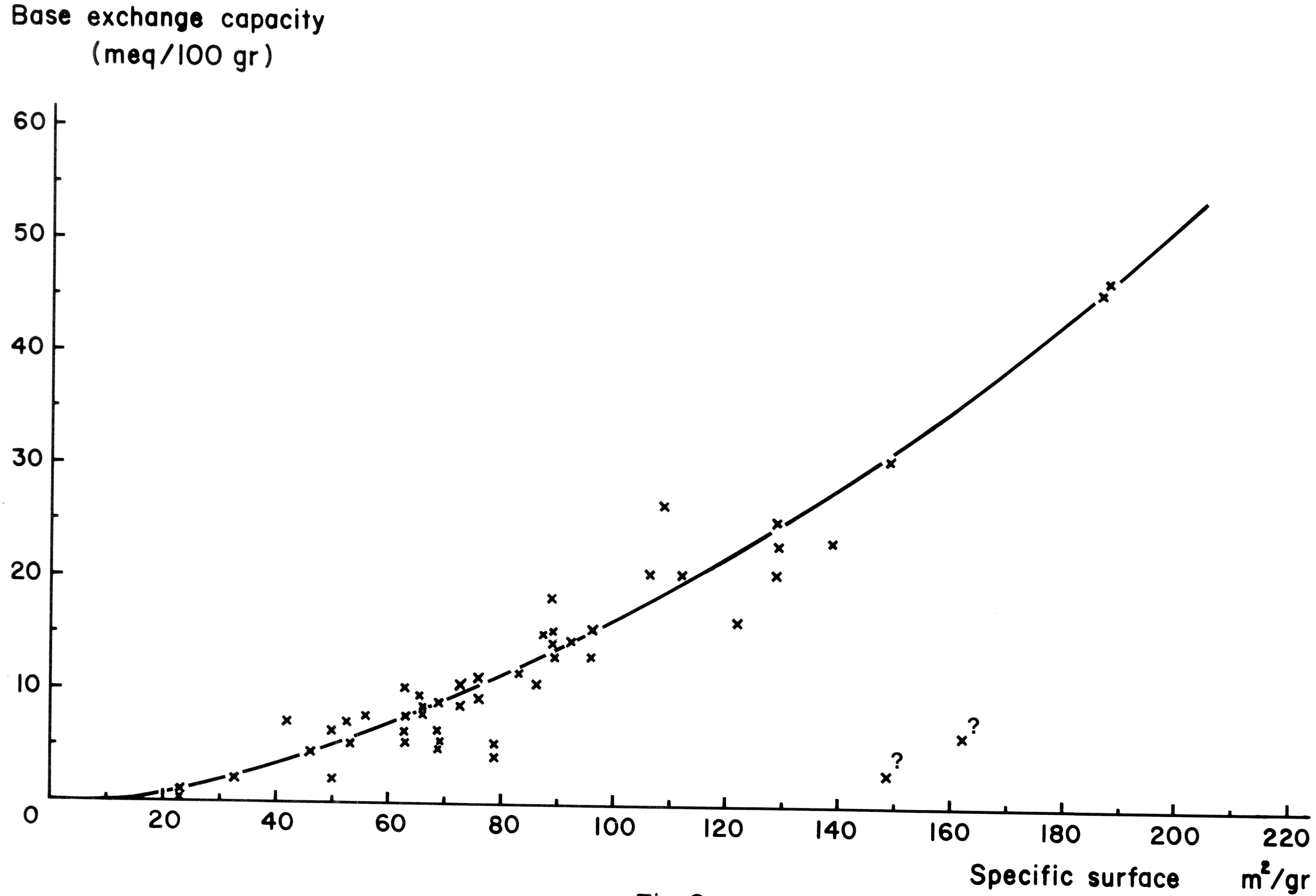
Base exchange capacity
(meq/100 gr)
60
50
40
30
20
10
0
20
40
60
80
100
120
140
160
180
200
220
?
?
Specific surface m²/gr

Fig. 2

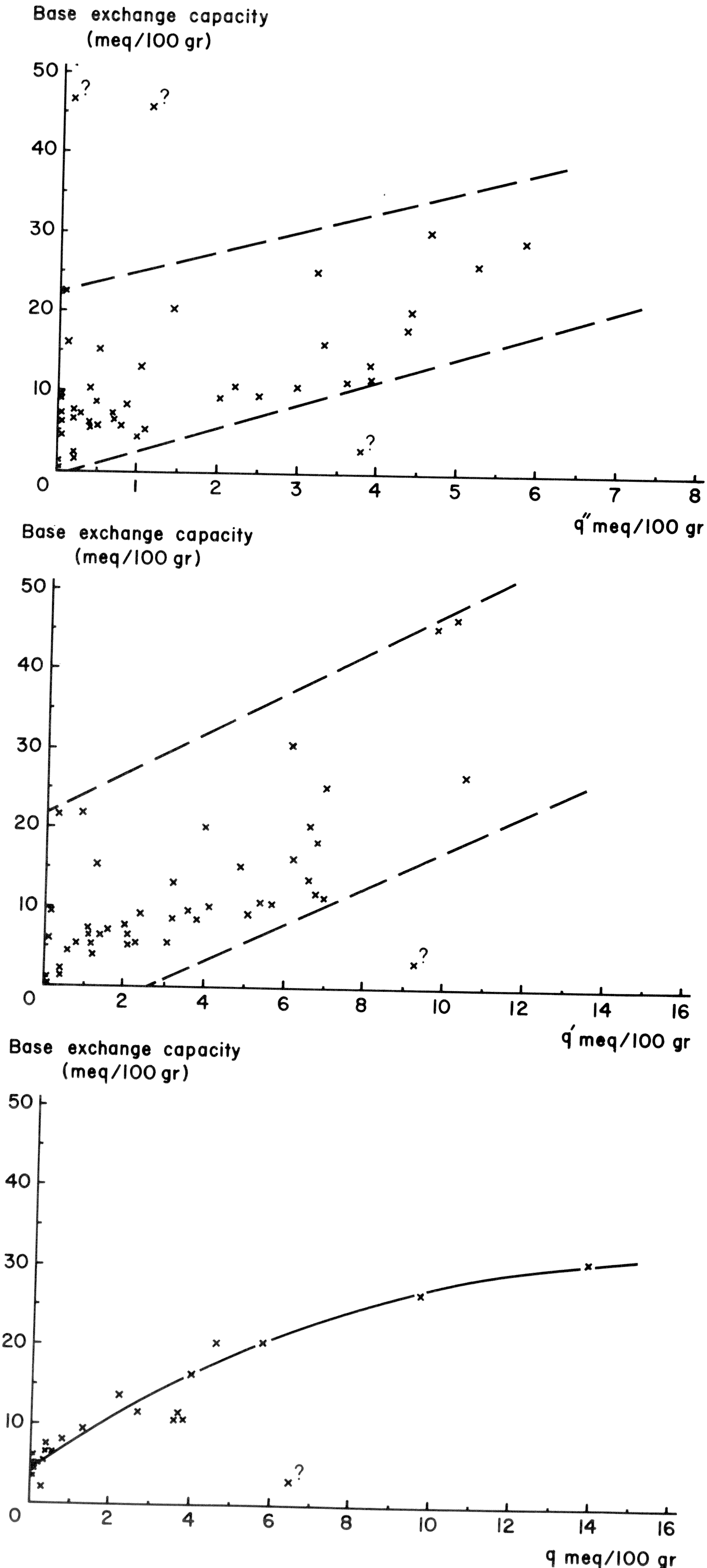
Base exchange capacity
(meq/100 gr)
50
40
30
20
10
0
1
2
3
4
5
6
7
8
q″ meq/100 gr
Base exchange capacity
(meq/100 gr)
50
40
30
20
10
0
2
4
6
8
10
12
14
16
q′ meq/100 gr
Base exchange capacity
(meq/100 gr)
50
40
30
20
10
0
2
4
6
8
10
12
14
16
q meq/100 gr

Fig 3