

Granulometric Analyses of Pelites using a Sedigraph: Examples from a Volcano-sedimentary Environment

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Abstract. This article presents granulometric data of pelites (less than 40 microns) of mixed composition from a volcano-sedimentary environment. The Sedigraph serves as an useful tool in the analyses of silt-clay fraction of marine sediments. A cumulative curve from 40 to 1 micron can be obtained in 20 minutes. Pelites analysed show wide variations in grain size characteristics with the median value oscillating between 22 and 3 microns. In general, two fine grain size facies, each showing significant variations, are deciphered. Parabolic facies represents coarse silts whereas logarithmic facies comprise medium to fine silts. The type of grain size curves largely depends on the abundance of carbonate and pyroclastic mineral content of individual pelites. As compared to total pelites, their decalcified fractions sometimes show a significant shift of the grain median towards finer sizes. The intricacies of grain size studies of pelites of mixed composition are described in this paper.

Keywords: Sedigraph, Sedimentology, Pelites.

INTRODUCTION

Grain size distribution data is generally used as an indicator of sediment type, sedimentary environments and related processes. Granulometric analyses of fine sediments consisting of particles which are mineralogically homogenous is considered as a reliable tool for the understanding the type of sediments, modes of transport and sedimentary processes. However, if a sediment is composed of several subgroups which are mineralogically variable, it can be expected that each of these may have undergone independent styles of dynamic behaviour, considering different properties of individual particles. This is particularly true in case of fine sediments rich in carbonate constituents. The evaluation of grain size data of such poly-mineral sediments may thus be hampered.

Some conventional procedures demand

the removal of carbonates before analyses a method followed by several authors. The inferences drawn therefore exclusively rely on a sediment without its carbonate component. Whereas this may be valid for sediments with negligible carbonate content, it may not be the case of sediments rich in calcareous material. These carbonate particles, in whatever amounts, cannot be neglected. A question therefore arises whether or not carbonates are to be considered and in what manner the calcareous material affects and influences the grain size distribution curves of pelites of mixed mineralogical composition.

This paper reports grain size characteristics of the sediment fraction less than 40 microns. Granulometric analyses were carried out on a Sedigraph 5000. This fraction of sediments which in our case consists of silt as the dominant size class,

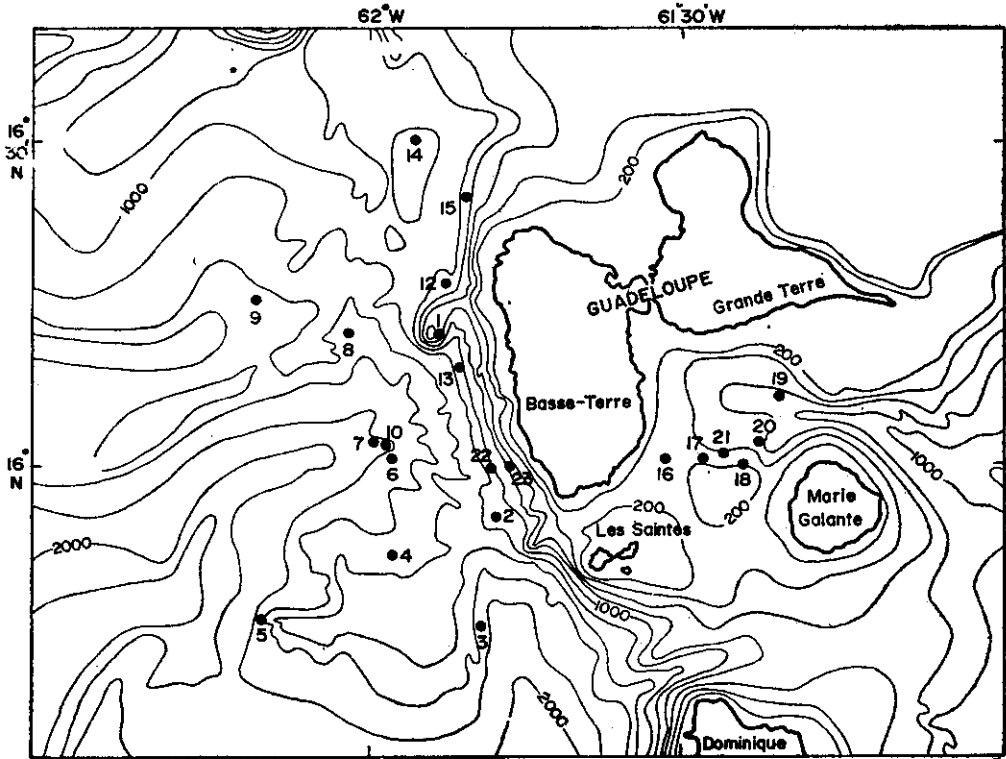


Figure 1. Map showing location of cores in the archipelago of Guadeloupe.

will be referred to as the pelitic fraction or 'pelites'. This article also describes bulk/total grain size analyses of pelites of mixed composition, the effect of decalcification on the grain size distribution, the significance of various grain size facies, and factors controlling the sedimentological characteristics of pelites of mixed composition.

GEOLOGY OF THE AREA

The tropical island of Guadeloupe (16°N lat., 62°W long.) is one of the major islands of the Lesser Antilles volcanic chain. It is divided into two parts: Basse Terre on the west is characterised by volcanic formations and Grande Terre on the East consists of calcareous deposits. The two parts of this island are separated

by a narrow channel. An active volcano 'La Soufriere' is located in the southern extremity of the island.

The insular margin of Guadeloupe shows an extremely complex morphology. The western margin is steep and incised by several east-west sea valleys with intervening highs. Some extinct submarine volcanoes are located along this margin. In contrast, the eastern margin shows a gentle and regular gradient; recent coral reefs are located along this section of the coastline.

Twenty two cores of varying lengths were collected during the expedition ANTIVOLC 81 in the archipelago of Guadeloupe, from water depths ranging between 165 and 1815 metres. No core could be collected at station 11 as the corer hit hard rock and as such Core 11

does not exist. These cores are located off the western and southeastern sectors of the island (Fig. 1). As the sediment cores are situated in different morpho-structural settings on the insular margin, their sedimentological, mineralogical and geochemical features are found to vary considerably (Mascarenhas, 1984, 1986, 1988).

PRINCIPLES AND METHODS

The Sedigraph 5000 is a particle sizer that determines the concentration of particles remaining at decreasing sedimentation depths in a cell containing the suspension. The attenuation by the settling suspension is measured as a function of time and height. The transmittance of the suspension which increases with time due to sedimentation of particles is electronically transformed into concentration values which are indicated linearly as cumulative mass per cent on the Y-axis of a X-Y recorder. The cell is continuously lowered relative to the X-ray beam; the cell movement is synchronised with the X-axis of the recorder so as to indicate the spherical diameter corresponding to time and particular sedimentation depth. The particle density (assumed as that of quartz), liquid density and viscosity and starting diameter are set into the Sedigraph which programs the instrument for specific analytical conditions (Micromeritics, 1978).

Grain size analyses were carried out on the pelitic fraction ($< 40 \mu\text{m}$) of sediments selected at particular intervals along core sections mainly based on their megascopic and physical characters. Pelites were separated by wet sieving through a 40 micron sieve. About 1 gram of (fine) pelitic sediment was well homogenised and dispersed in 25 ml of sodium hexametaphosphate solution, subjected to sonification for five minutes, so as to obtain a completely dispersed sediment. The con-

centration of suspension was maintained between 25 to 50 g/l as proposed by Stein (1985).

A cumulative curve from $40 \mu\text{m}$ to $1 \mu\text{m}$ can be obtained in about 20 minutes. This range offers good reproducibility. All analyses were terminated at $1 \mu\text{m}$ since data below this point is of questionable reliability. Various practical aspects about this instrument as well as its limitations have been discussed in detail by several authors (Stein, 1985; Singer *et al.* 1988; Jones *et al.* 1988; Weber *et al.* 1991).

In all, about 90 cumulative curves of the pelitic fraction ($< 40 \mu\text{m}$) were obtained. The samples were then decalcified using hydrochloric acid, centrifuged, washed and rerun on the Sedigraph. In this way, two curves are obtained for the same sediment: one curve representing bulk pelites, and the other a terrigenous curve, devoid of calcareous constituents.

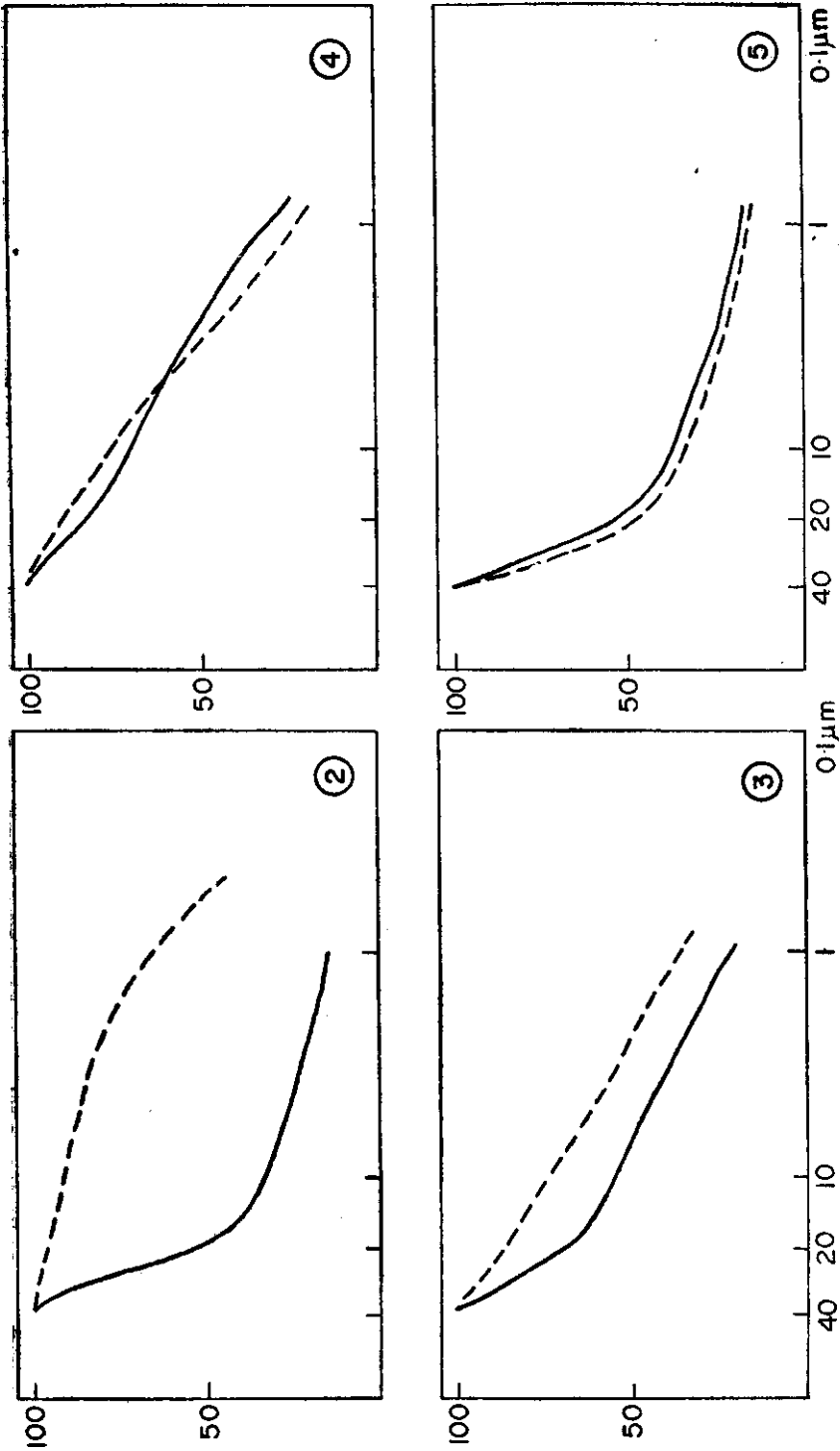
RESULTS

Bulk/Total Pelites

This section deals with selected grain size distribution curves. The most typical examples are presented in Figures 2, 3, 4 and 5. The nature and type of pelites are distinguished depending on the type of slope towards the coarser part of the respective cumulative curve and also by comparing them with the classification adopted by Riviere (1977). Two principal categories of facies are observed: parabolic curves and logarithmic curves.

A. Parabolic facies: This type of pelites are frequent in the cores studied. The median values oscillate between 22 and $6 \mu\text{m}$. This fraction mainly comprises coarse silt (Figs. 2 and 3). This grain size facies represents sediments with a very high carbonate content (50 to 87%).

Depending on the respective shapes of curves obtained, it is possible to further distinguish other varieties of pelites:



Figures 2, 3, 4 and 5.
 Four different types of fine grain size facies (continuous lines) and their decalcified homologues (dashed lines).
 Note the effects of decalcification which may sometimes alter the original shape of grain size curves.

- curves which are highly parabolic in nature, with a median between 20 and 8 μm ; the slope of the curve towards the coarser part is very steep (Fig. 2). All such pelitic fractions are rich in calcareous material. Such facies is typical of cores from the southeastern part of the archipelago where the carbonate content up to 87% was identified (Examples: Core 19, 00-333 cm, 654 m water depth; Core 20, 00-232 cm, 600 m water depth; Core 21, 00-223 cm, 394 m water depth).

- curves which are relatively less parabolic in shape, but with a median which falls between 9 and 4 μm (Fig. 3). As compared to the above, terrigenous material is important, but calcareous components (around 50%) dominate. This facies characterises the middle portions of the cores from the western sector of the archipelago (Examples: Core 04, 66-240 cm, 1480 m water depth; Core 08, 117-257 cm, 1569 m water depth; Core 09, 59-118 cm, 1300 m water depth).

- another facies identified is considerably different from the two preceding types. In this case, the pelitic fraction is entirely composed of pyroclastic material. The median falls around 11 μm (Fig. 5) and the carbonate content is around 16%. This type of facies is rare (Example: Core 12, 106-107 cm, 1103 m water depth; Core 14, 231-232 cm, 1198 m water depth).

B. Logarithmic/Rectilinear facies: In such pelites, the median varies between 5-3 and 1 μm (Fig. 4), with a carbonate content of 30 to 50%. This grain size facies is composed of a variable mixture of volcanogenous and calcareous constituents. In general, this facies was identified in the top and bottom portions of deeper cores from the western sector (Examples: Core 03, 00-36 cm and 102-156 cm, 1660 m water depth; Core 04,

00-66 cm and 240-316 cm, 1480 m water depth; Core 08, 00-117 cm and 257-329 cm, 1569 m water depth; Core 09, 00-59 cm and 118-368 cm, 1300 m water depth; Core 14, 00-70 cm and 232-330 cm, 1198 m water depth).

Based on the classification adopted by Gonthier *et al.* (1981), the following subtypes which correspond to fine silts can be occasionally identified:

- curves which are rectilinear with a median between 3 and 1 μm (Example: Full core 05, 00-335 cm, 1600 m water depth; full core 06, 00-260 cm, 1685 m water depth).

- curves which are logarithmic but with a parabolic tendency exhibiting a median between 5 and 3 μm (Example: Core 10, 105-134 cm, 1760 m water depth; Core 14, 36-102 cm, 1198 m water depth).

Decalcified Pelites

This exercise was undertaken so as to understand the nature and type of grain size distribution patterns without their carbonate component. Four categories can be distinguished:

a) *Pelites with a highly modified curve:* The parabolic facies described earlier get entirely modified after decalcification. In such pelites, a median of 22 μm shifts towards 1 μm after treatment with acid (Fig. 2). These characteristics are typically displayed by pelites in cores from the southeastern sector (Examples: Cores 19, 20 and 21). Thus, after decalcification, parabolic facies with a high carbonate content turn hyperbolic. In such samples, most of the carbonate material is located in the coarse silt class. Therefore, the total pelitic fraction depicts a typical parabolic curve whereas the terrigenous fraction (decalcified) shows a distinct hyperbolic curve.

b) *Pelites with a little modified curve*: Some parabolic curves described earlier show comparatively few variations after decalcification. The median value shifts from 8–5 μm to 2–1 μm . These fractions consist of relatively low carbonate content, equally distributed in all the size classes. It must be noted, however, that only those curves with a parabolic tendency show significant variations of the median (Fig 3). After decalcification, the terrigenous curves indicate a rectilinear shape (Example: Cores 04, 08 and 09, middle sections).

c) *Pelites with an identical curve*: Certain levels which are of mixed nature, with considerable pyroclastic material, an appreciable clay fraction and a low carbonate content show logarithmic curves with a median of 8–10 μm . These curves show negligible variations after decalcification (Fig. 4) (Examples: Cores 05 and 06).

d) *Pelites where the median shifts towards coarser size*: Several pelitic samples which are essentially volcanogenous show that, after decalcification, the median shifts towards coarser sizes by 1 to 3 μm (Fig. 5), as compared to the above three examples. Only a few such cases were identified in some cores from the insular shelf/slope (Example: Core 12).

DISCUSSION

Significance of various pelitic facies

If all the bulk and decalcified grain size distribution curves are combined, one can observe: parabolic, hyperbolic, rectilinear, and logarithmic curves with a parabolic tendency.

Based on the granulometric parameters proposed by Riviere (1977), Gonthier *et al.* (1981) and Monaco and Mear (1984), it is observed that the grain size facies represented by various types of distribution curves can indicate a variety of fine sedi-

ment texture and independent modes of transport in each case:

- a parabolic facies represents sediments wherein the components were transported by turbidity currents of a relatively high density and high velocity (coarse silts),

- a logarithmic facies comprises sediments transported close to the bottom or in the water column and indicate deposits resulting from weak turbidity currents (medium silts),

- a hyperbolic facies characterises sediments transported in suspension by surface currents (fine silts and clays).

If the classification adopted by Gonthier *et al.* (1981) and Monaco and Mear (1984) is followed, the above three facies would correspond to fine turbidites, hemipelagites and pelagites respectively. Each of these represent specific classes which undergo different sedimentary behaviour with respect to one another.

Implications of size analyses of pelites

Various situations that may arise can be examined from the following typical cases which have been specifically selected.

The first example (Fig. 2) represents pelites which are rich in calcareous material (50 to 87%) and exhibit parabolic curves whereas their decalcified counterparts depict a hyperbolic tendency. The principal mode shifts from 32–16 μm to less than 1 μm , indicating a different sedimentary behaviour for terrigenous (decalcified) particles in comparison to the bulk pelites. The parabolic curve for total pelites suggests a combined transport through turbidity currents according to Riviere (1977) and Gonthier *et al.* (1981) and would indicate fine turbidites according to Monaco and Mear (1984). On the contrary, the terrigenous fraction

of these pelites (without the carbonate component) is entirely different and its hyperbolic curve would indicate a pelagic nature of constituents transported through suspension. Moreover, the sorting index of bulk pelitic fraction (parabolic) is good whereas for terrigenous particles (hyperbolic) it is poor. Therefore, the two curves appear to furnish a contrasting information for the same sample.

The second example (Fig. 3) reveals a parabolic curve for bulk pelite (30 to 50% carbonates) as compared to the rectilinear curve for the terrigenous homologue. The latter would indicate a hemipelagic fine sediment transported close to the bottom (Gonthier *et al.* 1981) whereas the total pelitic facies would correspond to a fine turbidite carried through a weak turbidity current (Gonthier *et al.* 1981; Monaco and Mear, 1984). Here again, the two curves provide a divergent information.

The third example (Fig. 4) comprises pelites which contain maximum amounts of less than 2 micron fraction and low carbonate contents (around 35%). The shift of the median value is nominal and both the curves are almost identical. This suggests that the bulk pelites and their terrigenous counterparts have undergone the same type of sedimentary transport. But this need not/may not be the case since carbonate and volcanogenous components and clay size particles undergo different degrees and styles of transport.

The fourth example (Fig. 5) is a coarse silt with negligible carbonate content but extremely rich in hornblende, plagioclase, quartz, pyroxenes and volcanic glass (Mascarenhas, 1986, 1988). Although the median value indicates a small shift, both the curves remain parabolic indicating a bottom transport by strong turbidity currents for the entire pelitic sediment.

Based on these four examples (Figs. 2, 3, 4, 5), it can be categorised that the various types of modifications of the total

pelite curves after decalcification is a consequence of the variable amounts of carbonate material present in the samples. The present study has shown that the removal of carbonates from total pelites sometimes induces a shift of the median value towards finer sizes. A change in the principal grain size mode can also be deciphered (Fig. 6). The shape of terrigenous curves may be somewhat similar or entirely different from bulk pelites. Therefore, these effects can sometimes be very pronounced or sometimes negligible.

Factors controlling grain size of pelites

Bulk vs. terrigenous size analyses: It is clear that a large variety of grain size distribution curves can be obtained before and after decalcification. An element of doubt seems to arise whether to consider the bulk grain size curves or the terrigenous curves or both. Here, a certain philosophy has to be adopted. When the pelites are considered without the carbonate component, it is observed that its terrigenous counterpart exhibits different peculiarities with respect to total pelite (Figs. 3 and 4). In this case, the grain size information derived from one curve may be masked by the other. On the other hand, it is interesting to note that even in the case of some pelites which contain around 35% carbonate, the shape of the terrigenous homologue remains almost identical (Fig. 4). This suggests that calcareous material does not at all influence the total grain size distribution in the case of certain pelites. It is therefore obvious that the information obtained from grain size data of such pelites may be comprehensive but sometimes incomplete.

Effects of mineralogy: The present study reveals that the mineralogy of pelites is extremely variable. Pelites from

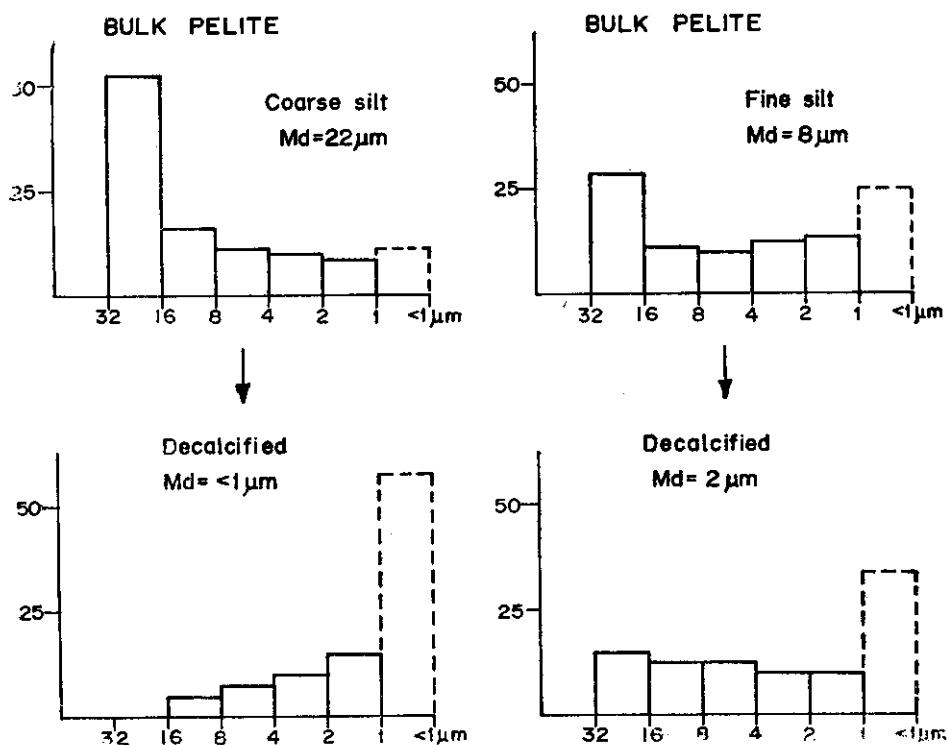


Figure 6. Distribution of grain size classes before and after decalcification. Note the shift of principal modes and also the median values.

the archipelago of Guadeloupe are composed of carbonate minerals and pyroclastic constituents in variable proportion. Calcite is dominant in the western sector; aragonite is a characteristic mineral in the southeast; magnesian calcite is relatively less abundant but concentrated in the southeast. Volcanogenous minerals such as plagioclase, pyroxenes, magnetite, quartz and volcanic glass (Mascarenhas, 1986) are much more important in the western sector of the study area. Interestingly, the fraction less than 2 microns also shows carbonate and pyroclastic components; typical clay minerals are of secondary importance (Mascarenhas, 1988).

Therefore, if a sediment is composed of a variety of mineralogical components,

as on the insular margins of Guadeloupe, an independent behaviour of each of the mineral species can be evidently expected considering the different size, density and form of individual sedimenting particles. This aspect is clearly visible in cores from the southeastern sector rich in carbonates, and western sector where pyroclastic minerals dominate. It is well established that, for example, carbonate and terrigenous sedimentation takes place independently and in different fashions (Gorsline, 1984; McCave, 1984a; Stow and Bowen, 1980; Stow, 1985). Hence, in the case of multi-mineral pelites, the interpretation of grain size distribution data may sometimes remain inconclusive.

If the pelites are mineralogically homogeneous, their interpretation would

be simple. But if pelites are mineralogically heterogeneous, with or without large and variable concentrations of carbonate and volcanogenous material, then the interpretation of granulometric data may be hindered. This is because the shape and nature of bulk and terrigenous grain size distribution curves principally depend on the abundance, type and proportion of carbonate and pyroclastic minerals present in individual pelites around the island of Guadeloupe.

Role of carbonates: Considering the significant proportion of carbonates in individual pelites, its exclusion cannot be justified. These carbonate particles, in whatever concentrations, cannot be neglected. If carbonate properties are eliminated, the entire concept of fine grain size analyses appears lost. This can probably be done in case of pelites with a negligible carbonate content; but since pelites from the archipelago of Guadeloupe are rich in mineralogically heterogeneous carbonate components, this factor cannot be neglected. Moreover, although the carbonate material appears as the main cause for the shift of the median, it was also observed in this study that some pelites with around 30–35% carbonate content do not indicate any noticeable shift in the grain size median (Fig. 4).

Most authors have excluded the carbonate component during grain size analyses. Even though the sedigraph has been widely employed in the grain size study of pelites of mixed composition, only Gonthier *et al.* (1981) have stressed the need to examine grain size curves independently; for this, a 'carbonate curve' was calculated mathematically. Although Gonthier *et al.* (1981) discuss three independent curves, details about the precise calculation of their 'carbonate curve' are not indicated. Nevertheless, serious restrictions have been noted regarding its implications mostly because it is not possible to cal-

culate or quantify single carbonate components of divers. Origins in individual size classes (*see* McCave, 1984b). Whereas a terrigenous curve can be obtained by dissolving carbonates, the reverse is impossible. These two fractions cannot be separated and run as two independent entities. Therefore, there appears no other option but to rely on the bulk pelitic curve and its terrigenous homologue only.

When the complexity of the above carbonate (and volcanogenous) mineral variety is known, the quantification of individual components becomes extremely difficult. In the silt fraction of the study area, forams occur in the form of broken pieces, coral material in the form of fine debris, pteropods get easily pulverised and nannoplanktons are too fine. There is no proper method wherein these diverse carbonate constituents can be identified and quantified under various size classes of regular Phi intervals. SEM method can of course be employed for specific counting, but certainly not to count grains down to submicron levels. This exercise is beyond the scope of this paper. McCave (1984b) has also indicated that sizing particles by microscopy is not only tedious but hardly any successful data can be obtained in this way since identifying all individual particles is impossible, but mostly because artifacts of identification and counting procedures are common and cannot be avoided.

It is precisely because of these restrictions that modern electronic particle sizers are especially valuable for fine grained sediments where all individual grains cannot be seen or measured directly. In deep sea, where natural depositional conditions are almost impossible to observe, fine granulometry has proved to be a standard tool to decipher the size ranges down to 1 micron. Of all electronic size analysers, there is no doubt that

the sedigraph has an edge over others as far as the quickness, resolution, type and reliability of results are concerned.

Aggregation of particles: The naturally occurring phenomenon of flocculation has often been invoked when grain size studies are attempted. It is well known that such studies have focussed only on estuarine sediments (Kranck, 1975) and there are hardly any determinations from deep sea (McCave, 1984b). Although some workers feel that flocculation modifies size distribution, others think the contrary. It has been shown that the principal grain size mode remains unchanged except that the volume is slightly flattened in case of Stoke's settled particles. Since the conditions of formation and behaviour of fragile flocs is not precisely known (Honjo *et al.* 1984), we have to rely on the principle of Stoke's settling where one size class is deposited at a time since comparatively, flocs are also made of grains which have the same proportional size distribution as the whole suspension (Krank, 1975, 1980; McCave, 1984a). In this study, all pelitic fractions were peptised; the data is, therefore, on single grain settling. However, few pelites run without this prior treatment showed a somewhat similar grain size distribution curve. No specific studies were carried out in this regard.

It must be mentioned in this context, that the above studies do not discuss the role and relation of specific mineralogical constituents and their effect on grain size distribution. In deeper sea, silt particles move as a part of bedload rather than suspension (Gorsline, 1984). Stow and Bowen (1980) proposed a mechanism of sheer sorting wherein flocculated sediment is broken by sheer forces where silt size particles settle through the bottom boundary layer and are subsequently deposited. In the study area, pyroclastic minerals

form an important component (Masca-renhas, 1986). Since these are heavy minerals, they probably do not tend to flocculate but move independently. Again, the typical clay minerals which have a high coagulation capacity are of minor importance even in the less than 2 micron fraction. It is not really known as to how such a diverse mineral suite reacts to the effects of flocculation.

Influence of morphostructure: The submarine topography exerts a strong influence on the grain size distribution of pelites. For example, pelites from cores 19, 20 and 21, collected from the wide eastern insular shelf, are characterised by highly parabolic curves which turn hyperbolic on decalcification. The carbonate material in these pelites is very high with reef derived aragonitic coral debris as a major component. Pyroclastic minerals are of secondary importance, and clay minerals are extremely rare. Cores 2, 12 and 22 located on the narrow western insular slope are composed of pelitic facies which remain parabolic even after decalcification. Volcanic minerals are the only major constituents. Active volcanoes are located on the island and several small rivers empty onto this shelf. Deep sea cores 03, 04, 08, 09 and 14 collected from troughs, depressions and valleys show three types of facies: logarithmic (top), parabolic (middle), logarithmic (bottom). On decalcification, the terrigenous curves indicate few variations whereas in the case of parabolic facies (middle portions of cores), the grain median shifts considerably. Cores 05 and 06 are implanted on the flanks of ridges and entirely comprise logarithmic facies which remain unchanged after decalcification. As compared to other cores these contain maximum proportions of less than 2 micron fraction. It can, therefore, be asserted that the submarine topography and mineralogy are the

key factors which control the distribution and type of pelitic facies in this archipelago.

Here it must be added that although the study area is small, it forms a part of a complex volcano-sedimentary environment (Got *et al.* 1984). The western part of the island of Guadeloupe is entirely composed of volcanic products and related rock types whereas the eastern portion is exclusively made up of calcareous deposits which are much older in age. Coral reefs are located at many parts along the insular shore line. The geological setting of this small area, therefore, plays an important role in governing the type of sediments. Being a tropical region, the area comes under the influence of seasonal rains. The erosion of the volcanic western part and calcareous eastern half, the explosive nature of the presently active volcanoes, the variable width and the irregular topography of the insular margins, coupled with a variety of marine calcareous deposition has resulted in a diverse type of insular sedimentation. These factors result in remarkable variations in the grain size and mineralogy of the pelitic fraction. These are the main causes due to which such a variety of granulometric facies are encountered.

SUMMARY

1. The Sedigraph is an useful and reliable equipment for the rapid analyses of fine fraction of marine sediments. A grain size cumulative curve can be obtained in 20 minutes. Separation of total sediment at 40 μm is very convenient for fine grain size analyses. Sedigraph analyses are accurate and highly reproducible. Compared to other electronic size analyzers, the sedigraph has an edge as far as the quickness, resolution, type and reliability of results are concerned.

2. This electronic particle sizing technique has proved to be valuable for

(fine-grained) pelites where individual grains cannot simply be examined or counted. In deep sea, where natural depositional conditions are almost impossible to observe directly, fine granulometry has proved to be a standard tool to decipher the size ranges down to 1 micron.

3. Size analyses of the pelites revealed two major facies. Pelites depicting a parabolic facies characterise middle portions of cores from the western sector and entire cores from the southeastern sector of the archipelago of Guadeloupe. Pelites showing logarithmic facies are frequent and typify the top and bottom portions of western cores. The western and southeastern zones can thus be distinguished based on the grain size characteristics of pelites.

4. The type of curves obtained mainly depend on the variability, nature and quantity of carbonate and pyroclastic minerals present in individual pelites. Pelitic sediments from the archipelago of Guadeloupe are texturally variable and mineralogically heterogenous. These spatial and temporal characteristics result in a variety of grain size facies.

5. As compared to bulk pelites, their decalcified fraction can be granulometrically distinguished into four types: pelites with a highly modified curve (parabolic to hyperbolic), pelites with a little modified curve, pelites with an identical curve and pelites in which the median shifts towards coarser sizes. Decalcification often results in a shift of the median towards finer sizes. Carbonate material is mostly located in the coarse silt class.

6. Granulometric characteristics of bulk pelites may be close to, identical or entirely different from their decalcified equivalents, as evidenced by the respective shapes of individual grain size curves. Therefore, the relation between the mineralogically variable terrigenous (decalci-

fied) fraction to bulk pelites may sometimes lead to divergent sedimentological interpretation.

7. The extremely complex submarine geology of the study area plays a very significant role. The geological setting of the island, the presently explosive volcanoes, the volcanic and coral formations along the shoreline, insular erosion due to seasonal rains and draining streams, variable width of the insular shelves and their steep insular slopes, the highly rugged submarine topography including highs, lows and numerous valleys, some submarine extinct volcanoes, all exert a strong influence on mineral distribution patterns and play a very significant role in governing the type and grain size of pelites.

ACKNOWLEDGEMENTS

This work was carried out when the author was at the Laboratoire de Sédimentologie et Géochimie Marines, Université de Perpignan, France. The author acknowledges the grant of a long term scholarship by the Government of France. He is deeply indebted to Prof. Henri Got and Dr. Andre Monaco for the unstinted encouragement, the facilities provided and continuous guidance during his stay in France. Mr. Jacques Carbonne provided laboratory assistance. Mr. R.R. Nair, Head, Geological Oceanography Division, NIO, Goa, is thanked for various constructive comments which improved the manuscript. The help provided by Mr. C. Prakash Babu and Mr. Cesar Moraes (NIO, Goa) is highly appreciated.

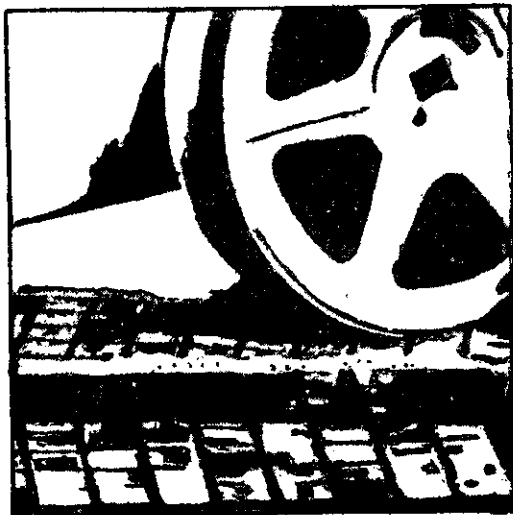
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(Received: July 2, 1992; Revised form accepted: Dec. 26, 1992)

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