MASTER

SEABED DISPOSAL PROGRAM: GEOCHEMICAL AND SEDIMENTOLOGICAL
ASSESSMENT OF DEEP-SEA SEDIMENTS

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REA

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ABSTRACT

Sorption experiments involving deep-sea sediments (including MPG clays) and Eu in 0.7M NaCl solutions have shown surprisingly uniform partition coefficients (K_p) of 10,000 to 70,000 for most samples at 15°C. The concentration dependence of K_p is given by:

$$K_p = bC^a$$

where "b" depends on sediment type and temperature, C is the final solution concentration, and "a", which is a constant for a given cation and sediment, ranges from about -0.6 to -1.0 for Eu. The Eu-sediment experiments yield similar results in both the sorption and desorption directions. The high values of "a" imply that sorption is very strong and approaches irreversibility at very low concentrations. The combined SLA and URI sorption results show that heavy elements, particularly rare earths and actinides, have similar K_p values at $1\mu\text{M}$ ($1000 < K_p < 100,000$) and similar a values of < -0.6 .

Magnetic and geochemical data for MPG-I sediments show consistent core to core depositional patterns like those previously reported for the MPG-II area. The magnetic data support the ichthyolith time scale and suggest that sedimentation has not suffered major interruptions for the past 70 million years. The geochemical data show trends that parallel the sorption results, supporting the hope that we will be able to predict the sorptive behavior of sediments from more easily determined geochemical properties.

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Introduction

As part of a multi-institutional, multidisciplinary evaluation of the feasibility of using the bed of the deep sea for the permanent disposal of high-level radioactive wastes, we are determining the barrier properties of pelagic sediments and the long term stability and predictability of sedimentation in two test areas of the central North Pacific and one in the western North Atlantic. Factors guiding the selection of test areas and the overall plan of attack for the Seabed Disposal Program are outlined in a special issue of Oceanus (Vol. 20, No. 1, 1977).

Progress January-December 1977

1. Environmental predictability and characterization.

1.1 Geochemical properties.

1.1.1 MPG-I NRM/DRM studies.

Studies of the magnetic properties of sediments from the giant piston core LL44-GPC3 (reported in C00-2689-8) and from Vema cruise 32 cores have been completed. All the data are listed in appendices B-E.

A draft manuscript is in hand, and will be submitted as soon as a final ichthyolith stratigraphy for the core is available. The magnetic data show that the MPG I and II areas have similar depositional histories.

In each case, the surficial sediments (3-5m) are quartz-illite-rich clays containing a stable detrital remanent magnetization. These sediments were deposited during the past 2½ million years (Appendix A).

They are dominated by wind-blown continental debris derived from the periglacial and loess deposits of Asia and North America. The appearance of these sediments coincides with the first major development of glacial conditions in the northern hemisphere that marks the initiation of our present glacial-interglacial climatic regime. Comparison of the

upper section of LL44-GPC3 with the Vema-32 cores (Fig. 1) shows that the general patterns of sedimentation are very consistent from core to core, even though the integrated accumulation rates vary by a factor of two within the area. The great similarity in depositional features between the MPG I and MPG II areas, which are some 700 km apart, suggests that sedimentation on the mid-Pacific plate beneath the North Pacific gyre has been continuous and predictable for millions of years. The factor-of-two variations in accumulation rates from core to core within the study areas is ascribed to topographically steered bottom currents. The long-term stability of the patterns suggests that inertial or tidal currents, rather than advective bottom flow (which likely has varied over geologic time) exert the greatest influence on the deposition of fine sediments.

Sediments older than about 3 million years have unstable natural remanent magnetizations and virtually no magnetization after "cleaning" in a 75 oe alternating field. Such a result implies an absence of detrital magnetic particles, a conclusion that is consistent with the inferred authigenic origin of these smectite-ferromanganese oxyhydroxide-rich deposits.

In the case of LL44-GPC3, a suite of samples between 22 and 23 m appear to retain a stable detrital remanent magnetization. The average inclination of the magnetic vector in these samples is about 20° , some 30° less than the current value at the core site of about 50° . This difference is consistent with a northward component of absolute drift of the Pacific lithospheric plate. Based on a published history of drift rates (van Andel, Heath and Moore, 1975), the sediments at 2250 cm

Figure 1. Uniform depositional patterns in the MPG-I area revealed by correlation plots of magnetic reversal boundaries in GPC-3 and V-32 cores. Even though core to core accumulation rates vary by factors of up to 2, the cores respond virtually identically to the marked increase in sedimentation rate from less than $\frac{1}{2}$ m/my during the Tertiary to several m/my for the youngest sediments.

were deposited 60 to 70 million years ago. This age is in excellent agreement with P. Doyle's ichthyolith date for the same interval. It is noteworthy that the paleolatitude of deposition of the magnetically stable samples presently receives eolian detritus from the Pacific southwest carried by the northeast trades. The existence of a similar pattern 60-70 million years ago could account for the presence of magnetically stable detrital grains in LL44-GPC3.

During the next year we will submit for publication the magnetic results from the MPG-I cores.

1.1.2 Elemental geochemistry of LL44-GPC-3

During 1977 we have established the long-term trend of geochemical variations in GPC-3. To do this we analyzed the 18 geochemical samples which are being used to assess downcore variations in sorptive properties. The geochemical samples were analyzed for Mg, Al, Ca, Mn, Fe, Ni, Cu and Zn by atomic absorption spectrometry. The concentrations of these elements in the samples are given in Appendix I. Two groups of elements show coherent trends, the transition elements, Mn, Fe, Ni, Cu and Zn, and the silicate mineral elements, Si and Al. The concentrations of the transition elements increase downcore in GPC-3 and have their maxima from about 13 to 19 m depth in the core (Fig. 2). Calcium, although not generally associated with transition elements, also has higher concentrations from 16 to 19 m than at higher or lower levels in the core. Aluminum and silicon show the opposite pattern, decreasing to minimum concentrations in samples from 13 to 19 m (Fig. 3).

The pattern of transition-metal enrichment corresponds roughly to the increase in sorptive capacity of sediments in GPC-3 determined in our experiments using Eu (see following section and Appendix H)

Figure 2. Transition metal abundances as a function of depth in core LL44-GPC3 from the MPG-I study area. The Mn-rich samples are strong Eu sorbers. Fe and Mn in weight percent, Zn and Cu in ppm.

Figure 3. Abundances of Si and Al (typical "detrital" elements) as a function of depth in core LL44-GPC3. Note the negative correlations with transition metals (Fig. 2).

A decrease in the concentrations of Al and Si, which are abundant in detrital silicate minerals, and a corresponding increase in transition-element concentrations point to the presence of large amounts of poorly crystallized Fe-rich smectite and amorphous iron and manganese oxyhydroxides at these depths. Such phases have higher surface potentials than the well crystallized quartz, illite and other terrigenous debris found at shallower depths in the core. Differential chemical dissolution measurements using an ammonium oxalate-oxalic acid leach solution to determine the composition and amount of the amorphous component in the sediment are in progress. The X-ray diffraction measurements made last year also will be further analyzed to determine the proportions of the identifiable mineral phases in the sediments.

The concentrations data, X-ray data, and results of the leach experiments will allow us to relate the geochemistry of GPC-3 to the sorptive capacity of its sediments and may shed light on the relation between the sorptive properties and mineralogy. They will not, however, provide a basis with which to evaluate the core site in terms of its geochemical history. This is because concentration data for elements can be distorted by varying amounts of diluent material even though the rate of supply of the element (or sediment component in which the element is found) remains unchanged. Thus, to study the geochemical history of GPC-3 and to evaluate this core site relative to alternative deep-sea disposal sites it is necessary to determine changes in element accumulation rates ($\text{gm/cm}^2/\text{my}$) which are not affected by dilution. Such rates are calculated from the bulk density and sedimentation rates for the core.

A dry bulk density model for GPC-3 has been constructed from the specific gravity and water content profiles of the sediment determined by Silva (SAND 77-1270). These bulk densities, when multiplied by the sedimentation rate in m/my (determined from our paleomagnetic measurements and the ichthyolith stratigraphy of Doyle) give bulk-sediment accumulation rates for the core. Several preliminary sedimentation rate models for GPC-3 which are consistent with both the paleomagnetic and preliminary ichthyolith stratigraphies have been constructed. Accumulation rate models can be calculated from each of these sedimentation rate models. The accumulation rate models vary somewhat, especially for sediments deposited 35 - 55 m.y. ago (13-19 m in the core; the same samples in which transition metal concentrations and sorptive capacity are highest) but all the models show the same general trends. The maximum accumulation rates for all elements occur in Late Pliocene and Quaternary age sediments (2.5 m.y. to recent in age; the upper 4 m of the core). Accumulation rates for older sediments are generally an order of magnitude less than for the Late Pliocene to recent sediments. For sediments older than 2.5 m.y. the highest transition-metal accumulation rates are found in sediments 40 to 50 m.y. in age. Aluminum and silicon have minimum accumulation rates for the same interval (Fig. 4). Calcium has a maximum pre-Pliocene accumulation rate in sediments about 50 m.y. in age. Accumulation rate variations such as these are consistent with an increase in the supply of Fe-rich smectite and of amorphous manganese and iron oxide phases about 40 to 50 m.y. ago.

During the next year we will:

- a) use the final paleomagnetic and ichthyolith stratigraphies to develop an optimum accumulation-rate model;

Figure 4. Accumulation rates of selected elements in core LL44-GPC3 from the MPG-I study area. Rates are derived from elemental analyses by M. Leinen, water content and bulk density analyses by A. Silva, and ichthyolith dates by P. Doyle. Units are $\text{g/cm}^2/\text{my}$ for Si, AL and Fe; $\text{mg/cm}^2/\text{my}$ for Cu and Ni.

- b) analyze the geochemical and sorption data using multivariate statistical techniques to establish associations between element and sediment component concentrations, accumulation rates and sorptive properties; and
- c) apply partitioning models to the geochemical data to determine which sedimentary sources are responsible for the contribution of each element to the sediment.

These studies are designed to evaluate the geochemical and sedimentological parameters which control the sorptive capacity of the sediment, with the goal of predicting sorptive properties from simpler geochemical parameters. This information, combined with our knowledge of the accumulation rates of sediment components and elements also will allow us to compare GPC-3 with sediments from other Seabed study areas.

1.2. Preliminary assessment of Atlantic sediments (MPG-III).

Our studies to date have focused on North Pacific sediments. These efforts have established that sedimentation is continuous and predictable over distances of hundreds of kilometers and periods of tens of millions of years. We now propose to develop a third study area in the Atlantic in a region of slow pelagic sedimentation. This extension of the program has the following goals:

- a) To compare the lateral and vertical coherence of Atlantic pelagic sediments with MPG-I and MPG-II deposits.
- b) To determine the small-scale depositional patterns and predictability of sedimentation within an area covering a few tens of square kilometers.
- c) To compare the sorptive and geotechnical properties of profiles of Atlantic pelagic sediments with MPG I and II profiles in the Pacific.

Figure 5. Generalized bathymetry (in meters, from NAVOCEANO) and location of the southern Bermuda Rise relative to the 200 nautical mile limits of Bermuda and the Bahamas/Antilles, and to the MODE-I site. More detailed bathymetry for the hachured area around the MODE-I site has been compiled by Bush (1976).

We are focusing our attention on the southern Bermuda Rise (Fig. 5). This area fits the basic Seabed Disposal criteria, viz:

Tectonic stability (mid-plate location)

Low biologic productivity

Absence of strong bottom currents or turbidites

The region has the additional advantages (relative to the Pacific study areas) of:

1. A thick layer of clay sediments (Fig. 6 shows the section recovered at Deep Sea Drilling Project site 418).
2. Easy access from a number of countries interested in assessing the disposal option of sub-seabed burial.
3. Partial coverage by the MODE I experiment. This physical oceanographic study has gathered an enormous amount of data on the mean circulation and transient mesoscale disturbances in the area. We probably know more about the physical characteristics of the water column here than in any comparable piece of ocean on earth.

Work to date has involved compilation of bathymetric and acoustic reflection records, as well as the location of existing sediment cores in the area (Appendix J). A cruise is planned for the early summer of 1978, on R/V Endeavor, to establish lateral coherence of sediment layers by acoustic profiling, and to collect sediment cores for geochemical and geotechnical characterization. Prior to the cruise, maps of sediment distribution and gross lithology will be prepared from existing seismic profiles and core descriptions.

2. Sediment barrier to nuclide migration.

2.1 Sorption experiments

2.1.1 Th and UO₂ reactions with illitic and smectitic North Pacific

Figure 6. Graphic log of the sediments and basalt drilled at DSDP Site 418A (see Fig. 5 for location). Note the thick sequence of oxidized (brown and orange) pelagic clays at the surface. The section from 0 to 100 m was cored more completely at the adjacent DSDP Site 417.

From GEOTIMES, September 1977.

clays. The experiments begun in 1976 have been completed. In all cases, the partition coefficient K_p , given by:

$$K_p = (\text{moles/gm of sediment})/(\text{moles/ml of solution})$$

increases systematically with decreasing cation concentration in solution. This concentration dependence is described by a relation of the form:

$$K_p \approx bC_s^a$$

where "b" is a function of temperature and sediment type, and "a", which is a constant for a given ion and sediment, ranges from -0.84 for Th on illitic clay to -0.78 for Th on smectitic clay, and -0.57 for UO_2 on illitic clay to -0.51 for UO_2 on smectitic clay at 15°C. The experimental data are tabulated in Appendix F.

2.1.2 Eu reactions with GPC-3 samples.

Most of the efforts of this laboratory during 1977 were focused on the first phase of a program to evaluate the vertical variability of the sorption characteristics of MPG-I sediments. Such information is a necessary input to numerical models of the migration of dissolved nuclides away from a breached buried waste canister. The first phase of the study involved determinations of the sorption and desorption equilibria of Eu (utilizing a Eu-154 spike) dissolved in 0.7N NaCl relative to GPC-3 sediments as a function of Eu concentration and temperature. Eu is being used as a representative of the rare earths and because its column exchange behavior is similar to the heavier actinides, particularly americium. The concentration experiments at

15°C were completed during 1977, and the experiments at 85°C will be completed during the first quarter of 1978. The results are tabulated in Appendix H. Several general conclusions already are apparent:

- a) The partition coefficient for Eu varies by an order of magnitude down the core.
- b) The downcore variations in K_p are not random (Fig. 7) but increase systematically for a $1\mu\text{M}$ solution from around 3000 ml/gm in the illitic surface sediments to 30,000 ml/gm and more in the smectite-ferromanganese oxyhydroxide sediments from 13 to 19m in the core. The deepest sediments, below 20m, show slightly lower K_p values of around 10,000, which are consistent with the greater detrital content of these deposits inferred from the magnetic and geochemical studies.
- c) Sorption and desorption experiments yield essentially identical K_p values at 1mM (Fig. 7), suggesting that our 1-day equilibration times are adequate for the reactions to approach equilibrium.
- d) The concentration dependence of K_p for sorption reactions also varies systematically downcore, with values of $d \log K_p / d \log c$ (the constant "a" in the earlier expression) ranging from about -0.7 near the surface to less than -0.8 in the 13 to 19m interval (Fig. 7). Preliminary high temperature data suggest that this difference is less at 85°C than at 15°C. Such a difference implies at least two sorption reactions; a fast, highly reversible ion exchange, and a slower Eu uptake, whether into structural or inaccessible interlayer sites, that is less reversible. It is noteworthy that for an ideal system where the activities of dissolved

Figure 7. Downcore variations in Eu sorption from 0.7N NaCl solutions at 15°C by MPG-1 sediments from core GPC-3. Filled circles are based on sorption experiments, open circles from desorption experiments. A value of -1.0 for $d \log K_p / d \log C$ implies irreversible sorption. Each data point is the mean of three determinations for a sediment sample. Differences between pairs of points are a measure of the variability in sorption properties of closely spaced samples.

and sorbed ions are independent of concentration, $d \log K_p / d \log C$ is 0, whereas for a system where sorption is irreversible, $d \log K_p / d \log C$ is 1. The values we have measured are closer to 1 than to 0. In a number of our desorption experiments, where solution concentrations are in the micromolar range, the $d \log K_p / d \log C$ values are analytically indistinguishable from 1.

2.1.3 Eu reactions with a spectrum of deep-sea sediments.

In parallel with the GPC-3 studies, we have determined the sorption and desorption of Eu in 0.7N NaCl solutions with respect to a suite of siliceous and calcareous oozes and a South Pacific red clay (Appendix G). At 15°C, the calcareous oozes have K_p values of 40-70,000 for 1 μ M Eu, and sorption $d \log K_p / d \log C$ values in the -0.9 to -1 range. In contrast, the siliceous ooze and red clay samples have 1 μ M K_p 's of 12-16,000, and sorption $d \log K_p / d \log C$ values of -0.8 to -1. Apparently the reaction between calcite and dissolved Eu is strong and quite irreversible, whereas red clay and siliceous ooze behave more like our MPG sediments. Further work at higher temperatures and in seawater matrices are planned to clarify these similarities and differences. If the initial results are applicable to a range of elements and environmental conditions, the selection of a sediment type for sub-seabed disposal may depend more on its permeability and geotechnical properties than on its sorptive characteristics.

2.1.4 Overview of SLA/URI sorption work.

Fig. 8 summarizes the results obtained through 1977. These phase I experiments were carried out with single-element additions to a 0.7N NaCl solution; usually at temperatures below 25°C. Thus, the results

Figure 8. Summary of sorption data (partition coefficients at $1 \mu M$ cation concentration in solution, and concentration dependence of partition coefficients) obtained at Sandia Laboratories (SLA) and University of Rhode Island (URI). The individual element work used a pelagic clay from the MPG-I area (core LL44-GPC2, $30^{\circ} 20.9'N$, $157^{\circ} 50.85'W$) and a matrix solution of 0.7M NaCl. For the lithologic variability experiments, the sediments used were: CN = North Pacific nannofossil ooze from $7^{\circ} 36.7'N$, $134^{\circ} 1.2'W$; CF = equatorial Pacific foraminiferal ooze from $0^{\circ} 52.5'N$, $160^{\circ} 56.6'E$; SR = North Pacific radiolarian ooze from $14^{\circ} 13'N$, $146^{\circ} 24'W$; and RC = South Pacific pelagic ("red") clay from $7^{\circ} 20.6's$, $168^{\circ} 20.8'W$.

should not be generalized too far at this stage. It does appear, however, that the general increase in K_p with increasing atomic number (Z) evident in Duursma's results (see SAND 77-1270) is supported by our data. The relatively low Pu value may reflect a lack of equilibrium in the natural environment, or operational difficulties in distinguishing dissolved Pu from material sorbed to colloidal particles. The concentration dependence of K_p also increases with increasing Z . The range of K_p values for Eu and GPC-3 sediments encompasses most of the values for heavy metals and a range of deep-sea sediments. Thus, our strategy of determining K_p values for a range of elements with a smectitic MPG-1 sediment, and for Eu with a range of sediment types appears sound and capable of defining the field of sorption behaviours likely to be encountered at a potential disposal site. During the next year we will:

- a) Complete 85°C Eu in 0.7N NaCl experiments with GPC-3 and other deep-sea sediments.
- b) Begin Eu in seawater sorption experiments.
- c) Determine effect of heating/cooling cycle on sorptive properties of MPG sediments.
- d) Use chemical dissolution techniques to determine whether silicate or oxyhydroxide phases are primarily responsible for the enhanced sorptive ability of GPC-3 sediments from 13-19m.
- e) Begin sorption experiments with MPG-III sediments to allow comparison with MPG-I and II deposits.

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PALEOMAGNETIC STRATIGRAPHY OF NORTH PACIFIC GIANT PISTON CORE LL44-GPC3
(30° 20'N, 157° 50'W; MPG-I STUDY AREA)

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ABSTRACT

Stable detrital remanent magnetization in North Pacific core GPC-3 (30° 19.9' N, 157° 49.9' W) allows the upper 4.5 m to be dated by correlation with the standard geomagnetic time scale. The sedimentation rate for this interval decreases from 2.5 mm/1000 yr at the surface to 1.1 mm/1000 yr. at 2 m.y. Older sediments lack the consistently stable DRM required for similar dating, but stable DRM paleoinclination measurements at 2250 cm suggest deposition at a paleolatitude between 7.6 and 13.1° N. Based on current reconstructions of the absolute drift of the crust of the Pacific, this implies an age of deposition of 61 - 71 m.y. Such a range is consistent with P. Doyle's biostratigraphic estimates based on ichthyolith assemblages. Sedimentation at GPC-3 appears to have been continuous for the past 70 million years, with the rate increasing from less than 0.3 m/my at the base to 2.5 m/my at the sea floor.

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INTRODUCTION

Giant piston core LL44-GPC3 was collected in the Seabed Disposal Program's North Pacific study area MPG-I during cruise LL-44 of C/V Long Lines. The undisturbed portion of the core is 24.4 m long, and was collected at $30^{\circ} 19.9'$ N, $157^{\circ} 49.4'$ W in a water depth of 5705 m. The core was extruded on board. Pairs of samples for magnetic studies were taken in 5.79 cc cubic plastic boxes at 5 cm intervals down the core. Samples were refrigerated prior to analysis.

All magnetic measurements were made on a superconducting cryogenic magnetometer in Dr. N.D. Watkins laboratory at the Graduate School of Oceanography, U.R.I. Samples were demagnetized by spinning in a four-axis tumbler in an alternating field (a.f.) of controllable intensity.

NRM RESULTS

The natural remanent magnetization (NRM) of all samples was measured prior to demagnetization. The average of the mean intensities at all depths is 1.34×10^{-4} emu/cc, with a standard deviation of 0.625×10^{-4} emu/cc. The intensities of paired samples agree well; the mean difference is 0.168×10^{-4} emu/cc, with a standard deviation of 0.203×10^{-4} emu/cc, corresponding to 14.7 and 18.5 percent of the means, respectively. This agreement may be fortuitous, inasmuch as samples were taped together in the same orientation prior to analysis, so NRM changes due to extraneous fields during transport and storage would affect paired samples in the same way. Figure 1 shows the NRM intensity (average of paired samples) as a function of depth for GPC-3 sediments.

LL44-GPC3 NRM(EMU/CC) AVERAGED 3

Figure 1. Downcore profile of NRM intensity (average of paired samples) in core GPC-3. Samples taken for chemical analysis and sorption studies are shown at left (asterisks). The 25 samples chosen for stepwise demagnetization are identified at right (small dots) and their NRM values indicated by solid circles on the profile.

Further work on the character of the NRM properties and on their mineralogical implications is in progress and will be reported elsewhere.

DRM RESULTS

One half of the samples from the upper portion (0 - 775 cm) of the core were demagnetized at 75 oersted (oe) and then remeasured ("Set 1" of Fig. 2) to determine their remanent magnetization (DRM). The 75 oe value was chosen on the basis of unpublished work on Vema-32 cores from the MPG-I area by M. Kominz (written communication, 1976), which showed that 50 - 75 oe was the optimum a.f. intensity for "cleaning" the sediments by removing unstable secondary components of magnetization. This first set of GPC-3 samples was run without testing for the optimum a.f. value in order to determine how much of the upper part of the core preserved a stable paleomagnetic stratigraphy. Following this initial test, which showed a stratigraphy consistent with those of Kominz (written communication, 1976) and Kent and Lowrie (1974), 25 samples were selected down the core for detailed stepwise demagnetization. Samples were chosen to provide information on the major NRM (Fig. 1) and lithologic units, as well as on sediments selected for chemical analysis and sorption studies. All the lithologic units described in Hollister (1977) and most of the major NRM intensity peaks were sampled. These samples were demagnetized in 25 oe steps from 0 to 300 oe. Intensity and apparent pole position changes during these steps confirm that 75 oe is a reasonable value for "cleaning" the samples; a.f. intensities over 100 oe lead to erratic changes in magnetic properties. Samples taken above the color change between 390 and 470 cm have relatively stable magnetic inclinations (for example, #83 at 107 cm and #139 at 279 cm in the Brunhes and Matuyama magnetic epochs, respectively, Figs. 3

Figure 2. Normal (black) and reversed (white) polarity intervals of the upper 775cm of GPC-3. Sets 1 and 2 are paired samples taken at the same depths.

Figure 3. (a) Ratio of measured intensity of GPC-3 sample 83 (107 cm depth; Brunhes normal magnetic epoch) after demagnetization to NRM intensity vs. a.f. demagnetization intensity (25 oe steps). (b) Measured inclination as a function of stepwise demagnetization (25 oe steps). (c) Stereographic projection of magnetic vectors of sample after stepwise demagnetization.

and 4).

PRECISION OF THE MAGNETIC MEASUREMENTS

Repeated demagnetization of several samples at the same a.f. intensity provides a measure of the precision of the magnetic measurements. Figure 5 is a stereographic plot of the scatter of magnetic pole positions due to such repetitive measurements for 3 samples at 25 oe. In all cases, the scatter in inclination is less than 5° , but the declination varies over a range of 5 to 32° . The inclination is determined from the Z component of the raw measurement alone, whereas the declination is determined from the X and Y components, both of which were found to be noisier and less stable than the Z component when determined in the cryogenic magnetometer. Inasmuch as declination is meaningless for this core (sections were not oriented relative to one another) the poor precision of the declination measurements is not important for this study. It is clear, however, that scatter such as that in Figures 3c and 4c may be due as much to imprecision in the measurements as to real changes in the magnetic vector.

During the precision tests, the intensity of magnetization of all 3 samples decreased steadily, with a total decrease of 10 - 20% from first to last measurement. Such a decrease points to the presence of a time dependent viscous component which does not completely randomize over the short (1 minute) length of time used for a.f. demagnetizations.

MAGNETIC STRATIGRAPHY AND SEDIMENTATION RATES

The pairs of DRM values determined after 75 oe demagnetization were vector averaged to produce the DRM profiles of Figures 6 and 7. The average

Figure 4. Influence of stepwise a.f. demagnetization (25 oe steps) of GPC-3 sample 139 (279 cm depth; Matuyama reversed magnetic epoch) on: (a) Intensity of magnetization relative to NRM; (b) Inclination; and (c) Position of magnetic vector (stereographic projection).

REPETITIVE MEASUREMENTS
TO CHECK PRECISION

Figure 5. Directions of magnetic vectors (stereographic projection) of samples 149 (305cm), 171 (520 cm), and 323 (750cm) after repeated demagnetization in a 25oe alternating field.

DRM inclination after demagnetization at 75 oe is shown in Figure 6. Also shown are the depth of each reversal boundary and its correlation (as far as the Matuyama-Gauss boundary) with the time scale of Cox (1969). Sedimentation rates for this upper part of the core decrease smoothly from 2.5mm/1000 yr. at the surface to 1.1mm/1000 yr. at 2 m.y. (Table 1; Fig. 7). The anomalously high rate from 0.69 to 0.8 m.y. probably results from the sample spacing and uncertainties in the ages of the magnetic boundaries. The Matuyama-Gauss magnetic boundary at 430 cm falls within the lithologic transition between 390 and 470 cm. A dramatic decrease in DRM intensity is associated with this lithologic transition (Fig. 6). Below this boundary the correlation between the observed polarity profile and the standard sequence of Cox (1969) breaks down. For an average sedimentation rate of 0.29 m/my for the rest of the core, based on the biostratigraphically dated base (see subsequent section on correlation with biostratigraphy), the observed reversal at 530 cm would correspond to 5.83 m.y. on the extended time scale of McDougall and others (1977), implying that eight reversed sequences are missing in the sampled record (line (A) of Fig. 7; Fig. 8). Alternatively, if it is assumed that the observed record sampled all reversals, correlation with the Cox time scale would require an erratic sedimentation rate with an average of 1.34 m/my for the period 2.24 - 4.48 m.y. (line (B) of Fig. 7). Figure 8 is an expansion of the core from 430 - 570 cm showing the measured polarity of individual sediment samples versus the predicted polarity for sedimentation rates of 0.29 and 0.22 m/my, respectively (see Fig. 9). Neither model fits the observed data well. For rates of 0.22 m/my or less, however, many of the events are not resolvable even with a 5 cm

AVERAGE DRM (75 OE)

Figure 6. Average of DRM values for paired samples after a.f. cleaning at 75oe. Average inclination values of sample pairs are shown, as well as a polarity log and its correlation with the time scale of Cox (1969). Ratio of magnetic intensity after 75oe a.f. treatment to NRM intensity (average of sample pairs) is shown at right.

Table 1. Magnetic stratigraphy of LL44-GPC3

Depth(cm)	Magnetic Boundary	Age(m.y.)*	Sedimentation Rate (mm/1000 yr)
0	-	0.0	2.51
173	Brunhes-Matuyama	0.69	1.85
210	Jaramillo	0.8	
228		0.95	3.00
305	?	-	1.65
337	Gilsa	1.61	1.17
358		1.79	
433	Matuyama-Gauss	2.43	1.17

*From Cox (1969)

Figure 8. Expanded portion of GPC-3 showing measured polarity of individual samples (drawn to scale) vs. expected magnetic stratigraphy for two model sedimentation rates. Predicted polarity sequence based on Cox (1969) and McDougall et al. (1977).

■ NORMAL POLARITY
 ▤ ONE NORMAL & ONE REVERSED
 □ REVERSE POLARITY

sample spacing. Thus, we do not feel that the paleomagnetic stratigraphy of GPC-3 can be extended back beyond 2.43 m.y. in the absence of an independent, high-resolution dating technique.

CORRELATION OF MAGNETIC STRATIGRAPHY WITH BIOSTRATIGRAPHY

Figure 9 is an interpretation of the preliminary ichthyolith biostratigraphy of GPC-3 described in a memo from P. Doyle to C.D. Hollister dated 3/14/77. Tertiary epochs have been converted to absolute ages (Table 2) using the time scale of Berggren and van Couvering (1974). The paleomagnetic stratigraphy down to 430 cm is indicated by the open circles and solid line. The dashed lines are possible alternative age-depth curves for the upper part of the core. Line (1), corresponding to 1.34 m/my, is from Figure 7. It is derived from the assumption that the observed NRM profile is complete and can be correlated with Cox's standard time scale. This curve is not consistent with the biostratigraphic data, nor with geochemical arguments that the sedimentation rate should have been much lower in pre-Pleistocene time when the site did not receive windblown periglacial debris from Asia. For these reasons and because of the low DRM intensities below 4 - 5 m, we do not favor this interpretation.

Curve (2) corresponds to a constant average sedimentation rate of 0.29 m/my for the period from 2 to 70 m.y. ago. This is the simplest age-depth model. It fails to intersect only 2 of the biostratigraphic age estimates, and only misses one of them (37.5 - 53.5 m.y. at 13 m) by more than a couple of million years. Curve (3) is the best fit to the biostratigraphic data. It requires a threefold variation in sedimentation rate; 0.22 m/my from 2.5 - 43 m.y., 0.67 m/my from 43 - 53 m.y., and 0.23 m/my from 53 - 77 m.y. The

Table 2. Ichthyolith biostratigraphy (after P. Doyle, written communication, 1977)

Depth (cm)	Tertiary Epoch	Age Range*
94 - 110	L. Miocene or younger	<10.5
394 - 408	L. Miocene or younger	<10.5
595 - 607	M. or L. (?) Miocene	5 - 14
694 - 706	Miocene	5 - 22.5
798 - 809	Miocene	5 - 22.5
894 - 906	M. Miocene - L. Oligocene	14 - 32
995 - 1006	Miocene - L. Eocene	5 - 32
1103 - 1114	M. Miocene - L. Eocene	14 - 43
1200 - 1215	Oligocene(?) - Eocene(?)	22.5 - 53.5
1288 - 1300	Eocene(?)	37.5 - 53.5
1394 - 1408	Oligocene(?) - Eocene(?)	22.5 - 53.5
1483 - 1498	L.(?) Eocene	37.5 - 43(53.5)
1591 - 1607	E. - M. Eocene	45 - 53.5
1691 - 1708	Eocene - L. Paleocene	37.5 - 57.5
1789 - 1811	Eocene(?)	37.5 - 5.5
1893 - 1912	Eocene - L. Paleocene	37.5 - 57.5
1995 - 2008	Eocene - L. Paleocene	37.5 - 57.5
2103 - 2166	Paleocene(?)	53.5 - 65
2195 - 2207	Paleocene - Cretaceous	>53.5
2290 - 2304	E. Paleocene - Cretaceous	>63
2390 - 2408	E. Paleocene - Cretaceous	>63

*From Berggren and van Couvering (1974)

uncertainties in biostratigraphic ages are too great to allow us to choose between models (2) and (3). We favor (2) for simplicity, but will reassess these alternatives when additional geochemical and magnetic studies are completed. Results to date show no evidence of better preserved DRM in 43 - 53 m.y. samples (using model 3), suggesting that magnetite has not been protected from oxidation to maghemite by faster burial in this interval (Kent and Lowrie, 1974). The principal features of the three curves are summarized in Table 3.

PALEOLATITUDE FROM INCLINATION AND PLATE MOTION

The inclination (I) measured at any spot on the earth is related to the latitude (L) by the formula:

$$\tan I = 2 \cot(90 - L).$$

In theory, if we know the path the core site has taken through time due to plate motion (and hence the paleolatitude as a function of time), and also the inclination of a sample in the core, we can estimate the age of the sample by computing the paleolatitude from the above equation, and then determining when the core site was at that latitude.

This method was applied to a pair of samples at 2250 cm (#900 and #901). Both these samples show reasonable magnetic stability under step-wise demagnetization at levels up to and including 100 oe (Fig. 10). The inclinations and demagnetization behavior are similar for the two samples, which are deep enough in the core to show paleoinclinations significantly shallower than those found today. Table 4 lists the predicted position of the core at 5 m.y. intervals from 75 m.y. ago to the present, and Figure 12 shows its paleolatitude as a function of age. The calculations are based on van Andel and others' (1975) history of the absolute rotation of the Pacific plate.

Table 3. Sedimentation rate models (see also Fig. 9).

Model	Depth Range (cm)	Age Range (m.y.)	Sedimentation Rate (cm/1000 yr)
1	433 - 528	2.43 - 2.80	2.57
	528 - 538	2.80 - 2.90	1.00
	538 - 543	2.90 - 2.94	1.25
	543 - 553	2.94 - 3.06	0.83
	553 - 608	3.06 - 3.32	2.12
	608 - 628	3.32 - 3.70	0.53
	628 - 673	3.70 - 3.92	2.05
	673 - 688	3.92 - 4.05	1.15
	688 - 723	4.05 - 4.25	1.75
	723 - 733	4.25 - 4.38	0.77
	733 - >775	4.38 - 4.50	>3.50
2	433 - 2400	2.43 - 70.0	0.29
3	433 - 1300	2.43 - 43.0	0.21
	1300 - 1970	43.0 - 53.0	0.67
	1970 - 2400	53.0 - 72.0	0.23

Figure 10. Influence of stepwise a.f. demagnetization (25 Oe steps) of GPC-3 sample 900 (2250 cm depth) on: (a) Intensity of magnetization relative to NRM; (b) Inclination; and (c) Direction of magnetic vector.

Figure 12. Paleolatitude vs. age plot for the site of GPC-3, based on the absolute plate rotation model of van Andel, Heath and Moore (1975).

Figures 10b and 11b indicate that the paleoinclination lies between 15° and 25° (in contrast to the present inclination of 50°). This range corresponds to a paleolatitude of 7.6° to 13.1°N , which is equivalent to a depositional age of 61 to 71 m.y. (Table 4). Age-depth curves (2) and (3) in Figure 10, based on ichthyolith stratigraphy, both give an age of about 65 m.y. for 2250 cm. The agreement is probably fortuitously good, but the total independence of the methods lends credence to the age.

Following this initial test, all sample pairs between 2155 and 2345 cm were demagnetized at 25, 50 and 75 oe. The interval between 2230 and 2255 cm (Fig. 13) contains samples #900 and #901, as well as five other pairs which appear stable and indicate a similar inclination range. The remaining data do not show a clear pattern, although, as predicted by the plate rotation model, they generally have inclinations markedly lower than the present 50° . Below 2300 cm the scatter may be due to physical disturbance of the core, which is total below 2438 cm. Occasional disruption and faulting of layers are visible as far up the core as 1900 cm, but are minor above 2360 cm (shipboard description).

The sample pairs between 1215 and 1275 cm were also demagnetized at 50 and 75 oe in an attempt to determine an age which might distinguish between models (2) and (3) (Fig. 9). The inclination data are widely scattered, however, (Fig. 14) and show no trend suggestive of an inclination lower than the present 50° . (The inclination predicted by model (2) would be about 37° at a depth of 13 m in the core.) Little or no coherent detrital signal is preserved, rendering these samples unsuitable for paleoinclination studies.

Table 4. Paleopositions of GPC-3 based on poles and rates of notation from van Andel, Heath and Moore (1975).

Age (m.y. B.P.)	Latitude (N)	Longitude (W)	Rotation Rate (°/m.y.)	Rotation Pole
0	30° 20'	157° 49'	0.83	67°N 59°W
5	28° 44'	153° 53'		
10	27° 07'	150° 01'		
15	25° 30'	146° 13'		
20	23° 53'	142° 28'		
25	22° 17'	138° 45'	0.25	67°N 59°W
30	21° 48'	137° 37'		
35	21° 20'	136° 31'		
40	20° 51'	135° 24'		
45	20° 23'	134° 18'		
50	19° 54'	133° 12'	0.80	11°N 84°W
55	16° 57'	133° 20'		
60	13° 59'	133° 21'		
65	11° 02'	133° 13'		
70	8° 05'	132° 57'		
75	5° 08'	132° 33'

Figure 13. DRM inclination of individual GPC-3 samples in the interval from 2150 to 2350 cm after demagnetization at 50oe and 75oe. The six sample pairs indicated by filled circles cluster well and record an interval of stable magnetic inclination of 15° - 25°.

Figure 14. Inclination of individual GPC-3 samples in the interval from 1200 to 1280cm after demagnetization at 50oe (open circles) and 75oe (solid circles). The sample pairs do not cluster about a particular inclination, suggesting that they contain little stable DRM.

CONCLUSIONS

The DRM results for core LL44-GPC3 provide a detailed chronology for the upper 4.5 m, as well as an age at 22.5 m that is consistent with ichthyolith stratigraphy. Taken together, the magnetic and biostratigraphic data indicate that sedimentation has been continuous at the site of GPC-3 for the past 70 million years. The sedimentation rate has increased from less than 0.3 m/my at the base of the core, to 2.5 m/my at the sea floor.

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APPENDIX B

Natural remanent magnetization and remanent magnetization after 25,50 and 75 oe alternating-field demagnetization of LL44-GPC-3 sediments. Intensity values are emu/cc of wet sediment. Analyses by R. Prince.

DEPTH CM	SAMPLE #	DECL	IRM INCL	INTENSITY	DECL	IRM 25 INCL	OE INTENSITY	DECL	IRM 50 INCL	OE INTENSITY	DECL	IRM 75 INCL	OE INTENSITY
25	60	51.5	-18.6	.370E-04							53.7	21.5	.275E-04
31	61	27.1	39.7	.287E-04							37.7	44.7	.198E-04
36	62	38.0	40.0	.418E-04							40.8	41.4	.321E-04
36	63	34.1	43.8	.370E-04	132.6	45.1	.275E-04	42.3	45.9	.264E-04	41.8	44.6	.245E-04
44	65	52.3	47.9	.261E-04	67.3	45.6	.180E-04	74.3	47.6	.158E-04	61.6	51.2	.141E-04
45	64	49.6	48.5	.228E-04							70.0	46.3	.158E-04
53	66	62.8	41.9	.339E-04							222.8	59.0	.181E-04
58	67	135.8	46.1	.352E-04	153.5	44.2	.282E-04	163.9	46.3	.245E-04	162.0	45.3	.225E-04
58	68	145.1	47.7	.332E-04							159.6	44.8	.244E-04
66	69	111.5	50.6	.342E-04	116.9	50.9	.254E-04	123.6	51.4	.218E-04	124.9	51.5	.206E-04
66	70	109.5	55.0	.340E-04							128.2	52.6	.230E-04
70	71	110.3	57.8	.316E-04	122.8	50.8	.244E-04	128.6	53.6	.195E-04	128.2	50.1	.178E-04
72	72	106.9	58.4	.290E-04							119.6	51.5	.181E-04
77	73	187.9	59.3	.290E-04	177.4	48.9	.259E-04	189.2	49.1	.218E-04	189.6	50.3	.195E-04
77	74	198.2	57.9	.311E-04							198.1	49.8	.228E-04
82	75	35.5	44.0	.363E-04	40.1	44.8	.275E-04	41.1	45.1	.230E-04	43.4	45.0	.212E-04
82	76	36.5	25.9	.257E-04							37.4	28.4	.149E-04
87	78	22.8	46.5	.364E-04							29.4	48.9	.230E-04
88	77	28.9	46.6	.389E-04	34.5	48.5	.316E-04	35.8	48.9	.271E-04	39.0	49.3	.249E-04
94	79	60.9	51.3	.309E-04	55.2	49.2	.230E-04	51.5	51.8	.199E-04	57.9	51.2	.185E-04
94	80	72.4	43.5	.266E-04							73.0	45.6	.174E-04
100	81	63.8	54.0	.385E-04	60.6	51.7	.294E-04	66.1	53.7	.252E-04	68.3	53.1	.237E-04
101	82	59.1	50.1	.402E-04							250.8	53.5	.285E-04
107	83	50.2	46.9	.328E-04	63.1	48.3	.294E-04	50.2	50.1	.237E-04	51.8	49.9	.204E-04
108	84	74.4	41.1	.316E-04							77.3	41.6	.200E-04
115	85	44.7	45.0	.311E-04	41.2	48.0	.247E-04	45.7	47.1	.195E-04	47.1	48.2	.181E-04
116	86	48.9	43.7	.264E-04							52.5	44.0	.158E-04
124	87	116.4	50.2	.302E-04							120.9	46.4	.197E-04
124	88	119.3	54.9	.323E-04				127.5	51.8	.199E-04	125.7	52.1	.197E-04
128	89	65.8	47.7	.306E-04							66.8	47.0	.187E-04
133	90	54.7	53.9	.297E-04							66.1	52.4	.183E-04
133	91	52.9	50.2	.316E-04	49.3	49.6	.235E-04	55.9	49.5	.195E-04	60.2	48.2	.181E-04
139	92	80.5	49.7	.280E-04							76.5	50.1	.202E-04
138	93	96.2	49.5	.297E-04	97.8	47.2	.233E-04	106.1	46.3	.195E-04	103.9	52.3	.180E-04
143	94	94.8	45.4	.418E-04							103.5	48.7	.295E-04
143	95	82.8	47.4	.337E-04	82.3	46.3	.285E-04	91.2	49.0	.242E-04	87.9	46.7	.225E-04
148	96	80.5	50.6	.273E-04							90.1	52.2	.180E-04
150	97	55.9	55.8	.295E-04	53.2	57.0	.247E-04	56.5	57.3	.214E-04	58.5	56.8	.199E-04
160	98	67.5	47.3	.306E-04							67.5	49.5	.187E-04
164	99	72.6	49.3	.302E-04							75.6	49.1	.193E-04
168	100	62.7	54.0	.209E-04							71.5	53.2	.109E-04
175	101	48.5	46.4	.864E-05	28.0	55.9	.345E-05	331.7	-4.8	.145E-05	318.4	-21.8	.190E-05
175	102	63.8	34.9	.705E-05							274.6	-46.6	.335E-05
180	103	350.9	34.4	.180E-05	253.3	-21.8	.368E-05	255.4	-37.4	.592E-05	262.7	-38.0	.668E-05
180	104	61.4	45.8	.145E-04							57.3	36.9	.573E-05
185	105	117.4	13.8	.409E-05	308.9	-88.7	.178E-05	270.6	-63.9	.453E-05	270.8	-57.9	.478E-05
185	106	103.7	4.5	.496E-05							272.6	-76.5	.553E-05
196	107	89.3	39.5	.713E-05	69.6	7.2	.250E-05	356.1	-76.8	.206E-05	312.4	-81.5	.223E-05
196	108	209.3	-42.7	.237E-05							269.1	-59.1	.116E-04
200	109	210.2	-20.3	.561E-05	237.3	-54.6	.891E-05	244.8	-53.1	.128E-04	258.7	-53.4	.128E-04
200	110	241.6	-23.1	.339E-05							265.1	-53.9	.118E-04
207	111	117.5	20.9	.518E-05							96.7	-30.2	.110E-04
212	112	259.6	63.0	.116E-04							166.2	82.9	.139E-05
217	113	266.9	54.0	.225E-04	263.3	51.0	.150E-04	271.0	53.9	.112E-04	269.7	52.0	.972E-05
212	114	241.6	57.0	.613E-05	160.2	2.3	.112E-05	131.2	-33.9	.351E-05	119.8	-31.0	.415E-05
217	115	271.2	40.6	.245E-04							266.3	42.3	.129E-04
222	116	88.8	64.7	.219E-04							151.3	55.5	.425E-05
222	117	92.2	61.1	.216E-04	205.9	16.8	.389E-05	226.6	3.9	.347E-05	218.0	15.4	.354E-05
226	118	96.8	48.2	.127E-04							120.4	36.4	.199E-05
226	119	109.7	52.5	.137E-04	89.2	52.0	.710E-05	113.6	57.2	.230E-05	115.5	63.3	.144E-05

DEPTH CM	SAMPLE #	DECL	NRM INCL	INTENSITY	DECL	DRM 25 INCL	OE INTENSITY	DECL	DRM 50 INCL	OE INTENSITY	DECL	DRM 75 INCL	OE INTENSITY
230	120	126.7	58.4	.758E-05							269.3	-34.7	.402E-05
230	121	138.5	60.5	.900E-05	122.9	47.5	.292E-05	233.5	-26.7	.212E-05	229.8	-31.7	.271E-05
236	122	155.6	50.3	.592E-05							250.0	-56.3	.739E-05
236	123	193.6	23.0	.427E-05	244.4	-55.3	.553E-05	264.5	-53.7	.981E-05	258.6	-54.6	.105E-04
241	124	171.2	59.4	.525E-05							263.8	-43.8	.807E-05
241	125	166.8	55.2	.442E-05	237.6	-55.4	.320E-05	257.8	-52.4	.686E-05	261.1	-54.0	.731E-05
249	126	143.1	67.4	.604E-05							252.0	-37.3	.511E-05
249	127	170.7	64.7	.480E-05	246.0	-32.8	.252E-05	259.6	-40.8	.568E-05	257.1	-43.8	.699E-05
255	128	111.7	69.1	.682E-05							248.4	-48.7	.276E-05
255	129	237.8	1.0	.337E-05	250.8	-44.6	.696E-05	260.9	-45.2	.101E-04	260.3	-48.4	.997E-05
259	130	225.3	4.5	.320E-05							250.1	-46.5	.101E-04
259	131	328.1	-52.6	.335E-05	254.3	-42.2	.618E-05	264.6	-45.7	.990E-05	261.5	-42.9	.998E-05
265	132	313.9	-61.1	.349E-05							250.9	-40.0	.124E-04
265	133	313.2	-65.6	.478E-05	241.6	-45.3	.756E-05	254.7	-46.7	.112E-04	254.4	-46.7	.119E-04
269	134	294.5	-56.5	.458E-05							247.3	-44.3	.133E-04
269	135	294.7	-54.8	.691E-05	239.7	-41.5	.857E-05	247.2	-46.2	.130E-04	246.9	-48.4	.127E-04
275	136	305.2	-36.9	.461E-05							252.2	-44.9	.105E-04
275	137	292.3	-30.1	.575E-05	239.9	-29.8	.672E-05	249.3	-37.1	.100E-04	252.1	-41.7	.105E-04
279	138	292.0	-32.5	.528E-05							251.8	-47.0	.106E-04
279	139	291.0	-32.4	.591E-05	202.2	-43.0	.549E-05	239.6	-46.4	.111E-04	239.2	-48.5	.113E-04
285	140	296.8	-26.2	.534E-05							247.0	-45.0	.111E-04
285	141	295.5	-23.8	.613E-05	236.5	-33.6	.705E-05	249.2	-45.1	.111E-04	254.4	-43.7	.112E-04
290	142	307.5	-11.4	.539E-05							245.6	-42.8	.817E-05
290	143	294.5	-22.5	.627E-05	239.9	-33.7	.679E-05	253.9	-43.8	.109E-04	249.3	-44.9	.108E-04
295	144	149.6	-6.8	.698E-05							251.0	-47.2	.121E-04
295	145	161.1	13.1	.758E-05	253.1	-6.7	.767E-05	261.5	-33.7	.111E-04	254.2	-32.2	.117E-04
300	146	158.5	1.9	.637E-05							255.7	-41.7	.121E-04
300	147	191.8	37.9	.653E-05	260.6	-12.5	.675E-05	264.2	-39.3	.111E-04	258.4	-38.9	.114E-04
305	148	106.2	51.4	.193E-04							99.9	44.8	.261E-05
305	149	109.3	55.1	.188E-04	78.1	64.9	.101E-04	104.5	-73.2	.408E-05	146.5	59.7	.285E-05
310	150	150.9	54.6	.869E-05							249.2	-36.0	.705E-05
310	151	177.9	54.2	.741E-05	236.6	39.1	.287E-05	255.7	-35.8	.668E-05	252.3	-41.5	.713E-05
315	152	212.0	36.9	.788E-05							259.4	-43.2	.940E-05
315	153	215.9	44.8	.542E-05	226.3	-12.7	.358E-05	253.9	-40.0	.874E-05	258.6	-43.6	.831E-05
320	154	230.6	18.3	.603E-05							252.8	-36.3	.102E-04
320	155	228.5	8.5	.596E-05	221.3	-26.8	.663E-05	250.0	-38.6	.101E-04	252.1	-41.3	.101E-04
325	156	231.4	-8.8	.604E-05							244.7	-51.8	.111E-04
325	157	243.6	-10.3	.715E-05	223.3	-41.6	.102E-04	258.2	-39.0	.124E-04	263.1	-40.6	.127E-04
330	158	156.3	26.6	.691E-05							281.6	-24.8	.834E-05
330	159	218.7	32.8	.646E-05	270.2	-14.5	.886E-05	279.8	-27.6	.116E-04	275.2	-30.8	.115E-04
335	160	167.3	26.8	.907E-05							252.7	-46.2	.891E-05
335	161	203.5	52.7	.879E-05	275.6	27.3	.484E-05	273.4	-17.2	.668E-05	269.7	-25.5	.712E-05
340	162	114.9	58.7	.207E-04							97.1	58.8	.472E-05
340	163	133.0	76.8	.142E-04	354.6	77.8	.725E-05	301.3	39.4	.489E-05	302.4	34.7	.402E-05
345	223	96.0	57.5	.233E-04	89.7	65.4	.148E-04	98.1	65.7	.990E-05	94.0	63.3	.895E-05
345	224	101.5	51.7	.211E-04							116.7	64.3	.781E-05
350	225	101.2	50.4	.209E-04	95.7	66.7	.125E-04	97.1	64.2	.829E-05	94.2	63.2	.668E-05
350	226	102.2	55.4	.254E-04							97.7	75.5	.971E-05
355	227	97.1	45.1	.212E-04	112.6	74.6	.988E-05	118.4	73.3	.525E-05	119.6	82.4	.485E-05
355	228	117.4	33.6	.223E-04							115.6	55.8	.584E-05
360	229	115.3	34.3	.172E-04	31.3	65.8	.478E-05	317.8	-8.6	.132E-05	268.7	-55.0	.964E-06
360	230	118.3	44.4	.138E-04							270.2	-42.6	.358E-05
365	231	128.6	52.2	.108E-04	260.3	39.0	.373E-05	274.8	-17.8	.554E-05	272.3	-31.1	.577E-05
365	232	132.5	55.1	.883E-05							258.1	-43.1	.523E-05
370	233	176.3	46.0	.449E-05	250.6	-27.8	.541E-05	259.9	-43.7	.986E-05	259.4	-45.8	.924E-05
370	234	165.2	71.2	.763E-05							257.2	-38.1	.720E-05
375	235	111.1	67.2	.130E-04	183.6	69.6	.641E-05	208.0	65.5	.199E-05	202.3	26.0	.153E-05
375	236	223.0	84.9	.801E-05							239.3	-28.0	.646E-05
380	237	322.6	79.4	.788E-05	223.5	45.7	.159E-05	259.8	-33.8	.478E-05	259.2	-30.4	.539E-05
380	238	277.9	17.5	.606E-05							278.7	-36.2	.119E-04
385	239	283.4	2.0	.779E-05	259.4	-45.6	.715E-05	270.3	-43.4	.110E-04	271.6	-46.0	.118E-04

DEPTH CM	SAMPLE #	DECL	HRM INCL	INTENSITY	DECL	DRM 25 INCL	OE INTENSITY	DECL	DRM 50 INCL	OE INTENSITY	DECL	DRM 75 INCL	OE INTENSITY
385	240	276.6	2.0	.850E-05							270.4	-33.9	.124E-04
390	241	275.8	-11.2	.720E-05	254.4	-42.9	.801E-05	266.8	-44.7	.114E-04	259.2	-45.7	.116E-04
390	242	168.1	5.2	.627E-05							250.1	-48.8	.119E-04
395	243	155.0	27.5	.699E-05	268.2	-16.9	.725E-05	266.1	-36.7	.110E-04	264.0	-37.1	.107E-04
395	244	153.3	29.2	.679E-05							257.5	-50.5	.113E-04
400	245	144.5	45.5	.756E-05	259.1	20.7	.389E-05	252.8	-34.1	.769E-05	255.9	-43.3	.838E-05
400	246	197.3	36.3	.428E-05							259.8	-47.2	.139E-04
405	247	192.3	45.0	.504E-05	247.3	-15.0	.613E-05	255.5	-34.2	.991E-05	260.2	-34.1	.101E-04
405	248	199.7	67.8	.611E-05							258.2	-28.7	.116E-04
410	249	216.7	60.4	.549E-05	239.0	-9.1	.516E-05	251.3	-32.0	.905E-05	255.5	-35.9	.893E-05
410	250	238.5	27.2	.442E-05							251.7	-39.6	.991E-05
415	251	253.3	-0.1	.717E-05	244.8	-29.2	.969E-05	253.4	-34.5	.138E-04	257.2	-39.5	.135E-04
415	252	258.2	-5.4	.718E-05							248.7	-34.7	.131E-04
420	253	261.9	-4.8	.758E-05	245.4	-35.2	.943E-05	257.5	-38.4	.137E-04	257.6	-36.8	.131E-04
420	254	257.2	10.4	.535E-05							265.2	-30.3	.114E-04
425	255	256.5	-28.9	.731E-05	254.3	-44.1	.117E-04	256.4	-45.5	.154E-04	255.5	-44.3	.153E-04
425	256	148.5	7.9	.130E-04							244.7	-41.4	.111E-04
430	257	128.0	39.3	.178E-04	270.8	64.7	.596E-05	259.6	-2.2	.434E-05	241.3	-11.6	.573E-05
430	258	128.0	42.6	.166E-04							242.7	-31.4	.535E-05
435	259	113.2	54.0	.238E-04	76.4	73.0	.109E-04	147.6	79.3	.390E-05	168.9	68.8	.385E-05
435	260	117.0	55.4	.238E-04							130.4	68.7	.504E-05
440	261	101.1	57.6	.278E-04	79.6	56.9	.155E-04	89.2	55.6	.832E-05	110.8	60.7	.668E-05
440	262	101.5	63.1	.276E-04							77.7	54.9	.561E-05
445	263	101.9	35.0	.206E-04	79.0	54.0	.192E-04	83.6	56.9	.110E-04	81.5	55.8	.810E-05
445	264	72.0	40.4	.192E-04							63.6	72.7	.872E-05
450	265	68.2	43.8	.192E-04	77.8	51.5	.193E-04	84.0	53.7	.108E-04	91.8	51.9	.774E-05
450	266	66.1	50.5	.192E-04							66.6	50.9	.869E-05
455	267	54.5	56.1	.211E-04	76.3	49.1	.187E-04	82.6	55.8	.106E-04	89.1	61.2	.869E-05
455	268	39.0	62.4	.185E-04							75.1	69.2	.568E-05
460	269	44.8	61.9	.282E-04	66.4	44.8	.154E-04	69.1	48.6	.946E-05	61.9	51.3	.822E-05
460	270	84.4	36.9	.328E-04							75.2	57.8	.102E-04
465	271	83.7	32.1	.285E-04	77.5	51.1	.207E-04	84.8	54.8	.109E-04	87.0	58.8	.896E-05
465	272	82.2	32.0	.273E-04							97.4	62.1	.946E-05
470	273	79.2	32.3	.257E-04	60.5	63.3	.161E-04	67.8	63.1	.836E-05	62.0	61.0	.672E-05
470	274	82.9	32.5	.245E-04							85.5	54.4	.805E-05
475	275	75.9	32.8	.211E-04	73.8	63.4	.153E-04	84.4	71.4	.691E-05	148.2	81.3	.594E-05
475	276	78.8	33.5	.238E-04							50.2	61.8	.693E-05
481	277	76.0	31.7	.168E-04	86.7	58.5	.137E-04	106.6	67.6	.560E-05	159.7	61.9	.480E-05
481	278	83.0	33.2	.178E-04							120.7	71.4	.634E-05
486	279	13.8	55.6	.121E-04	14.6	83.8	.118E-04	283.3	57.6	.686E-05	274.3	48.0	.613E-05
486	280	73.6	41.4	.117E-04							167.3	44.5	.377E-05
492	281	56.9	56.5	.108E-04	105.3	53.6	.922E-05	171.6	66.8	.252E-05	18.0	-81.3	.115E-05
492	282	61.5	55.8	.134E-04							116.4	81.3	.411E-05
500	165	224.3	52.7	.301E-04							246.6	51.3	.810E-05
505	164	218.1	54.0	.288E-04	228.5	55.2	.162E-04	254.8	50.0	.791E-05	219.9	58.5	.741E-05
505	166	221.4	52.4	.307E-04							243.8	40.9	.850E-05
510	167	229.7	54.2	.259E-04	210.9	50.6	.153E-04	211.4	47.0	.701E-05	201.5	41.8	.446E-05
510	168	225.5	51.4	.271E-04							224.1	49.6	.708E-05
515	169	225.8	52.8	.244E-04	213.2	52.5	.141E-04	209.6	52.2	.579E-05	216.9	64.3	.366E-05
515	170	232.1	45.1	.244E-04							200.5	43.8	.636E-05
520	171	231.9	49.7	.207E-04	190.5	27.8	.117E-04	189.1	19.3	.437E-05	193.4	2.3	.347E-05
520	172	168.6	46.5	.226E-04							243.5	51.9	.442E-05
525	173	160.8	50.3	.230E-04	240.3	58.9	.898E-05	288.4	55.2	.195E-05	158.4	56.0	.143E-05
525	174	173.2	47.8	.233E-04							232.5	58.4	.724E-06
530	175	175.0	51.9	.231E-04	239.9	63.7	.841E-05	1.2	52.7	.984E-06	49.7	1.2	.138E-05
530	176	184.6	53.7	.221E-04							9.5	-17.3	.237E-05
535	177	185.2	50.3	.206E-04	211.3	73.2	.687E-05	64.4	-9.6	.250E-05	59.3	-41.1	.218E-05
535	178	191.6	50.2	.216E-04							85.4	-9.5	.513E-05
540	179	203.5	52.1	.221E-04	186.1	71.4	.822E-05	94.7	10.1	.273E-05	94.2	8.5	.257E-05
540	180	214.8	47.6	.225E-04							87.6	-0.9	.287E-05

DEPTH CM	SAMPLE #	DECL	NRM INCL	INTENSITY	DECL	DRM 25 INCL	OE INTENSITY	DECL	DRM 50 INCL	OE INTENSITY	DECL	DRM 75 INCL	OE INTENSITY
545	181	217.2	48.8	.226E-04	175.6	70.0	.832E-05	81.3	29.9	.335E-05	78.0	8.4	.301E-05
545	182	219.9	47.2	.219E-04							93.5	-8.5	.363E-05
550	183	226.5	45.5	.218E-04	177.1	59.7	.623E-05	104.3	-7.3	.302E-05	103.3	-15.4	.408E-05
550	184	228.7	39.2	.207E-04							99.9	-9.6	.382E-05
555	185	227.9	37.9	.216E-04	218.8	40.0	.796E-05	154.5	11.6	.192E-05	138.5	-9.8	.159E-05
555	186	180.0	51.2	.263E-04							305.8	54.3	.139E-05
560	187	194.0	51.2	.292E-04	229.1	55.2	.158E-04	242.0	54.8	.720E-05	254.7	61.1	.418E-05
560	188	191.3	49.8	.287E-04							282.2	18.4	.313E-05
565	189	194.1	49.2	.285E-04	228.4	57.5	.113E-04	225.3	66.8	.409E-05	203.0	78.3	.263E-05
565	190	198.9	48.5	.283E-04							219.4	37.1	.361E-05
570	191	197.3	49.2	.297E-04	216.4	59.2	.133E-04	204.3	66.0	.444E-05	174.6	37.5	.399E-05
570	192	206.9	49.6	.288E-04							277.2	53.8	.420E-05
575	193	208.0	45.9	.287E-04	207.3	62.6	.136E-04	205.3	65.0	.530E-05	140.9	48.2	.247E-05
575	194	214.0	48.5	.269E-04							202.9	52.3	.342E-05
580	195	305.9	79.0	.202E-04	205.4	58.0	.131E-04	190.2	54.5	.503E-05	194.3	55.4	.323E-05
580	196	218.9	44.1	.282E-04							173.2	38.1	.439E-05
586	197	220.3	46.2	.263E-04	200.2	51.5	.119E-04	176.1	48.4	.468E-05	173.9	43.1	.311E-05
586	198	225.3	42.2	.242E-04							113.8	77.4	.339E-05
590	199	221.7	42.2	.218E-04	212.7	39.3	.948E-05	197.2	24.8	.352E-05	171.7	36.1	.409E-05
590	200	163.2	50.7	.199E-04							111.7	52.3	.456E-05
595	201	166.0	51.4	.195E-04	181.1	70.0	.137E-04	194.8	75.1	.454E-05	140.5	68.6	.335E-05
595	202	165.3	59.3	.225E-04							106.9	56.0	.228E-05
600	203	169.8	61.4	.225E-04	178.5	65.8	.870E-05	131.2	42.1	.264E-05	92.1	9.5	.237E-05
600	204	263.1	45.5	.171E-04							136.1	49.2	.269E-05
605	205	253.2	52.3	.153E-04	206.0	61.8	.819E-05	162.9	68.5	.316E-05	58.0	53.2	.180E-05
605	206	239.7	48.0	.107E-04							53.2	-28.5	.282E-05
610	207	240.7	54.2	.112E-04	211.9	66.1	.668E-05	52.7	26.3	.151E-05	17.8	-15.7	.238E-05
610	208	214.7	70.7	.879E-05							57.5	-90.3	.375E-05
615	209	201.7	59.2	.826E-05	242.6	35.9	.513E-05	71.1	-38.3	.257E-05	53.7	-33.5	.363E-05
615	210	193.7	68.6	.952E-05							34.5	1.3	.209E-05
620	211	183.4	64.8	.111E-04	239.2	39.8	.902E-05	121.5	20.8	.145E-05	103.2	-65.7	.139E-05
620	212	184.3	63.8	.927E-05							105.7	-48.3	.170E-05
625	213	195.9	60.5	.115E-04	241.8	32.4	.109E-04	228.7	11.1	.245E-05	260.1	12.5	.188E-05
625	214	227.1	68.3	.187E-04							124.2	-36.5	.366E-05
630	215	239.8	65.4	.166E-04	156.4	65.0	.808E-05	125.8	17.6	.193E-05	94.7	23.9	.214E-05
630	216	267.0	38.8	.173E-04							284.0	-22.1	.250E-05
635	217	37.9	62.6	.193E-04	55.1	54.2	.109E-04	150.6	75.3	.288E-05	197.8	36.4	.352E-05
635	218	49.3	52.9	.178E-04							207.3	31.5	.311E-05
640	219	27.5	60.8	.207E-04	37.5	61.0	.116E-04	244.0	84.7	.382E-05	296.7	79.9	.256E-05
640	220	52.8	55.3	.287E-04							97.0	56.8	.364E-05
645	221	63.5	55.0	.233E-04	48.9	61.2	.120E-04	87.5	65.4	.449E-05	172.7	67.3	.337E-05
645	222	60.8	52.8	.235E-04							65.3	66.8	.261E-05
650	283	249.8	50.4	.181E-04	282.6	28.4	.743E-05	289.8	-2.5	.160E-05	43.9	-25.2	.572E-06
650	284	155.2	34.2	.306E-04							315.0	72.9	.558E-05
655	285	161.3	44.8	.358E-04	201.5	65.6	.173E-04	215.9	67.5	.784E-05	177.5	78.3	.601E-05
655	286	170.1	48.6	.358E-04							216.3	62.6	.309E-05
660	287	175.4	53.3	.297E-04	193.5	70.1	.106E-04	145.6	84.4	.313E-05	186.6	66.0	.377E-05
660	288	184.7	55.6	.332E-04							260.9	50.4	.247E-05
665	289	200.1	56.7	.328E-04	207.1	57.7	.102E-04	171.4	76.9	.380E-05	27.1	37.1	.276E-05
665	290	199.8	55.1	.313E-04							214.1	37.6	.259E-05
670	291	201.0	56.5	.306E-04	193.9	49.7	.862E-05	171.9	71.0	.266E-05	57.3	69.4	.171E-05
670	292	209.9	55.8	.332E-04							321.2	-13.0	.808E-06
675	293	216.4	56.4	.273E-04	204.8	53.5	.763E-05	135.8	35.8	.204E-05	100.1	-5.8	.144E-05
675	294	212.3	51.0	.269E-04							154.9	-11.8	.247E-05
682	295	225.9	50.0	.244E-04	217.2	44.5	.791E-05	129.9	63.8	.115E-05	96.5	18.0	.167E-05
682	296	235.9	46.3	.242E-04							115.4	29.1	.284E-05
685	297	235.0	39.0	.195E-04	234.8	45.4	.713E-05	10.4	-13.8	.542E-06	5.7	-22.8	.990E-06
685	298	157.3	39.0	.294E-04							95.4	14.4	.363E-05
690	299	168.8	43.9	.321E-04	172.9	64.0	.178E-04	175.4	67.6	.466E-05	162.6	74.7	.364E-05
690	300	174.3	44.9	.351E-04							138.5	11.2	.340E-05
695	301	175.5	54.7	.377E-04	203.8	59.4	.185E-04	197.6	56.7	.686E-05	282.6	58.9	.466E-05
695	302	193.3	50.4	.368E-04							175.6	56.5	.720E-05

DEPTH CM	SAMPLE #	DECL	NRM INCL	INTENSITY	DECL	DRM 25 INCL	OE INTENSITY	DECL	DRM 50 INCL	OE INTENSITY	DECL	DRM 75 INCL	OE INTENSITY
700	303	193.8	51.5	.351E-04	183.2	54.8	.158E-04	187.1	58.1	.741E-05	199.4	58.2	.459E-05
700	304	199.9	49.9	.330E-04							199.2	47.9	.427E-05
705	305	202.7	51.0	.349E-04	187.6	51.1	.148E-04	187.3	60.5	.679E-05	186.5	39.2	.465E-05
705	306	217.0	49.3	.347E-04							183.9	62.5	.449E-05
710	307	222.1	49.3	.344E-04	205.2	49.5	.151E-04	202.7	53.1	.677E-05	227.2	64.1	.463E-05
710	308	228.1	47.4	.333E-04							194.9	66.6	.399E-05
715	309	234.0	45.3	.337E-04	219.2	47.5	.159E-04	204.4	51.2	.713E-05	202.6	63.7	.487E-05
715	310	237.7	42.5	.302E-04							215.3	37.1	.470E-05
720	311	242.2	31.1	.266E-04	229.9	42.2	.142E-04	229.2	35.7	.397E-05	248.0	41.4	.352E-05
720	312	173.3	45.5	.299E-04							105.7	33.3	.130E-05
725	313	177.3	45.6	.290E-04	162.6	77.4	.116E-04	54.8	26.3	.197E-05	51.2	-10.1	.311E-05
725	314	182.1	44.4	.288E-04							9.8	-21.7	.456E-05
730	315	187.1	49.7	.330E-04	166.0	64.7	.128E-04	89.8	82.6	.352E-05	67.3	-14.0	.896E-06
730	316	188.3	51.0	.313E-04							35.8	-12.3	.399E-05
735	317	197.0	48.7	.311E-04	178.5	57.5	.129E-04	175.8	70.4	.368E-05	264.5	74.6	.173E-05
735	318	197.8	50.3	.351E-04							232.0	75.0	.427E-05
740	319	205.7	49.4	.320E-04	189.9	54.6	.137E-04	182.0	70.8	.396E-05	146.5	39.9	.463E-05
740	320	209.4	52.4	.323E-04							186.8	54.9	.385E-05
745	321	213.6	52.6	.318E-04	206.2	54.3	.124E-04	175.3	69.4	.385E-05	137.4	73.2	.249E-05
745	322	222.5	51.6	.325E-04							190.1	42.3	.290E-05
750	323	224.9	50.3	.329E-04	214.0	53.1	.137E-04	206.7	60.5	.546E-05	179.4	76.5	.340E-05
750	324	228.3	45.5	.321E-04							240.9	53.8	.592E-05
755	325	233.2	41.7	.266E-04	226.7	47.3	.136E-04	222.2	42.5	.411E-05	233.8	18.9	.257E-05
755	326	140.2	38.5	.280E-04							168.8	52.0	.508E-05
760	327	146.4	36.9	.259E-04	191.2	45.9	.138E-04	171.1	40.4	.566E-05	135.5	49.2	.513E-05
760	328	153.3	41.4	.244E-04							198.0	37.1	.623E-05
765	329	149.1	42.8	.187E-04	190.2	49.1	.136E-04	172.0	52.3	.587E-05	155.5	30.3	.302E-05
765	330	163.1	43.5	.159E-04							157.1	43.1	.382E-05
770	331	181.2	53.2	.131E-04	198.0	51.2	.141E-04	205.6	54.6	.549E-05	193.4	22.4	.211E-05
770	332	185.9	62.7	.140E-04							48.8	83.7	.423E-05
775	333	238.6	62.2	.121E-04	217.5	56.1	.130E-04	223.6	74.4	.492E-05	251.4	78.0	.306E-05
775	334	243.0	62.2	.148E-04							268.8	44.0	.326E-05
780	335	268.9	53.7	.145E-04									
780	336	271.8	56.9	.188E-04									
785	337	273.2	57.2	.212E-04									
785	338	275.8	54.6	.242E-04									
790	339	277.4	60.6	.264E-04									
790	340	133.0	61.4	.212E-04									
795	341	137.3	61.2	.192E-04									
795	342	140.1	63.3	.174E-04									
800	343	66.0	32.3	.158E-04									
800	344	43.2	35.9	.295E-04									
805	345	19.3	35.4	.285E-04									
805	346	30.4	35.1	.283E-04									
810	347	11.3	34.8	.261E-04									
810	348	16.1	33.4	.280E-04									
815	349	16.0	33.3	.283E-04									
815	350	3.5	36.5	.285E-04									
820	351	7.9	36.3	.359E-04									
820	352	11.1	39.1	.387E-04									
825	353	358.2	52.3	.211E-04									
825	354	320.0	23.7	.256E-04									
830	355	331.5	29.5	.228E-04									
830	356	343.8	33.0	.223E-04									
835	357	352.2	36.4	.275E-04									
835	358	355.9	44.5	.252E-04									
840	359	10.1	42.5	.225E-04									
840	360	29.6	50.7	.174E-04									
845	361	31.0	47.3	.190E-04									
845	362	40.0	50.9	.231E-04									
850	363	49.6	46.8	.278E-04									

DEPTH CM	SAMPLE #	DECL	DRM 25 OE			DRM 50 OE			DRM 75 OE		
			INCL	INTENSITY	DECL	INCL	INTENSITY	DECL	INCL	INTENSITY	
850	364	46.8	46.6	.292E-04							
855	365	46.3	47.3	.313E-04							
855	366	48.4	45.2	.307E-04							
860	367	53.3	45.7	.345E-04							
860	368	353.3	34.8	.338E-04							
865	369	4.4	37.1	.364E-04							
865	370	4.1	41.2	.316E-04							
870	371	10.5	43.8	.342E-04							
870	372	20.2	48.2	.337E-04							
875	373	22.4	46.8	.332E-04							
875	374	29.9	46.1	.345E-04							
880	375	31.3	44.6	.373E-04							
880	376	28.3	48.0	.354E-04							
885	377	39.8	45.9	.375E-04							
885	378	39.9	47.6	.354E-04							
890	379	43.5	46.6	.420E-04							
890	380	36.7	50.1	.458E-04							
895	381	38.1	47.2	.466E-04	17.2	59.1	.318E-04	3.3	58.7	.156E-04	
895	382	73.6	41.9	.420E-04							
900	383	73.3	30.2	.263E-04							
900	384	68.7	26.5	.226E-04							
905	385	52.7	30.6	.321E-04							
905	386	52.1	32.6	.342E-04							
910	387	36.3	-0.7	.155E-04							
910	388	26.3	0.2	.170E-04							
915	389	30.4	27.4	.396E-04							
915	390	30.1	27.8	.421E-04							
920	391	21.7	29.3	.397E-04							
920	392	15.2	31.1	.413E-04							
925	393	10.3	31.8	.329E-04							
925	394	7.3	35.5	.427E-04							
930	395	2.7	37.1	.420E-04							
930	396	54.8	36.6	.387E-04							
935	397	53.6	29.8	.380E-04							
935	398	51.5	33.8	.392E-04							
940	399	44.6	29.8	.358E-04							
940	400	45.2	29.3	.339E-04							
945	401	38.6	28.5	.321E-04							
945	402	32.8	30.5	.356E-04							
950	403	30.7	30.3	.428E-04							
950	404	24.6	33.9	.465E-04							
955	405	16.5	29.8	.206E-04							
954	406	1.2	33.1	.295E-04							
960	407	11.0	39.1	.242E-04							
960	408	5.3	38.0	.223E-04							
965	409	3.4	39.3	.276E-04							
965	410	78.3	21.3	.259E-04							
970	411	59.4	21.7	.294E-04							
970	412	50.1	19.4	.309E-04							
975	413	38.8	22.2	.344E-04							
975	414	34.9	18.2	.299E-04							
980	415	25.4	20.1	.332E-04	8.6	44.2	.188E-04	357.1	42.6	.998E-05	
980	416	24.0	22.0	.321E-04							
985	417	16.0	19.7	.273E-04							
985	418	6.2	19.5	.294E-04							
990	419	6.5	23.2	.290E-04							
990	420	359.7	26.2	.311E-04							
995	421	354.3	29.2	.337E-04							
995	422	343.7	36.3	.394E-04							
1000	423	353.6	43.6	.401E-04							
1000	424	45.5	29.5	.380E-04							

DEPTH CM	SAMPLE #	DECL	DRM 25 OE			DRM 50 OE			DRM 75 OE		
			NRM INCL	INTENSITY	DECL	INCL	INTENSITY	DECL	INCL	INTENSITY	
1005	425	36.5	26.4	.371E-04							
1005	426	41.4	22.3	.354E-04							
1010	427	34.7	24.3	.323E-04							
1010	428	31.3	23.7	.321E-04							
1015	429	28.1	26.4	.347E-04							
1015	430	19.5	27.2	.330E-04							
1020	431	19.9	27.3	.278E-04							
1020	432	15.0	28.6	.301E-04	357.4	48.4	.148E-04	334.4	46.9	.428E-05	
1025	433	8.2	30.8	.292E-04							
1025	434	2.4	-29.4	.285E-04							
1030	435	356.5	33.4	.294E-04							
1030	436	356.8	38.5	.340E-04							
1035	437	5.3	46.4	.288E-04							
1035	438	72.3	20.8	.249E-04							
1040	439	71.8	20.4	.226E-04							
1040	440	55.0	25.9	.195E-04							
1045	441	57.7	19.4	.230E-04							
1045	442	42.7	20.8	.285E-04							
1050	443	34.8	14.9	.301E-04							
1050	444	27.5	21.1	.294E-04							
1055	445	24.5	15.3	.278E-04							
1055	446	13.3	17.0	.263E-04							
1060	447	10.2	18.0	.290E-04							
1060	448	7.9	23.0	.269E-04							
1065	449	5.9	24.9	.283E-04							
1065	450	1.5	26.6	.276E-04							
1070	451	346.1	19.1	.261E-04							
1070	452	76.3	24.8	.259E-04							
1075	453	79.5	21.1	.170E-04							
1075	454	73.5	26.2	.156E-04							
1085	455	44.5	27.9	.181E-04							
1085	456	25.9	61.5	.161E-04							
1090	457	15.4	25.3	.174E-04							
1090	458	15.7	27.9	.185E-04							
1095	459	0.6	30.2	.176E-04							
1095	460	357.3	21.7	.211E-04							
1100	461	338.5	41.9	.263E-04	346.8	48.5	.130E-04	327.3	33.9	.484E-05	
1100	462	341.1	23.8	.228E-04							
1104	463	323.7	19.5	.214E-04							
1104	464	334.6	17.4	.211E-04							
1107	465	313.8	28.5	.325E-04							
1107	466	25.4	48.1	.160E-04							
1115	467	104.9	34.3	.299E-04							
1115	468	117.4	44.2	.278E-04							
1120	469	178.7	52.1	.257E-04							
1120	470	161.5	41.9	.212E-04							
1126	471	188.7	47.8	.172E-04							
1126	472	183.6	49.1	.221E-04							
1139	473	348.3	38.1	.156E-04							
1139	474	352.1	34.4	.151E-04							
1145	475	329.9	25.0	.146E-04							
1145	476	322.5	28.7	.150E-04							
1150	477	319.9	29.8	.115E-04							
1150	478	315.4	34.8	.119E-04							
1155	479	322.5	33.4	.271E-04							
1155	480	95.6	23.1	.190E-04							
1160	481	69.0	27.2	.176E-04							
1160	482	55.8	31.9	.173E-04							
1165	483	55.3	30.7	.144E-04							
1165	484	42.6	35.7	.122E-04							
1170	485	13.9	21.6	.112E-04							

DEPTH CM	SAMPLE #	DRM 25 OE			DRM 50 OE			DRM 75 OE		
		DECL	INCL	INTENSITY	DECL	INCL	INTENSITY	DECL	INCL	INTENSITY
1170	486	352.4	35.5	.136E-04						
1175	487	358.5	25.6	.146E-04						
1175	488	348.9	52.4	.181E-04						
1180	489	349.6	47.8	.197E-04						
1180	490	342.9	48.4	.211E-04						
1185	491	347.8	44.5	.238E-04	320.0	38.8	.156E-04	318.0	34.5	.672E-05
1185	492	352.2	50.5	.219E-04						
1190	493	350.0	43.6	.197E-04						
1190	494	5.7	46.2	.190E-04						
1195	495	357.1	41.7	.204E-04						
1195	496	2.2	48.3	.214E-04						
1202	497	354.6	47.3	.269E-04						
1202	498	348.3	47.2	.299E-04						
1210	499	348.3	41.5	.330E-04						
1210	500	344.8	49.0	.311E-04						
1215	501	348.7	43.8	.311E-04			324.8	40.3	.107E-04	318.6
1215	502	348.5	47.3	.345E-04			327.8	49.6	.138E-04	320.5
1222	503	326.3	57.8	.330E-04			323.0	44.2	.124E-04	329.5
1222	504	337.4	49.3	.344E-04			321.6	49.5	.125E-04	329.7
1227	505	335.5	47.2	.259E-04			312.5	54.2	.504E-05	330.2
1227	506	335.6	48.0	.245E-04			299.6	48.9	.646E-05	328.3
1232	507	342.8	46.4	.233E-04			313.2	46.4	.337E-05	276.7
1232	508	23.2	40.8	.156E-04			250.6	59.1	.132E-05	226.7
1238	509	45.4	39.3	.223E-04			188.6	40.0	.159E-05	202.7
1238	510	44.4	39.1	.193E-04			29.4	17.0	.974E-06	170.1
1242	511	29.6	52.0	.176E-04			162.7	77.4	.371E-05	263.9
1242	512	8.6	57.2	.152E-04			237.4	47.6	.304E-05	232.2
1248	513	15.5	41.7	.185E-04			278.6	57.2	.354E-05	259.5
1249	514	6.8	39.2	.195E-04			305.8	39.3	.306E-05	281.8
1255	515	359.6	36.9	.183E-04			261.3	67.0	.406E-05	255.1
1255	516	339.6	29.5	.212E-04			331.3	60.3	.273E-05	290.9
1260	517	337.6	30.4	.254E-04			328.2	68.9	.492E-05	16.3
1260	518	323.5	26.5	.333E-04			298.3	43.2	.520E-05	274.6
1265	519	330.7	32.6	.271E-04			309.4	56.6	.202E-05	189.7
1265	520	321.3	20.2	.321E-04			291.4	6.8	.206E-05	206.9
1270	521	322.1	24.5	.351E-04			280.1	52.8	.333E-05	291.1
1270	522	22.1	46.0	.244E-04			301.2	-3.0	.299E-05	281.3
1275	523	97.5	33.7	.316E-04			125.4	68.0	.294E-05	94.4
1275	524	98.1	32.4	.299E-04			114.7	48.2	.396E-05	133.1
1280	525	96.8	36.2	.307E-04						
1280	526	92.7	36.6	.278E-04						
1288	527	1.8	41.1	.240E-04						
1289	528	358.7	36.0	.252E-04						

DEPTH CM	SAMPLE #	DECL	DRM 25 OE			DRM 50 OE			DRM 75 OE		
			INCL	INTENSITY	DECL	INCL	INTENSITY	DECL	INCL	INTENSITY	
1345	547	292.4	45.2	.278E-04							
1345	548	307.0	42.4	.297E-04							
1350	549	302.5	35.4	.339E-04							
1350	550	106.4	73.2	.199E-04							
1355	551	112.7	83.5	.225E-04							
1355	552	147.2	60.1	.106E-04							
1360	553	14.6	86.3	.207E-04							
1360	554	223.6	79.0	.943E-05							
1365	555	315.4	77.5	.237E-04							
1365	556	331.6	71.2	.242E-04							
1370	557	325.0	72.5	.254E-04							
1370	558	321.5	64.5	.278E-04							
1375	559	310.8	54.2	.280E-04	311.1	47.3	.132E-04	309.0	41.0	.658E-05	
1375	560	310.9	47.3	.269E-04							
1380	561	311.3	44.0	.256E-04							
1380	562	318.4	43.8	.245E-04							
1385	563	311.2	40.5	.247E-04							
1385	564	17.7	42.0	.139E-04							
1390	565	25.4	46.8	.139E-04							
1390	566	24.4	42.2	.162E-04							
1395	567	16.5	42.9	.195E-04							
1395	568	16.1	41.0	.150E-04							
1400	569	6.3	41.6	.204E-04							
1400	570	3.3	41.2	.207E-04							
1405	571	0.6	42.1	.233E-04							
1405	572	356.0	39.6	.193E-04							
1410	573	354.5	32.3	.165E-04							
1410	574	8.5	21.9	.143E-04							
1415	575	324.3	48.6	.190E-04							
1415	576	318.1	45.7	.181E-04							
1420	577	323.5	52.7	.134E-04							
1420	578	53.9	47.8	.105E-04							
1425	579	40.0	53.3	.136E-04							
1425	580	73.6	27.5	.216E-04							
1430	581	31.2	59.1	.160E-04							
1430	582	31.1	57.6	.167E-04	192.7	73.5	.672E-05	123.6	49.4	.356E-05	
1435	583	10.3	65.2	.158E-04							
1435	584	357.0	63.5	.180E-04							
1440	585	348.7	65.6	.188E-04							
1445	586	339.5	70.0	.161E-04							
1445	587	331.5	78.1	.151E-04							
1450	588	354.4	58.1	.138E-04							
1450	589	345.5	58.6	.131E-04							
1455	590	357.2	57.2	.124E-04							
1460	592	228.2	56.9	.230E-04							
1460	593	234.2	47.7	.212E-04							
1465	594	242.7	43.6	.221E-04							
1465	595	246.2	46.1	.219E-04							
1470	596	245.6	42.1	.230E-04							
1470	597	245.3	42.3	.223E-04							
1475	598	235.5	44.0	.187E-04							
1475	599	234.0	44.9	.183E-04							
1480	600	242.7	41.0	.211E-04							
1480	601	250.0	41.5	.221E-04							
1485	602	256.3	40.8	.238E-04							
1485	603	259.3	37.4	.249E-04							
1490	604	259.8	45.8	.230E-04							
1490	605	257.9	47.1	.235E-04							
1494	606	272.5	61.9	.176E-04							
1494	607	271.4	60.4	.187E-04							
1500	608	281.4	59.5	.228E-04							

DEPTH CM	SAMPLE #	DECL	DRM 25 OE			DRM 50 OE			DRM 75 OE		
			INCL	INTENSITY	DECL	INCL	INTENSITY	DECL	INCL	INTENSITY	
1500	609	282.0	57.0	.193E-04							
1505	610	279.4	54.2	.233E-04							
1505	611	277.6	53.0	.242E-04							
1510	612	285.8	52.2	.214E-04							
1510	613	275.9	54.9	.207E-04							
1515	614	280.6	46.8	.221E-04							
1515	615	272.7	48.7	.233E-04							
1520	616	281.2	45.6	.245E-04							
1520	617	279.0	44.1	.231E-04	275.1	50.4	.112E-04	281.0	51.7	.658E-05	
1525	618	277.1	51.0	.228E-04							
1525	619	282.3	57.2	.218E-04							
1530	620	268.7	65.3	.209E-04							
1530	621	263.6	70.4	.185E-04							
1535	622	263.7	72.0	.219E-04							
1535	623	274.5	66.0	.211E-04							
1540	624	282.9	58.4	.266E-04							
1540	625	275.4	58.0	.244E-04							
1545	626	280.7	57.5	.252E-04							
1545	627	280.2	55.8	.261E-04							
1550	628	292.4	51.2	.269E-04							
1550	629	293.8	49.4	.278E-04							
1555	630	292.6	45.9	.283E-04							
1555	631	295.4	50.0	.301E-04							
1560	632	291.2	48.5	.261E-04							
1560	633	293.1	51.7	.264E-04							
1570	634	259.9	54.0	.252E-04							
1570	635	251.0	54.3	.240E-04							
1575	636	256.1	57.7	.185E-04							
1575	637	259.2	58.4	.178E-04							
1580	638	254.9	60.7	.168E-04							
1580	639	273.9	59.0	.192E-04							
1585	640	266.3	53.9	.204E-04							
1585	641	256.5	54.5	.178E-04							
1590	642	265.2	52.9	.192E-04							
1590	643	263.3	52.4	.212E-04							
1595	644	271.8	48.7	.240E-04							
1595	645	269.7	48.2	.242E-04							
1600	646	270.9	46.3	.271E-04							
1600	647	277.4	48.9	.254E-04							
1605	648	238.3	57.7	.219E-04							
1605	649	236.6	58.6	.244E-04							
1610	650	237.5	61.8	.244E-04							
1610	651	239.9	59.5	.216E-04							
1615	652	243.2	58.5	.233E-04							
1615	653	250.3	59.6	.235E-04							
1620	654	250.2	57.1	.233E-04							
1620	655	251.5	50.1	.240E-04							
1625	656	258.1	50.8	.261E-04							
1625	657	259.4	50.6	.259E-04							
1630	658	266.3	57.2	.249E-04							
1630	659	266.2	54.6	.263E-04							
1635	660	272.3	51.1	.278E-04							
1635	661	271.3	51.9	.275E-04							
1640	662	229.6	57.7	.287E-04							
1640	663	222.7	57.9	.263E-04							
1645	664	230.3	62.0	.271E-04							
1645	665	228.8	59.5	.263E-04							
1650	666	221.9	65.1	.257E-04							
1650	667	236.4	54.7	.269E-04							
1655	668	248.3	62.3	.254E-04							
1655	669	251.3	60.5	.273E-04							

DEPTH CM	SAMPLE #	DECL	DRM 25 DE			DRM 50 DE			DRM 75 DE		
			INCL	INTENSITY	DECL	INCL	INTENSITY	DECL	INCL	INTENSITY	
1660	670	260.2	56.5	.263E-04							
1660	671	255.1	53.6	.256E-04							
1665	672	268.4	50.2	.249E-04							
1665	673	264.8	38.7	.257E-04							
1670	674	268.1	50.5	.275E-04							
1670	675	263.8	52.8	.271E-04							
1675	676	215.2	58.6	.226E-04							
1675	677	210.4	60.5	.256E-04							
1680	678	217.4	63.3	.223E-04							
1680	679	214.2	59.9	.223E-04							
1685	680	217.5	61.4	.235E-04							
1685	681	225.0	59.1	.225E-04							
1690	682	232.8	57.1	.228E-04							
1690	683	237.0	57.8	.231E-04							
1695	684	234.9	63.1	.242E-04							
1695	685	250.0	56.9	.269E-04							
1700	686	252.0	59.9	.256E-04	247.0	52.0	.140E-04	245.2	53.1	.642E-05	
1700	687	254.8	59.6	.256E-04							
1705	688	266.9	55.8	.256E-04							
1705	689	266.5	59.4	.221E-04							
1710	690	221.1	48.1	.223E-04							
1710	691	218.4	50.7	.219E-04							
1715	692	196.3	39.9	.187E-04							
1715	693	183.7	51.5	.209E-04							
1721	694	163.7	49.0	.299E-04							
1721	695	177.6	55.6	.283E-04							
1726	696	185.5	53.7	.269E-04							
1726	697	186.0	56.1	.256E-04							
1730	698	189.9	55.3	.269E-04							
1730	699	197.2	60.5	.264E-04							
1735	700	199.5	61.8	.252E-04							
1735	701	206.6	64.6	.244E-04							
1740	702	215.3	55.2	.261E-04							
1740	703	211.4	66.6	.226E-04							
1745	704	177.6	51.0	.252E-04							
1745	705	173.1	47.3	.297E-04							
1750	706	177.7	46.9	.282E-04							
1750	707	171.0	50.7	.290E-04							
1755	708	178.1	52.6	.306E-04							
1755	709	177.9	50.7	.326E-04							
1760	710	182.3	55.0	.283E-04							
1761	711	154.4	52.8	.156E-04							
1765	712	189.9	58.3	.264E-04							
1765	713	171.0	56.4	.155E-04							
1770	714	192.4	64.6	.228E-04							
1770	715	200.8	65.6	.289E-04							
1775	716	193.5	69.1	.197E-04							
1775	717	201.2	62.5	.197E-04							
1780	718	176.9	31.2	.152E-04							
1780	719	178.3	45.9	.266E-04							
1785	720	168.2	44.9	.269E-04							
1785	721	173.9	46.1	.252E-04							
1790	722	179.7	48.2	.280E-04							
1790	723	188.9	48.2	.261E-04							
1795	724	186.0	46.5	.259E-04							
1795	725	191.5	47.8	.261E-04							
1800	726	191.0	51.3	.235E-04							
1800	727	194.4	53.4	.247E-04							
1805	728	195.9	57.0	.223E-04							
1805	729	205.7	55.6	.219E-04							
1810	730	207.3	58.4	.238E-04							

DEPTH CM	SAMPLE #	DECL	DRM 25 OE			DRM 50 OE			DRM 75 OE		
			NRM INCL	INTENSITY	DECL	INCL	INTENSITY	DECL	INCL	INTENSITY	
1810	731	208.9	55.5	.225E-04							
1815	732	187.2	52.8	.325E-04							
1815	733	175.2	51.4	.311E-04							
1820	734	175.4	44.8	.306E-04							
1820	735	174.1	43.6	.306E-04							
1825	736	110.2	44.9	.174E-04							
1825	737	169.9	42.8	.278E-04							
1830	738	167.0	44.4	.228E-04							
1830	739	168.8	42.4	.209E-04							
1835	740	169.4	51.7	.172E-04							
1835	741	170.9	51.2	.166E-04							
1840	742	112.3	-44.9	.118E-04							
1840	743	134.8	-49.0	.874E-05							
1847	744	138.2	67.4	.131E-04							
1847	745	238.7	71.1	.149E-04							
1855	746	180.0	59.7	.214E-04							
1855	747	203.6	56.1	.181E-04							
1860	748	182.2	48.1	.207E-04							
1860	749	190.3	45.4	.202E-04							
1864	750	168.8	46.0	.190E-04							
1864	751	195.1	38.5	.192E-04							
1868	752	182.8	56.7	.142E-04							
1868	753	200.6	54.9	.147E-04							
1875	754	191.4	52.8	.168E-04							
1875	755	197.8	50.8	.174E-04							
1880	756	200.3	58.1	.163E-04							
1880	757	206.6	65.0	.128E-04							
1885	758	189.1	65.0	.864E-05							
1885	759	201.0	63.7	.126E-04							
1890	760	181.5	69.0	.902E-05							
1890	761	141.8	68.6	.979E-05							
1895	762	124.4	67.4	.772E-05							
1895	763	137.2	66.1	.715E-05							
1900	764	109.3	59.5	.489E-05							
1900	765	142.6	66.7	.674E-05							
1905	766	19.8	68.2	.946E-05							
1905	767	19.9	61.1	.843E-05							
1910	768	235.8	88.5	.812E-05							
1910	769	194.1	69.8	.983E-05							
1915	770	72.2	81.9	.684E-05							
1915	771	52.6	79.2	.693E-05							
1920	772	278.4	83.2	.693E-05	3.9	55.6	.339E-05	5.5	2.9	.356E-05	
1920	773	246.8	78.1	.774E-05					6.9	-9.0 .423E-05	
1925	774	62.0	69.9	.819E-05							
1925	775	123.6	78.1	.934E-05							
1930	776	113.1	67.4	.118E-04	58.2	59.0	.535E-05	19.2	9.2	.397E-05	
1930	777	121.3	70.0	.109E-04					9.3	-4.3 .416E-05	
1935	778	90.0	72.3	.110E-04							
1934	779	97.7	63.6	.101E-04							
1940	780	97.6	44.9	.115E-04							
1940	781	91.9	41.9	.110E-04							
1945	782	180.7	71.9	.144E-04							
1945	783	184.2	64.7	.193E-04							
1950	784	196.8	60.8	.228E-04							
1950	785	193.8	36.9	.195E-04							
1955	786	188.3	63.0	.176E-04							
1955	787	190.1	61.0	.174E-04							
1960	788	182.7	52.4	.180E-04							
1960	789	175.8	31.2	.180E-04							
1965	790	174.0	43.2	.240E-04							
1965	791	171.0	42.3	.252E-04							

DEPTH CM	SAMPLE #	DECL	NRM INCL	INTENSITY	DECL	DRM 25 INCL	OE INTENSITY	DECL	DRM 50 INCL	OE INTENSITY	DECL	DRM 75 INCL	OE INTENSITY
1970	792	173.3	50.6	.249E-04									
1970	793	174.3	45.6	.240E-04									
1973	794	179.0	53.6	.185E-04									
1975	795	177.8	54.9	.197E-04									
1980	796	189.4	62.6	.142E-04									
1980	797	195.7	61.9	.132E-04									
1985	798	187.4	73.0	.864E-05									
1985	799	199.4	73.3	.793E-05									
1990	800	206.2	66.9	.173E-04									
1990	801	353.4	84.2	.634E-05									
1995	802	160.1	63.4	.151E-04									
1995	803	151.9	54.5	.166E-04									
2000	804	161.3	54.3	.187E-04									
2000	805	163.7	52.9	.174E-04									
2005	806	158.1	59.5	.133E-04									
2005	807	165.2	55.8	.132E-04									
2010	808	179.7	47.7	.199E-04									
2010	809	187.1	46.7	.214E-04									
2015	810	186.3	45.6	.418E-04									
2015	811	179.7	42.4	.411E-04									
2020	812	179.9	27.8	.373E-04									
2020	813	179.4	30.5	.546E-04									
2030	814	349.8	26.3	.504E-04									
2030	815	4.5	25.5	.558E-04									
2035	816	359.9	38.3	.390E-04									
2035	817	20.4	49.0	.332E-04									
2041	818	39.5	50.8	.288E-04									
2041	819	38.3	48.4	.318E-04									
2045	820	31.6	47.3	.328E-04									
2045	821	35.1	44.6	.347E-04									
2050	822	27.4	47.2	.321E-04									
2050	823	11.9	51.5	.320E-04									
2055	824	11.2	47.9	.287E-04									
2055	825	12.1	48.0	.304E-04									
2060	826	1.6	54.3	.209E-04									
2060	827	357.9	52.6	.216E-04									
2065	828	5.4	38.3	.240E-04									
2065	829	220.4	53.1	.397E-05									
2070	830	154.1	30.4	.150E-04									
2070	831	168.1	24.8	.160E-04									
2075	832	43.6	53.6	.111E-04									
2075	833	34.7	57.4	.133E-04									
2080	834	150.8	65.8	.130E-04									
2080	835	176.2	49.9	.132E-04									
2085	836	162.8	70.0	.130E-04									
2085	837	163.4	64.3	.116E-04									
2090	838	18.2	48.4	.159E-04									
2090	839	7.7	44.7	.170E-04	359.6	39.5	.124E-04	356.8	33.3	.493E-05	352.0	30.1	.784E-05
2095	840	14.4	41.7	.151E-04									
2095	841	16.7	40.2	.158E-04									
2100	842	9.6	38.4	.242E-04									
2100	843	359.4	42.2	.199E-04									
2105	844	12.3	38.5	.160E-04									
2105	845	15.2	41.4	.211E-04									
2110	846	9.6	35.3	.230E-04									
2110	847	13.8	43.7	.209E-04									
2115	848	18.3	43.3	.178E-04									
2115	849	14.9	35.6	.218E-04									
2120	850	14.2	35.6	.223E-04									
2120	851	12.9	44.7	.226E-04									
2125	852	11.8	36.4	.263E-04									

DEPTH CM	SAMPLE #	DECL	NRM INCL	INTENSITY	DECL	DRM 25 OE INCL	INTENSITY	DECL	DRM 50 OE INCL	INTENSITY	DECL	DRM 75 OE INCL	INTENSITY
2125	853	1.4	37.8	.302E-04									
2130	854	359.2	33.7	.326E-04									
2130	855	356.1	41.4	.313E-04									
2135	856	0.4	40.9	.271E-04									
2135	857	347.9	43.2	.278E-04									
2140	858	10.4	22.5	.364E-04									
2140	859	12.1	25.4	.264E-04									
2145	860	11.6	35.1	.335E-04									
2145	861	6.3	35.2	.333E-04									
2150	862	14.2	29.2	.268E-04									
2150	863	16.4	36.8	.283E-04	1.0	19.5	.290E-04	2.9	13.5	.207E-04	1.2	9.6	.170E-04
2155	864	23.2	34.6	.275E-04	6.3	16.8	.271E-04	8.5	9.7	.197E-04	11.4	10.2	.183E-04
2155	865	8.0	40.8	.333E-04	354.8	26.8	.318E-04	0.2	21.6	.230E-04	353.8	19.0	.207E-04
2160	866	0.9	37.2	.290E-04	351.7	23.6	.282E-04	349.4	21.0	.207E-04	355.7	19.7	.167E-04
2160	867	7.0	42.4	.259E-04	354.3	27.8	.225E-04	357.2	24.9	.147E-04	3.2	20.0	.133E-04
2168	868	23.8	34.5	.282E-04	10.9	21.4	.221E-04	359.3	16.6	.178E-04	7.3	17.7	.159E-04
2168	869	26.1	43.8	.278E-04	9.0	31.1	.216E-04	6.4	22.1	.142E-04	16.4	22.5	.120E-04
2173	870	23.5	41.7	.249E-04	7.3	30.5	.187E-04	7.0	26.0	.110E-04	2.3	18.9	.945E-05
2173	871	31.7	45.5	.275E-04	17.6	37.2	.197E-04	15.0	32.1	.122E-04	40.8	34.8	.100E-04
2180	872	359.0	16.9	.558E-04	343.4	16.5	.453E-04	349.9	10.1	.366E-04	353.0	12.2	.323E-04
2180	873	357.0	20.8	.416E-04	331.1	22.4	.356E-04	342.8	18.8	.268E-04	347.6	16.8	.238E-04
2185	874	21.8	35.3	.461E-04	4.7	42.3	.354E-04	2.3	41.2	.259E-04	13.0	43.4	.231E-04
2185	875	1.8	34.4	.463E-04	344.3	36.4	.390E-04	341.7	34.3	.309E-04	346.5	37.5	.275E-04
2192	876	358.4	13.4	.656E-04	348.6	12.4	.563E-04	348.4	9.9	.470E-04	346.9	8.6	.423E-04
2192	877	1.6	21.4	.551E-04	351.6	19.9	.461E-04	348.5	18.3	.375E-04	353.9	17.6	.340E-04
2195	878	347.3	19.1	.724E-04	338.9	16.6	.653E-04	339.1	17.0	.546E-04	337.1	17.1	.503E-04
2195	879	0.3	23.9	.447E-04	344.4	21.5	.368E-04	342.5	19.5	.271E-04	342.0	18.9	.231E-04
2200	880	347.2	13.9	.504E-04	337.3	11.6	.432E-04	336.7	10.3	.333E-04	334.4	7.6	.297E-04
2200	881	342.6	21.5	.409E-04	329.1	18.4	.345E-04	325.8	22.7	.259E-04	329.6	13.5	.226E-04
2205	882	337.9	37.7	.385E-04	324.1	39.3	.337E-04	316.3	36.7	.244E-04	311.2	36.2	.228E-04
2205	883	336.8	25.1	.489E-04	327.0	25.3	.432E-04	325.2	22.1	.339E-04	325.0	25.3	.307E-04
2210	884	149.6	14.9	.216E-04	164.1	9.6	.250E-04	160.5	-3.6	.307E-04	161.0	-9.3	.282E-04
2210	885	342.7	57.8	.195E-04	303.6	64.9	.157E-04	248.9	74.3	.775E-05	205.3	70.7	.760E-05
2215	886	328.5	20.7	.618E-04	317.3	23.7	.520E-04	316.9	18.6	.408E-04	316.5	19.1	.363E-04
2215	887	336.0	28.2	.611E-04	321.9	30.3	.549E-04	319.7	27.8	.428E-04	322.4	28.5	.366E-04
2220	888	0.2	22.9	.482E-04	344.8	28.9	.368E-04	338.5	26.5	.275E-04	343.2	24.5	.244E-04
2220	889	357.6	39.3	.656E-04	341.3	42.1	.547E-04	339.3	45.7	.434E-04	342.2	45.9	.361E-04
2225	890	348.8	36.1	.694E-04	333.0	40.9	.518E-04	329.2	38.1	.408E-04	331.5	36.8	.361E-04
2225	891	357.5	42.6	.613E-04	344.9	47.7	.516E-04	339.8	47.9	.413E-04	338.4	47.4	.354E-04
2230	892	351.8	17.3	.454E-04	340.4	21.3	.354E-04	340.2	22.1	.273E-04	335.2	18.4	.245E-04
2230	893	340.4	21.5	.592E-04	328.3	21.6	.509E-04	330.7	17.7	.394E-04	330.9	17.5	.352E-04
2235	894	355.4	20.8	.622E-04	346.2	23.0	.516E-04	346.1	20.1	.416E-04	344.0	23.2	.361E-04
2235	895	357.8	25.2	.508E-04	348.1	24.7	.421E-04	346.3	22.5	.345E-04	346.1	20.0	.304E-04
2240	896	345.8	13.1	.658E-04	342.8	11.5	.573E-04	340.7	10.5	.468E-04	341.9	12.4	.413E-04
2240	897	339.4	25.5	.585E-04	331.2	21.6	.503E-04	332.5	18.8	.418E-04	333.3	17.9	.368E-04
2245	898	344.3	24.7	.516E-04	334.2	24.5	.454E-04	337.4	23.4	.356E-04	331.4	22.7	.337E-04
2245	899	346.9	36.8	.518E-04	340.9	36.6	.454E-04	338.5	35.0	.375E-04	339.6	31.6	.342E-04
2250	900	352.9	26.2	.553E-04	346.3	22.0	.449E-04	339.6	21.1	.397E-04	343.2	19.7	.323E-04
2250	901	354.9	24.9	.499E-04	346.1	24.0	.401E-04	345.9	23.2	.354E-04	350.1	22.6	.318E-04
2255	902	347.1	25.7	.622E-04	340.2	22.1	.525E-04	344.6	24.9	.418E-04	338.9	23.3	.388E-04
2255	903	348.0	30.7	.537E-04	343.6	28.3	.449E-04	343.0	26.2	.356E-04	337.4	26.2	.318E-04
2260	904	354.7	29.1	.411E-04	345.1	26.6	.325E-04	341.8	27.3	.218E-04	340.9	27.2	.190E-04
2260	905	358.9	42.3	.363E-04	340.8	43.8	.275E-04	339.6	44.5	.167E-04	344.5	55.5	.140E-04
2265	906	194.9	7.3	.869E-05	186.9	-0.1	.154E-04	186.4	-14.6	.206E-04	182.5	-20.0	.204E-04
2265	907	192.4	-14.0	.159E-04	185.6	-17.2	.226E-04	180.4	-27.5	.276E-04	181.2	-24.9	.247E-04
2270	908	184.4	32.6	.197E-04	178.6	15.4	.247E-04	178.3	-1.6	.294E-04	176.4	-4.8	.299E-04
2270	909	185.0	11.0	.247E-04	180.0	2.5	.308E-04	174.2	-7.5	.340E-04	174.4	-6.7	.311E-04
2275	910	221.2	29.4	.107E-04	183.8	4.2	.156E-04	171.0	-15.5	.221E-04	174.7	-15.0	.212E-04
2275	911	174.9	-5.8	.200E-04	171.3	-14.3	.280E-04	172.2	-22.9	.340E-04	165.1	-22.9	.278E-04
2280	912	173.0	65.7	.116E-04	203.8	32.2	.106E-04	188.9	6.2	.138E-04	192.5	-7.7	.138E-04
2280	913	198.1	3.1	.190E-04	188.0	-8.2	.245E-04	177.0	-15.7	.274E-04	181.9	-17.7	.249E-04

DEPTH CM	SAMPLE #	DECL	NRM INCL	INTENSITY
2430	975	181.5	74.8	.969E-05
2437	976	61.0	55.1	.451E-04
2437	977	35.2	47.0	.492E-04
2441	978	11.5	48.6	.409E-04
2441	979	11.9	46.2	.449E-04
2446	980	5.4	45.2	.375E-04
2446	981	358.8	41.4	.415E-04
2450	982	5.7	45.5	.373E-04
2450	983	359.9	58.9	.392E-04
2454	984	5.6	51.0	.345E-04
2454	985	0.4	69.4	.413E-04
2459	986	357.7	31.9	.307E-04
2459	987	346.9	53.6	.383E-04
2462	988	16.9	45.4	.328E-04
2463	989	9.5	48.6	.396E-04
2463	990	6.2	20.5	.266E-04
2463	991	11.1	52.3	.382E-04
2472	992	3.4	26.6	.245E-04
2472	993	358.2	57.2	.373E-04
2476	994	22.9	65.6	.216E-04
2476	995	18.1	54.6	.380E-04
2481	996	179.1	81.3	.185E-04
2481	997	23.9	54.6	.392E-04
2486	998	225.1	48.4	.252E-04
2486	999	30.6	35.3	.192E-04
2485	1000	24.4	46.4	.439E-04

APPENDIX C

Remanent magnetization of selected LL44-GPC-3 sediment samples after stepwise demagnetization in 100 to 300 oe alternating fields. Intensity values in emu/cc of wet sediment. Analyses by R. Prince.

DEPTH CM	SAMPLE #	DECL	DRM 100 INCL	OE INTENSITY	DECL	DRM 125 INCL	OE INTENSITY	DECL	DRM 150 INCL	OE INTENSITY	DECL	DRM 175 INCL	OE INTENSITY
107	83	52.0	49.2	.193E-04	53.9	47.4	.166E-04	53.2	50.9	.153E-04	46.5	47.0	.133E-04
279	139	229.9	-47.5	.107E-04	243.1	-50.3	.983E-05	229.7	-48.8	.103E-04	245.1	-45.8	.788E-05
400	245	250.5	-47.5	.604E-05	269.5	-32.4	.893E-05	226.5	-42.5	.805E-05	223.8	8.6	.409E-05
465	271	122.9	58.6	.734E-05	130.5	44.6	.680E-05	61.8	42.2	.613E-05	80.4	32.4	.903E-05
515	169	179.4	15.2	.646E-05	134.8	39.2	.494E-05	168.0	60.6	.699E-05	233.3	54.3	.401E-05
610	207	91.3	-18.1	.345E-05	69.2	-14.0	.401E-05	94.8	14.8	.846E-05	215.7	-4.9	.832E-05
695	301	126.2	55.3	.672E-05	91.8	1.4	.459E-05	61.7	20.3	.491E-05	211.1	-10.5	.706E-05
895	381	21.3	64.2	.121E-04	340.1	63.6	.924E-05	93.1	67.2	.822E-05	26.2	49.8	.181E-04
980	415	340.2	15.9	.515E-05	341.3	63.2	.775E-05	218.9	-29.7	.101E-04	199.1	-13.5	.883E-05
1020	432	71.4	46.1	.606E-05	248.3	54.3	.484E-05	9.0	-20.2	.608E-05	248.9	21.6	.691E-05
1100	461	247.5	-38.4	.851E-05	26.8	-65.8	.318E-05	29.6	-54.4	.729E-05	270.8	16.7	.105E-04
1185	491	313.4	57.9	.401E-05	115.6	24.5	.729E-05	106.0	63.1	.437E-05	169.6	-38.4	.938E-05
1375	559	119.4	85.4	.718E-05	267.3	74.4	.518E-05	204.1	-49.5	.860E-05	52.9	43.8	.857E-05
1430	582	100.9	-55.8	.473E-05	134.5	-31.8	.603E-05	29.4	-4.7	.106E-04	59.4	12.3	.378E-05
1520	617	249.8	18.9	.339E-05	230.0	36.6	.411E-05	159.8	25.2	.425E-05	283.1	65.0	.793E-05
1700	686	273.2	12.6	.639E-05	317.6	67.9	.554E-05	193.6	8.2	.634E-05	279.7	-26.6	.107E-04
1920	772	350.0	12.1	.466E-05	38.3	6.9	.352E-05	66.7	-26.4	.221E-05	114.2	57.4	.651E-05
1930	776	9.5	-24.1	.482E-05	82.7	19.4	.551E-05	1.0	-9.2	.990E-05	1.2	2.8	.294E-05
2090	839	358.8	27.8	.522E-05	16.5	37.6	.698E-05	25.4	23.0	.120E-04	49.0	14.7	.660E-05
2168	868	348.7	32.1	.132E-04	16.4	0.7	.902E-05	12.9	4.9	.501E-05	42.5	27.6	.144E-04
2250	900	336.7	15.4	.202E-04	19.6	24.9	.240E-04	338.8	62.4	.142E-04	340.5	23.7	.172E-04
2290	901	349.4	23.4	.252E-04	4.4	30.4	.193E-04	54.1	42.6	.101E-04	303.0	-6.3	.181E-04
2320	928	173.0	-2.4	.737E-05	167.4	-34.9	.139E-04	223.5	43.3	.181E-04	160.7	12.1	.591E-05
2361	944	50.3	-7.0	.377E-05	186.0	-34.4	.378E-05	59.2	16.8	.969E-05	285.3	-54.1	.106E-04
2427	972	164.6	73.3	.434E-05	179.3	45.8	.767E-05	60.3	-15.7	.148E-04	126.3	48.7	.705E-05

DEPTH CM	SAMPLE #	DECL	DRM 200 INCL	OE INTENSITY	DECL	DRM 225 INCL	OE INTENSITY	DECL	DRM 250 INCL	OE INTENSITY	DECL	DRM 275 INCL	OE INTENSITY
107	83	67.8	49.1	.150E-04	45.8	46.9	.131E-04	50.6	50.8	.125E-04	38.1	61.7	.102E-04
279	139	262.9	-17.1	.466E-05	272.3	-38.9	.694E-05	265.0	-18.7	.143E-04	240.5	-55.2	.110E-04
400	245	231.9	-45.9	.907E-05	247.1	-43.6	.406E-05	216.4	-39.8	.287E-05	130.8	-39.2	.646E-05
465	271	339.6	29.2	.105E-04	210.6	70.8	.865E-05	241.2	45.4	.768E-05	350.2	-10.1	.248E-05
515	169	229.1	45.0	.699E-05	148.4	45.0	.808E-05	109.4	4.5	.627E-05	248.8	43.9	.881E-05
610	207	53.9	46.3	.560E-05	35.5	-6.6	.812E-05	162.0	34.7	.117E-04	307.9	10.8	.675E-05
695	301	109.7	6.4	.839E-05	270.8	-2.8	.148E-04	67.3	-41.6	.102E-04	339.5	20.5	.123E-04
895	381	58.6	59.1	.207E-04	346.5	-20.8	.114E-04	52.0	67.6	.805E-05	352.8	14.1	.168E-04
980	415	357.0	25.4	.663E-05	316.5	-71.5	.110E-04	232.2	18.2	.762E-05	295.6	-31.5	.103E-04
1020	432	216.6	56.9	.739E-05	310.9	-43.9	.427E-05	247.1	-46.6	.164E-04	82.2	-15.8	.252E-04
1100	461	48.1	51.5	.864E-05	313.9	-40.9	.620E-05	310.1	3.1	.121E-04	201.3	-22.3	.492E-05
1185	491	279.3	-37.5	.202E-04	219.7	46.2	.459E-05	358.1	64.9	.102E-04	347.9	-39.1	.857E-05
1375	559	114.7	54.7	.118E-04	315.2	-30.9	.122E-04	217.5	-1.7	.200E-04	68.1	-1.4	.857E-05
1430	582	38.0	21.1	.608E-05	204.7	-44.6	.667E-05	170.5	-26.0	.900E-05	239.5	-38.8	.101E-04
1520	617	262.4	25.1	.769E-05	223.6	22.4	.132E-04	303.3	-75.0	.106E-04	200.9	25.9	.114E-04
1700	686	7.7	20.3	.153E-04	290.6	-0.6	.223E-04	309.0	24.8	.172E-04	326.4	-32.8	.199E-04
1920	772	273.0	-21.2	.584E-05	261.5	33.2	.618E-05	262.4	-43.9	.114E-04	151.1	-29.4	.320E-05
1930	776	359.3	16.6	.886E-05	159.2	-20.7	.549E-05	226.4	-22.2	.642E-05	356.3	-77.8	.775E-05
2090	839	357.7	-5.6	.325E-05	161.7	14.3	.126E-04	44.6	-46.6	.153E-04	207.6	-17.0	.150E-04
2168	868	92.5	-40.0	.230E-04	255.8	7.4	.180E-04	173.1	-16.6	.188E-04	326.4	17.1	.202E-04
2250	900	326.2	29.0	.223E-04	297.6	43.8	.193E-04	27.0	-45.5	.158E-04	338.0	17.3	.444E-04
2290	901	56.3	58.7	.150E-04	234.1	-0.7	.200E-04	283.0	36.6	.228E-04	275.6	26.0	.484E-04
2320	928	38.4	-5.8	.141E-04	124.6	-51.1	.244E-04	283.8	2.6	.163E-04	73.9	-27.2	.275E-04
2361	944	118.3	-5.3	.148E-04	98.2	-22.9	.663E-05	316.0	6.8	.214E-04	4.0	-72.4	.146E-04
2427	972	347.8	-49.6	.687E-05	84.3	-68.8	.306E-04	261.8	-10.8	.192E-04	262.4	-1.9	.128E-04

DEPTH CM	SAMPLE #	DECL	DRM300 INCL	OE INTENSITY
107	83	10.1	48.2	.156E-04
279	139	231.6	7.8	.862E-05
400	245	67.4	-45.9	.984E-05
465	271	54.0	39.0	.156E-05
515	159	22.7	-54.8	.160E-04
610	207	191.4	-53.5	.663E-05
695	301	7.7	-79.4	.114E-04
895	381	77.3	-4.1	.104E-04
980	415	276.5	47.7	.190E-04
1020	432	88.4	25.2	.112E-04
1100	461	244.6	-23.5	.128E-04
1185	491	329.3	-21.6	.102E-04
1375	559	59.0	22.5	.130E-04
1430	582	182.6	43.9	.145E-04
1520	617	321.7	58.3	.864E-05
1700	686	26.2	28.9	.136E-04
1920	772	219.2	14.1	.101E-04
1930	776	249.0	46.6	.756E-05
2090	839	108.7	56.9	.159E-04
2158	868	283.3	0.1	.183E-04
2250	900	252.0	-27.2	.202E-04
2250	901	352.7	-33.4	.259E-04
2320	928	331.5	-51.5	.108E-04
2361	944	114.4	59.8	.110E-04
2427	972	244.9	-4.3	.522E-04

APPENDIX D

Natural remanent magnetization and remanent magnetization after 75 oe alternating-field demagnetization of LL44-GPC-3 sediment samples averaged by depth. Intensities are in emu/cc of wet sediment (cols. 4 and 8) or emu/cc of water-free sediment (cols. 5 and 10). Analyses by R. Prince. Water content data from A. Silva.

DEPTH CM	DECL	AVERAGE INCL	NRM INTENSITY	WATER CORRECT INTENSITY	DECL	AVERAGE 75 INCL	OE ORN INTENSITY	WATER CORRECT INTENSITY	% WATER WET WT
25	51.5	-18.6	.370E-04	.810E-04	53.7	21.5	.275E-04		54.36
31	27.1	39.7	.287E-04	.637E-04	37.7	44.7	.190E-04	.422E-04	55.00
36	36.1	41.9	.394E-04	.856E-04	41.3	43.0	.283E-04	.616E-04	54.01
44	52.3	47.9	.261E-04	.580E-04	66.0	48.8	.149E-04	.332E-04	55.02
45	49.6	48.5	.228E-04	.495E-04					53.95
53	62.0	41.9	.339E-04	.735E-04	222.8	59.0	.181E-04	.390E-04	53.93
58	140.4	47.0	.342E-04	.746E-04	160.8	45.1	.233E-04	.504E-04	54.19
66	110.6	52.8	.340E-04	.726E-04	126.5	52.1	.218E-04	.465E-04	53.16
70	110.3	57.8	.316E-04	.679E-04					53.43
72	106.9	58.4	.290E-04	.628E-04	124.0	50.9	.180E-04	.386E-04	53.82
77	13.2	58.7	.301E-04	.651E-04	193.9	50.1	.211E-04	.456E-04	53.86
82	36.1	35.0	.309E-04	.668E-04	40.1	36.7	.181E-04	.393E-04	53.74
87	22.8	46.5	.364E-04	.794E-04					54.11
88	28.9	46.6	.389E-04	.836E-04	34.2	49.2	.238E-04	.515E-04	53.53
94	67.1	47.5	.287E-04	.626E-04	65.9	48.6	.180E-04	.391E-04	54.22
100	63.8	54.0	.385E-04	.855E-04	351.7	89.0	.261E-04	.562E-04	54.97
101	59.1	50.1	.402E-04	.894E-04					54.97
107	50.2	46.9	.328E-04	.701E-04					53.21
108	74.4	41.1	.316E-04	.678E-04	65.5	46.5	.202E-04	.456E-04	53.39
115	44.7	45.0	.311E-04	.670E-04	49.9	46.1	.170E-04	.383E-04	53.58
116	48.9	43.7	.264E-04	.562E-04					52.95
124	117.8	52.6	.313E-04	.667E-04	123.2	49.3	.197E-04	.428E-04	53.10
128	65.8	47.7	.306E-04	.646E-04	66.8	47.0	.187E-04	.407E-04	52.66
133	53.3	52.1	.306E-04	.646E-04	63.0	50.3	.181E-04	.397E-04	52.70
138	88.4	49.9	.288E-04	.624E-04	89.9	52.0	.190E-04	.410E-04	53.77
143	88.9	46.6	.377E-04	.808E-04	95.5	48.0	.259E-04	.561E-04	53.38
148	80.5	50.6	.273E-04	.589E-04	90.1	52.2	.180E-04	.385E-04	53.64
150	55.9	55.8	.295E-04	.629E-04	58.5	56.8	.199E-04	.427E-04	53.07
160	67.5	47.3	.306E-04	.646E-04	67.5	49.5	.187E-04	.410E-04	52.67
164	72.6	49.3	.302E-04	.628E-04	75.6	49.1	.193E-04	.422E-04	51.86
168	62.7	54.0	.209E-04	.438E-04	71.5	53.2	.109E-04	.238E-04	51.43
175	56.8	40.9	.784E-05	.164E-04	299.9	-36.2	.263E-05	.568E-05	52.24
180	29.8	35.6	.812E-05	.172E-04	341.9	-2.5	.620E-05	.133E-04	52.71
185	110.5	9.2	.453E-05	.948E-05	270.8	-67.2	.515E-05	.109E-04	52.25
195	146.9	3.2	.475E-05	.999E-05	278.4	-71.2	.689E-05	.142E-04	52.43
200	45.7	22.5	.449E-05	.950E-05	257.9	-53.9	.123E-04	.251E-04	52.75
207	117.5	20.9	.518E-05	.110E-04	96.7	-30.2	.110E-04	.225E-04	52.73
212	69.8	60.3	.886E-05	.185E-04	125.2	26.8	.276E-05	.570E-05	52.15
217	89.3	47.3	.235E-04	.486E-04	267.8	47.2	.113E-04	.234E-04	51.71
222	90.6	62.9	.218E-04	.461E-04	194.4	40.0	.389E-05	.792E-05	52.75
226	103.0	50.5	.132E-04	.285E-04	118.6	49.9	.171E-05	.345E-05	53.67
230	132.4	59.6	.829E-05	.173E-04	249.2	-34.8	.337E-05	.695E-05	52.02
236	178.2	38.1	.509E-05	.106E-04	254.4	-55.5	.893E-05	.188E-04	51.87
241	168.9	57.3	.484E-05	.100E-04	262.6	-48.9	.769E-05	.156E-04	51.86
249	157.6	66.7	.542E-05	.113E-04	254.4	-40.6	.604E-05	.122E-04	52.01
255	37.7	48.5	.509E-05	.106E-04	254.4	-48.7	.636E-05	.128E-04	51.98
259	79.8	34.4	.326E-05	.691E-05	256.0	-44.8	.100E-04	.202E-04	52.77
265	313.6	63.4	.413E-05	.875E-05	252.6	-43.4	.121E-04	.245E-04	52.85
269	294.6	55.7	.573E-05	.121E-04	247.1	-46.4	.130E-04	.267E-04	52.43
275	298.5	33.7	.518E-05	.108E-04	252.1	-43.3	.105E-04	.221E-04	52.10
279	291.5	32.5	.560E-05	.117E-04	245.6	-47.9	.110E-04	.228E-04	52.26
285	296.1	25.0	.573E-05	.121E-04	250.7	-44.4	.112E-04	.227E-04	52.79
290	301.2	17.1	.582E-05	.124E-04	247.4	-43.9	.948E-05	.194E-04	52.98
295	155.3	3.2	.727E-05	.152E-04	252.8	-39.7	.119E-04	.249E-04	52.14
300	173.1	20.7	.644E-05	.137E-04	257.1	-40.3	.117E-04	.247E-04	52.85
305	107.7	53.3	.190E-04	.399E-04	119.0	54.5	.273E-05	.555E-05	52.39
310	164.5	55.2	.805E-05	.166E-04	250.7	-38.8	.708E-05	.148E-04	51.66
315	33.8	40.9	.665E-05	.138E-04	259.0	-43.4	.884E-05	.182E-04	51.97
320	49.5	13.4	.599E-05	.125E-04	252.5	-38.8	.101E-04	.202E-04	51.97
325	57.5	9.6	.660E-05	.138E-04	254.8	-46.6	.119E-04	.240E-04	52.17

DEPTH CM	DECL	AVERAGE INCL	NRM INTENSITY	WATER CORRECT INTENSITY	DECL	AVERAGE 75 INCL	OE DRM INTENSITY	WATER CORRECT INTENSITY	% WATER WET WT
330	6.4	33.7	.668E-05	.142E-04	278.5	-27.8	.993E-05	.201E-04	53.03
335	1.8	41.1	.893E-05	.188E-04	262.3	-36.1	.801E-05	.163E-04	52.58
340	120.4	68.0	.174E-04	.367E-04	334.4	73.7	.437E-05	.921E-05	52.41
345	98.9	54.6	.221E-04	.463E-04	105.1	64.2	.838E-05	.172E-04	52.25
350	101.7	52.9	.231E-04	.486E-04	95.5	70.4	.819E-05	.167E-04	52.34
355	108.1	39.8	.218E-04	.440E-04	116.4	69.1	.534E-05	.108E-04	50.52
360	116.7	39.4	.155E-04	.317E-04	269.5	-48.8	.226E-05	.462E-05	51.01
365	130.5	53.7	.983E-05	.198E-04	265.8	-37.3	.549E-05	.111E-04	50.33
370	172.8	58.7	.606E-05	.123E-04	258.2	-42.0	.822E-05	.167E-04	50.87
375	124.2	79.3	.105E-04	.212E-04	230.5	-1.1	.399E-05	.805E-05	50.44
380	284.7	49.6	.696E-05	.144E-04	264.8	-33.4	.862E-05	.179E-04	51.82
385	280.0	2.0	.813E-05	.166E-04	270.9	-40.0	.121E-04	.247E-04	50.98
390	41.4	5.1	.674E-05	.138E-04	254.8	-47.3	.117E-04	.240E-04	51.25
395	154.2	28.4	.689E-05	.141E-04	261.1	-43.8	.110E-04	.226E-04	51.18
400	172.9	44.0	.592E-05	.122E-04	257.8	-45.3	.111E-04	.229E-04	51.58
405	14.9	56.4	.558E-05	.115E-04	259.2	-31.4	.108E-04	.223E-04	51.58
410	50.8	44.3	.496E-05	.102E-04	253.6	-37.8	.941E-05	.194E-04	51.37
415	75.7	2.8	.717E-05	.144E-04	252.8	-37.2	.133E-04	.267E-04	50.20
420	79.6	2.8	.646E-05	.133E-04	261.5	-33.6	.123E-04	.253E-04	51.46
425	17.6	17.4	.102E-04	.215E-04	250.0	-43.0	.132E-04	.279E-04	52.66
430	128.0	40.9	.172E-04	.360E-04	242.0	-21.5	.554E-05	.116E-04	52.27
435	115.1	54.7	.238E-04	.492E-04	149.6	69.8	.444E-05	.917E-05	51.57
440	101.3	60.4	.276E-04	.578E-04	92.5	58.3	.615E-05	.129E-04	52.16
445	87.5	38.7	.199E-04	.417E-04	75.3	64.5	.841E-05	.177E-04	52.36
450	67.2	47.2	.192E-04	.400E-04	79.1	52.1	.820E-05	.171E-04	52.07
455	47.5	59.5	.197E-04	.401E-04	83.2	65.4	.718E-05	.146E-04	50.86
460	69.9	51.0	.304E-04	.628E-04	68.0	54.7	.922E-05	.191E-04	51.63
465	82.3	32.1	.278E-04	.585E-04	91.9	60.6	.921E-05	.194E-04	52.48
470	81.0	32.4	.250E-04	.525E-04	74.8	58.2	.737E-05	.155E-04	52.33
475	77.3	33.2	.225E-04	.471E-04	68.6	75.7	.642E-05	.135E-04	52.33
481	79.5	32.5	.173E-04	.370E-04	144.1	67.8	.556E-05	.119E-04	53.37
486	48.3	52.4	.119E-04	.255E-04	218.3	60.3	.494E-05	.106E-04	53.47
492	59.2	56.2	.121E-04	.258E-04	67.2	0.0	.263E-05	.561E-05	53.22
500	224.3	52.7	.301E-04	.641E-04	246.6	51.3	.810E-05	.173E-04	53.14
505	39.8	33.2	.297E-04	.630E-04	234.1	50.3	.794E-05	.169E-04	52.87
510	47.5	52.8	.264E-04	.559E-04	212.0	46.3	.577E-05	.122E-04	52.70
515	49.2	49.0	.244E-04	.512E-04	206.6	54.3	.501E-05	.105E-04	52.46
520	19.2	52.6	.216E-04	.454E-04	212.1	29.3	.394E-05	.828E-05	52.42
525	167.2	49.2	.231E-04	.484E-04	194.0	62.8	.108E-05	.225E-05	52.20
530	179.7	52.9	.226E-04	.472E-04	30.1	-8.6	.187E-05	.389E-05	52.06
535	8.4	50.3	.211E-04	.439E-04	74.1	-25.9	.364E-05	.759E-05	51.98
540	29.0	50.0	.223E-04	.465E-04	90.9	3.8	.271E-05	.566E-05	52.06
545	38.6	48.0	.223E-04	.467E-04	81.7	-0.1	.332E-05	.695E-05	52.31
550	47.7	42.4	.212E-04	.446E-04	101.6	-12.5	.394E-05	.826E-05	52.35
555	26.9	47.1	.238E-04	.499E-04	155.6	55.8	.149E-05	.312E-05	52.22
560	12.6	50.5	.288E-04	.602E-04	219.3	42.5	.364E-05	.761E-05	52.12
565	16.5	48.9	.283E-04	.590E-04	216.1	57.9	.311E-05	.648E-05	52.00
570	22.1	49.5	.292E-04	.607E-04	215.5	58.1	.409E-05	.851E-05	51.91
575	30.9	47.2	.278E-04	.586E-04	170.4	54.5	.294E-05	.619E-05	52.35
580	53.6	65.8	.242E-04	.514E-04	182.0	47.2	.380E-05	.807E-05	52.92
585	42.9	44.2	.252E-04	.544E-04	161.2	62.6	.325E-05	.700E-05	53.61
590	15.0	50.3	.207E-04	.452E-04	146.3	48.2	.432E-05	.941E-05	54.11
595	165.7	55.4	.209E-04	.454E-04	120.1	63.3	.282E-05	.612E-05	53.39
600	47.7	62.6	.197E-04	.418E-04	109.4	31.2	.252E-05	.536E-05	52.94
605	66.1	50.3	.130E-04	.275E-04	55.1	12.4	.230E-05	.486E-05	52.72
610	49.5	68.0	.997E-05	.219E-04	33.5	-34.6	.306E-05	.671E-05	54.43
615	17.6	68.9	.888E-05	.196E-04	44.3	-16.3	.285E-05	.631E-05	54.81
620	3.9	64.3	.102E-04	.223E-04	104.7	-57.0	.155E-05	.339E-05	54.45
625	29.2	65.2	.151E-04	.334E-04	205.6	-28.8	.276E-05	.612E-05	54.82
630	77.6	52.8	.169E-04	.371E-04	4.7	10.9	.231E-05	.508E-05	54.40
635	43.9	62.9	.185E-04	.409E-04	202.7	34.0	.332E-05	.734E-05	54.84

DEPTH CM	DECL	AVERAGE INCL	NRM INTENSITY	WATER CORRECT INTENSITY	DECL	AVERAGE INCL	75 DE ORN INTENSITY	WATER CORRECT INTENSITY	% WATER WET WT
640	41.1	58.7	.207E-04	.463E-04	88.2	78.0	.309E-05	.691E-05	55.28
645	62.1	53.9	.233E-04	.521E-04	118.2	75.9	.299E-05	.668E-05	55.25
650	14.3	53.0	.244E-04	.550E-04	26.0	29.0	.307E-05	.695E-05	55.74
655	165.5	46.7	.358E-04	.814E-04	204.7	71.3	.454E-05	.103E-04	56.09
660	179.9	54.5	.314E-04	.716E-04	227.8	79.1	.311E-05	.708E-05	56.10
665	19.9	55.9	.320E-04	.724E-04	303.7	85.4	.268E-05	.607E-05	55.86
670	25.3	56.2	.318E-04	.715E-04	341.7	35.4	.128E-05	.283E-05	55.57
675	34.2	53.7	.271E-04	.618E-04	127.3	-9.9	.195E-05	.445E-05	56.13
682	51.1	48.3	.242E-04	.551E-04	105.5	23.8	.185E-05	.421E-05	56.13
685	16.2	46.1	.244E-04	.548E-04	52.0	-5.9	.494E-06	.111E-05	55.57
690	171.5	44.4	.335E-04	.756E-04	143.5	43.4	.352E-05	.795E-05	55.66
695	4.8	52.9	.371E-04	.844E-04	188.6	58.4	.592E-05	.135E-04	55.99
700	16.9	50.7	.340E-04	.775E-04	199.3	53.1	.442E-05	.101E-04	56.12
705	30.0	50.4	.347E-04	.794E-04	185.5	50.9	.456E-05	.104E-04	56.29
710	45.2	48.4	.339E-04	.778E-04	211.8	66.2	.430E-05	.989E-05	56.50
715	55.9	43.9	.320E-04	.734E-04	210.8	50.6	.478E-05	.110E-04	56.47
720	31.7	43.7	.282E-04	.649E-04	167.9	66.8	.242E-05	.557E-05	56.60
725	179.7	45.0	.288E-04	.667E-04	31.1	-16.9	.383E-05	.887E-05	56.78
730	7.7	50.4	.321E-04	.751E-04	51.5	-13.6	.244E-05	.569E-05	57.20
735	17.4	49.5	.330E-04	.772E-04	248.5	75.4	.299E-05	.700E-05	57.29
740	27.5	50.9	.321E-04	.755E-04	163.6	49.2	.423E-05	.994E-05	57.43
745	38.1	52.2	.321E-04	.755E-04	176.0	59.9	.269E-05	.633E-05	57.44
750	46.7	47.9	.323E-04	.762E-04	224.6	67.7	.466E-05	.110E-04	57.64
755	5.3	50.7	.273E-04	.643E-04	209.0	39.9	.382E-05	.899E-05	57.54
760	149.7	39.2	.250E-04	.589E-04	170.2	47.6	.568E-05	.134E-04	57.50
765	156.1	43.4	.173E-04	.415E-04	156.2	36.7	.342E-05	.822E-05	58.40
770	3.2	58.0	.136E-04	.326E-04	189.0	58.7	.316E-05	.759E-05	58.33
775	60.8	62.2	.135E-04	.322E-04	264.9	61.2	.316E-05	.755E-05	58.15
780	270.3	55.3	.167E-04	.386E-04					56.74
785	274.5	55.9	.226E-04	.522E-04					56.66
790	27.4	80.4	.238E-04	.564E-04					57.71
795	138.7	62.3	.183E-04	.436E-04					58.05
800	54.8	34.6	.226E-04	.539E-04					57.99
805	24.9	35.4	.283E-04	.669E-04					57.67
810	13.7	34.1	.269E-04	.629E-04					57.14
815	9.9	35.1	.283E-04	.673E-04					57.90
820	9.5	37.7	.373E-04	.887E-04					57.96
825	335.2	39.5	.233E-04	.555E-04					57.99
830	337.5	31.4	.225E-04	.537E-04					58.16
835	353.9	40.5	.263E-04	.623E-04					57.88
840	19.1	47.0	.199E-04	.478E-04					58.46
845	35.3	49.2	.211E-04	.511E-04					58.80
850	48.2	46.7	.285E-04	.699E-04					59.25
855	47.4	46.3	.309E-04	.752E-04					58.90
860	20.6	44.3	.337E-04	.807E-04					58.27
865	4.3	39.2	.340E-04	.815E-04					58.25
870	15.2	46.1	.339E-04	.809E-04					58.18
875	26.2	46.5	.349E-04	.825E-04					57.70
880	29.8	46.3	.363E-04	.863E-04					58.00
885	39.8	46.8	.364E-04	.879E-04					58.56
890	40.2	48.4	.439E-04	.106E-03					58.55
895	56.7	45.9	.442E-04	.106E-03	27.4	59.0	.127E-04	.355E-04	58.15
900	71.0	28.4	.244E-04	.578E-04					57.89
905	52.4	31.6	.332E-04	.788E-04					57.89
910	31.3	0.3	.162E-04	.387E-04					58.02
915	30.3	27.6	.408E-04	.953E-04					57.22
920	18.5	30.2	.404E-04	.965E-04					58.14
925	8.8	33.7	.423E-04	.993E-04					57.41
930	28.8	39.8	.402E-04	.965E-04					58.28
935	52.6	31.8	.385E-04	.915E-04					57.89
940	44.9	29.6	.347E-04	.830E-04					58.17

DEPTH CM	DECL	AVERAGE INCL	NRM INTENSITY	WATER CORRECT INTENSITY	DECL	AVERAGE 75 INCL	OE DRM INTENSITY	WATER CORRECT INTENSITY	% WATER WET WT
945	35.7	29.5	.339E-04	.788E-04					57.02
950	27.7	32.1	.446E-04	.105E-03					57.50
954	1.2	33.1	.295E-04	.698E-04					57.71
955	16.5	29.8	.206E-04	.487E-04					57.80
960	8.1	38.6	.231E-04	.557E-04					58.46
965	44.9	36.3	.268E-04	.647E-04					58.62
970	54.7	20.6	.301E-04	.738E-04					59.26
975	36.8	20.2	.321E-04	.788E-04					59.23
980	24.7	21.1	.326E-04	.805E-04	333.2	35.8	.717E-05	.192E-04	59.47
985	11.1	19.7	.283E-04	.704E-04					59.79
990	3.1	24.7	.301E-04	.747E-04					59.78
995	349.2	32.9	.364E-04	.906E-04					59.77
1000	22.1	39.5	.390E-04	.975E-04					59.97
1005	39.0	24.4	.363E-04	.904E-04					59.90
1010	33.0	24.0	.321E-04	.799E-04					59.80
1015	23.8	26.9	.339E-04	.842E-04					59.80
1020	17.5	28.0	.288E-04	.719E-04	269.9	9.1	.323E-05	.986E-05	59.89
1025	5.3	0.7	.288E-04	.721E-04					60.00
1030	356.6	36.0	.316E-04	.781E-04					59.51
1035	44.5	38.4	.268E-04	.651E-04					58.90
1040	63.6	23.4	.211E-04	.523E-04					59.68
1045	50.2	20.3	.257E-04	.658E-04					60.87
1050	31.2	18.0	.297E-04	.763E-04					61.06
1055	18.9	16.2	.269E-04	.675E-04					60.10
1060	9.1	20.5	.280E-04	.701E-04					60.09
1065	3.7	25.8	.280E-04	.698E-04					59.89
1070	30.0	29.7	.259E-04	.641E-04					59.58
1075	76.6	23.7	.163E-04	.418E-04					61.11
1085	38.0	45.0	.171E-04	.447E-04					61.73
1090	15.5	25.6	.180E-04	.472E-04					61.21
1095	358.9	26.0	.193E-04	.506E-04					61.77
1100	339.9	32.9	.245E-04	.639E-04	3.5	14.6	.356E-05	.111E-04	61.62
1104	329.2	18.3	.212E-04	.538E-04					60.55
1107	344.0	44.1	.242E-04	.628E-04					61.49
1115	110.7	39.4	.288E-04	.735E-04					60.75
1120	169.3	47.3	.235E-04	.589E-04					60.11
1126	6.2	48.5	.197E-04	.490E-04					59.85
1139	350.2	36.3	.153E-04	.376E-04					59.22
1145	326.3	26.9	.148E-04	.367E-04					59.74
1150	317.7	32.3	.117E-04	.294E-04					60.18
1155	35.4	53.3	.230E-04	.570E-04					59.72
1160	62.6	29.7	.174E-04	.438E-04					60.13
1165	49.1	33.4	.153E-04	.340E-04					60.92
1170	3.9	29.0	.124E-04	.314E-04					60.37
1175	354.6	39.1	.164E-04	.402E-04					59.29
1180	346.3	48.1	.204E-04	.499E-04					59.17
1185	349.9	47.5	.228E-04	.559E-04	289.7	49.7	.484E-05	.151E-04	59.20
1190	357.7	45.2	.193E-04	.485E-04					60.11
1195	359.5	45.0	.209E-04	.535E-04					60.95
1202	351.4	47.3	.283E-04	.722E-04					60.76
1210	347.0	45.3	.320E-04	.812E-04					60.66
1215	348.6	45.6	.328E-04	.832E-04	319.5	43.1	.120E-04	.355E-04	60.55
1222	332.4	53.7	.337E-04	.850E-04	329.6	48.2	.104E-04	.305E-04	60.39
1227	335.5	47.6	.252E-04	.639E-04	328.7	70.4	.225E-05	.679E-05	60.53
1232	4.1	45.0	.195E-04	.496E-04	255.6	45.8	.207E-05	.643E-05	60.69
1238	44.9	39.2	.207E-04	.522E-04	185.9	18.3	.200E-05	.618E-05	60.33
1242	19.8	55.1	.164E-04	.409E-04	245.3	46.8	.321E-05	.988E-05	59.97
1249	11.1	40.5	.190E-04	.479E-04	269.7	58.3	.320E-05	.980E-05	60.30
1255	349.2	33.6	.197E-04	.503E-04	265.3	63.8	.354E-05	.108E-04	60.83
1260	330.4	28.6	.294E-04	.737E-04	297.8	60.1	.371E-05	.114E-04	60.17
1255	325.7	26.5	.295E-04	.739E-04	198.3	-3.9	.247E-05	.761E-05	60.03

DEPTH CM	DECL	AVERAGE INCL	NRM INTENSITY	WATER CORRECT INTENSITY	DECL	AVERAGE INCL	75 OF DRM INTENSITY	WATER CORRECT INTENSITY	X WATER WET WT
1270	347.7	39.1	.297E-04	.763E-04	284.5	40.3	.231E-05	.705E-05	61.06
1275	97.8	33.1	.307E-04	.786E-04	122.7	81.0	.240E-05	.723E-05	60.86
1280	94.8	36.4	.292E-04	.742E-04					60.64
1288	0.2	38.6	.245E-04	.630E-04					61.04
1295	349.2	32.4	.226E-04	.573E-04					60.55
1300	343.3	28.9	.290E-04	.753E-04					61.45
1305	335.7	29.4	.288E-04	.742E-04					61.13
1313	346.8	66.7	.238E-04	.611E-04					61.01
1320	122.5	76.5	.237E-04	.597E-04					60.39
1325	118.1	83.6	.254E-04	.645E-04					60.64
1330	298.3	75.4	.259E-04	.654E-04					60.40
1335	307.9	72.8	.282E-04	.711E-04					60.39
1340	296.0	57.4	.301E-04	.749E-04					59.85
1345	299.9	44.0	.287E-04	.732E-04					60.84
1350	311.0	70.5	.268E-04	.686E-04					60.99
1355	141.0	72.3	.165E-04	.426E-04					61.20
1360	56.7	86.0	.151E-04	.387E-04					61.05
1365	325.1	74.5	.238E-04	.615E-04					61.23
1370	322.9	68.5	.266E-04	.691E-04					61.49
1375	310.9	50.8	.275E-04	.709E-04	313.5	36.5	.541E-05	.173E-04	61.26
1380	315.0	44.0	.250E-04	.643E-04					61.08
1385	344.0	46.4	.193E-04	.499E-04					61.24
1390	24.9	44.5	.150E-04	.387E-04					61.11
1395	16.3	42.0	.173E-04	.445E-04					61.21
1400	4.8	41.4	.206E-04	.529E-04					61.18
1405	358.3	40.9	.212E-04	.554E-04					61.64
1410	1.8	27.3	.154E-04	.399E-04					61.38
1415	321.1	47.2	.185E-04	.478E-04					61.32
1420	11.7	59.6	.120E-04	.305E-04					60.66
1425	60.2	41.6	.176E-04	.448E-04					60.68
1430	31.1	58.3	.164E-04	.415E-04	119.7	40.3	.368E-05	.122E-04	60.63
1435	3.4	64.5	.169E-04	.425E-04					60.30
1440	348.7	65.6	.188E-04	.475E-04					60.34
1445	336.5	74.1	.156E-04	.398E-04					60.90
1450	350.0	58.4	.134E-04	.336E-04					59.96
1455	357.2	57.2	.124E-04	.310E-04					60.08
1460	51.5	52.3	.221E-04	.549E-04					59.73
1465	64.4	44.9	.219E-04	.544E-04					59.67
1470	65.5	42.2	.226E-04	.560E-04					59.62
1475	54.8	44.5	.185E-04	.458E-04					59.64
1480	66.3	41.3	.216E-04	.539E-04					59.91
1485	77.8	39.1	.244E-04	.603E-04					59.60
1490	78.9	46.5	.231E-04	.578E-04					59.94
1494	271.9	61.2	.181E-04	.451E-04					59.76
1500	281.7	58.3	.211E-04	.524E-04					59.81
1505	278.5	53.6	.237E-04	.591E-04					59.99
1510	281.0	53.7	.211E-04	.532E-04					60.42
1515	276.7	47.8	.226E-04	.573E-04					60.53
1520	280.1	44.9	.238E-04	.603E-04	238.8	33.5	.344E-05	.106E-04	60.48
1525	279.5	54.1	.223E-04	.563E-04					60.43
1530	86.4	67.9	.197E-04	.497E-04					60.38
1535	89.8	69.1	.214E-04	.545E-04					60.69
1540	279.1	58.3	.254E-04	.640E-04					60.30
1545	280.4	56.7	.256E-04	.644E-04					60.28
1550	293.1	50.3	.273E-04	.695E-04					60.74
1555	293.9	48.0	.292E-04	.738E-04					60.44
1560	292.1	50.1	.263E-04	.658E-04					60.10
1570	80.4	54.2	.245E-04	.615E-04					60.15
1575	77.6	58.1	.181E-04	.453E-04					59.94
1580	89.5	59.9	.180E-04	.450E-04					60.04
1585	81.4	54.3	.190E-04	.468E-04					59.44

DEPTH CM	DECL	AVERAGE INCL	NRM INTENSITY	WATER CORRECT INTENSITY	DECL	AVERAGE INCL	75 DE GRM INTENSITY	WATER CORRECT INTENSITY	% WATER WET WT
1590	84.2	52.7	.202E-04	.494E-04					59.06
1595	270.7	48.5	.240E-04	.592E-04					59.43
1600	274.1	47.6	.263E-04	.643E-04					59.19
1605	57.5	58.2	.231E-04	.569E-04					59.34
1610	58.7	60.7	.230E-04	.575E-04					60.08
1615	66.7	59.1	.233E-04	.585E-04					60.12
1620	70.9	53.6	.237E-04	.595E-04					60.21
1625	78.8	50.7	.259E-04	.654E-04					60.36
1630	86.2	55.9	.256E-04	.652E-04					60.81
1635	271.8	51.5	.276E-04	.690E-04					59.93
1640	46.2	57.8	.275E-04	.688E-04					60.08
1645	49.5	60.8	.266E-04	.661E-04					59.76
1650	50.3	60.1	.263E-04	.649E-04					59.58
1655	69.8	61.4	.263E-04	.647E-04					59.45
1660	77.6	55.1	.259E-04	.638E-04					59.41
1665	86.4	44.5	.252E-04	.619E-04					59.29
1670	86.0	51.7	.273E-04	.668E-04					59.12
1675	32.9	59.6	.240E-04	.592E-04					59.46
1680	35.7	61.6	.223E-04	.547E-04					59.23
1685	41.4	60.3	.230E-04	.566E-04					59.41
1690	54.9	57.5	.230E-04	.566E-04					59.40
1695	63.2	60.2	.256E-04	.625E-04					59.13
1700	73.4	59.8	.256E-04	.627E-04	322.7	57.9	.335E-05	.104E-04	59.20
1705	86.7	57.6	.238E-04	.582E-04					59.08
1710	39.8	49.4	.221E-04	.539E-04					58.95
1715	10.7	45.9	.197E-04	.481E-04					59.06
1721	170.1	52.5	.290E-04	.714E-04					59.36
1726	5.7	54.9	.263E-04	.652E-04					59.74
1730	13.3	58.0	.266E-04	.656E-04					59.44
1735	22.9	63.2	.247E-04	.610E-04					59.19
1740	33.7	60.9	.244E-04	.594E-04					59.02
1745	175.3	49.2	.275E-04	.671E-04					59.05
1750	174.5	48.8	.285E-04	.695E-04					59.02
1755	178.0	51.7	.316E-04	.776E-04					59.28
1760	182.3	55.0	.283E-04	.695E-04					59.25
1761	154.4	52.8	.156E-04	.378E-04					58.70
1765	0.2	57.7	.209E-04	.512E-04					59.20
1770	16.5	65.2	.218E-04	.541E-04					59.75
1775	17.8	65.8	.197E-04	.488E-04					59.62
1780	177.5	38.6	.209E-04	.517E-04					59.57
1785	171.0	45.5	.261E-04	.639E-04					59.21
1790	0.3	48.2	.269E-04	.665E-04					59.46
1795	8.7	47.2	.259E-04	.646E-04					59.93
1800	12.7	52.4	.240E-04	.590E-04					59.34
1805	20.9	56.4	.221E-04	.564E-04					60.78
1810	28.1	57.0	.231E-04	.570E-04					59.40
1815	1.1	52.3	.318E-04	.779E-04					59.21
1820	174.7	44.2	.306E-04	.780E-04					60.80
1825	140.6	47.9	.226E-04	.576E-04					60.72
1830	167.9	43.4	.218E-04	.544E-04					60.03
1835	170.2	51.5	.169E-04	.418E-04					59.61
1840	123.1	47.5	.103E-04	.249E-04					58.73
1847	2.6	76.3	.140E-04	.347E-04					59.62
1855	12.4	58.4	.197E-04	.498E-04					60.50
1860	6.4	46.8	.204E-04	.517E-04					60.62
1864	2.7	43.0	.190E-04	.480E-04					60.44
1869	11.9	56.1	.144E-04	.362E-04					60.17
1876	14.7	51.8	.171E-04	.421E-04					59.38
1880	23.1	61.6	.146E-04	.362E-04					59.77
1885	15.2	64.5	.106E-04	.267E-04					60.42
1890	161.5	70.0	.940E-05	.237E-04					60.31

DEPTH CM	DECL	AVERAGE INCL	NRM INTENSITY	WATER CORRECT INTENSITY	DECL	AVERAGE 75 INCL	OE DRM INTENSITY	WATER CORRECT INTENSITY	% WATER WET WT
1895	131.0	66.3	.743E-05	.179E-04					58.48
1900	124.1	64.0	.580E-05	.145E-04					59.92
1905	19.9	64.6	.895E-05	.217E-04					58.81
1910	16.8	79.3	.896E-05	.224E-04					59.92
1915	61.0	80.7	.687E-05	.168E-04					59.07
1920	78.2	81.0	.732E-05	.182E-04	6.9	-9.0	.423E-05	.136E-04	59.86
1925	84.3	76.0	.876E-05	.217E-04					59.62
1930	117.0	68.7	.113E-04	.279E-04	9.3	-0.3	.416E-05	.130E-04	59.41
1934	97.7	63.6	.101E-04	.245E-04					58.99
1935	90.0	72.3	.110E-04	.280E-04					60.86
1940	94.7	43.4	.113E-04	.266E-04					57.64
1945	2.7	58.3	.148E-04	.343E-04					56.75
1950	15.2	58.9	.211E-04	.481E-04					56.16
1955	9.2	62.0	.174E-04	.419E-04					58.37
1960	179.2	51.9	.180E-04	.417E-04					56.98
1963	172.5	42.8	.245E-04	.574E-04					57.30
1970	173.8	48.1	.244E-04	.579E-04					57.94
1975	178.4	54.3	.190E-04	.445E-04					57.27
1980	12.6	62.3	.137E-04	.319E-04					57.00
1985	13.3	73.2	.827E-05	.193E-04					57.12
1990	36.3	80.7	.118E-04	.277E-04					57.49
1995	156.1	64.0	.158E-04	.382E-04					58.50
2000	162.5	53.6	.180E-04	.424E-04					57.63
2005	161.3	57.7	.132E-04	.336E-04					60.58
2010	3.4	47.3	.206E-04	.500E-04					58.31
2015	2.9	44.0	.415E-04	.998E-04					58.45
2020	179.7	29.2	.560E-04	.140E-03					60.08
2030	357.2	26.1	.530E-04	.132E-03					59.73
2035	9.2	44.1	.361E-04	.893E-04					59.57
2041	38.9	49.6	.302E-04	.756E-04					60.01
2045	33.4	46.0	.337E-04	.834E-04					59.64
2050	20.0	49.6	.320E-04	.799E-04					60.00
2055	11.6	48.0	.295E-04	.734E-04					59.78
2060	359.7	53.5	.212E-04	.516E-04					58.84
2065	315.8	72.3	.140E-04	.346E-04					59.60
2070	161.3	27.8	.155E-04	.375E-04					58.68
2075	39.4	55.6	.122E-04	.300E-04					59.40
2080	166.4	58.5	.131E-04	.323E-04					59.44
2085	163.1	67.2	.123E-04	.295E-04					58.38
2090	12.8	46.7	.165E-04	.407E-04	352.0	30.1	.784E-05	.244E-04	59.60
2095	15.6	41.0	.155E-04	.389E-04					60.21
2100	4.6	40.4	.219E-04	.532E-04					58.76
2105	13.7	40.0	.185E-04	.454E-04					59.33
2110	11.6	39.5	.219E-04	.518E-04					57.67
2115	16.5	39.5	.197E-04	.468E-04					57.92
2120	13.6	40.2	.225E-04	.525E-04					57.20
2125	6.6	37.2	.282E-04	.666E-04					57.73
2130	357.7	37.6	.320E-04	.751E-04					57.46
2135	354.3	42.2	.275E-04	.651E-04					57.81
2140	11.2	24.0	.314E-04	.759E-04					58.61
2145	9.0	35.2	.333E-04	.817E-04					59.21
2150	15.3	33.0	.275E-04	.665E-04	1.2	9.6	.170E-04	.509E-04	58.71
2155	15.9	37.9	.304E-04	.736E-04	2.8	14.8	.195E-04	.549E-04	58.68
2160	3.8	39.8	.275E-04	.676E-04	359.4	19.9	.150E-04	.452E-04	59.39
2168	24.9	39.2	.280E-04	.697E-04	11.8	20.2	.139E-04	.418E-04	59.88
2173	27.5	43.7	.261E-04	.650E-04	20.1	28.2	.974E-05	.297E-04	59.88
2180	358.0	18.9	.487E-04	.119E-03	350.3	14.5	.280E-04	.767E-04	59.16
2185	11.7	35.3	.461E-04	.115E-03	359.2	41.2	.252E-04	.665E-04	60.03
2192	360.0	17.4	.603E-04	.148E-03	350.3	13.1	.382E-04	.103E-03	59.16
2195	353.7	21.6	.585E-04	.144E-03	339.5	18.0	.366E-04	.995E-04	59.33
2200	344.9	17.7	.456E-04	.114E-03	332.0	10.6	.261E-04	.725E-04	60.12

DEPTH CM	DECL	AVERAGE INCL	NRM INTENSITY	WATER CORRECT INTENSITY	DECL	AVERAGE INCL	75 OE ORN INTENSITY	WATER CORRECT INTENSITY	% WATER MET MT
2205	337.3	31.4	.437E-04	.109E-03	319.4	30.9	.268E-04	.756E-04	59.85
2210	134.5	67.2	.206E-04	.508E-04	171.7	32.1	.178E-04	.496E-04	59.53
2215	332.1	24.5	.615E-04	.153E-03	319.3	23.8	.364E-04	.101E-03	59.78
2220	359.0	31.1	.568E-04	.142E-03	342.8	35.2	.302E-04	.859E-04	59.93
2225	352.9	39.4	.608E-04	.147E-03	334.7	42.2	.358E-04	.103E-03	58.57
2230	346.2	19.5	.523E-04	.127E-03	333.0	18.0	.299E-04	.861E-04	58.90
2235	356.6	23.0	.565E-04	.136E-03	345.1	21.6	.332E-04	.936E-04	58.37
2240	342.7	19.3	.622E-04	.152E-03	337.7	15.2	.390E-04	.113E-03	58.96
2245	345.5	30.4	.516E-04	.123E-03	335.3	27.2	.339E-04	.955E-04	57.88
2250	353.9	25.6	.525E-04	.125E-03	346.6	21.2	.320E-04	.906E-04	57.89
2255	347.5	28.2	.579E-04	.135E-03	338.2	24.8	.349E-04	.101E-03	57.11
2260	353.0	35.7	.587E-04	.909E-04	342.3	41.4	.165E-04	.475E-04	57.44
2265	13.7	3.4	.123E-04	.290E-04	181.9	-22.5	.225E-04	.640E-04	57.56
2270	4.7	21.8	.221E-04	.523E-04	175.4	-5.8	.304E-04	.873E-04	57.75
2275	16.4	12.8	.154E-04	.363E-04	170.0	-19.0	.245E-04	.707E-04	57.62
2280	37.9	39.4	.153E-04	.354E-04	187.3	-12.8	.193E-04	.537E-04	56.85
2285	107.1	82.4	.230E-04	.529E-04	246.0	38.5	.174E-04	.489E-04	56.58
2290	95.2	76.0	.156E-04	.364E-04	239.7	-9.5	.115E-04	.318E-04	57.11
2295	24.4	77.5	.123E-04	.285E-04	205.6	24.4	.879E-05	.247E-04	57.00
2300	64.7	14.9	.862E-05	.201E-04	132.2	-50.7	.174E-04	.475E-04	57.03
2305	26.0	40.3	.983E-05	.232E-04	132.8	-26.4	.860E-05	.234E-04	57.62
2310	316.7	8.3	.100E-04	.235E-04	219.8	-54.9	.137E-04	.365E-04	57.35
2315	26.0	15.5	.102E-04	.241E-04	171.9	-46.6	.127E-04	.342E-04	57.58
2320	117.9	42.7	.111E-04	.262E-04	162.2	-22.6	.147E-04	.399E-04	57.82
2325	128.6	13.7	.131E-04	.308E-04	166.5	-22.6	.183E-04	.494E-04	57.33
2329	342.9	10.4	.125E-04	.294E-04	241.3	-65.2	.763E-05	.202E-04	57.46
2335	359.2	50.7	.244E-04	.562E-04	245.8	68.7	.680E-05	.176E-04	56.68
2340	343.9	51.9	.142E-04	.333E-04	175.2	-3.5	.577E-05	.149E-04	57.38
2345	341.0	68.3	.680E-05	.158E-04	173.1	-31.1	.122E-04	.315E-04	56.91
2350	30.9	56.4	.242E-04	.570E-04					57.55
2351	98.8	48.4	.176E-04	.414E-04					57.44
2358	10.1	55.9	.183E-04	.423E-04					56.70
2361	3.6	41.7	.153E-04	.347E-04	294.4	-74.4	.200E-05	.536E-05	55.97
2365	297.9	52.0	.145E-04	.330E-04					56.16
2370	339.5	37.7	.134E-04	.312E-04					57.15
2375	285.6	1.9	.473E-05	.110E-04					57.09
2380	169.4	42.0	.190E-04	.438E-04					56.63
2385	171.1	46.2	.195E-04	.450E-04					56.63
2390	123.4	68.1	.181E-04	.424E-04					57.18
2395	162.3	38.9	.113E-04	.262E-04					56.79
2400	26.3	21.2	.142E-04	.330E-04					56.96
2405	72.3	74.7	.152E-04	.347E-04					56.32
2410	121.9	27.9	.134E-04	.310E-04					56.65
2414	143.4	39.4	.195E-04	.452E-04					56.82
2419	125.6	28.4	.124E-04	.286E-04					56.68
2423	301.4	57.4	.152E-04	.350E-04					56.62
2427	329.9	58.6	.159E-04	.366E-04	193.7	22.1	.983E-05	.258E-04	56.43
2430	181.5	74.8	.969E-05	.223E-04					56.57
2431	165.9	81.1	.193E-04	.445E-04					56.53
2437	47.0	51.8	.472E-04	.109E-03					56.58
2441	11.7	47.4	.428E-04	.986E-04					56.55
2446	2.0	43.3	.394E-04	.905E-04					56.48
2450	3.2	52.2	.382E-04	.883E-04					56.76
2454	3.7	60.2	.378E-04	.874E-04					56.74
2459	354.0	47.9	.345E-04	.798E-04					56.72
2462	16.9	45.4	.328E-04	.762E-04					56.94
2463	9.5	48.6	.396E-04	.908E-04					56.45
2468	8.1	36.4	.323E-04	.746E-04					56.68
2472	1.4	41.9	.309E-04	.709E-04					56.42
2476	20.1	60.1	.297E-04	.683E-04					56.51
2481	32.1	76.1	.288E-04	.666E-04					56.69
2485	14.9	66.5	.294E-04	.681E-04					56.86

APPENDIX E

Natural remanent magnetization and remanent magnetization after 75 oe alternating-field demagnetization of Vema-32 piston core samples. Intensity values in emu/cc of wet sediment. Analyses by M. Kominz.

CORE #	DEPTH CM	DECL	NRH INCL	INTENSITY	DECL	DRM 75 OF INCL	OE INTENSITY
116	6	8.6	55.7	.210E-04	1.6	56.8	.131E-04
116	15	96.2	50.3	.195E-04	116.3	51.9	.114E-04
116	25	116.4	47.2	.117E-04	148.0	43.8	.610E-05
116	35	109.5	38.3	.243E-04	116.0	36.9	.167E-04
116	45	109.5	39.9	.207E-04	116.2	37.5	.119E-04
116	55	128.4	37.1	.223E-04	133.9	33.0	.141E-04
116	65	127.3	32.8	.221E-04	130.3	24.7	.136E-04
116	75	121.8	39.5	.270E-04	125.6	39.6	.163E-04
116	85	124.8	43.9	.338E-04	127.3	44.0	.207E-04
116	95	130.4	39.8	.310E-04	134.4	38.7	.183E-04
116	105	123.3	36.7	.248E-04	129.6	35.2	.143E-04
116	115	126.2	39.4	.334E-04	130.2	36.8	.217E-04
116	125	130.4	40.6	.334E-04	139.7	40.0	.225E-04
116	135	129.0	34.0	.284E-04	136.0	33.5	.167E-04
116	145	125.5	18.1	.161E-04	129.6	2.6	.845E-05
116	155	118.4	15.2	.269E-04	121.6	6.7	.158E-04
116	165	91.7	-36.4	.830E-05	48.8	-79.0	.880E-05
116	175	123.4	26.4	.178E-04	116.7	10.6	.831E-05
116	185	113.3	16.8	.106E-04	96.6	-36.7	.427E-05
116	195	118.4	18.6	.146E-04	109.3	-8.7	.456E-05
116	205	88.8	-10.1	.571E-05	348.5	-63.2	.610E-05
116	215	101.6	2.7	.714E-05	39.1	-62.6	.541E-05
116	225	107.5	-8.6	.590E-05	18.3	-71.9	.703E-05
116	234	89.4	-69.0	.437E-05	339.3	-66.3	.105E-04
116	246	132.2	-35.1	.683E-05	356.6	-81.3	.105E-04
116	255	114.0	-24.4	.446E-05	351.2	-63.3	.856E-05
116	265	143.2	32.1	.141E-04	117.7	0.1	.186E-05
116	275	153.6	31.3	.180E-04	161.4	19.2	.638E-05
116	290	135.1	-14.3	.167E-04	122.2	-46.4	.987E-05
116	298	115.8	-43.8	.820E-05	325.6	-69.8	.194E-04
116	305	94.9	-51.4	.122E-04	329.1	-58.3	.141E-04
116	315	95.0	-59.8	.147E-04	333.7	-61.3	.149E-04
116	325	122.6	-33.8	.141E-04	36.7	-59.7	.105E-04
116	332	126.2	-55.1	.221E-04	178.1	-88.0	.559E-05
116	345	173.2	29.9	.283E-04	203.3	44.7	.748E-05
116	355	167.3	26.1	.277E-04	195.6	28.1	.349E-05
116	365	167.1	23.4	.252E-04	184.4	23.4	.278E-05
116	375	171.2	19.8	.225E-04	268.1	-9.4	.143E-05
116	385	171.3	22.4	.299E-04	158.0	37.6	.182E-05
116	395	180.1	22.8	.271E-04	243.8	5.8	.334E-05
116	405	173.0	16.7	.188E-04	181.6	-21.6	.183E-05
116	415	167.7	3.6	.149E-04	255.1	-79.8	.440E-05
116	425	173.5	8.1	.165E-04	220.2	-69.9	.213E-05
116	435	167.7	3.6	.149E-04	286.3	-24.4	.109E-05

CORE #	DEPTH CM	DECL	NRH INCL	INTENSITY	DECL	DRM 75 OF INCL	OE INTENSITY
116	445	174.4	16.3	.182E-04	238.5	-27.7	.373E-05
116	455	184.2	18.5	.161E-04	221.2	-9.4	.268E-05
116	465	183.8	16.5	.147E-04	171.4	-56.4	.162E-05
116	475	176.4	13.5	.125E-04	210.8	-67.8	.449E-05
116	485	191.6	26.1	.170E-04	263.1	27.0	.359E-05
116	495	207.0	21.8	.216E-04	236.4	-5.9	.719E-05
116	505	190.7	27.5	.223E-04			
116	515	185.3	29.0	.240E-04			
116	525	183.6	29.2	.244E-04			
116	535	189.1	30.8	.258E-04			
116	545	187.3	21.9	.210E-04			
116	555	181.1	25.3	.218E-04			
116	562	176.9	13.7	.197E-04			
116	575	144.1	10.9	.237E-04			
116	585	138.2	6.0	.240E-04			
116	595	142.2	7.1	.239E-04			
116	605	132.9	7.1	.191E-04			
116	615	141.0	11.6	.201E-04			
116	625	144.9	14.5	.193E-04			
116	635	142.4	32.0	.247E-04			
116	645	143.1	23.1	.255E-04			
116	655	145.5	24.1	.265E-04			
116	665	143.9	23.9	.289E-04			
116	675	148.1	27.9	.269E-04			
116	685	157.4	35.9	.255E-04			
116	695	154.9	26.4	.280E-04			
116	705	157.3	24.2	.301E-04			
116	715	157.1	23.3	.296E-04			
116	725	133.6	10.8	.219E-04			
116	736	141.5	13.6	.250E-04			
116	745	144.3	16.6	.255E-04			
116	755	134.6	16.8	.259E-04			
116	765	88.2	20.4	.189E-04			
116	775	141.5	30.2	.287E-04			
116	785	136.6	30.7	.322E-04			
116	794	142.6	27.6	.286E-04			
116	805	146.4	20.9	.272E-04			
116	814	147.6	15.3	.221E-04			
116	825	138.7	5.5	.161E-04			
116	835	139.0	14.0	.229E-04			
116	845	141.1	13.3	.208E-04			
116	856	173.0	-46.9	.228E-04			
116	865	176.0	-55.2	.195E-04			
116	875	181.1	-62.7	.233E-04			
116	885	177.0	-65.5	.295E-04			

CORE #	DEPTH CM	DECL	NRH INCL	INTENSITY
116	895	185.4	-62.0	.306E-04
116	905	178.4	-68.8	.311E-04
116	915	187.7	-65.1	.296E-04
116	925	178.9	-67.6	.315E-04
116	935	171.9	-67.5	.268E-04
116	945	175.0	-68.3	.243E-04
116	955	193.4	7.3	.157E-04
116	965	223.9	-57.3	.162E-04

CORE #	DEPTH CM	DECL	NRM INCL	INTENSITY	DECL	DRM 75 OF INCL	INTENSITY
116	6	8.6	55.7	.210E-04	1.6	56.8	.131E-04
116	15	96.2	50.3	.195E-04	116.3	51.9	.114E-04
116	25	116.4	47.2	.117E-04	148.0	43.8	.610E-05
116	35	109.5	38.3	.243E-04	116.0	36.9	.167E-04
116	45	109.5	39.9	.207E-04	116.2	37.5	.119E-04
116	55	128.4	37.1	.223E-04	133.9	33.0	.141E-04
116	65	127.3	32.8	.221E-04	130.3	24.7	.136E-04
116	75	121.8	39.5	.270E-04	125.6	39.6	.163E-04
116	85	124.8	43.9	.338E-04	127.3	44.0	.207E-04
116	95	130.4	39.0	.310E-04	134.4	38.7	.183E-04
116	105	123.3	36.7	.248E-04	129.6	35.2	.143E-04
116	115	126.2	39.4	.334E-04	130.2	36.8	.217E-04
116	125	130.4	40.6	.334E-04	139.7	40.0	.225E-04
116	135	129.0	34.0	.284E-04	136.0	33.5	.167E-04
116	145	125.5	18.1	.161E-04	129.6	2.6	.845E-05
116	155	118.4	15.2	.269E-04	121.6	6.7	.158E-04
116	165	91.7	-36.4	.830E-05	48.8	-79.0	.880E-05
116	175	123.4	26.4	.178E-04	116.7	10.6	.831E-05
116	185	113.3	16.8	.106E-04	96.6	-36.7	.427E-05
116	195	118.4	18.6	.146E-04	109.3	-8.7	.456E-05
116	205	88.8	-10.1	.571E-05	348.5	-63.2	.610E-05
116	215	101.6	2.7	.714E-05	39.1	-62.6	.541E-05
116	225	107.5	-8.6	.590E-05	18.3	-71.9	.703E-05
116	234	89.4	-69.0	.437E-05	339.3	-66.3	.105E-04
116	246	132.2	-35.1	.683E-05	356.6	-81.3	.105E-04
116	255	114.0	-24.4	.446E-05	351.2	-63.3	.856E-05
116	265	143.2	32.1	.141E-04	117.7	0.1	.186E-05
116	275	153.6	31.3	.180E-04	161.4	19.2	.638E-05
116	290	135.1	-14.3	.167E-04	122.2	-46.4	.987E-05
116	298	115.0	-43.0	.820E-05	325.6	-69.8	.104E-04
116	305	94.9	-51.4	.122E-04	329.1	-58.3	.141E-04
116	315	95.0	-59.8	.147E-04	333.7	-61.3	.149E-04
116	325	122.6	-33.8	.141E-04	36.7	-59.7	.105E-04
116	332	126.2	-55.1	.221E-04	178.1	-88.0	.559E-05
116	345	173.2	29.9	.283E-04	203.3	44.7	.748E-05
116	355	167.3	26.1	.277E-04	195.6	28.1	.349E-05
116	365	167.1	23.4	.252E-04	184.4	23.4	.278E-05
116	375	171.2	19.8	.225E-04	268.1	-9.4	.143E-05
116	385	171.3	22.4	.299E-04	198.0	37.6	.182E-05
116	395	180.1	22.8	.271E-04	243.8	5.8	.334E-05
116	405	173.8	16.7	.180E-04	181.6	-21.6	.183E-05
116	415	167.7	3.6	.149E-04	255.1	-79.8	.440E-05
116	425	173.5	8.1	.165E-04	220.2	-69.9	.213E-05
116	435	167.7	3.6	.149E-04	286.3	-24.4	.109E-05

CORE #	DEPTH CM	DECL	NRM INCL	INTENSITY	DECL	DRM 75 OF INCL	INTENSITY
116	445	174.4	16.3	.182E-04	238.5	-27.7	.373E-05
116	455	184.2	18.5	.161E-04	221.2	-9.4	.268E-05
116	465	183.8	16.5	.147E-04	171.4	-56.4	.162E-05
116	475	176.4	13.5	.125E-04	210.8	-67.8	.449E-05
116	485	191.6	26.1	.170E-04	263.1	27.0	.359E-05
116	495	207.0	21.8	.216E-04	236.4	-5.9	.719E-05
116	505	190.7	27.5	.223E-04			
116	515	185.3	29.0	.240E-04			
116	525	183.6	29.2	.244E-04			
116	535	189.1	30.8	.258E-04			
116	545	187.3	21.9	.210E-04			
116	555	181.1	25.3	.218E-04			
116	562	176.9	13.7	.197E-04			
116	575	144.1	10.9	.237E-04			
116	585	138.2	6.0	.240E-04			
116	595	142.2	7.1	.239E-04			
116	605	132.9	7.1	.191E-04			
116	615	141.0	11.6	.201E-04			
116	625	144.9	14.5	.193E-04			
116	635	142.4	32.0	.247E-04			
116	645	143.1	23.1	.255E-04			
116	655	145.5	24.1	.265E-04			
116	665	143.9	23.9	.289E-04			
116	675	148.1	27.9	.269E-04			
116	685	157.4	35.9	.255E-04			
116	695	154.9	26.4	.280E-04			
116	705	157.3	24.2	.301E-04			
116	715	157.1	23.3	.296E-04			
116	725	133.6	10.8	.219E-04			
116	736	141.5	13.6	.250E-04			
116	745	144.3	16.6	.255E-04			
116	755	134.6	16.8	.259E-04			
116	765	88.2	20.4	.189E-04			
116	775	141.5	30.2	.287E-04			
116	785	136.6	30.7	.322E-04			
116	794	142.6	27.6	.286E-04			
116	805	146.4	20.9	.272E-04			
116	814	147.6	15.3	.221E-04			
116	825	138.7	5.5	.161E-04			
116	835	139.0	14.0	.229E-04			
116	845	141.1	13.3	.208E-04			
116	856	173.0	-46.9	.228E-04			
116	865	176.0	-55.2	.195E-04			
116	875	181.1	-62.7	.233E-04			
116	885	177.0	-65.5	.295E-04			

CORE #	DEPTH CM	DECL	NRM INCL	INTENSITY
116	895	185.4	-62.0	.306E-04
116	905	178.4	-68.8	.311E-04
116	915	187.7	-65.1	.296E-04
116	925	178.9	-67.6	.315E-04
116	935	171.9	-67.5	.268E-04
116	945	175.0	-68.3	.243E-04
116	955	193.4	7.3	.157E-04
116	965	223.9	-57.3	.162E-04

CORE #	DEPTH CM	DECL	NRM INCL	INTENSITY	DECL	DRM 75 INCL	OE INTENSITY
117	6	69.4	-36.8	.144E-04	84.0	-47.2	.947E-05
117	16	55.3	31.5	.272E-04	54.8	32.0	.168E-04
117	26	53.1	43.7	.295E-04	53.4	38.6	.192E-04
117	36	59.1	39.1	.274E-04	61.1	33.9	.161E-04
117	46	58.9	47.1	.341E-04	55.8	38.4	.252E-04
117	56	60.6	34.9	.220E-04	59.5	28.9	.141E-04
117	66	54.2	33.9	.232E-04	51.8	24.3	.165E-04
117	76	59.9	20.9	.679E-05	66.0	-47.6	.242E-05
117	86	35.9	40.4	.418E-04	31.5	34.3	.324E-04
117	96	53.2	45.2	.315E-04	48.5	42.3	.215E-04
117	106	59.5	41.4	.263E-04	52.8	42.3	.180E-04
117	116	71.1	-6.1	.770E-05	184.7	-75.7	.444E-05
117	126	85.2	-44.8	.704E-05	213.1	-66.1	.869E-05
117	136	77.6	-14.8	.775E-05	194.7	-81.6	.623E-05
117	146	122.2	-61.1	.564E-05	233.1	-48.5	.117E-04
117	156	153.4	-61.5	.674E-05	233.5	-49.2	.128E-04
117	166	87.4	42.4	.231E-04	85.1	36.7	.129E-04
117	176	139.6	-27.9	.618E-05	215.0	-39.5	.105E-04
117	186	135.8	-12.4	.446E-05	266.0	-46.1	.930E-05
117	196	111.4	4.2	.696E-05	210.5	-49.2	.566E-05
117	206	123.8	26.7	.609E-05	168.4	48.3	.839E-05
117	216	157.7	42.3	.498E-05	196.5	50.4	.114E-04
117	226	128.0	39.1	.623E-05	197.0	66.5	.785E-05
117	236	113.2	34.0	.150E-04	106.6	43.1	.149E-04
117	243	151.0	53.2	.210E-04	130.6	59.1	.212E-04
117	256	104.9	17.6	.113E-04	105.2	27.9	.107E-04
117	266	110.4	6.6	.115E-04	110.5	20.4	.102E-04
117	286	73.1	-59.1	.968E-05	246.5	-68.6	.121E-04
117	296	155.4	-45.1	.121E-04	243.4	-58.0	.129E-04
117	306	132.1	17.6	.166E-04	146.7	-19.9	.343E-05
117	316	113.4	31.0	.227E-04	112.3	37.2	.899E-05
117	326	130.0	1.7	.102E-04	227.1	-42.1	.607E-05
117	337	148.2	-43.9	.110E-04	228.5	-54.5	.140E-04
117	346	170.6	-42.7	.978E-05	243.4	-39.7	.159E-04
117	355	185.8	-53.5	.133E-04	243.1	-49.4	.195E-04
117	366	196.8	-50.4	.131E-04	249.8	-40.2	.209E-04
117	376	205.5	-18.1	.983E-05	255.8	-29.4	.187E-04
117	386	206.6	-50.2	.184E-04	245.1	-40.6	.240E-04
117	396	187.2	-38.5	.166E-04	248.0	-40.6	.196E-04
117	406	141.7	14.9	.141E-04	253.0	-17.5	.526E-05
117	416	57.9	44.9	.171E-04	1.1	62.2	.535E-05
117	426	66.8	41.6	.226E-04	14.6	66.5	.812E-05
117	436	66.9	46.6	.217E-04	33.2	66.6	.684E-05
117	446	67.8	42.5	.224E-04	19.8	59.9	.583E-05

CORE #	DEPTH CM	DECL	NRM INCL	INTENSITY	DECL	DRM 75 INCL	OE INTENSITY
117	456	68.7	57.5	.137E-04	246.4	20.2	.252E-05
117	466	80.8	48.8	.169E-04	251.8	60.4	.304E-05
117	476	92.4	53.2	.128E-04	225.0	16.1	.287E-05
117	486	73.7	47.8	.321E-04	49.7	63.6	.116E-04
117	496	118.0	44.8	.141E-04	189.6	-15.1	.500E-05
117	507	208.0	48.7	.265E-04	221.4	33.2	.877E-05
117	516	84.3	65.3	.178E-04	184.3	54.1	.643E-05
117	526	144.9	39.6	.132E-04	191.9	-7.6	.978E-05
117	536	171.3	19.4	.157E-04	196.6	-14.3	.146E-04
117	546	167.4	29.6	.168E-04	199.2	0.0	.126E-04
117	556	123.8	13.8	.457E-05	189.2	-36.9	.749E-05
117	566	104.8	30.1	.528E-05	188.1	-29.2	.612E-05
117	576	103.2	18.0	.569E-05	172.7	-37.1	.562E-05
117	586	116.3	-7.1	.575E-05	177.8	-42.3	.887E-05
117	596	72.3	36.6	.108E-04	116.3	-28.2	.201E-05
117	606	82.7	33.2	.115E-04	254.9	-71.1	.248E-05
117	615	57.5	21.2	.778E-05	147.5	-53.5	.258E-05
117	626	52.8	24.5	.171E-04	182.7	-9.6	.105E-05
117	636	67.6	32.3	.171E-04	106.9	33.3	.279E-05
117	646	72.7	41.5	.160E-04	171.8	3.6	.166E-05
117	656	67.2	40.3	.256E-04	77.4	44.8	.599E-05
117	666	77.6	42.6	.186E-04	185.4	-5.9	.231E-05
117	676	107.3	33.7	.171E-04	181.6	-40.7	.386E-05
117	686	152.3	10.7	.103E-04	227.6	-26.3	.103E-04
117	696	144.8	5.4	.146E-04	238.5	-37.3	.931E-05
117	706	152.1	-3.7	.130E-04	238.9	-46.0	.111E-04
117	716	125.6	-17.8	.113E-04	237.4	-46.2	.102E-04
117	726	131.1	-8.4	.113E-04	228.1	-54.2	.868E-05
117	737	111.8	11.6	.139E-04	245.4	-29.7	.670E-05
117	746	110.7	23.1	.182E-04	194.2	7.6	.167E-05
117	756	106.0	28.0	.276E-04	94.9	32.2	.467E-05
117	766	105.6	32.8	.226E-04	121.6	33.2	.550E-05
117	776	115.2	37.2	.220E-04	175.1	-12.1	.254E-05
117	786	120.3	33.7	.315E-04	136.1	28.7	.469E-05
117	796	121.6	27.0	.354E-04	101.2	40.5	.593E-05
117	806	121.1	30.7	.367E-04	115.4	17.0	.433E-05
117	816	132.3	27.1	.154E-04	225.0	-35.6	.488E-05
117	826	120.4	36.6	.236E-04	146.9	42.0	.428E-05
117	836	153.6	6.4	.462E-05	265.1	-45.4	.167E-04
117	846	146.7	8.1	.172E-04	215.6	-51.7	.526E-05
117	856	68.6	40.8	.209E-04	107.4	35.7	.304E-05
117	866	71.8	-48.3	.364E-04	69.4	-74.6	.245E-04
117	876	61.0	-69.8	.361E-04	271.7	-85.2	.282E-04
117	886	79.8	-72.0	.461E-04	339.0	-88.6	.393E-04
117	896	73.3	-75.8	.565E-04	93.7	-88.6	.454E-04
117	906	82.6	-75.9	.521E-04	19.7	-83.8	.416E-04

CORE #	DEPTH CM	DECL	NRH INCL	INTENSITY	DECL	DRM 75 INCL	OE INTENSITY
120	6	44.7	0.2	.124E-04	35.2	0.3	.840E-05
120	15	58.1	39.1	.319E-04	55.9	36.4	.229E-04
120	25	63.9	32.6	.293E-04	59.1	29.8	.188E-04
120	35	68.7	35.4	.313E-04	61.8	31.4	.217E-04
120	45	66.9	33.5	.362E-04	58.7	31.2	.234E-04
120	55	71.2	40.2	.352E-04	56.0	41.7	.223E-04
120	65	72.8	38.1	.372E-04	63.5	41.1	.234E-04
120	75	58.8	43.6	.207E-04	77.8	40.9	.114E-04
120	85	59.2	41.9	.283E-04	61.0	47.5	.127E-04
120	95	57.2	49.8	.236E-04	56.7	40.6	.146E-04
120	105	61.4	39.7	.339E-04	60.0	36.2	.236E-04
120	115	62.1	48.6	.307E-04	64.7	43.9	.218E-04
120	125	61.5	45.6	.232E-04	66.7	43.2	.135E-04
120	135	98.0	27.2	.566E-05	159.9	-22.1	.341E-05
120	145	121.7	29.4	.456E-05	176.1	-34.3	.410E-05
120	155	204.2	-47.6	.101E-04	226.2	-53.4	.156E-04
120	165	96.7	42.4	.928E-05	152.1	23.2	.174E-05
120	175	152.9	34.4	.406E-05	222.8	-37.8	.610E-05
120	185	197.6	-23.3	.492E-05	226.8	-28.8	.104E-04
120	195	202.7	-31.1	.722E-05	223.4	-40.3	.142E-04
120	205	198.2	-17.2	.708E-05	221.1	-34.8	.123E-04
120	215	170.1	-40.0	.719E-05	240.0	-31.7	.129E-04
120	225	197.5	-36.2	.900E-05	234.0	-45.5	.129E-04
120	235	112.9	19.8	.137E-04	185.8	5.9	.254E-05
120	246	104.2	16.3	.934E-05	182.4	-71.3	.370E-05
120	255	121.9	-22.1	.466E-05	221.4	-57.0	.731E-05
120	265	130.8	-22.5	.485E-05	247.0	-58.0	.769E-05
120	275	191.8	-37.5	.723E-05	239.0	-46.9	.154E-04
120	285	156.5	-50.5	.646E-05	238.4	-48.8	.124E-04
120	295	246.5	-48.4	.963E-05	274.9	-65.7	.116E-04
120	305	182.3	34.7	.115E-04	164.0	-32.5	.321E-05
120	315	176.9	33.6	.165E-04	167.5	-60.4	.150E-05
120	325	181.6	41.3	.199E-04	134.8	55.1	.599E-05
120	335	171.6	47.4	.175E-04	104.5	12.5	.405E-05
120	345	147.6	40.9	.149E-04	122.9	72.4	.354E-05
120	356	178.2	34.8	.197E-04	137.8	30.1	.512E-05
120	365	193.3	24.1	.185E-04	253.8	-84.5	.243E-05
120	375	182.8	15.5	.168E-04	141.4	0.5	.307E-05
120	386	191.0	3.6	.133E-04	100.7	-43.4	.668E-05
120	395	47.7	34.1	.153E-04	342.2	27.6	.287E-05
120	403	47.8	34.6	.161E-04	51.4	58.7	.463E-05
120	413	48.6	37.5	.121E-04	213.3	34.5	.232E-05
120	425	51.7	21.5	.770E-05	328.1	-71.9	.392E-05
120	435	63.4	25.1	.556E-05	240.0	-13.1	.450E-05

CORE #	DEPTH CM	DECL	NRH INCL	INTENSITY	DECL	DRM 75 INCL	OE INTENSITY
120	445	85.3	30.7	.884E-05	168.2	26.9	.164E-05
120	455	111.2	20.9	.795E-05	219.1	-40.9	.782E-05

CORE #	DEPTH CM	DECL	NRM INCL	INTENSITY	DECL	DRM 75 INCL	OE INTENSITY
122	6	148.0	15.4	.124E-04	151.2	19.2	.116E-04
122	15	237.5	51.5	.109E-04	241.0	58.5	.149E-04
122	25	259.1	59.2	.116E-04	264.4	52.2	.164E-04
122	35	278.8	48.8	.156E-04	277.9	48.1	.209E-04
122	45	284.9	53.1	.274E-04	283.9	55.2	.205E-04
122	55	267.3	46.0	.347E-04	267.3	44.6	.261E-04
122	65	281.9	54.1	.262E-04	272.5	51.2	.177E-04
122	75	265.2	59.8	.276E-04	295.2	56.9	.219E-04
122	85	297.2	55.1	.276E-04	295.1	59.5	.195E-04
122	95	297.3	57.0	.173E-04	302.0	56.1	.112E-04
122	105	112.2	47.3	.272E-05	141.2	1.7	.259E-05
122	115	307.6	55.8	.206E-04	299.5	52.9	.172E-04
122	125	103.1	23.9	.337E-05	168.7	-13.2	.465E-05
122	135	100.5	57.0	.468E-05	144.7	-7.7	.372E-05
122	145	111.4	3.2	.605E-05	133.7	-30.3	.616E-05
122	155	112.2	23.9	.899E-05	144.1	-42.6	.889E-05
122	165	100.8	-6.0	.904E-05	120.1	-30.1	.932E-05
122	175	140.0	-28.0	.114E-04	127.0	-50.9	.131E-04
122	183	147.9	-14.5	.895E-05	138.2	-37.4	.111E-04
122	195	134.0	-20.6	.109E-04	128.4	-41.8	.134E-04
122	205	359.3	85.4	.710E-05	91.6	59.3	.230E-05
122	215	147.9	82.2	.477E-05	143.1	-10.9	.344E-05
122	225	126.2	34.3	.352E-05	117.0	-6.4	.512E-05
122	235	125.8	-18.3	.892E-05	121.5	-21.9	.876E-05
122	246	343.3	60.0	.108E-04	325.7	61.3	.475E-05
122	255	97.2	-24.1	.674E-05	121.6	-34.4	.963E-05
122	265	254.0	70.4	.487E-05	89.1	17.8	.169E-05
122	275	274.9	73.6	.113E-04	265.9	36.7	.474E-05
122	285	309.9	64.9	.158E-04	286.1	64.2	.682E-05
122	295	326.1	41.3	.145E-04	340.3	31.2	.499E-05
122	305	338.7	41.7	.144E-04	297.3	48.1	.371E-05
122	315	338.5	35.1	.145E-04	340.2	32.5	.412E-05
122	325	306.0	55.8	.648E-05	251.3	1.1	.329E-05
122	335	8.5	56.1	.111E-04	243.4	-27.8	.604E-06
122	345	35.1	26.6	.850E-05	141.3	-46.5	.549E-05
122	355	11.2	51.1	.134E-04	243.8	65.3	.172E-05
122	365	.9	49.2	.129E-04	276.3	29.5	.165E-05
122	375	28.1	30.0	.991E-05	151.7	-14.2	.521E-05
122	385	49.8	41.9	.758E-05	170.5	-23.0	.646E-05
122	395	52.4	24.5	.674E-05	158.9	-39.2	.533E-05
122	405	33.8	33.4	.988E-05	131.2	-20.4	.373E-05
122	415	55.2	87.0	.874E-05	245.4	48.0	.312E-05
122	425	13.4	54.7	.950E-05	170.6	15.0	.580E-05
122	435	3.2	51.3	.150E-04	212.6	77.1	.417E-05

CORE #	DEPTH CM	DECL	NRM INCL	INTENSITY	DECL	DRM 75 INCL	OE INTENSITY
122	445	1.9	43.6	.207E-04	320.0	37.9	.524E-05
122	455	19.3	38.0	.161E-04	32.0	27.3	.246E-05
122	466	71.6	-79.4	.361E-04	140.5	-81.2	.218E-04
122	475	339.6	62.2	.106E-04			
122	484	331.6	73.9	.163E-04	243.2	54.4	.533E-05
122	495	6.4	43.7	.807E-05			
122	505	7.3	58.5	.117E-04			
122	515	331.5	51.8	.151E-04			
122	525	292.5	46.9	.151E-04			
122	535	300.5	44.0	.201E-04			
122	545	306.2	40.4	.190E-04			
122	555	338.7	29.0	.674E-05			
122	565	332.5	25.3	.888E-05			
122	575	330.7	31.3	.711E-05			
122	585	214.8	69.6	.103E-04			
122	595	34.4	49.3	.765E-05			
122	605	32.0	57.5	.969E-05			
122	615	26.1	43.3	.176E-04			
122	625	89.9	49.0	.110E-04			
122	635	60.6	46.5	.158E-04			
122	645	56.8	57.7	.122E-04			
122	655	65.2	60.8	.134E-04			
122	665	92.0	35.0	.101E-04			
122	675	39.2	47.6	.124E-04			
122	685	58.5	46.8	.121E-04			
122	695	60.9	47.0	.118E-04			
122	706	84.6	48.9	.920E-05			
122	715	73.2	35.4	.104E-04			
122	725	63.4	29.4	.955E-05			
122	736	148.5	40.8	.978E-05			
122	745	120.1	50.2	.949E-05			
122	755	134.6	48.5	.149E-04			
122	765	110.7	-66.3	.366E-04			
122	775	137.3	-30.3	.138E-04			
122	785	138.9	-50.9	.315E-04			
122	793	140.1	-61.3	.282E-04			
122	805	163.3	-52.5	.279E-04			

APPENDIX F

Tabulated experimental data for Th and UO₂ sorption. Unless otherwise noted, all experiments were carried out in 0.68N NaCl solution. Experiments involve equilibration of dialyzed, freeze-dried sediment with NaCl solution at experimental temperature, followed by centrifugation and equilibration with NaCl solution containing Th (with NaCl solution containing Th (with Th-228 spike) or UO₂. In each case, 100 mg of sediment is reacted with 25 ml of solution. After 24 hours, the solution is removed and filtered for counting. Column headings: Cs = Solution concentration (moles) in sorption equilibrium with sediment; K_p = Partition coefficient (ml/g); S = Sorbed Eu (mM/100g). Detection limits: In the experiments tabulated here, the average detection limit for Th in Cs was $3.5 \times 10^{-8}M$, while the limit for U was $1 \times 10^{-6}M$.

Sample ID	Cs	Kp	S	Log Cs	Log Kp
THORIUM,.002M/Q1 SEDIMENT/5 C/O.681 NACL/1 DAY					
80	9.256E-04	7.545E 01	7.0	-3.034	1.878
81	9.759E-04	6.990E 01	6.8	-3.011	1.844
82	9.682E-04	6.009E 01	5.8	-3.014	1.779
MEAN	9.566E-04	6.848E 01	6.5	-3.020	1.834
S.DEV.	2.709E-05	7.778E 00	0.6	0.013	0.050
RE-EXTRACTION					
80A	1.968E-05	3.491E 03	6.9	-4.706	3.543
81A	2.036E-05	3.267E 03	6.6	-4.691	3.514
82A	1.216E-05	4.815E 03	5.8	-4.915	3.683
MEAN	1.740E-05	3.858E 03	6.5	-4.771	3.580
S.DEV.	4.551E-06	8.366E 02	0.5	0.125	0.090
THORIUM,.0002M/Q1 SEDIMENT/5 C/O.68U NACL/1 DAY					
86	4.174E-07	4.279E 04	1.8	-6.379	4.631
87	1.135E-06	1.565E 04	1.8	-5.945	4.195
88	9.256E-07	2.210E 04	2.0	-6.034	4.344
MEAN	8.260E-07	2.685E 04	1.9	-6.119	4.390
S.DEV.	3.690E-07	1.418E 04	0.2	0.229	0.222
THORIUM,.02M/Q1 SEDIMENT/15 C/O.68U NACL/1 DAY					
31	1.338E-02	6.138E 00	8.2	-1.874	0.788
32	1.359E-02	4.021E 00	5.5	-1.867	0.604
33	1.324E-02	7.928E 00	10.5	-1.878	0.899
MEAN	1.340E-02	6.029E 00	8.1	-1.873	0.764
S.DEV.	1.762E-04	1.956E 00	2.5	0.006	0.149
THORIUM,.002M/Q1 SEDIMENT/15 C/O.68U NACL/1 DAY					
37	6.839E-04	1.441E 02	9.8	-3.165	2.159
THORIUM,.002M/Q1 SEDIMENT/15 C/O.68U NACL/1 DAY					
41	9.365E-04	7.899E 01	7.4	-3.028	1.898
42	8.836E-04	8.825E 01	7.8	-3.054	1.946
43	8.863E-04	8.030E 01	7.1	-3.052	1.905
MEAN	9.021E-04	8.251E 01	7.4	-3.045	1.916
S.DEV.	2.979E-05	5.011E 00	0.3	0.014	0.026
RE-EXTRACTION					
41A	1.066E-05	6.913E 03	7.4	-4.972	3.840
42A	9.499E-06	8.202E 03	7.8	-5.022	3.914
43A	7.050E-06	1.012E 04	7.1	-5.152	4.005
MEAN	9.070E-06	8.412E 03	7.4	-5.049	3.920
S.DEV.	1.843E-06	1.614E 03	0.3	0.093	0.083
THORIUM,.002M/Q1 SEDIMENT/15 C/IN WATER/1 DAY					
92	6.355E-04	1.776E 02	11.3	-3.197	2.250
93	6.778E-04	1.734E 02	11.8	-3.169	2.239
94	6.646E-04	1.720E 02	11.4	-3.177	2.336
MEAN	6.593E-04	1.743E 02	11.5	-3.181	2.275
S.DEV.	2.164E-05	2.914E 00	0.2	0.014	0.053
THORIUM,.002M/Q1 SEDIMENT/15 C/O.68U NACL/18 DAYS					
20-1	7.929E-04	1.452E 02	11.5	-3.101	2.162
20-2	6.557E-04	1.428E 02	9.4	-3.183	2.155
20-3	4.237E-04	1.809E 02	7.7	-3.373	2.257
MEAN	6.241E-04	1.563E 02	9.5	-3.219	2.191
S.DEV.	1.866E-04	2.134E 01	1.9	0.140	0.057
THORIUM,.0002M/Q1 SEDIMENT/15 C/O.68U NACL/1 DAY					
47	4.494E-07	4.419E 04	2.0	-6.347	4.645
48	3.512E-07	5.183E 04	1.8	-6.454	4.715
49	9.597E-07	2.278E 04	2.2	-6.018	4.358
MEAN	5.868E-07	3.960E 04	2.0	-6.273	4.573
S.DEV.	3.267E-07	1.506E 04	0.2	0.227	0.189

Sample ID	Cs	Kp	S	Log Cs	Log Kp
THORIUM,.0002M/Q1 SEDIMENT/15 C/IN WATER/1 DAY					
95	1.688E-08	1.375E 06	2.3	-7.773	6.138
96	2.526E-08	8.392E 05	2.1	-7.597	5.924
97	1.710E-08	1.198E 06	2.0	-7.767	6.079
MEAN	1.975E-08	1.137E 06	2.2	-7.712	6.047
S.DEV.	4.776E-09	2.730E 05	0.1	0.100	0.111
THORIUM,.002M/Q1 SEDIMENT/25 C/O.68U NACL/1 DAY					
83	8.356E-04	9.767E 01	8.2	-3.078	1.990
84	7.978E-04	9.829E 01	7.8	-3.098	1.993
85	8.249E-04	8.130E 01	6.7	-3.084	1.910
MEAN	8.194E-04	9.242E 01	7.6	-3.087	1.964
S.DEV.	1.948E-05	9.635E 00	0.8	0.010	0.047
RE-EXTRACTION					
83A	1.423E-05	5.705E 03	8.1	-4.847	3.756
84A	1.141E-05	6.844E 03	7.8	-4.943	3.835
85A	1.028E-05	6.539E 03	6.7	-4.988	3.816
MEAN	1.197E-05	6.363E 03	7.5	-4.926	3.802
S.DEV.	2.034E-06	5.896E 02	0.7	0.072	0.041
THORIUM,.0002M/Q1 SEDIMENT/25 C/O.68U NACL/1 DAY					
89	3.767E-08	5.462E 05	2.0	-7.424	5.737
90	1.408E-07	1.574E 05	2.2	-6.852	5.197
91	2.045E-07	1.086E 05	2.2	-6.689	5.036
MEAN	1.277E-07	2.707E 05	2.2	-6.988	5.323
S.DEV.	8.419E-08	2.398E 05	0.1	0.386	0.367
THORIUM,.002M/Q1 SEDIMENT/45 C/O.68U NACL/1 DAY					
70	5.918E-04	1.919E 02	11.4	-3.228	2.283
71	5.634E-04	2.024E 02	11.4	-3.249	2.306
72	5.976E-04	1.906E 02	11.4	-3.224	2.280
MEAN	5.843E-04	1.950E 02	11.4	-3.234	2.290
S.DEV.	1.830E-05	6.470E 00	0.0	0.013	0.014
RE-EXTRACTION					
70A	5.038E-06	2.265E 04	11.4	-5.298	4.355
71A	4.747E-06	2.411E 04	11.4	-5.324	4.382
72A	4.154E-06	2.749E 04	11.4	-5.382	4.439
MEAN	4.646E-06	2.475E 04	11.4	-5.335	4.392
S.DEV.	4.505E-07	2.483E 03	0.0	0.043	0.043
THORIUM,.0002M/Q1 SEDIMENT/45 C/O.68U NACL/1 DAY					
73	9.084E-08	2.207E 05	2.0	-7.042	5.344
74	8.365E-08	2.635E 05	2.2	-7.078	5.421
75	8.605E-08	2.573E 05	2.2	-7.065	5.410
MEAN	8.685E-08	2.472E 05	2.1	-7.062	5.392
S.DEV.	3.661E-09	2.313E 04	0.1	0.018	0.042
THORIUM,.02M/Q1 SEDIMENT/85 C/O.68U NACL/1 DAY					
34	1.133E-02	3.341E 01	37.9	-1.946	1.524
35	1.133E-02	3.569E 01	40.4	-1.946	1.552
36	1.112E-02	3.560E 01	39.6	-1.954	1.551
MEAN	1.126E-02	3.490E 01	39.3	-1.949	1.542
S.DEV.	1.212E-04	1.291E 00	1.3	0.005	0.016
RE-EXTRACTION					
34A	8.166E-06	4.996E 04	40.8	-5.088	4.699
35A	7.462E-06	5.889E 04	43.9	-5.127	4.770
36A	7.462E-06	5.716E 04	42.6	-5.127	4.757
MEAN	7.697E-06	5.534E 04	42.5	-5.114	4.742
S.DEV.	4.065E-07	4.736E 03	1.6	0.023	0.038

Sample ID	Cs	Kp	S	Log Cs	Log Kp
THORIUM,.02M/Q1 SEDIMENT/85 C/0.68U NACL/1 DAY					
98	1.084E-02	4.302E 01	46.7	-1.964	1.634
99	1.130E-02	3.177E 01	35.9	-1.947	1.502
999	1.108E-02	3.994E 01	44.3	-1.955	1.601
MEAN	1.108E-02	3.824E 01	42.3	-1.955	1.579
S.DEV.	2.200E-04	5.814E 00	5.7	0.009	0.069
RE-EXTRACTION INTO SEA WATER					
98A	1.105E-06	4.517E 05	49.9	-5.957	5.655
99A	1.768E-06	2.200E 05	38.9	-5.753	5.342
999A	1.989E-06	2.444E 05	48.6	-5.701	5.388
MEAN	1.621E-06	3.054E 05	45.8	-5.804	5.462
S.DEV.	4.600E-07	1.273E 05	6.0	0.135	0.169

THORIUM,.002M/Q1 SEDIMENT/85 C/0.68U NACL/1 DAY

38 5.653E-05 3.040E 03 17.2 -4.248 3.483

THORIUM,.002M/Q1 SEDIMENT/85 C/0.68U NACL/1 DAY

44 7.885E-05 2.365E 03 18.6 -4.103 3.374
 45 1.216E-04 1.665E 03 20.2 -3.915 3.221
 46 9.243E-05 1.958E 03 18.1 -4.034 3.292
 MEAN 9.763E-05 1.996E 03 19.0 -4.017 3.296
 S.DEV. 2.184E-05 3.515E 02 1.1 0.095 0.077

RE-EXTRACTION

44A 2.319E-07 8.046E 05 18.7 -6.635 5.906
 45A 2.114E-07 9.589E 05 20.3 -6.675 5.982
 46A 3.178E-07 5.703E 05 18.1 -6.498 5.756
 MEAN 2.537E-07 7.779E 05 19.0 -6.603 5.881
 S.DEV. 5.645E-08 1.957E 05 1.1 0.093 0.115

THORIUM,.002M/Q1 SEDIMENT/85 C/0.68U NACL/1 DAY

18-1 1.028E-04 1.952E 03 20.1 -3.988 3.291
 18-2 1.052E-04 1.874E 03 19.7 -3.978 3.273
 18-3 9.521E-05 2.022E 03 19.3 -4.021 3.306
 MEAN 1.011E-04 1.949E 03 19.7 -3.996 3.290
 S.DEV. 5.215E-06 7.404E 01 0.4 0.023 0.017

RE-EXTRACTION INTO SEA WATER

18-1A 7.230E-07 2.775E 05 20.1 -6.141 5.443
 18-2A 4.796E-07 4.111E 05 19.7 -6.319 5.614
 18-3A 3.438E-07 5.600E 05 19.3 -6.464 5.748
 MEAN 5.155E-07 4.162E 05 19.7 -6.308 5.602
 S.DEV. 1.921E-07 1.413E 05 0.4 0.162 0.153

THORIUM,.0002M/Q1 SEDIMENT/85 C/0.68U NACL/1 DAY

50 3.760E-08 5.398E 05 2.0 -7.425 5.732
 51 3.760E-08 5.101E 05 1.9 -7.425 5.708
 52 3.760E-08 5.232E 05 2.0 -7.425 5.719
 MEAN 3.760E-08 5.244E 05 2.0 -7.425 5.720
 S.DEV. 1.305E-14 1.488E 04 0.1 0.000 0.012

THORIUM,.0002M/Q1 SEDIMENT/85 C/0.68U NACL/1 DAY

19-1 8.614E-09 2.376E 06 2.0 -8.065 6.376
 19-2 2.174E-08 1.001E 06 2.2 -7.663 6.000
 19-3 1.951E-08 1.541E 06 3.0 -7.710 6.188
 MEAN 1.662E-08 1.639E 06 2.4 -7.813 6.188
 S.DEV. 7.024E-09 6.928E 05 0.5 0.220 0.188

THORIUM,.002M/T2 SEDIMENT/5 C/0.68U NACL/1 DAY

100 3.078E-04 8.618E 02 26.5 -3.512 2.935
 101 2.499E-04 1.271E 03 31.8 -3.602 3.104
 102 2.868E-04 9.470E 02 27.2 -3.542 2.976
 MEAN 2.815E-04 1.027E 03 28.5 -3.552 3.005
 S.DEV. 2.931E-05 2.159E 02 2.9 0.046 0.088

Sample ID	Cs	Kp	S	Log Cs	Log Kp
THORIUM,.0002M/T2 SEDIMENT/5 C/0.68U NACL/1 DAY					
106	3.540E-08	9.196E 05	3.3	-7.451	5.964
107	7.856E-08	3.861E 05	3.0	-7.105	5.587
108	1.137E-07	2.259E 05	3.7	-6.944	5.513
MEAN	7.589E-08	5.105E 05	3.3	-7.167	5.688
S.DEV.	3.922E-08	3.632E 05	0.3	0.259	0.242

THORIUM,.02M/T2 SEDIMENT/15 C/0.68U NACL/1 DAY

1 1.183E-02 3.599E 01 42.6 -1.927 1.556
 2 1.204E-02 3.618E 01 43.6 -1.919 1.559
 3 1.197E-02 3.420E 01 40.9 -1.922 1.534
 MEAN 1.195E-02 3.546E 01 42.4 -1.923 1.550
 S.DEV. 1.069E-04 1.092E 00 1.3 0.004 0.014

THORIUM,.002M/T2 SEDIMENT/15 C/0.68U NACL/1 DAY

7 1.908E-04 1.348E 03 25.7 -3.719 3.130

THORIUM,.002M/T2 SEDIMENT/15 C/0.68U NACL/1 DAY

11 1.248E-04 2.674E 03 33.4 -3.904 3.427
 12 8.743E-05 3.723E 03 32.5 -4.058 3.571
 13 3.973E-05 7.292E 03 29.0 -4.401 3.863
 MEAN 8.399E-05 4.563E 03 31.6 -4.121 3.620
 S.DEV. 4.264E-05 2.421E 03 2.3 0.254 0.222

RE-EXTRACTION

11A 3.562E-07 9.382E 05 33.4 -6.448 5.972
 12A 3.972E-08 8.204E 06 32.6 -7.401 6.914
 13A 7.688E-09 3.771E 07 29.0 -8.114 7.576
 MEAN 1.345E-07 1.562E 07 31.7 -7.321 6.821
 S.DEV. 1.926E-07 1.947E 07 2.4 0.836 0.806

THORIUM,.002M/T2 SEDIMENT/15 C/0.68U NACL/18 DAYS

22-1 1.650E-06 1.847E 05 30.5 -5.783 5.266
 22-2 1.128E-05 2.771E 04 31.3 -4.948 4.443
 22-3 8.267E-06 3.959E 04 32.7 -5.083 4.598
 MEAN 7.066E-06 8.400E 04 31.5 -5.271 4.769
 S.DEV. 4.926E-06 8.741E 04 1.1 0.448 0.437

THORIUM,.0002M/T2 SEDIMENT/15 C/0.68U NACL/1 DAY

60 3.760E-08 7.833E 05 2.9 -7.425 5.894
 61 3.760E-08 9.350E 05 3.5 -7.425 5.971
 62 3.760E-08 8.716E 05 3.3 -7.425 5.940
 MEAN 3.760E-08 8.633E 05 3.2 -7.425 5.935
 S.DEV. 1.305E-14 7.619E 04 0.3 0.000 0.039

THORIUM,.0002M/T2 SEDIMENT/15 C/IN SEA WATER/1 DAY

21-1 3.632E-09 7.519E 06 2.7 -8.440 6.876
 21-2 3.632E-09 7.735E 06 2.8 -8.440 6.888
 21-3 3.632E-09 7.906E 06 2.9 -8.440 6.898
 MEAN 3.632E-09 7.720E 06 2.8 -8.440 6.887
 S.DEV. 2.719E-16 1.939E 05 0.1 0.000 0.011

THORIUM,.002M/T2 SEDIMENT/25 C/0.68U NACL/1 DAY

103 4.799E-05 6.239E 03 29.9 -4.319 3.795
 104 2.248E-05 1.259E 04 28.3 -4.648 4.100
 105 4.449E-05 7.308E 03 32.5 -4.352 3.864
 MEAN 3.832E-05 8.712E 03 30.2 -4.440 3.920
 S.DEV. 1.383E-05 3.400E 03 2.1 0.181 0.160

Sample ID	Cs	Kp	S	Log Cs	Log Kp
THORIUM, .0002M/T2 SEDIMENT/25 C/0.68U NACL/1 DAY					
109	5.795E-08	5.755E 05	3.3	-7.237	5.740
110	3.540E-08	1.110E 06	3.9	-7.451	6.045
111	7.007E-08	4.851E 05	3.4	-7.154	5.686
MEAN	5.447E-08	7.235E 05	3.5	-7.281	5.830
S.DEV.	1.759E-08	3.377E 05	0.3	0.153	0.190

THORIUM, .002M/T2 SEDIMENT/45 C/0.68U NACL/1 DAY					
63	4.689E-07	6.785E 05	31.8	-6.329	5.832
64	1.019E-06	3.154E 05	32.1	-5.992	5.499
65	7.830E-07	3.938E 05	30.8	-6.106	5.595
MEAN	7.570E-07	4.626E 05	31.6	-6.142	5.642
S.DEV.	2.760E-07	1.911E 05	0.7	0.171	0.171

THORIUM, .0002M/T2 SEDIMENT/45 C/0.68U NACL/1 DAY					
66	3.499E-08	8.699E 05	3.0	-7.456	5.939
67	3.499E-08	8.939E 05	3.1	-7.456	5.951
68	8.485E-08	3.987E 05	3.4	-7.071	5.601
MEAN	5.161E-08	7.208E 05	3.2	-7.328	5.830
S.DEV.	2.879E-08	2.792E 05	0.2	0.222	0.199

THORIUM, .02M/T2 SEDIMENT/85 C/0.68U NACL/1 DAY					
4	9.434E-03	1.125E 02	106.1	-2.025	2.051
5	8.407E-03	1.291E 02	107.2	-2.081	2.111
6	8.941E-03	1.202E 02	107.5	-2.049	2.080
MEAN	8.927E-03	1.206E 02	106.9	-2.052	2.081
S.DEV.	5.136E-04	8.307E 00	0.7	0.028	0.030

RE-EXTRACTION					
4A	5.132E-05	2.163E 04	111.0	-4.290	4.335
5A	5.871E-05	1.887E 04	110.8	-4.231	4.276
6A	4.611E-05	2.408E 04	111.1	-4.336	4.382
MEAN	5.205E-05	2.153E 04	111.0	-4.286	4.331
S.DEV.	6.331E-06	2.607E 03	0.2	0.053	0.053

THORIUM, .02M/T2 SEDIMENT/85 C/0.68U NACL/1 DAY					
17-1	9.236E-03	1.177E 02	108.7	-2.034	2.071
17-2	9.342E-03	1.080E 02	100.9	-2.030	2.034
17-3	9.124E-03	1.156E 02	105.5	-2.040	2.063
MEAN	9.234E-03	1.138E 02	105.0	-2.035	2.056
S.DEV.	1.090E-04	5.103E 00	3.9	0.005	0.019

RE-EXTRACTION INTO SEA WATER					
17-1A	2.431E-06	4.655E 05	113.2	-5.614	5.668
17-2A	1.768E-06	5.931E 05	104.9	-5.753	5.773
17-3A	1.547E-06	7.075E 05	109.4	-5.811	5.850
MEAN	1.915E-06	5.887E 05	109.2	-5.726	5.764
S.DEV.	4.600E-07	1.211E 05	4.2	0.101	0.091

THORIUM, .002M/T2 SEDIMENT/85 C/0.68U NACL/1 DAY					
B	3.027E-06	1.001E 05	30.3	-5.519	5.001

THORIUM, .002M/T2 SEDIMENT/85 C/0.68U NACL/1 DAY					
14	3.145E-07	9.779E 05	30.8	-6.502	5.990
15	3.145E-07	9.679E 05	30.4	-6.502	5.986
16	8.811E-07	3.462E 05	30.5	-6.055	5.539
MEAN	5.034E-07	7.640E 05	30.6	-6.353	5.838
S.DEV.	3.271E-07	3.619E 05	0.2	0.258	0.259

THORIUM, .0002M/T2 SEDIMENT/85 C/0.68U NACL/1 DAY					
57	3.760E-08	8.863E 05	3.3	-7.425	5.948
58	3.760E-08	9.483E 05	3.6	-7.425	5.977
59	3.760E-08	9.044E 05	3.4	-7.425	5.956
MEAN	3.760E-08	9.130E 05	3.4	-7.425	5.960
S.DEV.	1.305E-14	3.188E 04	0.1	0.000	0.015

Sample ID	Cs	Kp	S	Log Cs	Log Kp
THORIUM, .0002M/T2 SEDIMENT/85 C/0.68U NACL/1 DAY					
16-1	1.277E-09	2.913E 07	3.7	-8.894	7.464
16-2	1.492E-09	2.171E 07	3.2	-8.826	7.337
16-3	9.122E-10	3.696E 07	3.4	-9.040	7.568
MEAN	1.227E-09	2.927E 07	3.4	-8.920	7.456
S.DEV.	2.931E-10	7.626E 06	0.3	0.109	0.116

URANYL, .02M/Q1 SEDIMENT/15 C/0.68U NACL/1 DAY					
12-4	KD<0				
12-5	1.968E-02	5.929E 00	11.7	-1.706	0.773
12-6	1.975E-02	5.537E 00	10.9	-1.704	0.743
MEAN	1.971E-02	5.733E 00	11.3	-1.705	0.758
S.DEV.	4.950E-05	2.772E-01	0.5	0.001	0.021

URANYL, .002M/Q1 SEDIMENT/15 C/0.68U NACL/1 DAY					
12-8	1.778E-03	2.253E 01	4.0	-2.750	1.353

URANYL, .02M/Q1 SEDIMENT/85 C/0.68U NACL/1 DAY					
12-1	2.003E-02	2.605E 00	5.2	-1.698	0.415
12-2	2.048E-02	1.591E 00	3.3	-1.689	0.201
12-3	2.010E-02	2.856E 00	5.7	-1.697	0.455
MEAN	2.020E-02	2.351E 00	4.7	-1.695	0.357
S.DEV.	2.421E-04	6.698E-01	1.3	0.005	0.137

URANYL, .002M/Q1 SEDIMENT/85 C/0.68U NACL/1 DAY					
12-7	1.670E-03	3.613E 01	6.0	-2.777	1.558

URANYL, .02M/T2 SEDIMENT/15 C/0.68U NACL/1 DAY					
13-4	1.764E-02	3.894E 01	68.7	-1.754	1.590
13-5	1.764E-02	3.802E 01	67.1	-1.754	1.580
13-6	1.670E-02	5.747E 01	96.0	-1.777	1.759
MEAN	1.733E-02	4.481E 01	77.2	-1.762	1.643
S.DEV.	5.427E-04	1.097E 01	16.2	0.013	0.101

URANYL, .002M/T2 SEDIMENT/15 C/0.68U NACL/1 DAY					
13-8	1.143E-03	1.846E 02	21.1	-2.942	2.266

URANYL, .002M/T2 SEDIMENT/15C/0.68U NACL/1 DAY					
14-1	1.205E-03	1.551E 02	18.7	-2.919	2.191
14-2	1.205E-03	1.742E 02	21.0	-2.919	2.241
14-3	1.174E-03	1.569E 02	18.4	-2.930	2.196
MEAN	1.195E-03	1.621E 02	19.4	-2.923	2.209
S.DEV.	1.790E-05	1.055E 01	1.4	0.006	0.028

URANYL, .002M/T2 SEDIMENT/15 C/IN WATER/1 DAY					
15-1	7.228E-04	4.086E 02	29.5	-3.141	2.611
15-2	7.657E-04	4.330E 02	33.2	-3.116	2.636
15-3	7.074E-04	4.527E 02	32.0	-3.150	2.656
MEAN	7.320E-04	4.314E 02	31.6	-3.136	2.634
S.DEV.	3.021E-05	2.209E 01	1.9	0.018	0.023

URANYL, .02M/T2 SEDIMENT/85 C/0.68U NACL/1 DAY					
13-1	1.687E-02	4.963E 01	83.7	-1.773	1.696
13-2	1.642E-02	5.899E 01	96.9	-1.785	1.771
13-3	1.642E-02	5.269E 01	86.5	-1.785	1.722
MEAN	1.657E-02	5.377E 01	89.0	-1.781	1.730
S.DEV.	2.598E-04	4.773E 00	6.9	0.007	0.038

URANYL, .002M/T2 SEDIMENT/85 C/0.68U NACL/1 DAY					
13-7	3.326E-04	1.214E 03	40.4	-3.478	3.084

Appendix G

Tabulated experimental data for Eu sorption (excluding LL44-GPC3 samples). Experiments carried out in 0.68N NaCl solution. Sediments were dialyzed, freeze dried, equilibrated with 0.68N NaCl solution at experimental temperature and centrifuged, before being reacted with 0.68N NaCl solution containing EuCl_3 (Eu-154 spike). In each case, 100 mg of sediment was reacted with 25 ml of solution. After 24 hours, the solution was removed and filtered for counting. Column headings: C_s = concentration of dissolved Eu (moles) in equilibrium with sediment; K_p = partition coefficient for sediment/Eu-solution pair (ml/g); S = sorbed Eu (mM/100g). Sediments used:

CF1	ERDC 135BX	0°52.5'N	160°59.6'E	3509m
CN1	Equatow 27P	7°36.7'N	134°01.2'W	4430m
GPC-2	LL44-GPC2	30°20.9'N	157°50.85'W	5890m
RC1	CATO-36P	7°20.6'S	168°20.8'W	5668m
SR1	JYN-V-28P	14°13'N	146°24'W	4952m

CF (foram calcareous ooze), CN (nannofossil calcareous ooze), RC (pelagic "red" clay), and SR (radiolarian siliceous ooze) all from Scripps Institution of Oceanography. GPC-2 (pelagic clay) from about 30m sub-bottom depth, from Woods Hole Oceanographic Institution.

Sample ID	Cs	Kp	S	Log Cs	Log Kp
2/15/77					
EUROPIUM,.002M/CN1B SEDIMENT/15 C/0.68U NACL/1 DAY					
101-1	1.749E-03	32.1	5.61	-2.757	1.506
101-2	1.760E-03	28.2	4.96	-2.754	1.450
101-3	1.781E-03	25.9	4.61	-2.749	1.413
MEAN	1.763E-03	28.7	5.06	-2.754	1.456
STD.DEV.	1.612E-05	3.1	0.51	0.004	0.047
RE-EXTRACTION					
101-1A	1.342E-05	4290.0	5.75	-4.872	3.632
101-2A	1.940E-05	2600.0	5.05	-4.712	3.415
101-3A	2.077E-05	2300.0	4.78	-4.683	3.362
MEAN	1.786E-05	3060.0	5.20	-4.756	3.470
STD.DEV.	3.910E-06	1070.0	0.50	0.102	0.143
2/15/77					
EUROPIUM,.0005M/CN1A SEDIMENT/15 C/0.68U NACL/1 DAY					
100-4	2.905E-04	170.0	4.95	-3.537	2.231
100-5	2.846E-04	183.0	5.22	-3.546	2.263
100-6	2.846E-04	178.0	5.07	-3.546	2.251
MEAN	2.865E-04	177.0	5.08	-3.543	2.248
STD.DEV.	3.461E-06	6.6	0.14	0.005	0.016
RE-EXTRACTION					
100-4A	5.156E-07	97200.0	5.01	-6.288	4.987
100-5A	6.004E-07	87900.0	5.28	-6.221	4.944
100-6A	7.388E-07	71500.0	5.28	-6.131	4.854
MEAN	6.183E-07	85500.0	5.19	-6.214	4.929
STD.DEV.	1.126E-07	13000.0	0.16	0.078	0.068
2/15/77					
EUROPIUM,.0005M/CN1B SEDIMENT/15 C/0.68U NACL/1 DAY					
101-4	2.723E-04	201.0	5.48	-3.565	2.304
101-5	2.702E-04	201.0	5.44	-3.568	2.304
101-6	2.754E-04	197.0	5.43	-3.560	2.295
MEAN	2.726E-04	200.0	5.45	-3.564	2.301
STD.DEV.	2.635E-06	2.3	0.03	0.004	0.005
RE-EXTRACTION					
101-4A	6.049E-07	91500.0	5.54	-6.218	4.962
101-5A	5.186E-07	106000.0	5.49	-6.285	5.025
101-6A	5.201E-07	106000.0	5.52	-6.284	5.025
MEAN	5.479E-07	101000.0	5.51	-6.262	5.004
STD.DEV.	4.938E-08	8370.0	0.02	0.038	0.037
4/1/77					
EUROPIUM,.002M/RC1A SEDIMENT/15 C/0.68U NACL/1 DAY					
106-1	1.732E-03	32.9	5.70	-2.761	1.517
106-2	1.747E-03	30.0	5.24	-2.758	1.477
106-3	1.728E-03	33.4	5.76	-2.762	1.523
MEAN	1.735E-03	32.1	5.57	-2.761	1.506
STD.DEV.	9.973E-06	1.8	0.28	0.002	0.025
RE-EXTRACTION					
106C1A	1.006E-04	386.0	3.88	-3.997	2.587
106C2A	1.015E-04	335.0	3.40	-3.994	2.525
106C3A	9.989E-05	392.0	3.91	-4.000	2.593
MEAN	1.007E-04	371.0	3.73	-3.997	2.568
STD.DEV.	7.970E-07	31.3	0.29	0.003	0.038
4/1/77					
EUROPIUM,.002M/RC1B SEDIMENT/15 C/0.68U NACL/1 DAY					
107-1	1.726E-03	33.6	5.79	-2.763	1.526
107-2	1.714E-03	37.7	6.47	-2.766	1.577
107-3	1.710E-03	35.2	6.02	-2.767	1.546
MEAN	1.716E-03	35.5	6.09	-2.765	1.550
STD.DEV.	8.318E-06	2.1	0.34	0.002	0.026
RE-EXTRACTION					
107-1A	1.016E-04	383.0	3.89	-3.993	2.583
107-2A	9.930E-05	457.0	4.54	-4.003	2.660
107-3A	9.847E-05	428.0	4.22	-4.007	2.632
MEAN	9.978E-05	423.0	4.22	-4.001	2.625
STD.DEV.	1.595E-06	37.3	0.33	0.007	0.039

Sample ID	Cs	Kp	S	Log Cs	Log Kp
2/25/77					
EUROPIUM,.002M/CF1A SEDIMENT/15 C/0.68U NACL/1 DAY					
102-1	1.583E-03	61.4	9.73	-2.800	1.788
102-2	1.565E-03	63.4	9.92	-2.805	1.802
102-3	1.572E-03	60.7	9.55	-2.804	1.783
MEAN	1.573E-03	61.9	9.73	-2.803	1.791
STD.DEV.	9.252E-06	1.4	0.19	0.003	0.009
RE-EXTRACTION					
102-1A	2.406E-05	3960.0	9.53	-4.619	3.597
102-2A	3.024E-05	3240.0	9.80	-4.519	3.511
102-3A	2.028E-05	4620.0	9.37	-4.693	3.665
MEAN	2.486E-05	3940.0	9.57	-4.610	3.591
STD.DEV.	5.027E-06	690.0	0.22	0.087	0.077
2/25/77					
EUROPIUM,.002M/CF1B SEDIMENT/15 C/0.68U NACL/1 DAY					
103-1	1.562E-03	63.8	9.96	-2.806	1.805
103-2	1.561E-03	63.9	9.98	-2.807	1.806
103-3	1.583E-03	59.9	9.48	-2.801	1.778
MEAN	1.568E-03	62.5	9.81	-2.805	1.796
STD.DEV.	1.244E-05	2.3	0.28	0.003	0.016
RE-EXTRACTION					
103-1A	2.836E-05	3400.0	9.65	-4.547	3.532
103-2A	2.491E-05	3930.0	9.79	-4.604	3.594
103-3A	2.106E-05	4460.0	9.38	-4.676	3.649
MEAN	2.478E-05	3930.0	9.61	-4.609	3.592
STD.DEV.	3.649E-06	530.0	0.21	0.065	0.058
2/25/77					
EUROPIUM,.0005M/CF1A SEDIMENT/15 C/0.68U NACL/1 DAY					
102-4	1.869E-04	411.0	7.68	-3.728	2.614
102-5	1.828E-04	421.0	7.70	-3.738	2.625
102-6	1.809E-04	423.0	7.66	-3.743	2.627
MEAN	1.835E-04	419.0	7.68	-3.736	2.622
STD.DEV.	3.068E-06	6.4	0.02	0.007	0.007
RE-EXTRACTION					
102-4A	4.727E-07	163000.0	7.72	-6.325	5.213
102-5A	3.836E-07	201000.0	7.73	-6.416	5.304
102-6A	3.972E-07	193000.0	7.68	-6.401	5.286
MEAN	4.179E-07	186000.0	7.71	-6.381	5.268
STD.DEV.	4.801E-08	20000.0	0.02	0.049	0.048
2/25/77					
EUROPIUM,.0005M/CF1B SEDIMENT/15 C/0.68U NACL/1 DAY					
103-4	1.840E-04	409.0	7.53	-3.735	2.612
103-5	1.837E-04	412.0	7.57	-3.736	2.615
103-6	1.792E-04	431.0	7.72	-3.747	2.634
MEAN	1.823E-04	417.0	7.60	-3.739	2.620
STD.DEV.	2.686E-06	11.9	0.10	0.006	0.012
RE-EXTRACTION					
103-4A	4.757E-07	159000.0	7.56	-6.323	5.201
103-5A	6.509E-07	117000.0	7.60	-6.186	5.067
103-6A	4.622E-07	168000.0	7.75	-6.335	5.225
MEAN	5.296E-07	148000.0	7.64	-6.281	5.164
STD.DEV.	1.053E-07	27200.0	0.10	0.082	0.085
2/15/77					
EUROPIUM,.002M/CN1A SEDIMENT/15 C/0.68U NACL/1 DAY					
100-1	1.749E-03	29.4	5.15	-2.757	1.469
100-2	1.760E-03	27.3	4.80	-2.754	1.435
100-3	1.781E-03	25.7	4.58	-2.749	1.410
MEAN	1.763E-03	27.5	4.84	-2.754	1.438
STD.DEV.	1.612E-05	1.9	0.29	0.004	0.029
RE-EXTRACTION					
100-1A	1.146E-05	4710.0	5.39	-4.941	3.673
100-2A	1.297E-05	3840.0	4.98	-4.887	3.585
100-3A	1.568E-05	3000.0	4.71	-4.805	3.477
MEAN	1.337E-05	3850.0	5.03	-4.877	3.578
STD.DEV.	2.137E-06	855.0	0.35	0.068	0.098

Sample ID	Cs	Kp	S	Log Cs	Log Kp	
						4/1/77
EUROPIUM,.0005M/RC1A SEDIMENT/15 C/O.68U NACL/1 DAY						
106-4	3.278E-04	120.0	3.92	-3.484	2.078	
106-5	3.340E-04	116.0	3.87	-3.476	2.063	
106-6	3.271E-04	123.0	4.04	-3.485	2.091	
MEAN	3.296E-04	120.0	3.94	-3.482	2.078	
STD.DEV.	3.794E-06	3.5	0.09	0.005	0.014	
RE-EXTRACTION						
106-4A	1.922E-05	1870.0	3.59	-4.716	3.272	
106-5A	2.028E-05	1720.0	3.49	-4.693	3.236	
106-6A	2.196E-05	1640.0	3.60	-4.658	3.215	
MEAN	2.048E-05	1740.0	3.56	-4.689	3.241	
STD.DEV.	1.382E-06	117.0	0.06	0.029	0.029	
EUROPIUM,.0005M/RC1B SEDIMENT/15 C/O.68U NACL/1 DAY						4/1/77
107-4	3.074E-04	145.0	4.46	-3.512	2.162	
107-5	3.147E-04	141.0	4.44	-3.502	2.149	
107-6	3.076E-04	148.0	4.54	-3.512	2.169	
MEAN	3.099E-04	145.0	4.48	-3.509	2.160	
STD.DEV.	4.167E-06	3.5	0.05	0.006	0.010	
RE-EXTRACTION						
107-4A	2.097E-05	1940.0	4.06	-4.678	3.287	
107-5A	1.925E-05	2110.0	4.06	-4.716	3.324	
107-6A	1.940E-05	2160.0	4.19	-4.712	3.335	
MEAN	1.987E-05	2070.0	4.11	-4.702	3.315	
STD.DEV.	9.496E-07	115.0	0.08	0.020	0.025	
EUROPIUM,.002M/BR1A SEDIMENT/15 C/O.68U NACL/1 DAY						3/25/77
104-1	1.905E-03	6.6	1.25	-2.720	0.818	
104-2	1.908E-03	6.1	1.16	-2.719	0.783	
104-3	1.909E-03	6.0	1.15	-2.719	0.778	
MEAN	1.907E-03	6.2	1.19	-2.720	0.793	
STD.DEV.	2.446E-06	0.3	0.06	0.001	0.022	
RE-EXTRACTION						
104-1A	5.381E-05	112.0	0.60	-4.269	2.050	
104-2A	5.471E-05	90.1	0.49	-4.262	1.954	
104-3A	5.477E-05	92.1	0.50	-4.261	1.964	
MEAN	5.443E-05	98.1	0.53	-4.264	1.990	
STD.DEV.	5.411E-07	12.1	0.06	0.004	0.053	
EUROPIUM,.002M/BR1-B SEDIMENT/15 C/O.68U NACL/1 DAY						3/25/77
105-1	1.912E-03	5.9	1.12	-2.719	0.769	
105-2	1.920E-03	5.0	0.96	-2.717	0.698	
105-3	1.909E-03	6.2	1.18	-2.719	0.790	
MEAN	1.914E-03	5.7	1.09	-2.718	0.752	
STD.DEV.	5.368E-06	0.6	0.11	0.001	0.048	
RE-EXTRACTION						
105-1A	6.453E-05	39.0	0.25	-4.190	1.591	
105-2A	5.711E-05	31.7	0.18	-4.243	1.501	
105-3A	4.911E-05	137.0	0.67	-4.309	2.135	
MEAN	5.692E-05	69.1	0.37	-4.247	1.742	
STD.DEV.	7.714E-06	58.8	0.26	0.059	0.343	
EUROPIUM,.0005M/BR1-A SEDIMENT/15 C/O.68U NACL/1 DAY						3/25/77
104-4	4.445E-04	25.3	1.13	-3.352	1.404	
104-5	4.394E-04	28.1	1.23	-3.357	1.449	
104-6	4.401E-04	28.0	1.23	-3.356	1.447	
MEAN	4.413E-04	27.1	1.20	-3.355	1.433	
STD.DEV.	2.761E-06	1.6	0.06	0.003	0.025	
RE-EXTRACTION						
104-4A	1.722E-05	506.0	0.87	-4.764	2.704	
104-5A	1.793E-05	526.0	0.94	-4.746	2.721	
104-6A	1.721E-05	558.0	0.96	-4.764	2.747	
MEAN	1.745E-05	530.0	0.93	-4.758	2.724	
STD.DEV.	4.122E-07	26.2	0.05	0.010	0.022	

Sample ID	Cs	Kp	S	Log Cs	Log Kp	
						3/25/77
EUROPIUM,.0005M/BR1-B SEDIMENT/15 C/O.68U NACL/1 DAY						
105-4	4.443E-04	25.5	1.13	-3.352	1.406	
105-5	4.428E-04	25.6	1.13	-3.354	1.408	
105-6	4.417E-04	26.4	1.16	-3.355	1.421	
MEAN	4.429E-04	25.8	1.14	-3.354	1.412	
STD.DEV.	1.336E-06	0.5	0.02	0.001	0.008	
RE-EXTRACTION						
105-4A	1.994E-05	504.0	1.00	-4.700	2.702	
105-5A	1.720E-05	529.0	0.91	-4.765	2.723	
105-6A	1.821E-05	489.0	0.89	-4.740	2.690	
MEAN	1.845E-05	507.0	0.93	-4.735	2.705	
STD.DEV.	1.387E-06	20.2	0.06	0.032	0.017	
EUROPIUM,.002M/GPC2-1A SEDIMENT/15 C/O.68U NACL/1 DAY						4/15/77
108-1	1.774E-03	25.2	4.48	-2.751	1.402	
108-2	1.807E-03	20.9	3.78	-2.743	1.320	
108-3	1.784E-03	24.1	4.29	-2.749	1.381	
MEAN	1.788E-03	23.4	4.18	-2.748	1.368	
STD.DEV.	1.661E-05	2.2	0.36	0.004	0.042	
RE-EXTRACTION						
108-1A	9.873E-05	269.0	2.66	-4.005	2.430	
108-2A	9.794E-05	195.0	1.91	-4.009	2.291	
108-3A	9.902E-05	252.0	2.50	-4.004	2.401	
MEAN	9.856E-05	239.0	2.36	-4.006	2.374	
STD.DEV.	5.570E-07	38.8	0.39	0.002	0.073	
EUROPIUM,.002M/GPC2-1B SEDIMENT/15 C/O.68U NACL/1 DAY						4/15/77
109-1	1.810E-03	20.7	3.75	-2.742	1.317	
109-2	1.837E-03	17.2	3.15	-2.736	1.235	
109-3	1.823E-03	18.7	3.41	-2.739	1.271	
MEAN	1.823E-03	18.9	3.44	-2.739	1.274	
STD.DEV.	1.325E-05	1.8	0.30	0.003	0.041	
RE-EXTRACTION						
109-1A	8.920E-05	244.0	2.17	-4.050	2.387	
109-2A	9.029E-05	174.0	1.57	-4.044	2.240	
109-3A	1.035E-04	178.0	1.84	-3.985	2.250	
MEAN	9.434E-05	198.0	1.86	-4.026	2.292	
STD.DEV.	7.984E-06	39.3	0.30	0.036	0.082	
EUROPIUM,.0005M/GPC2-1A SEDIMENT/15 C/O.68U NACL/1 DAY						4/15/77
108-4	3.641E-04	83.9	3.05	-3.439	1.924	
108-5	3.700E-04	84.0	3.11	-3.432	1.924	
108-6	3.600E-04	90.3	3.25	-3.444	1.956	
MEAN	3.647E-04	86.1	3.14	-3.438	1.934	
STD.DEV.	5.064E-06	3.7	0.10	0.006	0.018	
RE-EXTRACTION						
108-4A	2.239E-05	1180.0	2.63	-4.650	3.070	
108-5A	2.492E-05	1030.0	2.57	-4.603	3.014	
108-6A	2.319E-05	1200.0	2.78	-4.635	3.079	
MEAN	2.350E-05	1140.0	2.66	-4.629	3.054	
STD.DEV.	1.291E-06	92.9	0.11	0.024	0.035	
EUROPIUM,.0005M/GPC2-1B SEDIMENT/15 C/O.68U NACL/1 DAY						4/15/77
109-4	3.884E-04	63.6	2.47	-3.411	1.803	
109-5	3.981E-04	58.7	2.34	-3.400	1.768	
109-6	4.028E-04	54.5	2.19	-3.395	1.736	
MEAN	3.964E-04	58.9	2.33	-3.402	1.769	
STD.DEV.	7.320E-06	4.6	0.14	0.008	0.034	
RE-EXTRACTION						
109-4A	1.913E-05	1120.0	2.14	-4.718	3.048	
109-5A	1.876E-05	1070.0	2.01	-4.727	3.029	
109-6A	1.535E-05	1260.0	1.94	-4.814	3.101	
MEAN	1.775E-05	1150.0	2.03	-4.753	3.059	
STD.DEV.	2.085E-06	98.5	0.10	0.053	0.037	

Sample ID	Cs	Kp	S	Log Cs	Log Kp
1/30/78					
EUROPIUM,.002M/GPC2-1C SEDIMENT/85 C/0.68U NACL/1 DAY					
211-1	1.636E-03	46.8	7.67	-2.786	1.671
211-2	1.619E-03	51.8	8.39	-2.791	1.714
211-3	1.660E-03	45.3	7.52	-2.780	1.656
MEAN	1.639E-03	48.0	7.86	-2.786	1.680
STD.DEV.	2.073E-05	3.4	0.46	0.005	0.030
RE-EXTRACTION					
211-1A	1.172E-04	497.0	5.83	-3.931	2.696
211-2A	1.154E-04	556.0	6.42	-3.938	2.745
211-3A	1.069E-04	517.0	5.53	-3.971	2.714
MEAN	1.132E-04	523.0	5.92	-3.947	2.718
STD.DEV.	5.488E-06	30.0	0.45	0.021	0.025
1/30/78					
EUROPIUM,.002M/GPC2-1D SEDIMENT/85 C/0.68U NACL/1 DAY					
212-1	1.649E-03	45.3	7.46	-2.783	1.656
212-2	1.644E-03	47.9	7.88	-2.784	1.680
212-3	1.627E-03	48.5	7.89	-2.789	1.686
MEAN	1.640E-03	47.2	7.74	-2.785	1.674
STD.DEV.	1.171E-05	1.7	0.24	0.003	0.016
RE-EXTRACTION					
212-1A	1.278E-04	431.0	5.50	-3.893	2.634
212-2A	1.191E-04	498.0	5.93	-3.924	2.697
212-3A	1.180E-04	507.0	5.98	-3.928	2.705
MEAN	1.216E-04	478.0	5.80	-3.915	2.679
STD.DEV.	5.368E-06	41.5	0.26	0.019	0.039
1/30/78					
EUROPIUM,.0005M/GPC2-1C SEDIMENT/85 C/0.68U NACL/1 DAY					
211-4	2.654E-04	209.0	5.54	-3.576	2.320
211-5	2.652E-04	207.0	5.49	-3.576	2.316
211-6	2.681E-04	200.0	5.35	-3.572	2.300
MEAN	2.662E-04	205.0	5.46	-3.575	2.312
STD.DEV.	1.625E-06	4.7	0.10	0.003	0.010
RE-EXTRACTION					
211-4A	2.612E-05	1930.0	5.04	-4.583	3.285
211-5A	2.503E-05	2000.0	5.00	-4.601	3.300
211-6A	2.736E-05	1780.0	4.86	-4.563	3.250
MEAN	2.617E-05	1900.0	4.97	-4.582	3.278
STD.DEV.	1.167E-06	112.0	0.09	0.019	0.026
1/30/78					
EUROPIUM,.0005M/GPC2-1D SEDIMENT/85 C/0.68U NACL/1 DAY					
212-4	2.678E-04	200.0	5.35	-3.572	2.300
212-5	2.526E-04	217.0	5.49	-3.597	2.337
212-6	2.782E-04	187.0	5.20	-3.556	2.272
MEAN	2.662E-04	201.0	5.35	-3.575	2.303
STD.DEV.	1.286E-05	15.0	0.14	0.021	0.032
RE-EXTRACTION					
212-4A	2.364E-05	2090.0	4.93	-4.626	3.319
212-5A	2.950E-05	1670.0	4.91	-4.530	3.221
212-6A	2.698E-05	1730.0	4.67	-4.569	3.238
MEAN	2.671E-05	1830.0	4.84	-4.575	3.259
STD.DEV.	2.941E-06	227.0	0.15	0.048	0.052

Sample ID	Cs	Kp	S	Log Cs	Log Kp
1/30/78					
EUROPIUM,.002M/GPC2 STANDARD SED/15 C/0.68U NACL/1 DAY					
209-1	1.769E-03	26.2	4.63	-2.752	1.418
209-2	1.760E-03	27.8	4.89	-2.754	1.444
209-3	1.768E-03	25.4	4.49	-2.752	1.405
MEAN	1.766E-03	26.5	4.67	-2.753	1.422
STD.DEV.	5.022E-06	1.2	0.20	0.001	0.020
RE-EXTRACTION					
209-1A	1.021E-04	278.0	2.84	-3.991	2.445
209-2A	1.044E-04	287.0	2.99	-3.981	2.457
209-3A	1.124E-04	236.0	2.66	-3.949	2.373
MEAN	1.063E-04	267.0	2.83	-3.974	2.425
STD.DEV.	5.413E-06	27.2	0.17	0.022	0.045
1/30/78					
EUROPIUM,.0005M/GPC2 STANDARD SED/15 C/0.68U NACL/1 DAY					
209-4	3.671E-04	80.0	2.94	-3.435	1.903
209-5	3.788E-04	67.7	2.56	-3.422	1.830
209-6	3.907E-04	61.1	2.39	-3.408	1.786
MEAN	3.789E-04	69.6	2.63	-3.422	1.840
STD.DEV.	1.183E-05	9.6	0.28	0.014	0.059
RE-EXTRACTION					
209-4A	2.838E-05	852.0	2.42	-4.547	2.930
209-5A	2.105E-05	1050.0	2.21	-4.677	3.022
209-6A	2.133E-05	958.0	2.04	-4.671	2.981
MEAN	2.359E-05	954.0	2.23	-4.631	2.978
STD.DEV.	4.154E-06	99.1	0.19	0.073	0.046
1/30/78					
EUROPIUM,.002M/GPC2 STANDARD SED/85 C/0.68U NACL/1 DAY					
210-1	1.642E-03	47.8	7.85	-2.785	1.680
210-2	1.616E-03	49.9	8.06	-2.792	1.698
210-3	1.616E-03	51.3	8.28	-2.791	1.710
MEAN	1.625E-03	49.7	8.07	-2.789	1.696
STD.DEV.	1.505E-05	1.7	0.22	0.004	0.015
RE-EXTRACTION					
210-1A	1.136E-04	507.0	5.76	-3.944	2.705
210-2A	1.202E-04	500.0	6.01	-3.920	2.699
210-3A	1.142E-04	547.0	6.25	-3.942	2.738
MEAN	1.160E-04	518.0	6.01	-3.936	2.714
STD.DEV.	3.637E-06	25.4	0.25	0.013	0.021
1/30/78					
EUROPIUM,.0005M/GPC2 STANDARD SED/85 C/0.68U NACL/1 DAY					
210-4	2.498E-04	223.0	5.58	-3.602	2.349
210-5	2.561E-04	222.0	5.69	-3.591	2.347
210-6	2.530E-04	222.0	5.62	-3.597	2.347
MEAN	2.530E-04	223.0	5.63	-3.597	2.347
STD.DEV.	3.154E-06	0.6	0.06	0.005	0.001
RE-EXTRACTION					
210-4A	2.883E-05	1750.0	5.04	-4.540	3.242
210-5A	2.593E-05	1990.0	5.16	-4.586	3.298
210-6A	2.236E-05	2340.0	5.23	-4.651	3.369
MEAN	2.570E-05	2020.0	5.14	-4.592	3.303
STD.DEV.	3.240E-06	297.0	0.10	0.055	0.063

Appendix H

Tabulated experimental data for Eu sorption by LL44-GPC3 (30°19.9'N, 157°49.4'W) sediments. Experiments carried out in 0.68N NaCl solution. Sediments were dialyzed, freeze dried, equilibrated with 0.68N NaCl solution at experimental temperature and centrifuged, before being reacted with 0.68N NaCl solution containing EuCl_3 (Eu-154 spike). In each case, 100 mg of sediment was reacted with 25 ml of solution. After 24 hours, the solution was removed and filtered for counting. Column headings: C_s = concentration of dissolved Eu (moles) in equilibrium with sediment; K_p = partition coefficient for sediment/Eu-solution pair (ml/g); S = sorbed Eu (mM/100g).

Sample depths:

<u>Sample ID</u>		<u>Sect.</u>
GPC3-2	58-68 + 77-87cm	23
3	172-182cm	22
4	272-282 + 297-307cm	21
5	387-397 + 422-432cm	20
6	540-550 + 580-590cm	19
7	690-710cm	18
8	832-842cm + 849-859cm	17
9	1045-1065cm	16
10	1157-1167 + 1187-1197cm	15
11	1314-1338cm	14
12	1501-1521cm	13
13	1610-1620 + 1670-1680cm	12
14	1815-1835cm	11
15	1920-1940cm	10
16	2055-2075cm	9
17	2191-2201 + 2211-2221cm	8
18	2365-2385cm	7
19	2435-2455vm (flow-in)	7

Sample ID	Cs	Kp	S	Log Cs	Log Kp
5/10/77					
EUROPIUM .002M/GPC3-2A SEDIMENT/15 C/0.68U NACL/1 DAY					
110-1	1.871E-03	12.3	2.29	-2.728	1.088
110-2	1.881E-03	11.2	2.11	-2.726	1.051
110-3	1.865E-03	13.6	2.53	-2.729	1.133
MEAN	1.872E-03	12.4	2.31	-2.728	1.091
STD.DEV.	7.969E-04	1.2	0.21	0.002	0.041
RE-EXTRACTION					
110-1A	7.527E-05	129.0	0.97	-4.123	2.110
110-2A	6.683E-05	135.0	0.90	-4.175	2.129
100-3A	7.311E-05	159.0	1.17	-4.136	2.202
MEAN	7.173E-05	141.0	1.01	-4.145	2.147
STD.DEV.	4.382E-06	15.9	0.14	0.027	0.049
5/10/77					
EUROPIUM .002M/GPC3-2B SEDIMENT/15 C/0.68U NACL/1 DAY					
111-1	1.860E-03	14.4	2.68	-2.730	1.158
111-2	1.853E-03	15.4	2.85	-2.732	1.187
111-3	1.858E-03	14.6	2.71	-2.731	1.164
MEAN	1.857E-03	14.8	2.75	-2.731	1.170
STD.DEV.	3.804E-06	0.5	0.09	0.001	0.015
RE-EXTRACTION					
111-1A	6.872E-05	206.0	1.42	-4.163	2.315
111-2A	6.727E-05	236.0	1.58	-4.172	2.372
111-3A	6.536E-05	232.0	1.52	-4.185	2.366
MEAN	6.712E-05	225.0	1.51	-4.173	2.351
STD.DEV.	1.686E-06	16.3	0.08	0.011	0.031
5/10/77					
EUROPIUM .0005M/GPC3-2A SEDIMENT/15 C/0.68U NACL/1 DAY					
110-4	4.081E-04	50.6	2.06	-3.389	1.704
110-5	4.122E-04	45.9	1.89	-3.385	1.662
110-6	4.154E-04	44.2	1.84	-3.382	1.645
MEAN	4.119E-04	46.9	1.93	-3.385	1.670
STD.DEV.	3.632E-06	3.3	0.12	0.004	0.030
RE-EXTRACTION					
110-4A	2.567E-05	593.0	1.52	-4.590	2.773
110-5A	2.577E-05	526.0	1.36	-4.589	2.721
110-6A	2.512E-05	539.0	1.35	-4.600	2.731
MEAN	2.552E-05	553.0	1.41	-4.593	2.742
STD.DEV.	3.550E-07	35.5	0.10	0.006	0.028
5/10/77					
EUROPIUM .0005M/GPC3-2B SEDIMENT/15 C/0.68U NACL/1 DAY					
111-4	4.077E-04	50.1	2.04	-3.390	1.700
111-5	4.107E-04	48.0	1.97	-3.386	1.681
111-6	4.115E-04	47.7	1.96	-3.386	1.678
MEAN	4.100E-04	48.6	1.99	-3.387	1.686
STD.DEV.	1.989E-06	1.3	0.04	0.002	0.012
RE-EXTRACTION					
111-4A	2.334E-05	670.0	1.56	-4.632	2.826
111-5A	2.390E-05	622.0	1.49	-4.622	2.794
111-6A	2.248E-05	669.0	1.50	-4.648	2.826
MEAN	2.324E-05	654.0	1.52	-4.634	2.815
STD.DEV.	7.172E-07	27.4	0.04	0.013	0.018

Sample ID	Cs	Kp	S	Log Cs	Log Kp
1/16/78					
EUROPIUM .002M/GPC3-2C SEDIMENT/85 C/0.68U NACL/1 DAY					
197-1	1.731E-03	37.7	6.53	-2.762	1.577
197-2	1.744E-03	36.1	6.29	-2.758	1.557
197-3	1.747E-03	34.6	6.04	-2.758	1.539
MEAN	1.741E-03	36.1	6.29	-2.759	1.557
STD.DEV.	8.244E-06	1.6	0.25	0.002	0.019
RE-EXTRACTION					
197-1A	8.779E-05	583.0	5.12	-4.057	2.766
197-2A	8.864E-05	563.0	4.99	-4.052	2.751
197-3A	8.965E-05	546.0	4.89	-4.047	2.737
MEAN	8.869E-05	564.0	5.00	-4.052	2.751
STD.DEV.	9.332E-07	18.5	0.11	0.005	0.014
1/16/78					
EUROPIUM .002M/GPC3-2D SEDIMENT/85 C/0.68U NACL/1 DAY					
198-1	1.765E-03	31.1	5.49	-2.753	1.492
198-2	1.749E-03	33.9	5.92	-2.757	1.530
198-3	1.751E-03	34.9	6.11	-2.757	1.543
MEAN	1.755E-03	33.3	5.84	-2.756	1.522
STD.DEV.	8.680E-06	2.0	0.32	0.002	0.026
RE-EXTRACTION					
198-1A	9.106E-05	473.0	4.31	-4.041	2.675
198-2A	9.193E-05	502.0	4.62	-4.036	2.701
198-3A	9.262E-05	515.0	4.77	-4.033	2.712
MEAN	9.187E-05	497.0	4.57	-4.037	2.694
STD.DEV.	7.808E-07	21.5	0.24	0.004	0.019
1/16/78					
EUROPIUM .0005M/GPC3-2C SEDIMENT/85 C/0.68U NACL/1 DAY					
197-4	3.000E-04	172.0	5.16	-3.523	2.235
197-5	3.021E-04	169.0	5.10	-3.520	2.227
197-6	2.866E-04	190.0	5.45	-3.543	2.279
MEAN	2.962E-04	177.0	5.24	-3.528	2.247
STD.DEV.	8.408E-06	11.4	0.19	0.012	0.028
RE-EXTRACTION					
197-4A	3.430E-05	1310.0	4.48	-4.465	3.116
197-5A	3.109E-05	1430.0	4.45	-4.507	3.155
197-6A	2.946E-05	1650.0	4.87	-4.531	3.219
MEAN	3.162E-05	1460.0	4.60	-4.501	3.163
STD.DEV.	2.464E-06	172.0	0.24	0.033	0.052
1/16/78					
EUROPIUM .0005M/GPC3-2D SEDIMENT/85 C/0.68U NACL/1 DAY					
198-4	3.098E-04	160.0	4.95	-3.509	2.203
198-5	3.023E-04	162.0	4.89	-3.520	2.209
198-6	3.278E-04	134.0	4.38	-3.484	2.126
MEAN	3.133E-04	152.0	4.74	-3.504	2.179
STD.DEV.	1.310E-05	15.6	0.31	0.018	0.046
RE-EXTRACTION					
198-4A	3.278E-05	1310.0	4.30	-4.484	3.117
198-5A	3.124E-05	1370.0	4.29	-4.505	3.137
198-6A	3.355E-05	1110.0	3.71	-4.474	3.043
MEAN	3.252E-05	1260.0	4.10	-4.488	3.099
STD.DEV.	1.176E-06	136.0	0.34	0.016	0.049

Sample ID	Cs	Kp	S	Log Cs	Log Kp
6/17/77					
EUROPIUM, .002M/GPC3-3A SEDIMENT/15 C/0.68U NACL/1 DAY					
124-1	1.867E-03	14.1	2.63	-2.729	1.149
124-2	1.863E-03	14.9	2.78	-2.730	1.174
124-3	1.858E-03	15.2	2.83	-2.731	1.183
MEAN	1.862E-03	14.8	2.75	-2.730	1.169
STD.DEV.	4.717E-06	0.6	0.10	0.001	0.017
RE-EXTRACTION					
124-1A	6.826E-05	199.0	1.36	-4.166	2.299
124-2A	6.198E-05	251.0	1.56	-4.208	2.400
124-3A	6.657E-05	235.0	1.57	-4.177	2.372
MEAN	6.560E-05	229.0	1.49	-4.183	2.357
STD.DEV.	3.246E-06	26.6	0.12	0.022	0.052
6/17/77					
EUROPIUM, .002M/GPC3-3B SEDIMENT/15 C/0.68U NACL/1 DAY					
125-1	1.855E-03	15.7	2.92	-2.732	1.196
125-2	1.861E-03	14.9	2.78	-2.730	1.174
125-3	1.853E-03	15.5	2.87	-2.732	1.190
MEAN	1.856E-03	15.4	2.86	-2.731	1.187
STD.DEV.	4.192E-06	0.4	0.07	0.001	0.011
RE-EXTRACTION					
125-1A	6.361E-05	264.0	1.68	-4.196	2.422
125-2A	6.353E-05	246.0	1.56	-4.197	2.391
125-3A	6.543E-05	255.0	1.67	-4.184	2.407
MEAN	6.419E-05	255.0	1.64	-4.193	2.407
STD.DEV.	1.074E-06	9.0	0.07	0.007	0.016
6/17/77					
EUROPIUM, .0005M/GPC3-3A SEDIMENT/15 C/0.68U NACL/1 DAY					
124-4	4.203E-04	42.5	1.79	-3.376	1.628
124-5	4.386E-04	30.8	1.35	-3.358	1.489
124-6	4.192E-04	42.9	1.80	-3.378	1.632
MEAN	4.260E-04	38.7	1.65	-3.371	1.583
STD.DEV.	1.092E-05	6.8	0.25	0.011	0.081
RE-EXTRACTION					
124-4A	2.073E-05	658.0	1.36	-4.683	2.818
124-5A	1.242E-05	899.0	1.12	-4.906	2.954
124-6A	1.956E-05	710.0	1.39	-4.709	2.851
MEAN	1.757E-05	756.0	1.29	-4.766	2.874
STD.DEV.	4.498E-06	127.0	0.15	0.122	0.071
6/17/77					
EUROPIUM, .0005M/GPC3-3B SEDIMENT/15 C/0.68U NACL/1 DAY					
125-4	4.105E-04	48.4	1.99	-3.387	1.684
125-5	4.174E-04	44.3	1.85	-3.379	1.646
125-6	4.166E-04	45.9	1.91	-3.380	1.662
MEAN	4.148E-04	46.2	1.91	-3.382	1.664
STD.DEV.	3.771E-06	2.1	0.07	0.004	0.019
RE-EXTRACTION					
125-4A	2.331E-05	643.0	1.50	-4.632	2.808
125-5A	2.325E-05	586.0	1.36	-4.634	2.768
125-6A	2.342E-05	599.0	1.40	-4.630	2.778
MEAN	2.333E-05	609.0	1.42	-4.632	2.784
STD.DEV.	8.547E-08	29.9	0.07	0.002	0.021

Sample ID	Cs	Kp	S	Log Cs	Log Kp
1/31/77					
EUROPIUM, .002M/GPC3-3C SEDIMENT/85 C/0.68U NACL/1 DAY					
213-1	1.749E-03	30.5	5.33	-2.757	1.484
213-2	1.738E-03	32.2	5.59	-2.760	1.508
213-3	1.720E-03	33.2	5.71	-2.764	1.521
MEAN	1.736E-03	31.9	5.54	-2.760	1.504
STD.DEV.	1.447E-05	1.4	0.19	0.004	0.019
RE-EXTRACTION					
213-1A	7.997E-05	491.0	3.93	-4.097	2.691
213-2A	8.016E-05	531.0	4.26	-4.096	2.725
213-3A	9.106E-05	471.0	4.29	-4.041	2.673
MEAN	8.373E-05	498.0	4.16	-4.078	2.696
STD.DEV.	6.346E-06	30.6	0.20	0.032	0.026
1/31/77					
EUROPIUM, .002M/GPC3-3D SEDIMENT/85 C/0.68U NACL/1 DAY					
214-1	1.742E-03	31.3	5.45	-2.759	1.495
214-2	1.697E-03	36.4	6.18	-2.770	1.561
214-3	1.699E-03	38.7	6.57	-2.770	1.587
MEAN	1.713E-03	35.4	6.06	-2.766	1.548
STD.DEV.	2.518E-05	3.8	0.57	0.006	0.047
RE-EXTRACTION					
214-1A	7.702E-05	545.0	4.20	-4.113	2.736
214-2A	8.584E-05	562.0	4.82	-4.066	2.750
214-3A	8.336E-05	614.0	5.12	-4.079	2.788
MEAN	8.207E-05	573.0	4.71	-4.086	2.758
STD.DEV.	4.545E-06	35.9	0.47	0.024	0.027
1/31/77					
EUROPIUM, .0005M/GPC3-3C SEDIMENT/85 C/0.68U NACL/1 DAY					
213-4	3.197E-04	130.0	4.17	-3.495	2.116
213-5	3.124E-04	137.0	4.27	-3.505	2.135
213-6	3.221E-04	128.0	4.11	-3.492	2.106
MEAN	3.181E-04	132.0	4.18	-3.497	2.119
STD.DEV.	5.063E-06	4.7	0.08	0.007	0.015
RE-EXTRACTION					
213-4A	2.955E-05	1200.0	3.54	-4.529	3.078
213-5A	3.115E-05	1170.0	3.65	-4.506	3.069
213-6A	2.969E-05	1190.0	3.52	-4.527	3.074
MEAN	3.013E-05	1190.0	3.57	-4.521	3.074
STD.DEV.	8.856E-07	15.4	0.07	0.013	0.005
1/31/77					
EUROPIUM, .0005M/GPC3-3D SEDIMENT/85 C/0.68U NACL/1 DAY					
214-4	3.227E-04	121.0	3.91	-3.491	2.083
214-5	3.115E-04	137.0	4.27	-3.506	2.137
214-6	3.277E-04	121.0	3.96	-3.484	2.082
MEAN	3.206E-04	126.0	4.05	-3.494	2.101
STD.DEV.	8.294E-06	9.2	0.20	0.011	0.031
RE-EXTRACTION					
214-4A	2.896E-05	1160.0	3.36	-4.538	3.064
214-5A	2.849E-05	1290.0	3.69	-4.545	3.112
214-6A	2.861E-05	1180.0	3.38	-4.543	3.072
MEAN	2.868E-05	1210.0	3.47	-4.542	3.083
STD.DEV.	2.436E-07	70.0	0.18	0.004	0.026

Sample ID	Cs	Kp	S	Log Cs	Log Kp
6/30/77					
EUROPIUM, .002M/GPC3-4A SEDIMENT/15 C/O.68U NACL/1 DAY					
132-1	1.865E-03	14.4	2.68	-2.729	1.157
132-2	1.872E-03	13.1	2.46	-2.728	1.119
132-3	1.859E-03	14.6	2.72	-2.731	1.165
MEAN	1.865E-03	14.0	2.62	-2.729	1.147
STD.DEV.	6.506E-06	0.8	0.14	0.001	0.025
RE-EXTRACTION					
132-1A	6.041E-05	250.0	1.51	-4.219	2.399
132-2A	5.666E-05	246.0	1.39	-4.247	2.390
132-3A	6.127E-05	250.0	1.53	-4.213	2.398
MEAN	5.945E-05	249.0	1.48	-4.226	2.396
STD.DEV.	2.449E-06	2.3	0.08	0.018	0.005
6/30/77					
EUROPIUM, .002M/GPC3-4B SEDIMENT/15 C/O.68U NACL/1 DAY					
133-1	1.870E-03	13.7	2.57	-2.728	1.137
133-2	1.874E-03	12.3	2.30	-2.727	1.090
133-3	1.865E-03	14.5	2.71	-2.729	1.162
MEAN	1.870E-03	13.5	2.53	-2.728	1.130
STD.DEV.	4.384E-06	1.1	0.21	0.001	0.037
RE-EXTRACTION					
133-1A	6.109E-05	224.0	1.37	-4.214	2.350
133-2A	5.108E-05	263.0	1.34	-4.292	2.419
133-3A	6.203E-05	238.0	1.47	-4.207	2.376
MEAN	5.807E-05	241.0	1.39	-4.238	2.382
STD.DEV.	6.066E-06	19.8	0.07	0.047	0.035
6/30/77					
EUROPIUM, .0005M/GPC3-4A SEDIMENT/15 C/O.68U NACL/1 DAY					
132-4	4.222E-04	41.1	1.74	-3.374	1.614
132-5	4.221E-04	41.2	1.74	-3.374	1.615
132-6	4.123E-04	48.2	1.99	-3.385	1.683
MEAN	4.189E-04	43.5	1.82	-3.378	1.637
STD.DEV.	5.709E-06	4.1	0.14	0.006	0.040
RE-EXTRACTION					
132-4A	2.174E-05	587.0	1.28	-4.663	2.769
132-5A	1.897E-05	711.0	1.35	-4.722	2.852
132-6A	2.268E-05	662.0	1.50	-4.644	2.821
MEAN	2.113E-05	653.0	1.38	-4.676	2.814
STD.DEV.	1.929E-06	62.5	0.12	0.040	0.042
6/30/77					
EUROPIUM, .0005M/GPC3-4B SEDIMENT/15 C/O.68U NACL/1 DAY					
133-4	4.200E-04	42.8	1.80	-3.377	1.632
133-5	4.327E-04	34.9	1.51	-3.364	1.542
133-6	4.207E-04	42.4	1.79	-3.376	1.628
MEAN	4.245E-04	40.1	1.70	-3.372	1.601
STD.DEV.	7.140E-06	4.5	0.16	0.007	0.051
RE-EXTRACTION					
133-4A	2.310E-05	563.0	1.30	-4.636	2.751
133-5A	1.286E-05	972.0	1.25	-4.891	2.988
133-6A	2.279E-05	568.0	1.29	-4.642	2.754
MEAN	1.958E-05	701.0	1.28	-4.723	2.831
STD.DEV.	5.825E-06	235.0	0.03	0.145	0.136

Sample ID	Cs	Kp	S	Log Cs	Log Kp
10/17/77					
EUROPIUM, .002M/GPC3-4A SEDIMENT/85 C/O.68U NACL/1 DAY					
176-1	1.811E-03	20.6	3.72	-2.742	1.313
176-2	1.822E-03	19.6	3.57	-2.739	1.292
176-3	1.828E-03	19.4	3.54	-2.738	1.287
MEAN	1.821E-03	19.8	3.61	-2.740	1.297
STD.DEV.	8.524E-06	0.6	0.10	0.002	0.014
RE-EXTRACTION					
176-1A	7.078E-05	360.0	2.55	-4.150	2.557
176-2A	6.669E-05	364.0	2.43	-4.176	2.561
176-3A	6.747E-05	350.0	2.36	-4.171	2.544
MEAN	6.831E-05	358.0	2.45	-4.166	2.554
STD.DEV.	2.173E-06	7.2	0.10	0.014	0.009
10/17/77					
EUROPIUM, .002M/GPC3-4B SEDIMENT/85 C/O.68U NACL/1 DAY					
177-1	1.837E-03	17.7	3.26	-2.736	1.249
177-2	1.838E-03	17.2	3.16	-2.736	1.235
177-3	1.825E-03	19.2	3.50	-2.739	1.283
MEAN	1.834E-03	18.0	3.31	-2.737	1.256
STD.DEV.	7.277E-06	1.0	0.18	0.002	0.025
RE-EXTRACTION					
177-1A	7.124E-05	300.0	2.14	-4.147	2.478
177-2A	6.524E-05	320.0	2.09	-4.185	2.505
177-3A	6.659E-05	361.0	2.40	-4.177	2.557
MEAN	6.769E-05	327.0	2.21	-4.170	2.513
STD.DEV.	3.149E-06	31.1	0.17	0.020	0.041
10/17/77					
EUROPIUM, .0005M/GPC3-4A SEDIMENT/85 C/O.68U NACL/1 DAY					
176-4	3.311E-04	116.0	3.85	-3.480	2.066
176-5	3.280E-04	118.0	3.88	-3.484	2.073
176-6	3.359E-04	113.0	3.79	-3.474	2.052
MEAN	3.317E-04	116.0	3.84	-3.479	2.064
STD.DEV.	3.978E-06	2.5	0.04	0.005	0.010
RE-EXTRACTION					
176-4A	1.812E-05	1930.0	3.50	-4.742	3.286
176-5A	1.926E-05	1840.0	3.54	-4.715	3.265
176-6A	2.719E-05	1190.0	3.24	-4.566	3.075
MEAN	2.152E-05	1650.0	3.43	-4.674	3.209
STD.DEV.	4.942E-06	404.0	0.17	0.095	0.116
10/17/77					
EUROPIUM, .0005M/GPC3-4B SEDIMENT/85 C/O.68U NACL/1 DAY					
177-4	3.284E-04	120.0	3.94	-3.484	2.079
177-5	3.322E-04	116.0	3.86	-3.479	2.065
177-6	3.363E-04	112.0	3.76	-3.473	2.048
MEAN	3.323E-04	116.0	3.85	-3.478	2.064
STD.DEV.	3.988E-06	4.0	0.09	0.005	0.015
RE-EXTRACTION					
177-4A	1.775E-05	2030.0	3.61	-4.751	3.308
177-5A	1.894E-05	1850.0	3.50	-4.723	3.267
177-6A	1.786E-05	1930.0	3.44	-4.748	3.284
MEAN	1.818E-05	1940.0	3.52	-4.740	3.286
STD.DEV.	6.586E-07	90.2	0.09	0.016	0.021

Sample ID	Cs	Kp	S	Log Cs	Log Kp
EUROPIUM, .002M/GPC3-5A SEDIMENT/15 C/0.68U NACL/1 DAY					
116-1	1.883E-03	10.9	2.05	-2.725	1.037
116-2	1.870E-03	12.6	2.36	-2.728	1.101
116-3	1.861E-03	14.1	2.63	-2.730	1.150
MEAN	1.871E-03	12.6	2.35	-2.728	1.096
STD.DEV.	1.122E-05	1.6	0.29	0.003	0.057
RE-EXTRACTION					
116-1A	6.749E-05	126.0	0.85	-4.171	2.102
116-2A	6.601E-05	175.0	1.14	-4.180	2.244
116-3A	6.923E-05	202.0	1.40	-4.160	2.306
MEAN	6.758E-05	168.0	1.14	-4.170	2.217
STD.DEV.	1.612E-06	38.5	0.27	0.010	0.105
EUROPIUM, .002M/GPC3-5B SEDIMENT/15 C/0.68U NACL/1 DAY					
117-1	1.841E-03	15.6	2.87	-2.735	1.193
117-2	1.849E-03	15.1	2.80	-2.733	1.180
117-3	1.863E-03	13.7	2.55	-2.730	1.136
MEAN	1.851E-03	14.8	2.74	-2.733	1.170
STD.DEV.	1.145E-05	1.0	0.17	0.003	0.030
RE-EXTRACTION					
117-1A	6.997E-05	247.0	1.73	-4.155	2.393
117-2A	6.808E-05	233.0	1.58	-4.167	2.367
117-3A	6.811E-05	191.0	1.30	-4.167	2.281
MEAN	6.872E-05	224.0	1.54	-4.163	2.347
STD.DEV.	1.081E-06	29.1	0.22	0.007	0.059
EUROPIUM, .0005M/GPC3-5A SEDIMENT/15 C/0.68U NACL/1 DAY					
116-4	4.171E-04	43.2	1.80	-3.380	1.635
116-5	4.154E-04	41.2	1.71	-3.381	1.615
116-6	4.151E-04	44.9	1.87	-3.382	1.653
MEAN	4.159E-04	43.1	1.79	-3.381	1.634
STD.DEV.	1.096E-06	1.9	0.08	0.001	0.019
RE-EXTRACTION					
116-4A	2.439E-05	537.0	1.31	-4.613	2.730
116-5A	2.397E-05	526.0	1.26	-4.620	2.721
116-6A	2.498E-05	546.0	1.36	-4.602	2.737
MEAN	2.445E-05	536.0	1.31	-4.612	2.729
STD.DEV.	5.066E-07	10.0	0.05	0.009	0.008
EUROPIUM, .0005M/GPC3-5B SEDIMENT/15 C/0.68U NACL/1 DAY					
117-4	4.090E-04	45.4	1.86	-3.388	1.657
117-5	4.215E-04	39.7	1.67	-3.375	1.599
117-6	4.156E-04	44.1	1.83	-3.381	1.645
MEAN	4.153E-04	43.1	1.79	-3.382	1.634
STD.DEV.	6.258E-06	3.0	0.10	0.006	0.031
RE-EXTRACTION					
117-4A	2.446E-05	571.0	1.40	-4.612	2.756
117-5A	2.197E-05	564.0	1.24	-4.658	2.751
117-6A	2.283E-05	602.0	1.38	-4.641	2.780
MEAN	2.308E-05	579.0	1.34	-4.637	2.762
STD.DEV.	1.265E-06	20.2	0.09	0.024	0.015

Sample ID	Cs	Kp	S	Log Cs	Log Kp
EUROPIUM, .002M/GPC3-5A SEDIMENT/85 C/0.68U NACL/1 DAY					
156-1	1.752E-03	28.9	5.07	-2.756	1.461
156-2	1.754E-03	29.8	5.22	-2.756	1.474
156-3	1.747E-03	28.8	5.04	-2.758	1.460
MEAN	1.751E-03	29.2	5.11	-2.757	1.465
STD.DEV.	3.364E-06	0.5	0.10	0.001	0.008
RE-EXTRACTION					
156-1A	7.381E-05	544.0	4.01	-4.132	2.735
156-2A	7.840E-05	508.0	3.98	-4.106	2.706
156-3A	7.594E-05	516.0	3.92	-4.119	2.712
MEAN	7.605E-05	522.0	3.97	-4.119	2.718
STD.DEV.	2.297E-06	18.9	0.05	0.013	0.016
EUROPIUM, .002M/GPC3-5B SEDIMENT/85 C/0.68U NACL/1 DAY					
157-1	1.754E-03	28.6	5.01	-2.756	1.456
157-2	1.737E-03	30.1	5.22	-2.760	1.478
157-3	1.748E-03	29.8	5.20	-2.757	1.474
MEAN	1.746E-03	29.5	5.15	-2.758	1.469
STD.DEV.	8.195E-06	0.8	0.12	0.002	0.012
RE-EXTRACTION					
157-1A	7.805E-05	501.0	3.91	-4.108	2.700
157-2A	8.410E-05	471.0	3.96	-4.075	2.673
157-3A	7.278E-05	565.0	4.11	-4.138	2.752
MEAN	7.831E-05	512.0	3.99	-4.107	2.708
STD.DEV.	5.664E-06	48.0	0.11	0.031	0.040
EUROPIUM, .0005M/GPC3-5A SEDIMENT/85 C/0.68U NACL/1 DAY					
156-4	3.119E-04	136.0	4.25	-3.506	2.134
156-5	3.281E-04	118.0	3.86	-3.484	2.071
156-6	3.044E-04	140.0	4.26	-3.517	2.146
MEAN	3.148E-04	131.0	4.12	-3.502	2.117
STD.DEV.	1.209E-05	11.7	0.23	0.017	0.040
RE-EXTRACTION					
156-4A	2.227E-05	1720.0	3.84	-4.652	3.237
156-5A	2.184E-05	1580.0	3.46	-4.661	3.199
156-6A	2.218E-05	1730.0	3.85	-4.654	3.239
MEAN	2.210E-05	1680.0	3.72	-4.656	3.225
STD.DEV.	2.230E-07	84.0	0.22	0.004	0.022
EUROPIUM, .0005M/GPC3-5B SEDIMENT/85 C/0.68U NACL/1 DAY					
157-4	3.175E-04	128.0	4.07	-3.498	2.108
157-5	3.138E-04	131.0	4.10	-3.503	2.116
157-6	3.090E-04	132.0	4.08	-3.510	2.120
MEAN	3.134E-04	130.0	4.08	-3.504	2.115
STD.DEV.	4.277E-06	2.1	0.01	0.006	0.006
RE-EXTRACTION					
157-4A	2.225E-05	1640.0	3.65	-4.653	3.215
157-5A	2.151E-05	1740.0	3.75	-4.667	3.241
157-6A	2.249E-05	1640.0	3.69	-4.648	3.215
MEAN	2.208E-05	1670.0	3.70	-4.656	3.224
STD.DEV.	5.118E-07	57.7	0.05	0.010	0.015

Sample ID	Cs	Kp	S	Log Cs	Log Kp
EUROPIUM, .002M/GPC3-6A SEDIMENT/15 C/O.68U NACL/1 DAY 6/24/77					
128-1	1.845E-03	17.0	3.14	-2.734	1.231
128-2	1.852E-03	15.4	2.84	-2.732	1.186
128-3	1.837E-03	17.2	3.15	-2.736	1.235
MEAN	1.845E-03	16.5	3.05	-2.734	1.217
STD.DEV.	7.385E-06	1.0	0.18	0.002	0.027
RE-EXTRACTION					
128-1A	6.906E-05	270.0	1.86	-4.161	2.431
128-2A	7.229E-05	195.0	1.41	-4.141	2.291
128-3A	7.170E-05	250.0	1.79	-4.144	2.398
MEAN	7.102E-05	238.0	1.69	-4.149	2.373
STD.DEV.	1.720E-06	38.8	0.24	0.011	0.073
EUROPIUM, .002M/GPC3-6B SEDIMENT/15 C/O.68U NACL/1 DAY 6/24/77					
129-1	1.823E-03	18.8	3.43	-2.739	1.275
129-2	1.840E-03	17.3	3.18	-2.735	1.237
129-3	1.851E-03	16.4	3.04	-2.733	1.216
MEAN	1.838E-03	17.5	3.22	-2.736	1.243
STD.DEV.	1.421E-05	1.2	0.20	0.003	0.030
RE-EXTRACTION					
129-1A	7.504E-05	271.0	2.04	-4.125	2.434
129-2A	6.524E-05	297.0	1.93	-4.185	2.472
129-3A	6.182E-05	297.0	1.84	-4.209	2.473
MEAN	6.737E-05	288.0	1.94	-4.173	2.460
STD.DEV.	6.862E-06	15.0	0.10	0.043	0.022
EUROPIUM, .0005M/GPC3-6A SEDIMENT/15 C/O.68U NACL/1 DAY 6/24/77					
128-4	4.070E-04	50.2	2.04	-3.390	1.701
128-5	4.042E-04	52.4	2.12	-3.393	1.719
128-6	4.024E-04	54.7	2.20	-3.395	1.738
MEAN	4.046E-04	52.4	2.12	-3.393	1.719
STD.DEV.	2.322E-06	2.2	0.08	0.002	0.019
RE-EXTRACTION					
128-4A	2.106E-05	772.0	1.63	-4.677	2.888
128-5A	2.180E-05	772.0	1.68	-4.662	2.887
128-6A	2.216E-05	785.0	1.74	-4.654	2.895
MEAN	2.167E-05	776.0	1.68	-4.664	2.890
STD.DEV.	5.628E-07	7.5	0.06	0.011	0.004
EUROPIUM, .0005M/GPC3-6B SEDIMENT/15 C/O.68U NACL/1 DAY 6/24/77					
129-4	4.054E-04	51.3	2.08	-3.392	1.710
129-5	4.020E-04	53.9	2.17	-3.396	1.732
129-6	3.995E-04	55.1	2.20	-3.398	1.741
MEAN	4.023E-04	53.5	2.15	-3.395	1.728
STD.DEV.	2.965E-06	1.9	0.06	0.003	0.016
RE-EXTRACTION					
129-4A	2.244E-05	721.0	1.62	-4.649	2.858
129-5A	2.237E-05	765.0	1.71	-4.650	2.883
129-6A	2.198E-05	798.0	1.75	-4.658	2.902
MEAN	2.226E-05	761.0	1.69	-4.652	2.881
STD.DEV.	2.475E-07	38.6	0.07	0.005	0.022

Sample ID	Cs	Kp	S	Log Cs	Log Kp
EUROPIUM, .002M/GPC3-6C SEDIMENT/85 C/O.68U NACL/1 DAY 10/26/77					
180-1	1.738E-03	31.5	5.47	-2.760	1.498
180-2	1.839E-03	17.1	3.15	-2.735	1.233
180-3	1.803E-03	20.8	3.74	-2.744	1.317
MEAN	1.793E-03	23.1	4.12	-2.746	1.349
STD.DEV.	5.140E-05	7.5	1.21	0.012	0.135
RE-EXTRACTION					
180-1A	9.741E-05	437.0	4.26	-4.011	2.641
180-2A	7.564E-05	277.0	2.09	-4.121	2.442
180-3A	9.164E-05	296.0	2.72	-4.038	2.472
MEAN	8.823E-05	337.0	3.02	-4.057	2.518
STD.DEV.	1.128E-05	87.4	1.12	0.057	0.107
EUROPIUM, .002M/GPC3-6D SEDIMENT/85 C/O.68U NACL/1 DAY 10/26/77					
181-1	1.826E-03	19.0	3.48	-2.738	1.279
181-2	1.755E-03	27.5	4.83	-2.756	1.439
181-3	1.813E-03	20.0	3.62	-2.741	1.301
MEAN	1.798E-03	22.2	3.98	-2.745	1.340
STD.DEV.	3.796E-05	4.6	0.74	0.009	0.087
RE-EXTRACTION					
181-1A	8.166E-05	296.0	2.42	-4.088	2.471
181-2A	8.592E-05	424.0	3.65	-4.066	2.628
181-3A	8.161E-05	297.0	2.42	-4.088	2.473
MEAN	8.306E-05	339.0	2.83	-4.081	2.524
STD.DEV.	2.474E-06	73.6	0.71	0.013	0.090
EUROPIUM, .0005M/GPC3-6C SEDIMENT/85 C/O.68U NACL/1 DAY 10/26/77					
180-4	3.166E-04	131.0	4.15	-3.499	2.118
180-5	2.920E-04	159.0	4.65	-3.535	2.202
180-6	2.887E-04	166.0	4.80	-3.540	2.220
MEAN	2.991E-04	152.0	4.53	-3.525	2.180
STD.DEV.	1.525E-05	18.5	0.34	0.022	0.055
RE-EXTRACTION					
180-4A	1.659E-05	2340.0	3.88	-4.780	3.369
180-5A	1.682E-05	2600.0	4.38	-4.774	3.415
180-6A	1.716E-05	2630.0	4.52	-4.765	3.420
MEAN	1.686E-05	2520.0	4.26	-4.773	3.402
STD.DEV.	2.876E-07	159.0	0.33	0.007	0.028
EUROPIUM, .0005M/GPC3-6D SEDIMENT/85 C/O.68U NACL/1 DAY 10/26/77					
181-4	2.801E-04	172.0	4.83	-3.553	2.237
181-5	2.926E-04	162.0	4.74	-3.534	2.210
181-6	2.726E-04	195.0	5.31	-3.564	2.290
MEAN	2.818E-04	176.0	4.96	-3.550	2.245
STD.DEV.	1.014E-05	16.9	0.31	0.016	0.041
RE-EXTRACTION					
181-4A	1.518E-05	3010.0	4.58	-4.819	3.479
181-5A	1.736E-05	2560.0	4.44	-4.760	3.408
181-6A	1.595E-05	3160.0	5.04	-4.797	3.500
MEAN	1.616E-05	2910.0	4.69	-4.792	3.462
STD.DEV.	1.105E-06	312.0	0.31	0.029	0.048

Sample ID	Cs	Kp	S	Log Cs	Log Kp
EUROPIUM,.002M/GPC3-7A SEDIMENT/15 C/O.68U NACL/1 DAY 5/27/77					
120-1	1.801E-03	22.7	4.08	-2.745	1.355
120-2	1.793E-03	22.8	4.09	-2.746	1.358
120-3	1.783E-03	24.0	4.27	-2.749	1.380
MEAN	1.792E-03	23.1	4.15	-2.747	1.364
STD.DEV.	8.880E-06	0.7	0.11	0.002	0.013
RE-EXTRACTION					
120-1A	7.240E-05	372.0	2.69	-4.140	2.570
120-2A	7.573E-05	349.0	2.64	-4.121	2.542
120-3A	8.170E-05	333.0	2.72	-4.088	2.522
MEAN	7.661E-05	351.0	2.68	-4.116	2.545
STD.DEV.	4.716E-06	19.6	0.04	0.026	0.024
EUROPIUM,.002M/GPC3-7B SEDIMENT/15 C/O.68U NACL/1 DAY 5/27/77					
121-1	1.792E-03	22.9	4.10	-2.747	1.359
121-2	1.811E-03	22.1	4.01	-2.742	1.345
121-3	1.808E-03	21.9	3.96	-2.743	1.341
MEAN	1.804E-03	22.3	4.02	-2.744	1.348
STD.DEV.	1.013E-05	0.5	0.07	0.002	0.010
RE-EXTRACTION					
121-1A	7.240E-05	390.0	2.82	-4.140	2.591
121-2A	7.573E-05	328.0	2.48	-4.121	2.515
121-3A	8.170E-05	289.0	2.36	-4.088	2.461
MEAN	7.661E-05	336.0	2.56	-4.116	2.522
STD.DEV.	4.716E-06	50.9	0.24	0.026	0.065
EUROPIUM,.0005M/GPC3-7A SEDIMENT/15 C/O.68U NACL/1 DAY 5/27/77					
120-4	3.661E-04	81.4	2.98	-3.436	1.910
120-5	3.630E-04	85.5	3.10	-3.440	1.932
120-6	3.730E-04	79.4	2.96	-3.428	1.900
MEAN	3.674E-04	82.1	3.01	-3.435	1.914
STD.DEV.	5.130E-06	3.1	0.08	0.006	0.016
RE-EXTRACTION					
120-4A	2.466E-05	1000.0	2.47	-4.608	3.001
120-5A	2.536E-05	1010.0	2.57	-4.596	3.006
120-6A	2.096E-05	1200.0	2.52	-4.679	3.080
MEAN	2.366E-05	1070.0	2.52	-4.627	3.029
STD.DEV.	2.362E-06	113.0	0.05	0.045	0.044
EUROPIUM,.0005M/GPC3-7B SEDIMENT/15 C/O.68U NACL/1 DAY 5/27/77					
121-4	3.737E-04	78.9	2.95	-3.427	1.897
121-5	3.649E-04	82.7	3.02	-3.438	1.918
121-6	3.659E-04	83.8	3.07	-3.437	1.923
MEAN	3.682E-04	81.8	3.01	-3.434	1.913
STD.DEV.	4.829E-06	2.6	0.06	0.006	0.014
RE-EXTRACTION					
121-4A	2.416E-05	1000.0	2.42	-4.617	3.001
121-5A	2.491E-05	1000.0	2.50	-4.604	3.001
121-6A	2.506E-05	1010.0	2.53	-4.601	3.004
MEAN	2.471E-05	1010.0	2.48	-4.607	3.002
STD.DEV.	4.796E-07	6.4	0.05	0.008	0.002

Sample ID	Cs	Kp	S	Log Cs	Log Kp
EUROPIUM,.002M/GPC3-7A SEDIMENT/85 C/O.68U NACL/1 DAY 9/19/77					
168-1	1.696E-03	37.2	6.31	-2.771	1.570
168-2	1.719E-03	35.0	6.01	-2.765	1.544
168-3	1.708E-03	36.4	6.21	-2.767	1.561
MEAN	1.708E-03	36.2	6.18	-2.768	1.558
STD.DEV.	1.154E-05	1.1	0.15	0.003	0.013
RE-EXTRACTION					
168-1A	8.370E-05	579.0	4.84	-4.077	2.763
168-2A	7.737E-05	602.0	4.66	-4.111	2.779
168-3A	7.691E-05	641.0	4.93	-4.114	2.807
MEAN	7.933E-05	607.0	4.81	-4.101	2.783
STD.DEV.	3.796E-06	31.3	0.14	0.020	0.022
EUROPIUM,.002M/GPC3-7B SEDIMENT/85 C/O.68U NACL/1 DAY 9/19/77					
169-1	1.709E-03	35.2	6.01	-2.767	1.546
169-2	1.687E-03	38.4	6.47	-2.773	1.584
169-3	1.696E-03	37.5	6.36	-2.770	1.574
MEAN	1.697E-03	37.0	6.28	-2.770	1.568
STD.DEV.	1.088E-05	1.7	0.24	0.003	0.020
RE-EXTRACTION					
169-1A	8.449E-05	534.0	4.51	-4.073	2.727
169-2A	8.345E-05	606.0	5.06	-4.079	2.782
169-3A	7.544E-05	667.0	5.03	-4.122	2.824
MEAN	8.113E-05	602.0	4.87	-4.091	2.778
STD.DEV.	4.951E-06	66.6	0.31	0.027	0.048
EUROPIUM,.0005M/GPC3-7A SEDIMENT/85 C/O.68U NACL/1 DAY 9/21/77					
168-4	2.652E-04	205.0	5.44	-3.576	2.312
168-5	2.634E-04	202.0	5.33	-3.579	2.306
168-6	2.539E-04	217.0	5.51	-3.595	2.336
MEAN	2.608E-04	208.0	5.43	-3.584	2.318
STD.DEV.	6.040E-06	7.9	0.09	0.010	0.016
RE-EXTRACTION					
168-4A	1.612E-05	3180.0	5.13	-4.793	3.502
168-5A	1.452E-05	3480.0	5.05	-4.838	3.541
168-6A	1.682E-05	3090.0	5.19	-4.774	3.489
MEAN	1.582E-05	3250.0	5.12	-4.802	3.511
STD.DEV.	1.178E-06	204.0	0.07	0.033	0.027
EUROPIUM,.0005M/GPC3-7B SEDIMENT/85 C/O.68U NACL/1 DAY 9/21/77					
169-1	2.564E-04	211.0	5.42	-3.591	2.325
169-2	2.707E-04	193.0	5.23	-3.567	2.286
169-3	2.571E-04	210.0	5.40	-3.590	2.322
MEAN	2.614E-04	205.0	5.35	-3.583	2.311
STD.DEV.	8.066E-06	10.1	0.18	0.013	0.021
RE-EXTRACTION					
169-4A	1.544E-05	3320.0	5.12	-4.811	3.521
169-5A	1.721E-05	2840.0	4.89	-4.764	3.454
169-6A	1.651E-05	3080.0	5.09	-4.782	3.489
MEAN	1.639E-05	3080.0	5.04	-4.786	3.488
STD.DEV.	8.912E-07	240.0	0.12	0.024	0.034

Sample ID	Cs	Kp	S	Log Cs	Log Kp
EUROPIUM,.002M/GPC3-BA SEDIMENT/15 C/O.68U NACL/1 DAY 7/8/77					
136-1	1.722E-03	34.5	5.95	-2.764	1.538
136-2	1.708E-03	37.1	6.33	-2.768	1.569
136-3	1.717E-03	35.6	6.12	-2.765	1.552
MEAN	1.715E-03	35.8	6.13	-2.766	1.553
STD.DEV.	7.301E-06	1.3	0.19	0.002	0.015
RE-EXTRACTION					
136-1A	9.449E-05	431.0	4.07	-4.025	2.634
136-2A	9.019E-05	505.0	4.56	-4.045	2.704
136-3A	9.215E-05	470.0	4.33	-4.035	2.672
MEAN	9.228E-05	469.0	4.32	-4.035	2.670
STD.DEV.	2.152E-06	37.0	0.24	0.010	0.035
EUROPIUM,.002M/GPC3-BB SEDIMENT/15 C/O.68U NACL/1 DAY 7/8/77					
137-1	1.725E-03	34.4	5.93	-2.763	1.536
137-2	1.727E-03	31.8	5.50	-2.763	1.503
137-3	1.731E-03	33.5	5.80	-2.762	1.525
MEAN	1.728E-03	33.2	5.74	-2.763	1.521
STD.DEV.	2.813E-06	1.3	0.22	0.001	0.017
RE-EXTRACTION					
137-1A	8.460E-05	501.0	4.24	-4.073	2.700
137-2A	7.896E-05	514.0	4.06	-4.103	2.711
137-3A	7.205E-05	610.0	4.40	-4.142	2.785
MEAN	7.853E-05	542.0	4.23	-4.106	2.732
STD.DEV.	6.283E-06	59.5	0.17	0.035	0.046
EUROPIUM,.0005M/GPC3-BA SEDIMENT/15 C/O.68U NACL/1 DAY 7/8/77					
136-4	3.162E-04	134.0	4.23	-3.500	2.126
136-5	3.175E-04	133.0	4.23	-3.498	2.124
136-6	3.115E-04	138.0	4.29	-3.506	2.139
MEAN	3.151E-04	135.0	4.25	-3.502	2.130
STD.DEV.	3.149E-06	2.6	0.04	0.004	0.008
RE-EXTRACTION					
136-4A	3.622E-06	11600.0	4.22	-5.441	4.066
136-5A	3.275E-06	12900.0	4.21	-5.485	4.109
136-6A	4.163E-06	10300.0	4.27	-5.381	4.011
MEAN	3.687E-06	11600.0	4.23	-5.435	4.062
STD.DEV.	4.472E-07	1300.0	0.03	0.052	0.049
EUROPIUM,.0005M/GPC3-BB SEDIMENT/15 C/O.68U NACL/1 DAY 7/8/77					
137-4	3.116E-04	138.0	4.31	-3.506	2.141
137-5	3.188E-04	128.0	4.07	-3.496	2.106
137-6	3.155E-04	134.0	4.22	-3.501	2.126
MEAN	3.153E-04	133.0	4.20	-3.501	2.124
STD.DEV.	3.610E-06	5.0	0.12	0.005	0.017
RE-EXTRACTION					
137-4A	2.159E-05	1780.0	3.85	-4.666	3.251
137-5A	2.336E-05	1540.0	3.60	-4.631	3.188
137-6A	1.770E-05	2190.0	3.88	-4.752	3.341
MEAN	2.088E-05	1840.0	3.78	-4.693	3.260
STD.DEV.	2.897E-06	329.0	0.15	0.062	0.077

Sample ID	Cs	Kp	S	Log Cs	Log Kp
EUROPIUM,.002M/GPC3-BA SEDIMENT/85 C/O.68U NACL/1 DAY 9/19/77					
172-1	1.605E-03	54.6	8.76	-2.794	1.737
172-2	1.614E-03	54.3	8.76	-2.792	1.734
172-3	1.618E-03	54.3	8.78	-2.791	1.735
MEAN	1.612E-03	54.4	8.77	-2.792	1.735
STD.DEV.	6.661E-06	0.2	0.01	0.002	0.001
RE-EXTRACTION					
172-1A	1.057E-04	659.0	6.96	-3.976	2.819
172-2A	1.041E-04	674.0	7.02	-3.982	2.829
172-3A	9.747E-05	725.0	7.06	-4.011	2.860
MEAN	1.024E-04	686.0	7.02	-3.990	2.836
STD.DEV.	4.374E-06	34.6	0.05	0.019	0.022
EUROPIUM,.002M/GPC3-BB SEDIMENT/85 C/O.68U NACL/1 DAY 9/19/77					
173-1	1.621E-03	53.6	8.69	-2.790	1.729
173-2	1.607E-03	54.8	8.81	-2.794	1.739
173-3	1.595E-03	55.6	8.86	-2.797	1.745
MEAN	1.608E-03	54.7	8.79	-2.794	1.738
STD.DEV.	1.289E-05	1.0	0.09	0.003	0.008
RE-EXTRACTION					
173-1A	1.190E-04	545.0	6.49	-3.924	2.737
173-2A	1.047E-04	677.0	7.09	-3.980	2.831
173-3A	1.009E-04	708.0	7.14	-3.996	2.850
MEAN	1.082E-04	643.0	6.91	-3.967	2.806
STD.DEV.	9.546E-06	86.6	0.36	0.038	0.061
EUROPIUM,.0005M/GPC3-BA SEDIMENT/85 C/O.68U NACL/1 DAY 9/19/77					
172-4	1.850E-04	408.0	7.55	-3.733	2.611
172-5	1.933E-04	378.0	7.31	-3.714	2.578
172-6	1.818E-04	416.0	7.57	-3.740	2.620
MEAN	1.867E-04	401.0	7.48	-3.729	2.603
STD.DEV.	5.951E-06	20.0	0.14	0.014	0.022
RE-EXTRACTION					
172-4A	1.292E-05	5650.0	7.30	-4.889	3.752
172-5A	1.164E-05	6110.0	7.12	-4.934	3.786
172-6A	1.374E-05	5310.0	7.30	-4.862	3.725
MEAN	1.277E-05	5690.0	7.24	-4.895	3.755
STD.DEV.	1.060E-06	402.0	0.11	0.036	0.031
EUROPIUM,.0005M/GPC3-BB SEDIMENT/85 C/O.68U NACL/1 DAY 9/19/77					
173-4	1.734E-04	446.0	7.74	-3.761	2.650
173-5	1.804E-04	421.0	7.59	-3.744	2.624
173-6	1.921E-04	384.0	7.37	-3.716	2.584
MEAN	1.820E-04	417.0	7.57	-3.740	2.619
STD.DEV.	9.429E-06	31.2	0.19	0.022	0.033
RE-EXTRACTION					
173-4A	1.035E-05	7300.0	7.56	-4.985	3.864
173-5A	1.173E-05	6300.0	7.39	-4.931	3.799
173-6A	1.351E-05	5280.0	7.13	-4.869	3.723
MEAN	1.186E-05	6300.0	7.36	-4.928	3.795
STD.DEV.	1.585E-06	1010.0	0.21	0.058	0.071

Sample ID	Cs	Kp	S	Log Cs	Log Kp
7/25/77					
EUROPIUM,.002M/GPC3-9A SEDIMENT/15 C/0.68U NACL/1 DAY					
146-1	1.613E-03	55.9	9.01	-2.792	1.747
146-2	1.604E-03	56.1	9.00	-2.794	1.749
146-3	1.613E-03	55.0	8.88	-2.792	1.741
MEAN	1.611E-03	55.7	8.96	-2.793	1.745
STD.DEV.	3.999E-06	0.5	0.07	0.001	0.004
RE-EXTRACTION					
146-1A	9.511E-05	748.0	7.12	-4.022	2.874
146-2A	9.394E-05	753.0	7.07	-4.027	2.877
146-3A	9.302E-05	750.0	6.97	-4.031	2.875
MEAN	9.402E-05	750.0	7.05	-4.027	2.875
STD.DEV.	1.045E-06	2.5	0.07	0.005	0.001
7/25/77					
EUROPIUM,.002M/GPC3-9B SEDIMENT/15 C/0.68U NACL/1 DAY					
147-1	1.582E-03	60.5	9.57	-2.801	1.782
147-2	1.603E-03	57.0	9.14	-2.795	1.756
147-3	1.616E-03	54.8	8.86	-2.791	1.739
MEAN	1.600E-03	57.4	9.19	-2.796	1.759
STD.DEV.	1.726E-05	2.9	0.36	0.005	0.022
RE-EXTRACTION					
147-1A	9.380E-05	808.0	7.58	-4.028	2.908
147-2A	9.194E-05	788.0	7.24	-4.036	2.896
147-3A	9.362E-05	739.0	6.91	-4.029	2.868
MEAN	9.312E-05	778.0	7.25	-4.031	2.891
STD.DEV.	1.026E-06	35.5	0.33	0.005	0.020
7/25/77					
EUROPIUM,.0005M/GPC3-9A SEDIMENT/15 C/0.68U NACL/1 DAY					
146-4	2.325E-04	281.0	6.53	-3.634	2.449
146-5	2.396E-04	264.0	6.33	-3.620	2.422
146-6	2.368E-04	272.0	6.43	-3.626	2.434
MEAN	2.363E-04	272.0	6.43	-3.627	2.435
STD.DEV.	3.592E-06	8.5	0.10	0.007	0.013
RE-EXTRACTION					
146-4A	1.798E-05	3420.0	6.14	-4.745	3.533
146-5A	1.392E-05	4330.0	6.03	-4.856	3.637
146-6A	1.499E-05	4080.0	6.11	-4.824	3.610
MEAN	1.563E-05	3940.0	6.10	-4.808	3.593
STD.DEV.	2.105E-06	470.0	0.06	0.057	0.054
7/25/77					
EUROPIUM,.0005M/GPC3-9B SEDIMENT/15 C/0.68U NACL/1 DAY					
147-4	2.340E-04	276.0	6.45	-3.631	2.440
147-5	2.324E-04	277.0	6.44	-3.634	2.443
147-6	2.335E-04	279.0	6.50	-3.632	2.445
MEAN	2.333E-04	277.0	6.46	-3.632	2.443
STD.DEV.	7.733E-07	1.6	0.04	0.001	0.002
RE-EXTRACTION					
147-4A	1.666E-05	3660.0	6.10	-4.778	3.563
147-5A	1.683E-05	3610.0	6.08	-4.774	3.558
147-6A	1.533E-05	4030.0	6.18	-4.814	3.606
MEAN	1.627E-05	3770.0	6.12	-4.789	3.576
STD.DEV.	8.193E-07	229.0	0.06	0.022	0.026

Sample ID	Cs	Kp	S	Log Cs	Log Kp
1/16/78					
EUROPIUM,.002M/GPC3-9C SEDIMENT/85 C/0.68U NACL/1 DAY					
199-1	1.515E-03	82.2	12.46	-2.820	1.915
199-2	1.391E-03	119.0	16.59	-2.857	2.076
199-3	1.398E-03	109.0	15.22	-2.854	2.037
MEAN	1.435E-03	103.0	14.74	-2.843	2.009
STD.DEV.	6.946E-05	19.0	2.10	0.021	0.084
RE-EXTRACTION					
199-1A	8.039E-05	1410.0	11.30	-4.095	3.148
199-2A	9.235E-05	1620.0	14.99	-4.035	3.210
199-3A	8.442E-05	1650.0	13.97	-4.074	3.219
MEAN	8.572E-05	1560.0	13.42	-4.068	3.192
STD.DEV.	6.085E-06	131.0	1.90	0.030	0.039
1/16/78					
EUROPIUM,.002M/GPC3-9D SEDIMENT/85 C/0.68U NACL/1 DAY					
200-1	1.393E-03	110.0	15.29	-2.856	2.040
200-2	1.389E-03	112.0	15.59	-2.857	2.050
200-3	1.338E-03	123.0	16.45	-2.873	2.090
MEAN	1.373E-03	115.0	15.78	-2.862	2.060
STD.DEV.	3.040E-05	7.0	0.60	0.010	0.026
RE-EXTRACTION					
200-1A	9.138E-05	1520.0	13.89	-4.039	3.182
200-2A	8.829E-05	1610.0	14.21	-4.054	3.207
200-3A	9.488E-05	1570.0	14.90	-4.023	3.196
MEAN	9.152E-05	1570.0	14.33	-4.039	3.195
STD.DEV.	3.301E-06	45.1	0.52	0.016	0.012
1/16/78					
EUROPIUM,.0005M/GPC3-9C SEDIMENT/85 C/0.68U NACL/1 DAY					
199-4	6.201E-05	1930.0	11.95	-4.208	3.285
199-5	5.040E-05	2410.0	12.15	-4.298	3.382
199-6	4.615E-05	2570.0	11.84	-4.336	3.409
MEAN	5.285E-05	2300.0	11.98	-4.280	3.359
STD.DEV.	8.206E-06	333.0	0.16	0.066	0.065
RE-EXTRACTION					
199-4A	2.649E-06	45100.0	11.95	-5.577	4.654
199-5A	2.843E-06	42600.0	12.10	-5.546	4.629
199-6A	2.920E-06	40500.0	11.82	-5.535	4.607
MEAN	2.804E-06	42700.0	11.96	-5.553	4.630
STD.DEV.	1.396E-07	2300.0	0.14	0.022	0.024
1/16/78					
EUROPIUM,.0005M/GPC3-9D SEDIMENT/85 C/0.68U NACL/1 DAY					
200-4	6.211E-05	1870.0	11.60	-4.207	3.271
200-5	5.127E-05	2300.0	11.78	-4.299	3.361
200-6	6.318E-05	1790.0	11.33	-4.190	3.254
MEAN	5.885E-05	1990.0	11.57	-4.232	3.295
STD.DEV.	6.594E-06	274.0	0.23	0.050	0.058
RE-EXTRACTION					
200-4A	1.527E-06	76100.0	11.62	-5.816	4.881
200-5A	1.307E-06	90200.0	11.80	-5.884	4.955
200-6A	3.225E-06	34900.0	11.27	-5.491	4.543
MEAN	2.020E-06	67100.0	11.56	-5.730	4.793
STD.DEV.	1.050E-06	28700.0	0.27	0.210	0.220

Sample ID	Cs	Kp	S	Log Cs	Log Kp
5/20/77					
EUROPIUM, .002M/GPC3-10A SEDIMENT/15 C/0.68U NaCl/1 DAY					
112-1	1.657E-03	43.5	7.21	-2.781	1.638
112-2	1.650E-03	45.7	7.54	-2.782	1.660
112-3	1.660E-03	44.3	7.36	-2.780	1.647
MEAN	1.656E-03	44.5	7.37	-2.781	1.648
STD.DEV.	5.228E-04	1.1	0.17	0.001	0.011
RE-EXTRACTION					
112-1A	8.309E-05	673.0	5.59	-4.080	2.828
112-2A	8.420E-05	700.0	5.89	-4.075	2.845
112-3A	8.243E-05	701.0	5.78	-4.084	2.846
MEAN	8.324E-05	691.0	5.75	-4.080	2.840
STD.DEV.	8.959E-07	15.9	0.15	0.005	0.010
5/20/77					
EUROPIUM, .002M/GPC3-10B SEDIMENT/15 C/0.68U NaCl/1 DAY					
113-1	1.639E-03	48.5	7.94	-2.785	1.685
113-2	1.617E-03	47.9	7.74	-2.791	1.680
113-3	1.647E-03	46.2	7.61	-2.783	1.665
MEAN	1.634E-03	47.5	7.76	-2.787	1.677
STD.DEV.	1.558E-05	1.1	0.17	0.004	0.010
RE-EXTRACTION					
113-1A	9.171E-05	662.0	6.07	-4.038	2.821
113-2A	9.171E-05	663.0	6.08	-4.038	2.822
113-3A	8.113E-05	746.0	6.05	-4.091	2.873
MEAN	8.818E-05	690.0	6.07	-4.055	2.838
STD.DEV.	6.110E-06	48.2	0.01	0.031	0.030
5/20/77					
EUROPIUM, .0005M/GPC3-10A SEDIMENT/15 C/0.68U NaCl/1 DAY					
112-4	2.610E-04	214.0	5.59	-3.583	2.330
112-5	2.563E-04	224.0	5.75	-3.591	2.351
112-6	2.532E-04	224.0	5.67	-3.597	2.350
MEAN	2.568E-04	221.0	5.67	-3.590	2.344
STD.DEV.	3.929E-06	5.8	0.08	0.007	0.012
RE-EXTRACTION					
112-4A	8.647E-06	6290.0	5.44	-5.063	3.798
112-5A	1.171E-05	4710.0	5.51	-4.931	3.673
112-6A	1.230E-05	4420.0	5.44	-4.910	3.646
MEAN	1.089E-05	5140.0	5.46	-4.968	3.706
STD.DEV.	1.961E-06	1010.0	0.04	0.083	0.082
5/20/77					
EUROPIUM, .0005M/GPC3-10B SEDIMENT/15 C/0.68U NaCl/1 DAY					
113-4	2.540E-04	230.0	5.85	-3.595	2.362
113-5	2.523E-04	232.0	5.86	-3.598	2.366
113-6	2.417E-04	255.0	6.16	-3.617	2.406
MEAN	2.494E-04	239.0	5.95	-3.603	2.378
STD.DEV.	6.692E-06	13.9	0.18	0.012	0.024
RE-EXTRACTION					
113-4A	1.177E-05	4780.0	5.62	-4.929	3.679
113-5A	1.267E-05	4430.0	5.61	-4.897	3.646
113-6A	1.228E-05	4820.0	5.92	-4.911	3.683
MEAN	1.224E-05	4670.0	5.72	-4.912	3.669
STD.DEV.	4.518E-07	215.0	0.18	0.016	0.020

Sample ID	Cs	Kp	S	Log Cs	Log Kp
1/17/78					
EUROPIUM, .002M/GPC3-10C SEDIMENT/85 C/0.68U NaCl/1 DAY					
201-1	1.485E-03	80.1	11.89	-2.828	1.903
201-2	1.498E-03	77.4	11.59	-2.824	1.888
201-3	1.502E-03	73.4	11.02	-2.823	1.865
MEAN	1.495E-03	76.9	11.50	-2.825	1.886
STD.DEV.	8.922E-04	3.4	0.44	0.003	0.019
RE-EXTRACTION					
201-1A	9.292E-05	1110.0	10.36	-4.032	3.047
201-2A	8.812E-05	1150.0	10.16	-4.055	3.062
201-3A	8.835E-05	1090.0	9.63	-4.054	3.037
MEAN	8.980E-05	1120.0	10.05	-4.047	3.049
STD.DEV.	2.708E-06	30.7	0.37	0.013	0.012
1/17/78					
EUROPIUM, .002M/GPC3-10D SEDIMENT/85 C/0.68U NaCl/1 DAY					
202-1	1.534E-03	66.0	10.12	-2.814	1.820
202-2	1.464E-03	81.5	11.93	-2.834	1.911
202-3	1.504E-03	70.8	10.65	-2.823	1.850
MEAN	1.500E-03	72.8	10.90	-2.824	1.860
STD.DEV.	3.482E-05	7.9	0.93	0.010	0.046
RE-EXTRACTION					
202-1A	8.532E-05	1050.0	8.94	-4.069	3.020
202-2A	9.308E-05	1120.0	10.43	-4.031	3.049
202-3A	8.919E-05	1060.0	9.42	-4.050	3.024
MEAN	8.920E-05	1080.0	9.60	-4.050	3.031
STD.DEV.	3.882E-06	37.9	0.76	0.019	0.016
1/17/78					
EUROPIUM, .0005M/GPC3-10C SEDIMENT/85 C/0.68U NaCl/1 DAY					
201-4	1.487E-04	554.0	8.24	-3.828	2.744
201-5	1.295E-04	655.0	8.48	-3.888	2.816
201-6	1.337E-04	640.0	8.55	-3.874	2.806
MEAN	1.373E-04	616.0	8.43	-3.863	2.789
STD.DEV.	1.011E-05	54.5	0.16	0.031	0.039
RE-EXTRACTION					
201-4A	4.961E-06	16500.0	8.20	-5.304	4.218
201-5A	4.105E-06	20600.0	8.45	-5.387	4.313
201-6A	5.651E-06	15000.0	8.50	-5.248	4.177
MEAN	4.906E-06	17400.0	8.38	-5.313	4.236
STD.DEV.	7.745E-07	2900.0	0.16	0.070	0.070
1/17/78					
EUROPIUM, .0005M/GPC3-10D SEDIMENT/85 C/0.68U NaCl/1 DAY					
202-4	1.256E-04	666.0	8.36	-3.901	2.823
202-5	1.168E-04	773.0	9.03	-3.933	2.888
202-6	1.193E-04	746.0	8.90	-3.923	2.873
MEAN	1.205E-04	728.0	8.76	-3.919	2.861
STD.DEV.	4.535E-06	55.6	0.35	0.016	0.034
RE-EXTRACTION					
202-4A	4.528E-06	18400.0	8.33	-5.344	4.265
202-5A	2.087E-06	43300.0	9.04	-5.680	4.636
202-6A	6.181E-06	14300.0	8.82	-5.209	4.154
MEAN	4.265E-06	25300.0	8.73	-5.411	4.352
STD.DEV.	2.060E-06	15700.0	0.36	0.243	0.253

Sample ID	Cs	Kp	S	Log Cs	Log Kp
6/30/77					
EUROPIUM,.002M/GPC3-11A SEDIMENT/15 C/0.68U NACL/1 DAY					
134-1	1.557E-03	65.9	10.25	-2.808	1.819
134-2	1.490E-03	78.8	11.74	-2.827	1.897
134-3	1.536E-03	69.8	10.71	-2.814	1.844
MEAN	1.527E-03	71.5	10.90	-2.816	1.853
STD.DEV.	3.425E-05	6.6	0.76	0.010	0.040
RE-EXTRACTION					
134-1A	9.659E-05	849.0	8.20	-4.015	2.929
134-2A	8.499E-05	1180.0	10.06	-4.071	3.073
134-3A	1.167E-04	706.0	8.23	-3.933	2.848
MEAN	9.943E-05	913.0	8.83	-4.006	2.950
STD.DEV.	1.604E-05	243.0	1.06	0.069	0.114
6/30/77					
EUROPIUM,.002M/GPC3-11B SEDIMENT/15 C/0.68U NACL/1 DAY					
135-1	1.586E-03	59.8	9.48	-2.800	1.777
135-2	1.562E-03	62.7	9.79	-2.806	1.797
135-3	1.637E-03	50.1	8.20	-2.786	1.700
MEAN	1.595E-03	57.5	9.16	-2.797	1.758
STD.DEV.	3.809E-05	6.6	0.84	0.010	0.051
RE-EXTRACTION					
135-1A	9.392E-05	810.0	7.61	-4.027	2.909
135-2A	1.100E-04	684.0	7.53	-3.959	2.835
135-3A	4.755E-05	1560.0	7.43	-4.323	3.194
MEAN	8.382E-05	1020.0	7.52	-4.103	2.979
STD.DEV.	3.243E-05	474.0	0.09	0.194	0.190
6/30/77					
EUROPIUM,.0005M/GPC3-11A SEDIMENT/15 C/0.68U NACL/1 DAY					
134-4	1.967E-04	375.0	7.37	-3.706	2.574
134-5	1.983E-04	362.0	7.17	-3.703	2.558
134-6	2.018E-04	357.0	7.20	-3.695	2.552
MEAN	1.989E-04	364.0	7.25	-3.701	2.561
STD.DEV.	2.586E-06	9.3	0.11	0.006	0.011
RE-EXTRACTION					
134-4A	1.191E-05	5990.0	7.14	-4.924	3.778
134-5A	1.213E-05	5720.0	6.94	-4.916	3.757
134-6A	1.085E-05	6440.0	6.99	-4.964	3.809
MEAN	1.163E-05	6050.0	7.02	-4.935	3.781
STD.DEV.	6.828E-07	364.0	0.10	0.026	0.026
6/30/77					
EUROPIUM,.0005M/GPC3-11B SEDIMENT/15 C/0.68U NACL/1 DAY					
135-4	2.146E-04	316.0	6.79	-3.668	2.500
135-5	1.993E-04	361.0	7.20	-3.701	2.558
135-6	2.197E-04	304.0	6.67	-3.658	2.482
MEAN	2.112E-04	327.0	6.89	-3.676	2.513
STD.DEV.	1.064E-05	30.1	0.28	0.022	0.039
RE-EXTRACTION					
135-4A	9.845E-06	6700.0	6.60	-5.007	3.826
135-5A	1.321E-05	5240.0	6.92	-4.879	3.719
135-6A	6.649E-06	9880.0	6.57	-5.177	3.995
MEAN	9.902E-06	7280.0	6.70	-5.021	3.847
STD.DEV.	3.280E-06	2370.0	0.20	0.150	0.139

Sample ID	Cs	Kp	S	Log Cs	Log Kp
1/25/78					
EUROPIUM,.002M/GPC3-11C SEDIMENT/85 C/0.68U NACL/1 DAY					
205-1	1.261E-03	137.0	17.27	-2.899	2.137
205-2	1.278E-03	131.0	16.75	-2.893	2.117
205-3	1.260E-03	134.0	16.94	-2.900	2.128
MEAN	1.266E-03	134.0	16.98	-2.897	2.128
STD.DEV.	1.013E-05	3.0	0.27	0.003	0.010
RE-EXTRACTION					
205-1A	1.049E-04	1470.0	15.41	-3.979	3.167
205-2A	1.345E-04	1060.0	14.31	-3.871	3.027
205-3A	1.157E-04	1290.0	14.88	-3.937	3.109
MEAN	1.183E-04	1270.0	14.86	-3.929	3.101
STD.DEV.	1.500E-05	206.0	0.55	0.054	0.070
1/25/78					
EUROPIUM,.002M/GPC3-11D SEDIMENT/85 C/0.68U NACL/1 DAY					
206-1	1.232E-03	149.0	18.34	-2.909	2.173
206-2	1.284E-03	127.0	16.32	-2.891	2.104
206-3	1.251E-03	138.0	17.22	-2.903	2.139
MEAN	1.255E-03	138.0	17.29	-2.901	2.139
STD.DEV.	2.660E-05	11.0	1.01	0.009	0.034
RE-EXTRACTION					
206-1A	8.479E-05	2000.0	16.99	-4.072	3.302
206-2A	9.422E-05	1540.0	14.51	-4.026	3.188
206-3A	1.094E-04	1390.0	15.24	-3.961	3.144
MEAN	9.615E-05	1650.0	15.58	-4.019	3.211
STD.DEV.	1.243E-05	318.0	1.27	0.056	0.082
1/25/78					
EUROPIUM,.0005M/GPC3-11C SEDIMENT/85 C/0.68U NACL/1 DAY					
205-4	8.028E-05	1250.0	10.02	-4.095	3.096
205-5	1.179E-04	761.0	8.97	-3.928	2.881
205-6	5.830E-05	1820.0	10.63	-4.234	3.261
MEAN	8.549E-05	1280.0	9.87	-4.086	3.079
STD.DEV.	3.014E-05	530.0	0.84	0.153	0.190
RE-EXTRACTION					
205-4A	3.967E-07	254000.0	10.08	-6.402	5.405
205-5A	1.035E-07	874000.0	9.04	-6.985	5.941
205-6A	4.001E-07	266000.0	10.63	-6.398	5.424
MEAN	3.001E-07	464000.0	9.92	-6.595	5.590
STD.DEV.	1.703E-07	355000.0	0.81	0.338	0.304
1/25/78					
EUROPIUM,.0005M/GPC3-11D SEDIMENT/85 C/0.68U NACL/1 DAY					
206-4	8.124E-05	1240.0	10.10	-4.090	3.094
206-5	5.344E-05	1920.0	10.27	-4.272	3.284
206-6	7.205E-05	1430.0	10.30	-4.142	3.155
MEAN	6.891E-05	1530.0	10.23	-4.168	3.178
STD.DEV.	1.417E-05	351.0	0.11	0.094	0.097
RE-EXTRACTION					
206-4A	3.555E-07	284000.0	10.10	-6.449	5.453
206-5A	6.419E-07	160000.0	10.27	-6.193	5.204
206-6A	4.464E-07	231000.0	10.33	-6.350	5.364
MEAN	4.813E-07	225000.0	10.23	-6.331	5.341
STD.DEV.	1.463E-07	62200.0	0.12	0.129	0.126

Sample ID	Cs	Kp	S	Log Cs	Log Kp
7/25/77					
EUROPIUM,.002M/GPC3-12A SEDIMENT/15 C/0.68U NaCl/U DAY					
150-1	1.527E-03	71.0	10.84	-2.816	1.851
150-2	1.500E-03	75.6	11.34	-2.824	1.878
150-3	1.519E-03	70.8	10.76	-2.818	1.850
MEAN	1.515E-03	72.4	10.98	-2.819	1.860
STD.DEV.	1.403E-05	2.7	0.32	0.004	0.016
RE-EXTRACTION					
150-1A	9.806E-05	907.0	8.89	-4.008	2.958
150-2A	1.019E-04	921.0	9.38	-3.992	2.964
150-3A	1.009E-04	875.0	8.83	-3.996	2.942
MEAN	1.003E-04	901.0	9.04	-3.999	2.955
STD.DEV.	1.981E-06	23.6	0.30	0.009	0.011
7/25/77					
EUROPIUM,.002M/GPC3-12B SEDIMENT/15 C/0.68U NaCl/1 DAY					
151-1	1.568E-03	61.2	9.60	-2.805	1.787
151-2	1.538E-03	64.9	9.98	-2.813	1.812
151-3	1.536E-03	67.2	10.32	-2.814	1.827
MEAN	1.547E-03	64.4	9.97	-2.810	1.809
STD.DEV.	1.831E-05	3.0	0.36	0.005	0.020
RE-EXTRACTION					
151-1A	1.021E-04	748.0	7.64	-3.991	2.874
151-2A	1.035E-04	781.0	8.08	-3.985	2.893
151-3A	1.054E-04	783.0	8.26	-3.977	2.894
MEAN	1.037E-04	771.0	7.99	-3.984	2.887
STD.DEV.	1.638E-06	19.7	0.32	0.007	0.011
7/25/77					
EUROPIUM,.0005M/GPC3-12A SEDIMENT/15 C/0.68U NaCl/1 DAY					
150-4	1.812E-04	409.0	7.40	-3.742	2.611
150-5	1.696E-04	454.0	7.70	-3.771	2.657
150-6	1.760E-04	434.0	7.63	-3.754	2.637
MEAN	1.756E-04	432.0	7.58	-3.756	2.635
STD.DEV.	5.813E-06	22.5	0.16	0.014	0.023
RE-EXTRACTION					
150-4A	1.132E-05	6360.0	7.20	-4.946	3.803
150-5A	9.134E-05	8250.0	7.54	-5.039	3.917
150-6A	1.509E-05	4860.0	7.33	-4.821	3.687
MEAN	1.185E-05	6490.0	7.36	-4.936	3.802
STD.DEV.	3.013E-06	1700.0	0.17	0.109	0.115
7/25/77					
EUROPIUM,.0005M/GPC3-12B SEDIMENT/15 C/0.68U NaCl/1 DAY					
151-4	1.821E-04	403.0	7.35	-3.740	2.606
151-5	1.941E-04	370.0	7.19	-3.712	2.568
151-6	1.914E-04	367.0	7.03	-3.718	2.565
MEAN	1.892E-04	380.0	7.19	-3.723	2.580
STD.DEV.	6.303E-06	20.0	0.16	0.015	0.023
RE-EXTRACTION					
151-4A	1.270E-05	5580.0	7.09	-4.896	3.747
151-5A	1.313E-05	5280.0	6.93	-4.882	3.722
151-6A	1.627E-05	4120.0	6.71	-4.788	3.615
MEAN	1.403E-05	5000.0	6.91	-4.855	3.695
STD.DEV.	1.952E-06	771.0	0.19	0.058	0.070

Sample ID	Cs	Kp	S	Log Cs	Log Kp
1/25/78					
EUROPIUM,.002M/GPC3-12C SEDIMENT/85 C/0.68U NaCl/1 DAY					
207-1	1.146E-03	172.0	19.66	-2.941	2.234
207-2	1.185E-03	157.0	18.66	-2.926	2.197
207-3	1.234E-03	143.0	17.70	-2.909	2.157
MEAN	1.188E-03	157.0	18.67	-2.925	2.196
STD.DEV.	4.405E-05	14.5	0.98	0.016	0.039
RE-EXTRACTION					
207-1A	8.649E-05	2100.0	18.19	-4.063	3.323
207-2A	8.175E-05	2100.0	17.19	-4.087	3.323
207-3A	2.638E-05	6660.0	17.58	-4.579	3.824
MEAN	6.487E-05	3620.0	17.65	-4.243	3.490
STD.DEV.	3.342E-05	2630.0	0.50	0.291	0.289
1/25/78					
EUROPIUM,.002M/GPC3-12D SEDIMENT/85 C/0.68U NaCl/1 DAY					
208-1	1.179E-03	158.0	18.66	-2.928	2.199
208-2	1.235E-03	142.0	17.55	-2.908	2.153
208-3	1.234E-03	138.0	17.02	-2.909	2.140
MEAN	1.216E-03	146.0	17.74	-2.915	2.164
STD.DEV.	3.194E-05	10.6	0.83	0.011	0.031
RE-EXTRACTION					
208-1A	1.070E-04	1590.0	17.03	-3.971	3.202
208-2A	8.545E-05	1880.0	16.09	-4.068	3.275
208-3A	4.748E-05	3480.0	16.51	-4.323	3.541
MEAN	7.996E-05	2320.0	16.54	-4.121	3.339
STD.DEV.	3.012E-05	1020.0	0.47	0.182	0.179
1/25/78					
EUROPIUM,.0005M/GPC3-12C SEDIMENT/85 C/0.68U NaCl/1 DAY					
207-4	6.841E-05	1520.0	10.37	-4.165	3.181
207-5	6.677E-05	1510.0	10.09	-4.175	3.179
207-6	8.787E-05	1100.0	9.69	-4.056	3.042
MEAN	7.435E-05	1380.0	10.05	-4.132	3.134
STD.DEV.	1.174E-05	240.0	0.34	0.066	0.079
RE-EXTRACTION					
207-4A	3.418E-07	305000.0	10.43	-6.466	5.485
207-5A	3.538E-07	287000.0	10.14	-6.451	5.457
207-6A	4.241E-07	229000.0	9.70	-6.372	5.359
MEAN	3.732E-07	273000.0	10.09	-6.430	5.434
STD.DEV.	4.446E-08	39700.0	0.37	0.050	0.066
1/25/78					
EUROPIUM,.0005M/GPC3-12D SEDIMENT/85 C/0.68U NaCl/1 DAY					
208-4	8.114E-05	1230.0	10.02	-4.091	3.091
208-5	9.363E-05	1030.0	9.64	-4.029	3.012
208-6	9.565E-05	1020.0	9.72	-4.019	3.007
MEAN	9.014E-05	1090.0	9.79	-4.046	3.037
STD.DEV.	7.862E-06	118.0	0.20	0.039	0.047
RE-EXTRACTION					
208-4A	1.943E-07	516000.0	10.02	-6.711	5.712
208-5A	1.377E-07	704000.0	9.70	-6.861	5.848
208-6A	1.412E-07	697000.0	9.84	-6.850	5.843
MEAN	1.578E-07	639000.0	9.85	-6.807	5.801
STD.DEV.	3.173E-08	107000.0	0.16	0.083	0.077

Sample ID	Cs	Kp	S	Log Cs	Log Kp
EUROPIUM, .002M/GPC3-13A SEDIMENT/15 C/O.68U NACL/1 DAY 5/27/77					
122-1	1.513E-03	72.5	10.97	-2.820	1.860
122-2	1.528E-03	69.1	10.56	-2.816	1.839
122-3	1.517E-03	72.6	11.02	-2.819	1.861
MEAN	1.519E-03	71.4	10.85	-2.818	1.854
STD.DEV.	7.772E-06	2.0	0.25	0.002	0.012
RE-EXTRACTION					
122-1A	1.026E-04	873.0	8.95	-3.989	2.941
122-2A	9.482E-05	918.0	8.71	-4.023	2.963
122-3A	8.613E-05	1090.0	9.35	-4.065	3.035
MEAN	9.451E-05	959.0	9.00	-4.026	2.980
STD.DEV.	8.222E-06	115.0	0.32	0.038	0.049
EUROPIUM, .002M/GPC3-13B SEDIMENT/15 C/O.68U NACL/1 DAY 5/27/77					
123-1	1.397E-03	99.2	13.87	-2.855	1.997
123-2	1.420E-03	96.4	13.69	-2.848	1.984
123-3	1.456E-03	85.5	12.45	-2.837	1.932
MEAN	1.424E-03	93.7	13.33	-2.846	1.971
STD.DEV.	2.970E-05	7.3	0.77	0.009	0.034
RE-EXTRACTION					
123-1A	7.373E-05	1690.0	12.45	-4.132	3.228
123-2A	6.491E-05	1920.0	12.48	-4.188	3.284
123-3A	4.119E-05	2870.0	11.81	-4.385	3.457
MEAN	5.994E-05	2160.0	12.25	-4.235	3.323
STD.DEV.	1.683E-05	626.0	0.38	0.133	0.120
EUROPIUM, .0005M/GPC3-13A SEDIMENT/15 C/O.L.U NACL/1 DAY 5/27/77					
122-4	1.534E-04	537.0	8.24	-3.814	2.730
122-5	1.480E-04	555.0	8.21	-3.830	2.744
122-6	1.566E-04	513.0	8.04	-3.805	2.710
MEAN	1.527E-04	535.0	8.16	-3.816	2.728
STD.DEV.	4.373E-06	21.1	0.11	0.012	0.017
RE-EXTRACTION					
122-4A	7.290E-06	11100.0	8.11	-5.137	4.046
122-5A	6.907E-06	11700.0	8.09	-5.161	4.069
122-6A	5.356E-06	14900.0	7.96	-5.271	4.172
MEAN	6.518E-06	12600.0	8.05	-5.190	4.096
STD.DEV.	1.024E-06	2040.0	0.08	0.071	0.067
EUROPIUM, .0005M/GPC3-13B SEDIMENT/15 C/O.68U NACL/1 DAY 5/27/77					
123-4	1.047E-04	891.0	9.33	-3.980	2.950
123-5	1.025E-04	927.0	9.50	-3.989	2.967
123-6	9.795E-05	925.0	9.06	-4.009	2.966
MEAN	1.017E-04	914.0	9.30	-3.993	2.961
STD.DEV.	3.454E-06	20.2	0.22	0.015	0.010
RE-EXTRACTION					
123-4A	1.300E-06	71800.0	9.33	-5.886	4.856
123-5A	1.404E-06	67600.0	9.49	-5.852	4.830
123-6A	9.830E-07	92200.0	9.07	-6.007	4.965
MEAN	1.229E-06	77200.0	9.30	-5.915	4.884
STD.DEV.	2.195E-07	13200.0	0.21	0.081	0.072

Sample ID	Cs	Kp	S	Log Cs	Log Kp
EUROPIUM, .002M/GPC3-13C SEDIMENT/85 C/O.68U NACL/1 DAY 10/26/77					
182-1	1.213E-03	148.0	17.96	-2.916	2.170
182-2	1.161E-03	165.0	19.12	-2.935	2.217
182-3	1.085E-03	188.0	20.42	-2.964	2.274
MEAN	1.153E-03	167.0	19.17	-2.939	2.221
STD.DEV.	6.414E-05	20.1	1.23	0.024	0.052
RE-EXTRACTION					
182-1A	4.018E-05	4440.0	17.84	-4.396	3.647
182-2A	4.363E-05	4320.0	18.86	-4.360	3.636
182-3A	5.726E-05	3490.0	19.96	-4.242	3.542
MEAN	4.702E-05	4080.0	18.89	-4.333	3.608
STD.DEV.	9.031E-06	517.0	1.06	0.080	0.058
EUROPIUM, .002M/GPC3-13D SEDIMENT/85 C/O.68U NACL/1 DAY 10/26/77					
183-1	1.056E-03	204.0	21.58	-2.976	2.310
183-2	1.086E-03	192.0	20.89	-2.964	2.284
183-3	1.033E-03	210.0	21.73	-2.986	2.323
MEAN	1.058E-03	202.0	21.40	-2.975	2.306
STD.DEV.	2.612E-05	9.2	0.45	0.011	0.020
RE-EXTRACTION					
183-1A	4.111E-05	5180.0	21.30	-4.386	3.714
183-2A	3.640E-05	5720.0	20.81	-4.439	3.757
183-3A	3.952E-05	5420.0	21.40	-4.403	3.734
MEAN	3.901E-05	5440.0	21.17	-4.409	3.735
STD.DEV.	2.392E-06	271.0	0.32	0.027	0.021
EUROPIUM, .0005M/GPC3-13C SEDIMENT/85 C/O.68U NACL/1 DAY 10/26/77					
182-4	3.196E-06	36800.0	11.76	-5.495	4.566
182-5	4.890E-05	2110.0	10.32	-4.311	3.324
182-6	2.482E-05	4390.0	10.89	-4.605	3.642
MEAN	2.564E-05	14400.0	10.99	-4.804	3.844
STD.DEV.	2.286E-05	19400.0	0.73	0.617	0.645
RE-EXTRACTION					
182-4A	4.090E-07	287000.0	11.75	-6.388	5.458
182-5A	3.805E-07	272000.0	10.35	-6.420	5.435
182-6A	2.004E-07	545000.0	10.91	-6.698	5.736
MEAN	3.300E-07	368000.0	11.01	-6.502	5.543
STD.DEV.	1.131E-07	153000.0	0.71	0.171	0.168
EUROPIUM, .0005M/GPC3-13D SEDIMENT/85 C/O.68U NACL/1 DAY 10/26/77					
183-4	3.490E-06	32900.0	11.48	-5.457	4.517
183-5	5.270E-06	21500.0	11.35	-5.278	4.333
183-6	6.386E-07	178000.0	11.38	-6.195	5.251
MEAN	3.133E-06	77500.0	11.40	-5.643	4.700
STD.DEV.	2.336E-06	87300.0	0.07	0.486	0.486
RE-EXTRACTION					
183-4A	1.719E-07	668000.0	11.48	-6.765	5.825
183-5A	2.154E-07	526000.0	11.33	-6.667	5.721
183-6A	2.934E-07	387000.0	11.36	-6.532	5.588
MEAN	2.269E-07	527000.0	11.39	-6.655	5.711
STD.DEV.	6.160E-08	141000.0	0.08	0.117	0.119

Sample ID	Cs	Kp	S	Log Cs	Log Kp
7/8/77					
EUROPIUM, .002M/GPC3-14A SEDIMENT/15 C/0.68U NACL/1 DAY					
138-1	1.503E-03	73.4	11.03	-2.823	1.866
138-2	1.504E-03	72.7	10.94	-2.823	1.862
138-3	1.509E-03	71.8	10.84	-2.821	1.856
MEAN	1.505E-03	72.7	10.94	-2.822	1.861
STD.DEV.	3.247E-06	0.8	0.09	0.001	0.005
RE-EXTRACTION					
138-1A	7.740E-05	1240.0	9.61	-4.111	3.094
138-2A	7.346E-05	1310.0	9.63	-4.134	3.117
138-3A	7.631E-05	1240.0	9.46	-4.117	3.093
MEAN	7.572E-05	1260.0	9.57	-4.121	3.102
STD.DEV.	2.038E-06	40.4	0.09	0.012	0.014
7/8/77					
EUROPIUM, .002M/GPC3-14B SEDIMENT/15 C/0.68U NACL/1 DAY					
139-1	1.479E-03	77.8	11.50	-2.830	1.891
139-2	1.469E-03	79.9	11.74	-2.833	1.903
139-3	1.482E-03	77.9	11.55	-2.829	1.892
MEAN	1.477E-03	78.5	11.60	-2.831	1.895
STD.DEV.	6.714E-06	1.2	0.13	0.002	0.007
RE-EXTRACTION					
139-1A	6.603E-05	1560.0	10.33	-4.180	3.194
139-2A	6.433E-05	1650.0	10.59	-4.192	3.216
139-3A	6.993E-05	1470.0	10.30	-4.155	3.168
MEAN	6.676E-05	1560.0	10.40	-4.176	3.193
STD.DEV.	2.874E-06	90.0	0.16	0.019	0.024
7/8/77					
EUROPIUM, .0005M/GPC3-14A SEDIMENT/15C/0.68U NACL/1 DAY					
138-4	1.646E-04	461.0	7.58	-3.784	2.663
138-5	1.581E-04	491.0	7.77	-3.801	2.691
138-6	1.594E-04	491.0	7.83	-3.798	2.691
MEAN	1.607E-04	481.0	7.73	-3.794	2.682
STD.DEV.	3.416E-06	17.3	0.13	0.009	0.016
RE-EXTRACTION					
138-4A	3.622E-06	20800.0	7.55	-5.441	4.319
138-5A	3.275E-06	23600.0	7.73	-5.485	4.373
138-6A	4.163E-06	18600.0	7.76	-5.381	4.271
MEAN	3.687E-06	21000.0	7.68	-5.435	4.321
STD.DEV.	4.472E-07	2510.0	0.12	0.052	0.051
7/8/77					
EUROPIUM, .0005M/GPC3-14B SEDIMENT/15 C/0.68U NACL/1 DAY					
139-4	1.514E-04	521.0	7.89	-3.820	2.717
139-5	1.552E-04	523.0	8.11	-3.809	2.718
139-6	1.551E-04	517.0	8.02	-3.809	2.714
MEAN	1.539E-04	520.0	8.01	-3.813	2.716
STD.DEV.	2.164E-06	3.1	0.11	0.006	0.002
RE-EXTRACTION					
139-4A	2.400E-06	32800.0	7.87	-5.620	4.516
139-5A	3.758E-06	21500.0	8.07	-5.425	4.332
139-6A	2.728E-06	29300.0	7.99	-5.564	4.467
MEAN	2.962E-06	27800.0	7.98	-5.536	4.438
STD.DEV.	7.087E-07	5780.0	0.10	0.100	0.095

Sample ID	Cs	Kp	S	Log Cs	Log Kp
9/19/77					
EUROPIUM, .002M/GPC3-14A SEDIMENT/85 C/0.68U NACL/1 DAY					
170-1	1.242E-03	136.0	16.84	-2.906	2.132
170-2	1.219E-03	143.0	17.40	-2.914	2.155
170-3	1.250E-03	136.0	16.95	-2.903	2.132
MEAN	1.237E-03	138.0	17.06	-2.908	2.140
STD.DEV.	1.641E-05	4.1	0.30	0.006	0.013
RE-EXTRACTION					
170-1A	6.664E-05	2360.0	15.74	-4.176	3.373
170-2A	6.709E-05	2450.0	16.45	-4.173	3.389
170-3A	7.477E-05	2090.0	15.66	-4.126	3.321
MEAN	6.950E-05	2300.0	15.95	-4.159	3.361
STD.DEV.	4.568E-06	187.0	0.43	0.028	0.036
9/19/77					
EUROPIUM, .002M/GPC3-14B SEDIMENT/85 C/0.68U NACL/1 DAY					
171-1	1.241E-03	136.0	16.91	-2.906	2.134
171-2	1.204E-03	143.0	17.27	-2.919	2.157
171-3	1.195E-03	150.0	17.90	-2.922	2.175
MEAN	1.214E-03	143.0	17.36	-2.916	2.155
STD.DEV.	2.442E-05	7.0	0.50	0.009	0.021
RE-EXTRACTION					
171-1A	6.641E-05	2390.0	15.90	-4.178	3.379
171-2A	4.336E-05	3880.0	16.83	-4.363	3.589
171-3A	5.103E-05	3380.0	17.24	-4.292	3.529
MEAN	5.360E-05	3220.0	16.66	-4.278	3.499
STD.DEV.	1.174E-05	758.0	0.68	0.093	0.108
9/21/77					
EUROPIUM, .0005M/GPC3-14A SEDIMENT/85 C/0.68U NACL/1 DAY					
170-4	1.569E-05	7220.0	11.33	-4.804	3.858
170-5	1.352E-05	8270.0	11.19	-4.869	3.918
170-6	1.034E-05	10600.0	10.95	-4.985	4.025
MEAN	1.318E-05	8690.0	11.15	-4.886	3.934
STD.DEV.	2.694E-06	1730.0	0.19	0.092	0.084
RE-EXTRACTION					
170-4A	2.580E-07	439000.0	11.33	-6.588	5.643
170-5A	1.759E-07	636000.0	11.18	-6.755	5.803
170-6A	1.945E-07	563000.0	10.96	-6.711	5.751
MEAN	2.095E-07	546000.0	11.16	-6.685	5.732
STD.DEV.	4.307E-08	99600.0	0.19	0.086	0.082
9/21/77					
EUROPIUM, .0005M/GPC3-14B SEDIMENT/85 C/0.68U NACL/1 DAY					
171-4	1.180E-05	9510.0	11.23	-4.928	3.978
171-5	7.675E-06	14600.0	11.19	-5.115	4.164
171-6	1.199E-05	9270.0	11.11	-4.921	3.967
MEAN	1.049E-05	11100.0	11.18	-4.988	4.036
STD.DEV.	2.438E-06	3010.0	0.06	0.110	0.110
RE-EXTRACTION					
171-1A	1.128E-07	995000.0	11.23	-6.948	5.998
171-2A	1.128E-07	993000.0	11.21	-6.948	5.997
171-6A	1.790E-07	621000.0	11.11	-6.747	5.793
MEAN	1.349E-07	870000.0	11.18	-6.881	5.929
STD.DEV.	3.819E-08	215000.0	0.06	0.116	0.118

Sample ID	Cs	Kp	S	Log Cs	Log Kp
6/3/77					
EUROPIUM, .002M/GPC3-15A SEDIMENT/15 C/0.68U NACL/1 DAY					
118-1	1.636E-03	47.5	7.77	-2.786	1.677
118-2	1.620E-03	49.6	8.04	-2.791	1.696
118-3	1.618E-03	49.8	8.06	-2.791	1.697
MEAN	1.625E-03	49.0	7.96	-2.789	1.690
STD.DEV.	1.007E-05	1.3	0.16	0.003	0.011
RE-EXTRACTION					
118-1A	1.002E-04	578.0	5.79	-3.999	2.762
118-2A	9.485E-05	656.0	6.23	-4.023	2.817
118-3A	9.728E-05	637.0	6.20	-4.012	2.804
MEAN	9.744E-05	624.0	6.07	-4.011	2.794
STD.DEV.	2.678E-06	40.7	0.24	0.012	0.029
6/3/77					
EUROPIUM, .002M/GPC3-15B SEDIMENT/15 C/0.68U NACL/1 DAY					
119-1	1.594E-03	54.7	8.71	-2.798	1.738
119-2	1.614E-03	52.6	8.49	-2.792	1.721
119-3	1.603E-03	53.8	8.63	-2.795	1.731
MEAN	1.604E-03	53.7	8.61	-2.795	1.730
STD.DEV.	1.035E-05	1.1	0.11	0.003	0.008
RE-EXTRACTION					
119-1A	9.315E-05	751.0	7.00	-4.031	2.876
119-2A	9.648E-05	680.0	6.56	-4.016	2.832
119-3A	1.089E-04	619.0	6.74	-3.963	2.792
MEAN	9.953E-05	683.0	6.77	-4.003	2.833
STD.DEV.	8.325E-06	66.1	0.22	0.036	0.042
6/3/77					
EUROPIUM, .0005M/GPC3-15A SEDIMENT/15 C/0.68U NACL/1 DAY					
118-4	2.395E-04	246.0	5.89	-3.621	2.391
118-5	2.419E-04	244.0	5.89	-3.616	2.387
118-6	2.349E-04	256.0	6.01	-3.629	2.408
MEAN	2.388E-04	249.0	5.93	-3.622	2.395
STD.DEV.	3.564E-06	6.4	0.07	0.006	0.011
RE-EXTRACTION					
118-4A	7.898E-06	7310.0	5.77	-5.102	3.864
118-5A	9.328E-06	6160.0	5.74	-5.030	3.789
118-6A	5.124E-06	11600.0	5.96	-5.290	4.065
MEAN	7.450E-06	8360.0	5.82	-5.141	3.906
STD.DEV.	2.137E-06	2870.0	0.12	0.134	0.143
6/3/77					
EUROPIUM, .0005M/GPC3-15B SEDIMENT/15 C/0.68U NACL/1 DAY					
119-4	2.375E-04	261.0	6.21	-3.624	2.417
119-5	2.427E-04	247.0	5.99	-3.615	2.392
119-6	2.380E-04	254.0	6.04	-3.623	2.404
MEAN	2.394E-04	254.0	6.08	-3.621	2.405
STD.DEV.	2.843E-06	7.0	0.12	0.005	0.012
RE-EXTRACTION					
119-4A	9.415E-06	6400.0	6.03	-5.026	3.806
119-5A	9.207E-06	6340.0	5.84	-5.036	3.802
119-6A	8.884E-06	6630.0	5.89	-5.051	3.821
MEAN	9.169E-06	6460.0	5.92	-5.038	3.810
STD.DEV.	2.676E-07	153.0	0.10	0.013	0.010

Sample ID	Cs	Kp	S	Log Cs	Log Kp
10/17/77					
EUROPIUM, .002M/GPC3-15A SEDIMENT/85 C/0.68U NACL/1 DAY					
178-1	1.457E-03	82.2	11.97	-2.837	1.915
178-2	1.417E-03	92.5	13.10	-2.849	1.966
178-3	1.444E-03	86.9	12.56	-2.840	1.939
MEAN	1.439E-03	87.2	12.54	-2.842	1.940
STD.DEV.	2.046E-05	5.1	0.56	0.006	0.026
RE-EXTRACTION					
178-1A	9.400E-05	1090.0	10.27	-4.027	3.039
178-2A	1.039E-04	1080.0	11.18	-3.983	3.032
178-3A	9.557E-05	1130.0	10.79	-4.020	3.052
MEAN	9.782E-05	1100.0	10.75	-4.010	3.041
STD.DEV.	5.319E-06	26.5	0.45	0.023	0.011
10/17/77					
EUROPIUM, .002M/GPC3-15B SEDIMENT/85 C/0.68U NACL/1 DAY					
179-1	1.448E-03	84.3	12.21	-2.839	1.926
179-2	1.444E-03	85.1	12.29	-2.840	1.930
179-3	1.403E-03	94.9	13.32	-2.853	1.977
MEAN	1.432E-03	88.1	12.60	-2.844	1.944
STD.DEV.	2.531E-05	5.9	0.62	0.008	0.029
RE-EXTRACTION					
179-1A	9.587E-05	1120.0	10.70	-4.018	3.048
179-2A	9.725E-05	1100.0	10.70	-4.012	3.041
179-3A	1.122E-04	1030.0	11.57	-3.950	3.013
MEAN	1.018E-04	1080.0	10.99	-3.993	3.034
STD.DEV.	9.046E-06	47.3	0.50	0.038	0.018
10/17/77					
EUROPIUM, .0005M/GPC3-15A SEDIMENT/85 C/0.68U NACL/1 DAY					
178-4	1.122E-04	813.0	9.12	-3.950	2.910
178-5	9.986E-05	939.0	9.38	-4.001	2.973
178-6	8.732E-05	1100.0	9.63	-4.059	3.043
MEAN	9.979E-05	952.0	9.38	-4.003	2.975
STD.DEV.	1.244E-05	144.0	0.26	0.054	0.066
RE-EXTRACTION					
178-4A	3.151E-07	290000.0	9.15	-6.501	5.463
178-5A	2.014E-07	467000.0	9.41	-6.696	5.669
178-6A	1.190E-07	812000.0	9.66	-6.924	5.909
MEAN	2.118E-07	523000.0	9.41	-6.707	5.681
STD.DEV.	9.848E-08	265000.0	0.26	0.212	0.223
10/17/77					
EUROPIUM, .0005M/GPC3-15B SEDIMENT/85 C/0.68U NACL/1 DAY					
179-4	1.081E-04	825.0	8.92	-3.966	2.916
179-5	1.249E-04	697.0	8.71	-3.903	2.843
179-6	1.288E-04	656.0	8.45	-3.890	2.817
MEAN	1.206E-04	726.0	8.69	-3.920	2.859
STD.DEV.	1.104E-05	88.2	0.24	0.041	0.052
RE-EXTRACTION					
179-4A	3.376E-07	266000.0	8.98	-6.472	5.425
179-5A	1.939E-07	452000.0	8.77	-6.712	5.655
179-6A	3.735E-07	228000.0	8.50	-6.428	5.357
MEAN	3.017E-07	315000.0	8.75	-6.537	5.479
STD.DEV.	9.507E-08	120000.0	0.24	0.153	0.156

Sample ID	Cs	Kp	S	Log Cs	Log Kp
1/31/77					
EUROPIUM, .002M/GPC3-16C SEDIMENT/85 C/0.68U NACL/1 DAY					
215-1	1.512E-03	49.4	10.53	-2.820	1.843
215-2	1.518E-03	49.7	10.58	-2.819	1.843
215-3	1.505E-03	73.4	11.05	-2.822	1.866
MEAN	1.512E-03	70.9	10.72	-2.820	1.851
STD.DEV.	4.390E-06	2.2	0.29	0.002	0.013
RE-EXTRACTION					
215-1A	1.067E-04	805.0	8.60	-3.972	2.906
215-2A	1.116E-04	754.0	8.42	-3.952	2.878
215-3A	1.045E-04	869.0	9.08	-3.981	2.939
MEAN	1.076E-04	810.0	8.70	-3.968	2.907
STD.DEV.	3.611E-06	57.6	0.34	0.014	0.031
1/31/77					
EUROPIUM, .002M/GPC3-16D SEDIMENT/85 C/0.68U NACL/1 DAY					
216-1	1.616E-03	51.4	8.30	-2.792	1.711
216-2	1.636E-03	48.3	7.91	-2.786	1.684
216-3	1.568E-03	41.5	9.65	-2.804	1.789
MEAN	1.607E-03	53.7	8.62	-2.794	1.728
STD.DEV.	3.486E-05	6.9	0.91	0.009	0.054
RE-EXTRACTION					
216-1A	9.832E-05	667.0	6.56	-4.007	2.824
216-2A	9.477E-05	663.0	6.29	-4.023	2.822
216-3A	9.918E-05	786.0	7.79	-4.004	2.895
MEAN	9.743E-05	705.0	6.88	-4.011	2.847
STD.DEV.	2.334E-06	49.9	0.80	0.010	0.042
1/31/77					
EUROPIUM, .0005M/GPC3-16C SEDIMENT/85 C/0.68U NACL/1 DAY					
215-4	2.062E-04	325.0	6.71	-3.686	2.512
215-5	2.060E-04	334.0	6.89	-3.686	2.524
215-6	2.023E-04	338.0	6.83	-3.694	2.529
MEAN	2.048E-04	332.0	6.81	-3.689	2.522
STD.DEV.	2.205E-06	6.7	0.09	0.005	0.008
RE-EXTRACTION					
215-4A	1.423E-05	4520.0	6.44	-4.847	3.655
215-5A	1.351E-05	4890.0	6.61	-4.869	3.690
215-6A	1.334E-05	4950.0	6.60	-4.875	3.694
MEAN	1.370E-05	4790.0	6.55	-4.864	3.680
STD.DEV.	4.715E-07	233.0	0.10	0.015	0.021
1/31/77					
EUROPIUM, .0005M/GPC3-16D SEDIMENT/85 C/0.68U NACL/1 DAY					
216-4	1.955E-04	356.0	6.95	-3.709	2.551
216-5	1.967E-04	350.0	6.88	-3.706	2.543
216-6	2.082E-04	320.0	6.67	-3.681	2.506
MEAN	2.001E-04	342.0	6.83	-3.699	2.533
STD.DEV.	7.003E-06	19.3	0.14	0.015	0.024
RE-EXTRACTION					
216-4A	9.832E-06	6900.0	6.79	-5.007	3.839
216-5A	1.546E-05	4270.0	6.60	-4.811	3.630
216-6A	1.158E-05	5570.0	6.45	-4.936	3.746
MEAN	1.229E-05	5580.0	6.61	-4.918	3.738
STD.DEV.	2.883E-06	1320.0	0.17	0.100	0.105

Sample ID	Cs	Kp	S	Log Cs	Log Kp
6/24/77					
EUROPIUM, .002M/GPC3-16A SEDIMENT/15 C/0.68U NACL/1 DAY					
130-1	1.737E-03	32.5	5.65	-2.760	1.512
130-2	1.729E-03	33.9	5.87	-2.762	1.531
130-3	1.728E-03	33.8	5.84	-2.762	1.528
MEAN	1.732E-03	33.4	5.79	-2.762	1.524
STD.DEV.	4.700E-06	0.8	0.12	0.001	0.010
RE-EXTRACTION					
130-1A	8.649E-05	447.0	3.87	-4.063	2.651
130-2A	8.275E-05	502.0	4.16	-4.082	2.701
130-3A	8.585E-05	485.0	4.16	-4.066	2.686
MEAN	8.503E-05	478.0	4.06	-4.070	2.679
STD.DEV.	2.000E-06	28.2	0.17	0.010	0.026
6/24/77					
EUROPIUM, .002M/GPC3-16B SEDIMENT/15 C/0.68U NACL/1 DAY					
131-1	1.759E-03	28.2	4.96	-2.755	1.450
131-2	1.757E-03	29.3	5.15	-2.755	1.467
131-3	1.774E-03	26.5	4.70	-2.751	1.423
MEAN	1.763E-03	28.0	4.94	-2.754	1.447
STD.DEV.	9.486E-06	1.4	0.22	0.002	0.022
RE-EXTRACTION					
131-1A	8.557E-05	386.0	3.31	-4.068	2.587
131-2A	7.207E-05	524.0	3.77	-4.142	2.719
131-3A	7.994E-05	393.0	3.14	-4.097	2.595
MEAN	7.919E-05	434.0	3.41	-4.102	2.634
STD.DEV.	6.778E-06	77.7	0.33	0.037	0.074
6/24/77					
EUROPIUM, .0005M/GPC3-16A SEDIMENT/15 C/0.68U NACL/1 DAY					
130-4	3.194E-04	130.0	4.16	-3.496	2.114
130-5	3.157E-04	133.0	4.21	-3.501	2.125
130-6	3.241E-04	123.0	3.99	-3.489	2.090
MEAN	3.198E-04	129.0	4.12	-3.495	2.110
STD.DEV.	4.222E-06	5.1	0.11	0.006	0.018
RE-EXTRACTION					
130-4A	1.710E-05	2230.0	3.81	-4.767	3.348
130-5A	1.353E-05	2910.0	3.94	-4.869	3.464
130-6A	2.181E-05	1630.0	3.55	-4.661	3.211
MEAN	1.748E-05	2250.0	3.76	-4.766	3.341
STD.DEV.	4.153E-06	640.0	0.20	0.104	0.126
6/24/77					
EUROPIUM, .0005M/GPC3-16B SEDIMENT/15 C/0.68U NACL/1 DAY					
131-4	3.419E-04	104.0	3.56	-3.466	2.018
131-5	3.386E-04	109.0	3.69	-3.470	2.037
131-6	3.524E-04	94.5	3.33	-3.453	1.976
MEAN	3.443E-04	103.0	3.53	-3.463	2.010
STD.DEV.	7.210E-06	7.3	0.18	0.009	0.032
RE-EXTRACTION					
131-4A	2.076E-05	1510.0	3.14	-4.683	3.179
131-5A	2.195E-05	1480.0	3.25	-4.658	3.170
131-6A	2.048E-05	1430.0	2.92	-4.689	3.154
MEAN	2.106E-05	1470.0	3.10	-4.677	3.168
STD.DEV.	7.806E-07	40.5	0.17	0.016	0.013

Sample ID	Cs	Kp	S	Log Cs	Log Kp
6/17/77					
EUROPIUM,.002M/GPC3-17A SEDIMENT/15 C/O.68U NACL/1 DAY					
126-1	1.718E-03	36.4	6.29	-2.765	1.564
126-2	1.709E-03	38.3	6.54	-2.767	1.583
126-3	1.693E-03	40.1	6.79	-2.771	1.603
MEAN	1.707E-03	38.3	6.54	-2.768	1.583
STD.DEV.	1.250E-05	1.7	0.25	0.003	0.020
RE-EXTRACTION					
126-1A	7.087E-05	688.0	4.87	-4.149	2.837
126-2A	8.152E-05	601.0	4.90	-4.089	2.779
126-3A	9.018E-05	551.0	4.97	-4.045	2.741
MEAN	8.086E-05	613.0	4.91	-4.094	2.786
STD.DEV.	9.675E-06	69.3	0.05	0.053	0.048
6/17/77					
EUROPIUM,.002M/GPC3-17B SEDIMENT/15 C/O.68U NACL/1 DAY					
127-1	1.704E-03	39.1	6.65	-2.769	1.592
127-2	1.695E-03	40.2	6.81	-2.771	1.604
127-3	1.676E-03	42.8	7.18	-2.776	1.632
MEAN	1.691E-03	40.7	6.88	-2.772	1.609
STD.DEV.	1.439E-05	1.9	0.27	0.004	0.021
RE-EXTRACTION					
127-1A	9.298E-05	509.0	4.74	-4.032	2.707
127-2A	9.563E-05	508.0	4.86	-4.019	2.706
127-3A	9.680E-05	541.0	5.24	-4.014	2.733
MEAN	9.513E-05	520.0	4.94	-4.022	2.715
STD.DEV.	1.958E-06	18.8	0.26	0.009	0.015
6/17/77					
EUROPIUM,.0005M/GPC3-17A SEDIMENT/15 C/O.68U NACL/1 DAY					
126-4	2.845E-04	179.0	5.08	-3.546	2.252
126-5	2.983E-04	163.0	4.85	-3.525	2.211
126-6	2.714E-04	200.0	5.43	-3.566	2.301
MEAN	2.847E-04	180.0	5.12	-3.546	2.255
STD.DEV.	1.342E-05	18.6	0.29	0.020	0.045
RE-EXTRACTION					
126-4A	1.302E-05	3720.0	4.84	-4.885	3.570
126-5A	1.667E-05	2700.0	4.50	-4.778	3.431
126-6A	1.347E-05	3830.0	5.16	-4.870	3.583
MEAN	1.439E-05	3420.0	4.84	-4.845	3.528
STD.DEV.	1.989E-06	623.0	0.33	0.058	0.084
6/17/77					
EUROPIUM,.0005M/GPC3-17B SEDIMENT/15 C/O.68U NACL/1 DAY					
127-4	2.999E-04	161.0	4.83	-3.523	2.207
127-5	3.024E-04	156.0	4.72	-3.519	2.193
127-6	3.075E-04	148.0	4.54	-3.512	2.169
MEAN	3.033E-04	155.0	4.69	-3.518	2.190
STD.DEV.	3.879E-06	6.6	0.15	0.005	0.019
RE-EXTRACTION					
127-4A	1.263E-05	3620.0	4.57	-4.898	3.559
127-5A	1.648E-05	2660.0	4.38	-4.783	3.424
127-6A	1.208E-05	3570.0	4.31	-4.918	3.553
MEAN	1.373E-05	3280.0	4.42	-4.866	3.512
STD.DEV.	2.396E-06	540.0	0.14	0.073	0.076

Sample ID	Cs	Kp	S	Log Cs	Log Kp
9/19/77					
EUROPIUM,.002M/GPC3-17A SEDIMENT/85 C/O.68U NACL/1 DAY					
174-1	1.533E-03	69.8	10.70	-2.814	1.844
174-2	1.524E-03	69.7	10.63	-2.817	1.843
174-3	1.524E-03	72.1	10.99	-2.817	1.858
MEAN	1.527E-03	70.5	10.77	-2.816	1.848
STD.DEV.	4.936E-06	1.3	0.19	0.001	0.008
RE-EXTRACTION					
174-1A	9.090E-05	1010.0	9.20	-4.041	3.005
174-2A	9.336E-05	978.0	9.13	-4.030	2.990
174-3A	9.238E-05	1010.0	9.34	-4.034	3.005
MEAN	9.221E-05	1000.0	9.22	-4.035	3.000
STD.DEV.	1.241E-06	18.5	0.10	0.006	0.008
9/19/77					
EUROPIUM,.002M/GPC3-17B SEDIMENT/85 C/O.68U NACL/1 DAY					
175-1	1.540E-03	68.7	10.58	-2.813	1.837
175-2	1.541E-03	66.6	10.26	-2.812	1.823
175-3	1.536E-03	68.0	10.45	-2.813	1.833
MEAN	1.539E-03	67.8	10.43	-2.813	1.831
STD.DEV.	2.215E-06	1.1	0.16	0.001	0.007
RE-EXTRACTION					
175-1A	9.124E-05	979.0	8.93	-4.040	2.991
175-2A	9.700E-05	878.0	8.52	-4.013	2.944
175-3A	9.711E-05	893.0	8.67	-4.013	2.951
MEAN	9.512E-05	917.0	8.71	-4.022	2.962
STD.DEV.	3.362E-06	54.5	0.21	0.015	0.025
9/19/77					
EUROPIUM,.0005M/GPC3-17A SEDIMENT/85 C/O.68U NACL/1 DAY					
174-4	1.089E-04	853.0	9.31	-3.963	2.932
174-5	1.406E-04	606.0	8.52	-3.852	2.783
174-6	1.382E-04	622.0	8.60	-3.859	2.794
MEAN	1.292E-04	694.0	8.81	-3.891	2.836
STD.DEV.	1.767E-05	139.0	0.43	0.062	0.083
RE-EXTRACTION					
174-4A	3.599E-06	25700.0	9.27	-5.444	4.411
174-5A	4.297E-06	19700.0	8.48	-5.367	4.295
174-6A	3.654E-06	23500.0	8.59	-5.437	4.371
MEAN	3.850E-06	23000.0	8.78	-5.416	4.359
STD.DEV.	3.881E-07	3040.0	0.42	0.043	0.059
9/19/77					
EUROPIUM,.0005M/GPC3-17B SEDIMENT/85 C/O.68U NACL/1 DAY					
175-4	1.238E-04	720.0	8.91	-3.907	2.857
175-5	1.592E-04	511.0	8.13	-3.798	2.708
175-6	1.214E-04	751.0	9.12	-3.916	2.876
MEAN	1.348E-04	660.0	8.72	-3.874	2.814
STD.DEV.	2.117E-05	131.0	0.52	0.066	0.092
RE-EXTRACTION					
175-4A	4.231E-06	21000.0	8.86	-5.373	4.321
175-5A	3.602E-06	22700.0	8.17	-5.443	4.356
175-6A	5.868E-06	15400.0	9.04	-5.231	4.187
MEAN	4.567E-06	19700.0	8.69	-5.349	4.288
STD.DEV.	1.170E-06	3820.0	0.46	0.108	0.089

Sample ID	Cs	Kp	S	Log Cs	Log Kp
7/25/77					
EUROPIUM, .002M/GPC3-18A SEDIMENT/15 C/0.68U NACL/1 DAY					
148-1	1.736E-03	33.5	5.81	-2.760	1.524
148-2	1.750E-03	31.7	5.54	-2.757	1.501
148-3	1.732E-03	33.6	5.81	-2.761	1.526
MEAN	1.740E-03	32.9	5.72	-2.759	1.517
STD.DEV.	9.317E-04	1.1	0.15	0.002	0.014
RE-EXTRACTION					
148-1A	9.366E-05	408.0	3.82	-4.028	2.611
148-2A	9.604E-05	366.0	3.51	-4.017	2.563
148-3A	9.501E-05	408.0	3.88	-4.022	2.611
MEAN	9.490E-05	394.0	3.74	-4.023	2.595
STD.DEV.	1.195E-04	24.2	0.20	0.005	0.028
7/25/77					
EUROPIUM, .002M/GPC3-18B SEDIMENT/15 C/0.68U NACL/1 DAY					
149-1	1.730E-03	34.9	6.04	-2.762	1.543
149-2	1.737E-03	33.2	5.76	-2.760	1.520
149-3	1.735E-03	33.7	5.85	-2.761	1.528
MEAN	1.734E-03	33.9	5.88	-2.761	1.530
STD.DEV.	3.147E-04	0.9	0.14	0.001	0.011
RE-EXTRACTION					
149-1A	9.203E-05	448.0	4.12	-4.036	2.651
149-2A	9.467E-05	402.0	3.81	-4.024	2.604
149-3A	9.810E-05	390.0	3.82	-4.008	2.591
MEAN	9.493E-05	413.0	3.92	-4.023	2.615
STD.DEV.	3.045E-04	30.6	0.18	0.014	0.032
7/25/77					
EUROPIUM, .0005M/GPC3-18A SEDIMENT/15 C/0.68U NACL/1 DAY					
148-4	3.363E-04	116.0	3.91	-3.473	2.066
148-5	3.292E-04	131.0	4.31	-3.482	2.117
148-6	3.313E-04	120.0	3.97	-3.480	2.078
MEAN	3.323E-04	122.0	4.06	-3.478	2.087
STD.DEV.	3.641E-04	7.8	0.22	0.005	0.027
RE-EXTRACTION					
148-4A	2.538E-05	1320.0	3.34	-4.596	3.119
148-5A	2.307E-05	1640.0	3.78	-4.637	3.214
148-6A	2.517E-05	1360.0	3.43	-4.599	3.135
MEAN	2.454E-05	1440.0	3.52	-4.611	3.156
STD.DEV.	1.276E-04	174.0	0.23	0.023	0.051
7/25/77					
EUROPIUM, .0005M/GPC3-18B SEDIMENT/15 C/0.68U NACL/1 DAY					
149-4	3.455E-04	105.0	3.63	-3.461	2.021
149-5	3.478E-04	103.0	3.58	-3.459	2.013
149-6	3.402E-04	111.0	3.76	-3.468	2.044
MEAN	3.445E-04	106.0	3.66	-3.463	2.026
STD.DEV.	3.903E-04	4.2	0.10	0.005	0.016
RE-EXTRACTION					
149-4A	2.544E-05	1210.0	3.08	-4.594	3.084
149-5A	2.410E-05	1270.0	3.07	-4.618	3.105
149-6A	2.346E-05	1400.0	3.28	-4.630	3.145
MEAN	2.433E-05	1290.0	3.14	-4.614	3.111
STD.DEV.	1.009E-04	97.1	0.12	0.018	0.031

Sample ID	Cs	Kp	S	Log Cs	Log Kp
8/12/77					
EUROPIUM, .002M/GPC3-18A SEDIMENT/85 C/0.68U NACL/1 DAY					
158-1	1.582E-03	56.7	8.97	-2.801	1.754
158-2	1.548E-03	63.2	9.79	-2.810	1.801
158-3	1.573E-03	86.0	13.53	-2.803	1.934
MEAN	1.568E-03	68.6	10.76	-2.805	1.830
STD.DEV.	1.759E-05	15.4	2.43	0.005	0.094
RE-EXTRACTION					
158-1A	1.101E-04	633.0	6.97	-3.958	2.802
158-2A	1.085E-04	730.0	7.92	-3.965	2.863
158-3A	1.098E-04	977.0	10.72	-3.959	2.990
MEAN	1.094E-04	780.0	8.54	-3.961	2.885
STD.DEV.	8.656E-07	177.0	1.95	0.003	0.096
8/12/77					
EUROPIUM, .002M/GPC3-18B SEDIMENT/85 C/0.68U NACL/1 DAY					
159-1	1.596E-03	53.2	8.49	-2.797	1.726
159-2	1.591E-03	54.5	8.66	-2.798	1.736
159-3	1.588E-03	55.3	8.79	-2.799	1.743
MEAN	1.592E-03	54.3	8.65	-2.798	1.735
STD.DEV.	4.098E-06	1.1	0.15	0.001	0.009
RE-EXTRACTION					
159-1A	1.075E-04	618.0	6.65	-3.969	2.791
159-2A	1.094E-04	618.0	6.75	-3.961	2.791
159-3A	1.114E-04	601.0	6.70	-3.953	2.779
MEAN	1.094E-04	612.0	6.70	-3.961	2.787
STD.DEV.	1.985E-04	9.8	0.05	0.008	0.007
8/12/77					
EUROPIUM, .0005M/GPC3-18A SEDIMENT/85 C/0.68U NACL/1 DAY					
158-4	1.820E-04	393.0	7.15	-3.740	2.594
158-5	1.872E-04	377.0	7.06	-3.728	2.577
158-6	2.149E-04	303.0	6.52	-3.668	2.482
MEAN	1.947E-04	358.0	6.91	-3.712	2.551
STD.DEV.	1.769E-05	48.0	0.34	0.039	0.060
RE-EXTRACTION					
158-4A	1.582E-05	4340.0	6.87	-4.801	3.637
158-5A	1.483E-05	4560.0	6.77	-4.829	3.659
158-6A	1.090E-05	5810.0	6.33	-4.963	3.764
MEAN	1.385E-05	4900.0	6.66	-4.864	3.687
STD.DEV.	2.606E-04	793.0	0.29	0.087	0.068
8/12/77					
EUROPIUM, .0005M/GPC3-18B SEDIMENT/85 C/0.68U NACL/1 DAY					
159-4	2.307E-04	264.0	6.09	-3.637	2.421
159-5	2.071E-04	317.0	6.56	-3.684	2.501
159-6	2.170E-04	287.0	6.22	-3.664	2.457
MEAN	2.182E-04	289.0	6.29	-3.661	2.460
STD.DEV.	1.188E-05	26.6	0.24	0.024	0.040
RE-EXTRACTION					
159-4A	2.335E-05	2410.0	5.62	-4.632	3.381
159-5A	1.919E-05	3230.0	6.20	-4.717	3.509
159-6A	1.527E-05	3900.0	5.96	-4.816	3.591
MEAN	1.927E-05	3180.0	5.92	-4.722	3.494
STD.DEV.	4.037E-04	746.0	0.29	0.092	0.106

Sample ID	Cs	Kp	S	Log Cs	Log Kp
EUROPIUM, .002M/GPC3-19C SEDIMENT/85 C/0.68U NACL/1 DAY 1/17/78					
203-1	1.584E-03	58.0	9.19	-2.800	1.764
203-2	1.569E-03	60.2	9.44	-2.804	1.780
203-3	1.556E-03	62.9	9.79	-2.808	1.799
MEAN	1.569E-03	60.4	9.47	-2.804	1.781
STD.DEV.	1.404E-05	2.4	0.30	0.004	0.018
RE-EXTRACTION					
203-1A	1.192E-04	631.0	7.52	-3.924	2.800
203-2A	1.092E-04	715.0	7.81	-3.962	2.854
203-3A	1.151E-04	707.0	8.13	-3.939	2.849
MEAN	1.145E-04	684.0	7.82	-3.941	2.835
STD.DEV.	5.019E-06	46.4	0.31	0.019	0.030
EUROPIUM, .002M/GPC3-19D SEDIMENT/85 C/0.68U NACL/1 DAY 1/17/78					
204-1	1.557E-03	60.6	9.44	-2.808	1.783
204-2	1.553E-03	61.4	9.54	-2.809	1.788
204-3	1.569E-03	60.1	9.43	-2.804	1.779
MEAN	1.560E-03	60.7	9.47	-2.807	1.783
STD.DEV.	8.156E-06	0.7	0.06	0.002	0.005
RE-EXTRACTION					
204-1A	1.167E-04	670.0	7.82	-3.933	2.826
204-2A	1.173E-04	675.0	7.92	-3.931	2.829
204-3A	1.108E-04	690.0	7.64	-3.956	2.839
MEAN	1.149E-04	678.0	7.79	-3.940	2.831
STD.DEV.	3.611E-06	10.4	0.14	0.014	0.007
EUROPIUM, .0005M/GPC3-19C SEDIMENT/85 C/0.68U NACL/1 DAY 1/17/78					
203-4	1.772E-04	422.0	7.48	-3.751	2.625
203-5	2.010E-04	349.0	7.01	-3.697	2.543
203-6	2.099E-04	320.0	6.73	-3.678	2.506
MEAN	1.960E-04	364.0	7.07	-3.709	2.558
STD.DEV.	1.687E-05	52.6	0.38	0.038	0.061
RE-EXTRACTION					
203-4A	1.185E-05	6170.0	7.31	-4.926	3.791
203-5A	6.047E-06	11600.0	7.01	-5.218	4.064
203-6A	8.501E-06	7830.0	6.66	-5.070	3.894
MEAN	8.798E-06	8530.0	6.99	-5.072	3.916
STD.DEV.	2.912E-06	2780.0	0.33	0.146	0.138
EUROPIUM, .0005M/GPC3-19D SEDIMENT/85 C/0.68U NACL/1 DAY 1/17/78					
204-4	2.070E-04	325.0	6.73	-3.684	2.512
204-5	1.938E-04	344.0	6.67	-3.713	2.537
204-6	2.068E-04	330.0	6.83	-3.684	2.519
MEAN	2.025E-04	333.0	6.74	-3.694	2.523
STD.DEV.	7.569E-06	9.9	0.08	0.016	0.013
RE-EXTRACTION					
204-4A	6.411E-06	10500.0	6.73	-5.193	4.021
204-5A	7.780E-06	8500.0	6.61	-5.109	3.929
204-6A	8.399E-06	8070.0	6.78	-5.076	3.907
MEAN	7.530E-06	9020.0	6.71	-5.126	3.952
STD.DEV.	1.017E-06	1300.0	0.08	0.060	0.060

Sample ID	Cs	Kp	S	Log Cs	Log Kp
EUROPIUM, .002M/GPC3-19A SEDIMENT/15 C/0.68U NACL/1 DAY 5/20/77					
114-1	1.741E-03	30.6	5.33	-2.759	1.486
114-2	1.718E-03	31.7	5.44	-2.765	1.501
114-3	1.729E-03	32.0	5.53	-2.762	1.505
MEAN	1.729E-03	31.4	5.43	-2.762	1.497
STD.DEV.	1.131E-05	0.7	0.10	0.003	0.010
RE-EXTRACTION					
114-1A	9.135E-05	396.0	3.61	-4.039	2.597
114-2A	9.930E-05	363.0	3.60	-4.003	2.560
114-3A	1.011E-04	357.0	3.61	-3.995	2.553
MEAN	9.725E-05	372.0	3.61	-4.012	2.570
STD.DEV.	5.196E-06	21.0	0.00	0.023	0.024
EUROPIUM, .002M/GPC3-19B SEDIMENT/15 C/0.68U NACL/1 DAY 5/20/77					
115-1	1.725E-03	32.0	5.52	-2.763	1.505
115-2	1.725E-03	32.3	5.58	-2.763	1.509
115-3	1.714E-03	32.2	5.52	-2.766	1.508
MEAN	1.721E-03	32.2	5.54	-2.764	1.508
STD.DEV.	6.324E-06	0.2	0.03	0.002	0.002
RE-EXTRACTION					
115-1A	9.572E-05	385.0	3.69	-4.019	2.585
115-2A	1.005E-04	372.0	3.74	-3.998	2.571
115-3A	1.018E-04	365.0	3.71	-3.992	2.562
MEAN	9.932E-05	374.0	3.71	-4.003	2.573
STD.DEV.	3.184E-06	10.1	0.03	0.014	0.012
EUROPIUM, .0005M/GPC3-19A SEDIMENT/15 C/0.68U NACL/1 DAY 5/20/77					
114-4	3.295E-04	109.0	3.58	-3.482	2.036
114-5	3.283E-04	113.0	3.72	-3.484	2.054
114-6	3.323E-04	116.0	3.85	-3.478	2.063
MEAN	3.301E-04	113.0	3.71	-3.481	2.051
STD.DEV.	2.052E-06	3.5	0.14	0.003	0.014
RE-EXTRACTION					
114-4A	1.680E-05	1970.0	3.31	-4.775	3.295
114-5A	1.912E-05	1750.0	3.34	-4.718	3.242
114-6A	1.870E-05	1860.0	3.48	-4.728	3.269
MEAN	1.821E-05	1860.0	3.38	-4.740	3.269
STD.DEV.	1.236E-06	110.0	0.09	0.030	0.026
EUROPIUM, .0005M/GPC3-19B SEDIMENT/15 C/0.68U NACL/1 DAY 5/20/77					
115-4	3.290E-04	117.0	3.84	-3.483	2.067
115-5	3.355E-04	111.0	3.72	-3.474	2.044
115-6	3.418E-04	100.0	3.42	-3.466	2.001
MEAN	3.354E-04	109.0	3.66	-3.474	2.037
STD.DEV.	6.390E-06	8.6	0.21	0.008	0.034
RE-EXTRACTION					
115-4A	1.946E-05	1790.0	3.49	-4.711	3.254
115-5A	1.529E-05	2260.0	3.46	-4.816	3.354
115-6A	1.363E-05	2360.0	3.21	-4.866	3.373
MEAN	1.612E-05	2140.0	3.39	-4.797	3.327
STD.DEV.	3.003E-06	304.0	0.15	0.079	0.064

APPENDIX I

Elemental analyses of freeze-dried sediment from core LL44-GPC-3. All analyses by atomic absorption spectrometry (M. Leinen). Concentrations are on a salt-free basis. Mg, Al, Ca, Fe, Mn and Si values are weight percents; Cu, Ni and Zn values are ppm.

<u>SAMPLE #</u>	<u>DEPTH (cm)</u>	<u>Mg</u>	<u>Al</u>	<u>Ca</u>	<u>Fe</u>	<u>Mn</u>	<u>Si</u>	<u>Cu</u>	<u>NI</u>	<u>Zn</u>
2	120	1.98	9.82	.56	5.48	.34		184	236	140
3	177	1.87	6.20	.49	5.44	.34		200	226	145
4	290	1.77	8.81	.48	5.57	.41		253	277	155
5	410	1.78	7.84	.58	5.44	.48	28.23	267	219	156
6	565	1.94	9.48	.58	6.03	.58	22.11	281	160	178
7	700	2.03	9.37	.82	6.76	.91	24.11	369	237	183
8	845	2.07	8.86	1.10	6.70	1.41	21.92	491	344	172
9	1055	1.74	7.02	1.65	7.48	2.36		412	367	205
10	1175	1.52	9.02	1.71	4.94	2.19	21.25	283	383	152
11	1325	2.15	7.30	1.78	8.60	3.49	20.78	537	488	219
12	1510	2.18	7.15	1.91	11.29	3.37	19.07	533	398	271
13	1645	2.07	6.18	3.23	12.70	3.49	18.43	798	464	305
14	1825	1.84	6.30	3.41	7.64	2.79	12.61	727	587	246
15	1930	2.39	5.96	2.66	9.19	1.95	22.99	702	215	312
16	2065	1.65	7.73	1.28	6.93	1.05	27.71	427	208	193
17	2205	1.79	7.84	1.80	7.07	1.85	17.87	461	230	246
18	2375	2.28	8.16	1.15	6.95	1.78	22.33	531	418	229
19	2445	2.05	7.81	1.10	8.82	1.44	25.41	491	231	262

APPENDIX J

Identification and location of existing sediment cores from the southern Bermuda Rise. The MPG-III study area will be sited in this region. Core numbers on the map are keyed to the attached core list.

EXISTING CORES SOUTH OF BERMUDA

<u>MAP LOCN.</u>	<u>CORE</u>	<u>LAT.</u>	<u>LONG.</u>	<u>CORRECTED WATER DEPTH (m)</u>	<u>CORE LENGTH (cm)</u>	<u>TRIGGER CORE LENGTH (cm)</u>
<u>Cores at LDGO Atlantis</u>						
1	A172-19	24° 35'	64° 02'	5210	505	-
<u>Robert Conrad</u>						
2	RC4-1	30° 00'	69° 08.5'	5121	910	44
3	RC16-201	29° 29'	65° 29'	5099	919	59
4	RC17-7	29° 33'	68° 32'	5189	1168	44
5	RC17-8	29° 36'	66° 15'	5075	488	47.5
6	RC17-9	29° 25'	65° 04'	5013	862	63
7	RC17-10	27° 35'	63° 58'	5348	-	42.5
8	RC17-11	25° 41'	63° 59'	5602	40	48
9	RC19-42	30° 17.1	67° 41.2'	5154	1063	42
10	RC19-44	30° 32'	67° 58.6'	5196	1069	59
11	RC19-45	30° 07.1'	68° 50.7'	5240	869	51
12	RC19-46	30° 15.2'	68° 51.1'	5222	1046	47
<u>Vema</u>						
13	V17-1	28° 29'	65° 03'	5024	1089	19.3
14	V17-2	24° 56'	65° 32'	5303	490	38.0
15	V18-2	29° 28'	65° 11'	4781	865	42
16	V18-3	26° 47'	66° 08'	4993	715	52
17	V18-5	27° 08'	68° 03'	5174	1064	23 & 22
18	V18-6	28° 00'	68° 09'	5251	950	26 & 21
19	V18-366	26° 28'	68° 06'	5286	664	-
20	V19-6	28° 20'	68° 06'	5262	613	41
21	V19-7	27° 28'	68° 27'	5362	783	22
22	V23-139	29° 01'	64° 22'	4510	235	35
23	V25-3	28° 43'	67° 28'	5130	944	27
24	V25-4	28° 44'	63° 56'	5203	723	52
25	V26-154	24° 28.6'	65° 18.4'	5773	916	-
26	V26-156	27° 27.2'	65° 15.7'	5035	859	47
27	V26-157	29° 46.3'	67° 53.2'	5222	1139	-
28	V26-160	29° 56.8'	68° 56'	5256	1114	-
29	V26-162	29° 44.9'	68° 41.2'	5216	922	43
30	V26-165	30° 27.3'	67° 58.8'	5159	836	41
31	V26-166	29° 55.3'	68° 42.6'	5229	1445	40
32	V26-167	30° 29.8'	67° 43.8'	5148	796	48

EXISTING CORES SOUTH OF BERMUDA

- 2 -

<u>MAP LOCN.</u>	<u>CORE</u>	<u>LAT.</u>	<u>LONG.</u>	<u>CORRECTED WATER DEPTH (m)</u>	<u>CORE LENGTH (cm)</u>	<u>TRIGGER CORE LENGTH (cm)</u>
33	V26-168	30°05.4'	68°16.6'	5189	925	53
34	V31-166	28°55'	63°28'	5249	1146	69

Cores at WHOI

35	CHN47-2FF	29°30.5'	67°09.4'	4130	97	-
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Atlantis

36	A282-1GC	29°39'	66°22'	5128	209	-
37	A282-2GC	28°52'	66°51'	5451	190	-
38	A282-15GC	25°29'	64°34'	5706	245	-
39	A282-16GC	27°10'	65°40'	5413	197	-
40	A282-17GC	25°26.5'	66°40'	5602	254	-
41	A282-18GC	27°05'	67°56'	5195	246	-
42	A282-20GC	28°44'	69°05'	5325	243	-
43	A282-21GC	28°51'	66°50'	5306	244	-
44	A282-22GC	28°54'	64°39'	4846	301	-

Atlantis II

45	A1131-21PC	27°29.5	63°05.5'	5380	92 (65-92 void)	-
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Barriers to Radioactive Waste Migration

by G. Ross Heath

Regardless of the method that is ultimately chosen for the disposal of high-level radioactive waste, the definition of success must be that *there is almost no likelihood of radionuclides reaching man's environment while they are still radioactive*. Since one of the plutonium isotopes in the waste has a half-life (the time required for half the initial amount to decay away) of almost 400,000 years, the waste must be isolated from man for at least a million years. One of the main tasks of the Energy Research and Development Administration's seabed disposal program is to find out the speeds at which waste radionuclides buried in the seabed can move up through the sediment. If these speeds are so slow that all the radioactivity will decay long before any element can reach the sea floor, seabed disposal is environmentally acceptable (regardless of its political, technical, economic, or legal feasibility).

Three barriers lie between wastes buried in the seabed and the ocean. They are: 1) the glassy waste material itself; 2) the canister; and 3) the sediment that surrounds the canister.

An additional barrier might be provided by burial of the wastes in volcanic rock that lies beneath the sediments of the seabed. Recent deep drilling by the *Glomar Challenger*, however, suggests that the first few hundred meters of volcanic rock beneath the sediments is laced with fractures that formed as the rock cooled after eruption. At worst, these cracks could breach the barriers between man and waste mentioned earlier by allowing seawater to circulate freely through the rock. In any case, they prevent us from making reliable estimates of the speed at which various elements migrate through the rock, because neither their size nor spacing are uniform from one drillhole to another.

The Waste Form

The liquid waste produced during the reprocessing of reactor fuel rods is basically a solution of radioactive and nonradioactive elements in nitric acid. This solution is very corrosive, generates large amounts of heat, and is highly radioactive. Present plans call for solidification of the waste by evaporation of the acid followed by fusion of the salts into a glass, probably a borosilicate glass much like that in ordinary bottles (Figure 1). This glass is much easier to handle than liquid waste, and has the additional advantage that it is quite insoluble. Thus, the glass itself forms the first "barrier" in the sense that elements are released to the surrounding environment at least a million times more slowly than they would be from the soluble nitrate salts or from the solution before evaporation.

Figure 1. Silicate glass such as this would form the first "barrier" to the escape of radioactivity from the canister. The high-level wastes would actually be incorporated into the glass in a ratio of about 25 percent waste to 75 percent glass. (Courtesy ERDA)

Several questions about the properties of this waste form are still unanswered. Exact leach rates for most of the radioactive elements are not known because a final decision on the best type of glass has not been made. In addition, few if any leach experiments have been carried out using solutions resembling sediment pore waters, or at temperatures and pressures anticipated in the seabed after emplacement. Another question of concern is the long-term stability of the glass. The heat produced by the radionuclides during decay will ultimately devitrify the glass. This process converts the waste from a uniform, very thick "liquid" (glass) to a mass of tiny crystals. From our experience with natural volcanic glasses in deep-sea sediments, we know that devitrification greatly speeds up the rate at which elements are released from the glass. Thus, the effectiveness of a glassy barrier may be very different if devitrification occurs in a few years rather than a few centuries. At the same time, we know that radiation produced by decay of the waste radionuclides damages the structure of either glass or crystals, making these materials even more vulnerable to solution.

In any case, a glass waste form is unlikely to confine the radioactive elements for more than a thousand years — far less than the several million required. Since most of the heat produced by the waste is given off in the first few hundred years, however, it is important that we determine how effective the "waste form" barrier is.

The Canister

To confine the glassy wastes during processing, storage, and transportation, they will most likely be sealed in metal canisters. Glass or ceramic canisters are possible alternatives for some disposal options, but may be less suitable for seabed disposal because of the strength requirements for handling and shipment. The canister must be able to dissipate the heat from newly packaged waste, as well as be conveniently handled, so present designs center around cylinders about 1 foot in diameter by 10 feet long (Figure 2). When newly filled, such canisters will give off 10 to 30 kilowatts of heat as well as radiation so intense that anyone foolish enough to spend even a second at a distance of 3 feet from the canister would be exposed to as much radiation as the Nuclear Regulatory Commission presently permits people working with radioactive materials to receive during their entire lifetimes.

If seabed disposal ever becomes a reality, the canisters will be made of a metal or alloy that will resist corrosion as long as possible.

Unfortunately, seawater (which is much like sediment pore water) is an extremely corrosive natural fluid. The only candidates for canister materials that appear suitable at present are titanium and zirconium alloys. Research to better define the behavior of these materials in pore waters is being carried out by metallurgists at Sandia Laboratories, a government research facility in Albuquerque, New Mexico. Their best estimate at present is that material capable of confining the wastes for a few thousand years can be found if reasonable temperature levels are maintained (not greater than 200 degrees Centigrade). Again, this is far from the minimum of a million years of total containment that is needed. Nevertheless, as is the case for the waste form, this period is long enough to allow the waste to dissipate most of its heat before it begins to interact with the surrounding sediment, thereby enormously reducing the likelihood of rapid upward transport of radionuclides in convection currents that could be produced by the hot waste.

Figure 2. The proposed standard canister for high-level, low-level, and intermediate-level wastes. (Courtesy ERDA — Office of Waste Isolation, Oak Ridge, Tenn.)

Sediments of the Seabed

Deep-sea clays that form a large portion of marine sediments have a number of properties that make them attractive to a geochemist interested in using

them as part of the barrier sequence. They are extremely fine grained (most particles are less than 1 micrometer [$1/25,000$ of an inch] in diameter). As a result, they have low permeabilities (see page 34). They also have very large surface areas per unit volume of sediment, an important attribute in reactions between dissolved waste elements and clays, in addition to well-known and extensively studied abilities to extract (sorb) metals from solutions.

In examining the barrier properties of deep-sea clays, let us first consider where there is no flow of water through the sediment and where emplacement of the canister has no effect on the seabed. Reactions in this case are much like those in nature, where one type of sediment is buried by another.

For waste elements that react little or not at all with the sediments (for example, chlorine and tritium), the time required for the first molecules to diffuse from the canister to the sea floor is the depth of burial squared, divided by the diffusion coefficient for that element in the particular sediment. Based on a diffusion coefficient of 3×10^{-8} square centimeters per second (an average value for deep-sea sediments), it would take waste chlorine buried 100 meters (328 feet) below the sea floor a million years to appear in the ocean. This time is beginning to approach the isolation time required for high-level waste. It is certainly encouraging enough to lead us to study the migration of elements that *do* react with the sediments. The waste elements with long half-lives, such as plutonium, fall into this latter group (Table 1).

A solution of metal in a clay sediment equilibrates itself so that some of the metal is sorbed to the sediment and some remains dissolved in the pore waters. The ratio between the sorbed and dissolved fractions is called the distribution coefficient. Because only the dissolved fraction diffuses through the sediment, the rate of diffusion of a reactive element is much slower than the rate for the nonreactive elements discussed earlier. In fact, we can get a good idea of the diffusion rate of a reactive element by dividing the nonreactive rate by the distribution coefficient. The nonreactive rate is about a hundred meters per million years. To provide a reasonable safety margin, distribution coefficients for long-lived waste elements should be more than 10, and preferably more than 100.

The measurement of these coefficients is one of the major tasks presently being undertaken by Sandia Laboratories and by our laboratory at the University of Rhode Island. This is a long-term project, because the coefficients must be determined

for the important radionuclides as a function of temperature, concentration, pressure, exposure time, and presence of other competing ions.

The experiments are quite simple. Small samples of deep-sea sediment are added to known volumes of artificial seawater, containing, in dissolved form, the element of interest. In each case, a tiny fraction of the element is a commercially available radioactive isotope. By measuring the radioactivity of the solution before and after it has equilibrated with the sediment, we can calculate the amount of the element sorbed by the sediment, and hence the distribution coefficient. In some cases, the sorption experiments are first carried out using a sodium chloride solution, rather than artificial seawater, so that we can distinguish reactions in the solution, such as the formation of insoluble salts, from sorption reactions. Figure 3 shows results from a series of experiments at 85 degrees Centigrade between thorium solutions in sodium chloride brine and surface sediment from the North Pacific. In this case, the weaker the thorium solution, the greater the proportion of the thorium sorbed onto the clay.

Figure 3. The lower the concentration of dissolved thorium, the greater the fraction bound to clay minerals. Thus, burial of waste elements in a highly insoluble form would greatly slow down their subsequent migration through the sediments.

Work by Egberg Duursma at the International Atomic Energy Agency laboratory in Monaco and preliminary results from our experiments suggest that for North Pacific clays, the

Table 1. Properties of high-level waste a year after separation from Light-Water Reactor fuel (1.4 years after removal from a reactor), compared to "throwaway" (unprocessed) fuel one and one thousand years after removal from a reactor.

Element	Radioactivity (curies per metric ton of heavy metals)		
	Waste	"Throwaway" Fuel 1 year	1000 years
Tritium	40	490	-
Selenium	-	3/10	3/10
Krypton	-	7,400	1/1,000,000
Rubidium	-	7/10,000	2/100,000
Strontium	54,000	70,000	1/1,000,000
Yttrium	55,000	79,000	1/1,000,000
Zirconium	6,400	35,000	2.3
Niobium	14,000	75,000	2.2
Tecnecium	11	11	11
Ruthenium	205,000	200,000	-
Rhodium	205,000	200,000	-
Palladium	-	7/100	7/100
Silver	20,000	20,000	-
Cadmium	25	23	-
Indium	-	4/100	-
Tin	320	640	4/10
Antimony	6,400	5,700	5/10
Tellurium	2,700	4,200	-
Iodine	-	24/1,000	24/1,000
Xenon	-	1/100,000	-
Cesium	180,000	200,000	3/10
Barium	77,000	77,000	8/1,000,000
Lanthanum	-	5/1,000	-
Cerium	310,000	480,000	2/100,000
Praseodymium	310,000	490,000	2/100,000
Neodymium	-	7/100,000	-
Promethium	80,000	87,000	-
Samarium	1,100	980	6/10
Europium	8,200	7,800	-
Gadolinium	-	5	-
Terbium	-	25	-
Uranium	4/100	3.2	2
Neptunium	140	6.5	6.3
Plutonium	1,500	71,000	660
Americium	780	170	530
Curium	380,000	3,500	1/10
Berkelium	-	8/100,000	-
Californium	-	3/1,000,000	-
Total	1,580,000	2,200,000	1,200

Note: After 10 years, the radiation level at 1 meter from this quantity of waste is 1.7 billion times the whole-body exposure level permitted by the Nuclear Regulatory Commission for people working with radioactive materials.

distribution coefficients for waste elements at low concentrations have values like 100 to 6000 for strontium 90, 1400 for cesium 137, 3000 to 20,000 for zinc 65, 140,000 for cerium 144, and 1,000,000 for thorium 228. Put another way, these figures indicate that in ten million years, the elements would diffuse over the following distances: strontium, 4 to

32 meters; cesium, 8 meters; zinc, 2 to 6 meters; cerium, 1 meter; and thorium, less than a third of a meter. These figures are in no way final estimates of waste migration in the seabed. They do, however, give a sense of the strong interaction between dissolved waste components and deep-sea sediments. Recent experiments suggest that these

figures are on the liberal side, so the actual barrier effect of the sediment may be even more impressive than it first appears. In particular, Duursma's studies show that distribution coefficients for natural clay-water systems that have existed for decades or centuries are greater than values measured in the laboratory for the same systems, suggesting that migration distances will be less than predicted from our experiments.

It seems that for an undisturbed system, deep-sea clays probably provide a satisfactory barrier to protect man from buried waste. We do, however, need to collect more information on the solutions formed by reactions between pore waters and wastes, and on the distribution coefficients for elements in such solutions.

In the case of undisturbed sediments, movement of the pore waters is much slower than diffusion of nonreactive elements. When we try to carry the arguments from an undisturbed system to a situation in which a hot canister has been forcibly inserted into the seabed, however, we become aware of the amount of study needed to assess the effectiveness of the sediment barrier after modification by the emplacement, heat, and radiation of the canister. In this real case, the hot canister may produce slow convection of the pore fluids, leading to faster-than-expected upward transport of the radionuclides. The physical disruption will not affect the sorption properties of the clays, but it may facilitate physical movement of the pore waters. This problem is being studied by Walter Schimmel and his associates at Sandia Laboratories and by Armand Silva at the University of Rhode Island (see page 31).

Finally, we know little of the effect of the increased temperature that would result from the burial of radioactive wastes either on distribution coefficients or on the diffusion of elements through sediments in general. Work in our laboratory has shown that a temperature increase from 15 to 85 degrees Centigrade roughly triples the distribution coefficient of thorium, thereby increasing the amount of thorium sorbed on the sediment. By increasing the barrier effect of the sediments, this change opposes the effect of any pore water movement. Much more experimental work is needed to determine whether all the radionuclides of environmental concern behave like thorium, and to decide whether the over-all effect of the disruption of the sediment during emplacement and of the heat produced by the wastes damages or reinforces the sediment barrier.

The gaps in our knowledge considerably exceed the facts in hand when it comes to deciding whether high-level radioactive wastes can be safely contained in the seabed of the deep oceans. Nevertheless, our findings to date are grounds for cautious optimism. We must now carry out experiments to determine the expected lifetime of a buried canister, the rate of leaching of waste material by pore waters, and the rate of movement of dissolved elements through the seabed. These will allow us to better assess the feasibility of high-level waste disposal in the geological formations beneath the oceans.

G. Ross Heath is an associate professor in the Graduate School of Oceanography at the University of Rhode Island, Narragansett.

Reference

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APPENDIX L

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ORGANIC CARBON IN DEEP-SEA SEDIMENTS

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ABSTRACT

The rate of accumulation of organic carbon in marine sediments is closely related to the bulk sediment accumulation rate and can be described by the equation: (Organic Carbon Accumulation Rate) = 0.01 (Sedimentation Rate)^{1.4}. Diagenetic reduction of the organic carbon content of older sediments appears to be exponential in both reduced and oxidized sediments, with half lives in the 15-55,000 year range. Pleistocene climatic fluctuations have resulted in marked variations in the supply of organic carbon to the deep-sea, in part due to oceanographic changes, and in part due to the destruction of nearshore depositional environments by lowered sea level. Carbonate-rich deposits contain organic matter that is intimately associated with test calcite. The climate and carbonate effects can mask the diagenetic pattern evident in uniformly deposited sediments, but they do not alter the basic relation between organic-carbon and total-sediment accumulation rates.

INTRODUCTION

Remarkably little is known of the geochemistry of organic carbon in a broad spectrum of deep-sea sediments. Previous studies (Bordovskiy 1965a, b; Müller, 1975; Stevenson and Cheng, 1972) have concentrated their efforts on relatively carbon-rich reduced sediments. Not only are data on the phases containing the carbon rare, but even the source or sources of the carbon, its distribution and rate of deposition in the ocean basins, and the degree of post-

depositional alteration are not well known. This study addresses the last two questions: where and how rapidly is organic carbon being deposited in the ocean basins, and how does early diagenesis modify the depositional pattern?

Within the past five years, large numbers of deep-sea sediment samples have been analyzed for organic carbon in the course of studies of organic matter in general (e.g. *Müller*, 1975), or as a byproduct of analyses for carbonate using combustion techniques (e.g. *Heath et al.*, 1976). At the same time, accumulation rates for large numbers of cores have been established by radiometric dating and by paleomagnetic and oxygen isotope stratigraphic determinations (e.g. *Ku et al.*, 1968; *Opdyke and Foster*, 1970; *Climap*, 1976). As a result, it is now possible to map not only the gross distribution of organic carbon in deep-sea sediments, but also its rate of accumulation and diagenesis in different depositional environments.

The data discussed in this paper are largely derived from samples analyzed under the CLIMAP Program. Cores studied (Table 1, Figure 1) are from the collections of the Lamont-Doherty Geological Observatory, Oregon State University, Scripps Institution of Oceanography, University of Southern California and the New Zealand Oceanographic Institute. Additional analyses from *Müller* (1975) were made on cores collected by the R/V's *Meteor* and *Valdivia* of the German Research Society. *Stevenson and Cheng* (1972) have also analyzed Lamont-Doherty Geological Observatory cores collected from the Argentine Basin.

METHODOLOGY

All organic carbon analyses in our laboratory have been made by Leco 714 carbon analyzer. Samples are ground, split, dried at 110°C and weighed. One split is analyzed in duplicate for total carbon. The other is heated to 500°C for two hours to oxidize organic carbon, then analyzed in duplicate for carbonate carbon (expressed as a percentage of 110°C weight). The difference between the two analyses is defined as organic carbon. Comparison with other techniques that use strong oxidizers to titrate organic carbon (e.g. *Müller*, 1975) or acid removal of carbonate before Leco analysis (e.g. *Boyce and Bode*, 1972) suggest good agreement for terrigenous and pelagic clays. For carbonate-rich deposits, however, our organic carbon numbers are consistently higher than those involving wet chemical treatments of the samples. It has been determined experimentally that the problem lies in the acid treatment used to remove carbonate prior to the chemical or combustive determination of organic carbon. Apparently some of the organic carbon is intimately associated with the calcite of foraminiferal or coccolith tests, either as surface or intercrystalline films. During acid treatment,

Fig. 1. Location of sediment cores analyzed for organic carbon in this study (closed circles), and by Stevenson and Cheng (1972), Hartmann et al. (1973) and Müller (1975). Identification numbers refer to Table 1. Base map from Chase (1975).

TABLE 1. Identification of Sediment Cores

Map Location	Core Identification	Latitude	Longitude	Water Depth (m)	Ref.*
1	RC10-161	33°55'N	158°00'E	3587	
3	Y71-10-117P	34°16'N	120° 3'W	570	1
4	BNFC-43PG3	20°10'N	109° 1'W	2720	
5	Y73-2-4P	24°36'N	114°35'W	4138	
6	Y73-2-3P	24°35'N	114°35'W	4138	
7	AHF-10614	32°52'N	119°49'W	1275	
8	LAPD-1G	22°53'N	110°59'W	2322	
9	Y6910-2	41°16'N	127° 1'W	2743	2
10	RC10-167	33°24'N	150°23'E	6092	3
11	Y71-6-12P	16°26'S	77°33'W	2734	
12	V20-119	47°57'N	168°47'E	2736	3
13	Z2108	33°23'S	161°37'E	1448	
14	Y71-7-36P	10° 3'S	102°51'W	4541	4
15	Y71-7-45P	11° 5'S	110° 6'W	3096	4
17	Y6910-4	41°19'N	128° 9'W	3130	
18	V23-81	54°15'N	16°50'W	2393	
19	Y70-1-5P	45°00'N	140°00'W	4374	
20	RC9-228	52°33'N	18°45'W	3981	
21	V27-20	54°00'N	46°12'W	3510	
22	Y69-108P	4° 9'N	85° 2'W	3390	
23	Y69-109P	2° 5'N	82°59'W	3721	
24	V23-98	23° 7'N	19°18'W	3506	
25	V19-309	31°10'N	45° 8'W	4544	
26	V27-16	44° 9'N	39°52'W	4797	
27	V27-19	52° 6'N	38°48'W	3466	
28	V27-141	35°29'N	24°56'W	4506	
31	Y6604-10	43°16'N	126°24'W	3002	2
32	Y6609-5	43°34'N	126°28'W	2978	2
33	V20-120	47°24'N	167°45'E	6216	3
35	Y70-1-13P	44°58'N	159°58'W	5492	
36	Y70-1-19P	45°00'N	175° 7'W	5973	
40	VALDIVIA	~10°N	~150°W	~5000	5
41	V15-141	45°44'S	50°45'W	5934	6
42	V15-142	44°54'S	51°32'W	5885	6
43	M12310	23°30'N	18°43'W	3076	7
44	M12327	23° 8'N	17°44'W	2037	7
45	M12329	19°22'N	19°56'W	3314	7
46	M12337	15°58'N	18° 7'W	3085	7
47	M12344	15°26'N	17°21'W	711	7
48	M12345	15°30'N	17°22'W	966	7
49	M12347	15°50'N	17°51'W	2710	7
50	M12392	25°10'N	16°51'W	2575	7

*1. Koide et al. (1972); Sholkovitz (1973); 2. Heath et al. (1976); 3. Robertson (1975); 4. Kendrick (1974); 5. Hartmann et al. (1973); 6. Stevenson and Cheng (1972); 7. Müller (1975).

this organic component is peptized and filtered off with the spent acid. As a result, organic carbon analyses on acid-treated carbonate-rich sediments tend to be uniformly low.

ORGANIC CARBON IN RECENTLY DEPOSITED SEDIMENTS

The organic carbon content of open-ocean deposits at the sea floor ranges from less than 0.1 percent in the most oxidized red clays to slightly more than 5 percent in reduced hemipelagic deposits close to continental margins - a range of about two orders of magnitude. The total-sediment accumulation rates of these same deposits range from about 0.03 to 100 gm/cm²/1000 yr. - a span of 3½ orders of magnitude. The two parameters, carbon content and accumulation rate, co-vary to some extent (Figure 2), so that the organic carbon accumulation rate ranges from about 4 x 10⁻⁵ to about 6 gm/cm²/1000 yr, a span of more than five orders of magnitude. Despite the diverse lithologies of the cores studied, the total sediment and organic carbon accumulation rates are highly correlated on a log-log plot (Figure 3). The regression line through the data of Figure 3 is given by:

$$(\text{Organic carbon accumulation rate}) = 0.01 (\text{sedimentation rate})^{1.4} \quad (1)$$

Fig. 2. Organic carbon content of marine sediments as a function of bulk-sediment accumulation rate (log scale). Dotted curve is the projected regression line of Figure 3.

Fig. 3. Accumulation rate of organic carbon versus bulk-sediment accumulation rate (both log scales) in the cores of Figure 1. The empirical regression line suggests that the organic carbon accumulation rate is 1 percent of (sedimentation rate)^{1.4}.

This relation predicts organic carbon accumulation rates from total sediment accumulation rates to within a factor of about 2.5 - a degree of accuracy that is certainly adequate for first-order distribution and geochemical balance studies.

The correlation of Figure 3 is surprising, given the diverse provenance of the original sediments, ranging from carbonate-rich biogenic ooze to hemipelagic muds rich in terrigenous plant debris (Emery, 1960). The correlation could be fortuitous, in which case the validity of the regression equation will have to be assessed for each new depositional environment. An alternative hypothesis, though, is that Figure 3 is a reflection of the "efficiency" of benthic organisms. In areas of very slow deposition, the benthos utilizes virtually all the organic material available, whereas in rapidly accumulating deposits luxury feeding takes place and the organic carbon content is never depleted. The regression equation suggests that the "efficiency" of the benthos is highly correlated to the accumulation rate, and may be independent of the organic

content of incoming detritus. Organic carbon analyses of sediment-trap collections from areas with contrasting accumulation rates and sea-floor lithologies are needed to test this suggestion and to distinguish between the two hypotheses.

Figure 4 shows the distribution of organic carbon in surface sediments of the Equatorial Pacific and North Pacific Oceans. The influence of both terrigenous input (along the continental margins) and surface biological productivity (particularly along the equator) are very apparent. Areas with high organic carbon concentrations also have the highest total sediment accumulation rates, in accord with the relations contained in Figures 2 and 3. These trends are also evident in Bezrukov *et al.*' (1961) compilation, although their map and Figure 4 differ considerably in detail, presumably due to our greater sample coverage.

PROFILES OF ORGANIC CARBON IN DEEP-SEA CORES

The organic carbon content of deep-sea cores changes with depth below the sea floor in virtually all cases. Such changes can be attributed to three dominant effects: 1) variations in the content of biogenic carbonate; 2) glacial-interglacial variations in the supply of organic carbon to the sea floor; and 3) post-depositional oxidation or diagenesis of organic components of the sediment.

Effect of Carbonate Fluctuations

Variations in the carbonate content of pelagic sediments deposited at a given location usually reflect either climatically induced variations in dissolution at the sea floor (Berger, 1973; Thompson and Saito, 1974) or migration of the depositional site into deeper and deeper water due to sea floor spreading. Figures 5 and 6 show examples of these two situations. Core V20-119, from the northern Emperor Seamounts in the North Pacific Ocean, shows a series of pronounced carbonate maxima at roughly 100,000 year intervals during the Brunhes normal polarity epoch. Such fluctuations are typical of Quaternary carbonate-bearing deposits from the Pacific Ocean, and reflect differences in the corrosiveness of bottom waters between interglacial and glacial periods, (Berger, 1973; Thompson and Saito, 1974).

In contrast, core Y71-7-36P (Figure 6) from the Bauer Deep in the southeast Pacific Ocean, is from a site that was formed some 16 million years ago at the crest of the Galapagos Rise (Hart, Yeats *et al.*, 1976) and subsided as the underlying crust cooled and moved away from the spreading center. Some 4 million years ago Kendrick (1974) the site sank below the calcite compensation level, to produce the sharp boundary evident in Figure 6.

Fig. 4. Distribution of organic carbon in surface sediments from the equatorial and North Pacific Ocean, shows the influence of high surface productivity and high accumulation rates on the pattern of organic carbon deposition. Isopleths in weight percent organic carbon.

Fig. 5. Covariation of organic carbon and calcium carbonate in core V20-119 from the North Pacific Ocean. B/M is the boundary between the Brunhes and Matuyama magnetic epochs (700,000 years b.p.).

In both of these cores, the carbonate fluctuations are accompanied by conforming variations in organic carbon. Such variations could in part reflect simply the faster accumulation rate of the carbonate-rich sediments, as discussed previously. In the case of core V71-7-36P, however, the nannofossil ooze in the lower part of the core apparently accumulated at less than $0.3\text{gm/cm}^2/1000\text{ yr}$ (Dymond *et al.*, 1976), rather than at about $5\text{gm/cm}^2/1000\text{yr}$ as would be implied from Figure 2. This anomalously high organic carbon content, in conjunction with Lipps' (1972 pers. comm.) observation of a thin organic layer covering the calcite plates of coccoliths,

Fig. 6. Covariation of organic carbon and calcium carbonate in core Y71-7-36P from the southeast Pacific Ocean. The decrease in calcium carbonate at 5 million years b.p. marks the migration of the core site through the calcite compensation depth due to seafloor spreading.

suggests that the organic carbon is structurally associated with the carbonate debris, rather than separate particles incidentally buried by the calcareous ooze.

Effects of Paleoclimatic Fluctuations

In addition to producing the carbonate and concomitant organic carbon fluctuations discussed above, Quaternary climatic and paleo-oceanographic changes produced systematic changes in the supply of organic carbon to deep-sea sediments. The changes are most striking in the North Atlantic Ocean, where the equatorward shift of surface isotherms during the last glacial period was most pronounced (Climap, 1976).

In cores that were very close to the glacial ice margin (e.g. core V27-20 in the Labrador Sea; Figure 7) the glacial deposits are depleted in organic carbon, presumably due to influx of organic-poor glacial rock flour combined with low surface-water biologic productivity. The change from the last glacial period to the present interglacial period is marked by a rapid increase in the organic carbon content of the sediment.

Cores north of the glacial polar front, but further from the ice margin (e.g. core V23-81, west of Ireland; Figure 7) again have relatively low organic carbon values in glacial deposits. During the transition from glacial to interglacial conditions, organic carbon values peaked as rejuvenated North Atlantic Deep Water swept accumulated hemipelagic sediment to the south (McIntyre, 1976). Subsequently, a slower rate of deposition has resulted in lower organic carbon values again.

Finally, cores from areas where neither the surface water characteristics nor the provenance of the sediments varied markedly (e.g. core V27-141, south of the Azores; Figure 7) have relatively uniform organic carbon contents throughout.

A global comparison of glacial and interglacial rates of organic carbon deposition is not yet possible, because most well-dated glacial sections come from the North Atlantic Ocean. The existing data suggest, however, that for a given sedimentation rate, glacial deposits are enriched in organic carbon relative to Holocene deposits. Since glacial deposition rates in the deep oceans were generally greater than interglacial rates (Broecker *et al.*, 1958; Ericson *et al.*, 1961; Heath *et al.*, 1976) we infer that during glacial times,

Fig. 7. Variations in the organic carbon content of North Atlantic Ocean sediments from the last glacial maximum 18,000 years ago (dotted line marked "18K") to the present. See text for a discussion of the different patterns.

organic carbon was supplied to deep-sea deposits at perhaps two to four times the present rate. It remains to be determined whether this increase in deep-sea organic carbon deposition is sufficient to balance the loss of depositional sites in paralic environments during periods of lowered sea level.

Effects of Post-Depositional Alteration.

The assessment of the degree of post-depositional alteration or destruction of organic carbon is severely impeded by the geologically recent climatic events discussed above. Fortunately, however, we have data for several cores which have sufficiently uniform lithologies that variations in organic carbon content attributable to diagenesis can be distinguished from changes in provenance.

Santa Barbara Basin

Deposition in the Santa Barbara Basin is so rapid (400 cm/1000 yr at the surface; *Koide et al.*, 1972) that several meters of sediment have accumulated during the relatively uniform climatic conditions of the Holocene. Analyses of organic carbon as a function of depth in core Y71-10-117P from the Basin (Figure 8) reflect the two sediment sources - carbon-poor detritus from the Los Angeles Basin deposited episodically after periods of high rainfall (*Drake*, 1971), and carbon-rich diatomaceous detritus deposited in the well-known annual varves *Hulsemann and Emery* (1961). The organic carbon content of both of these components decreases with depth of burial, apparently due to diagenesis. The existence of varves in the core allows the depths of Figure 8 to be converted to post-depositional ages. If the organic carbon values are plotted on a log scale versus age (Figure 9), both the end member high- and low-carbon samples can be fitted well by straight lines. The general equation for such lines is:

$$C = C_0 e^{-\lambda t} \quad (2)$$

where C is the carbon content at time t , C_0 is the initial carbon content, and λ is a decay constant. For the lines of Figure 9, $\lambda = 4.7 \times 10^{-5} \text{yr}^{-1}$ (half-life about 15,000 years) for the carbon-rich material, and $\lambda = 1.3 \times 10^{-5} \text{yr}^{-1}$ (half-life about 53,000 years) for the carbon-poor terrigenous component. The sense of these two values is reasonable. Presumably the terrigenous phase has been much more intensely degraded in the source area and in transit to the basin than the diatomaceous component. Thus, its residual carbon is more refractory and breaks down more slowly than the varved material.

Fig. 8. Organic carbon content as a function of subbottom depth in core Y71-10-117P from the Santa Barbara Basin, off southern California.

The Santa Barbara Basin deposits are anoxic. *Sholkovitz* (1973) has determined that sulfate reduction occurs in the top meter or so, with methane formation at greater depths. The rate-controlling step in the breakdown of the organic matter is unknown, although Figure 9 makes clear that the amount of remaining organic carbon (or a component proportional to this value) is a key factor.

Fig. 9. Organic carbon content (log scale) as a function of time of deposition in core Y73-10-117P from the Santa Barbara Basin. Dotted lines are suggested decay curves for the turbidite (low carbon) and pelagic (high carbon) organic components.

Deviations for the straight lines of Figure 9 presumably reflect mixing of the two main sedimentary components, or injections of excess organic carbon due to minor oceanographic fluctuations over the site. The latter phenomenon appears to occur about every 2500 years, a periodicity reminiscent of the spacing of "little ice ages" *Denton and Karlén (1973)*.

North Pacific Oceanic Deposits

In contrast to Santa Barbara Basin sediments, some North Pacific Ocean deposits appear to accumulate at a very slow rate that has

been little affected by global climatic changes. Despite their highly oxidized state and slow accumulation rates (fractions of lcm per 1000 yr) these deposits show exponential decreases in organic carbon with depth that are reminiscent of the Santa Barbara Basin core.

Figure 10a shows examples of two such North Pacific Ocean cores. One core, from the vicinity of $10^{\circ}\text{N}; 150^{\circ}\text{W}$ is described by Hartmann *et al.* (1973). No time scale is available for this section, but if a range of 3-6mm/1000yr (typical of this area of the Pacific Ocean) is used, the decay constant is $2-4 \times 10^{-5} \text{yr}^{-1}$ (half-life 16-32,000 yr). The other core, RC10-167, from the northwest Pacific Ocean Robertson (1975) has a decay curve defined by only 4 points (Figure 10b). The decay constant in this case, $2.2 \times 10^{-4} \text{yr}^{-1}$ (half-life 3000 yr), is obviously less reliable than the others.

The effect of post-depositional loss of organic carbon is well displayed by maps of the 600,000 year (in a glacial interval) and 700,000 year (Brunhes-Matuyama boundary) levels in North Pacific Ocean cores (Figures 11 and 12). Much of the oceanographic information evident in the surface map (Figure 4) has been lost. Only the equatorial zone of carbonate-rich deposits is marked by high organic carbon values. Such maps, together with the profiles discussed previously, illustrate why attempts to extract paleoclimatic and paleoceanographic information from organic carbon analyses of North Pacific cores have not been successful.

DISCUSSION AND CONCLUSIONS

When we began this study, we anticipated that the accumulation of organic carbon would be markedly influenced by oceanographic factors - biologic productivity of surface waters, relation of the depositional site to the oxygen minimum, etc. Such factors obviously have some influence, but are dominated by bulk sedimentation rate and post-depositional breakdown of the organic matter. Inasmuch as the latter effects have long time constants relative to the overturn time of the oceans, it is difficult to see how they can react quickly to changes in the feedback mechanisms that maintain the present balance between oxygen and carbon dioxide on the one hand, and recycled and mineralized organic carbon on the other. In particular, our first impression is that benthic activity will rapidly oxidize any additional organic carbon deposited as a result of the input of fossil-fuel carbon dioxide to surface ocean waters. If, on the other hand, the fossil-fuel carbon spike displaces the regression line of Figure 3 towards a higher organic carbon accumulation rate for a given bulk-sediment accumulation rate, the long time constant for post-depositional oxidation will allow the dissolution of pelagic carbonates to absorb the spike with minimal disturbance of existing depositional patterns. Our know-

Fig. 10a. Organic carbon content (log scale) as a function of depth of burial in a North Pacific Ocean box core from about 10°N ; 140°W (Hartmann *et al.*, 1973), showing suggested exponential decay of organic matter.

Fig. 10b. Organic carbon content (log scale) as a function of depth of burial in core RC10-167 from the northwest Pacific Ocean, showing suggested exponential decay of organic matter.

Fig. 11. Organic carbon content of equatorial and North Pacific Ocean sediments deposited during a glacial interval about 600,000 years ago. Contours in weight percent carbon.

Fig. 12. Organic carbon content of equatorial and North Pacific Ocean sediments deposited during the transition from the Matuyama to the Brunhes magnetic epoch (700,000 years ago). Climatic conditions were similar to those of the present. Contours in weight percent carbon.

ledge of the rate of degradation of organic carbon from the time it reaches the sea floor until it is beyond the reach of the benthos is inadequate to choose between these alternatives at the present time.

The ultimate form of mineralized organic matter has been studied in detail by Müller (1975). In general, the refractory component is enriched in nitrogen relative to carbon. In the extreme, in highly oxidized pelagic clays, the C/N ratio decreases to as little as 1.3. The only organic matter to survive oxidation in such sediments are amino acids and derivatives that are tightly bound to clay minerals.

In conclusion, the rate of accumulation of organic carbon in marine sediments is primarily determined by the bulk accumulation rate of the sediment. Labile organic matter is destroyed during diagenesis, with half lives of tens of thousands of years. The ultimate concentration of mineralized or fossilized organic carbon is undetermined in organic-rich deposits. In the case of organic-poor pelagic deposits, however, it appears to be controlled by the association of organic matter with calcium carbonate or of amino acid groups with clay minerals.

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SURVIVAL OF DEEP-SEA SEDIMENTARY SECTIONS

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Most sections drilled by the Deep Sea Drilling Project contain hiatuses. The sedimentary recycling implied by these hiatuses can be modeled if the proportion of surviving sections of a given age is representative of the mass of sediments of that age which remain beneath the deep-sea floor. The linear recycling model of Garrels and Mackenzie [1] overestimates the proportion of surviving Neogene sections and underestimates those of the Paleogene, suggesting that one of the underlying assumptions has been violated. A new model, in which the observed frequency of hiatus durations is used to modulate the probability of erosion with increasing age, fits the observations much better. Deviations from the general trend can be modeled by varying the mass of sediment deposited per million years and the area of non-deposition by factors of 4 and 20 respectively. The model permits a quantitative comparison of maxima and minima in surviving sections through the Cenozoic, free of the effect of an overall decline in the proportion of such sections with increasing age.

1. Introduction

The Deep Sea Drilling Project (DSDP) has recovered marine sections that provide a comprehensive record of the world ocean for at least the last 100 m.y. When interpreted using newly developed biostratigraphies [2–5] which have been tied to an absolute time scale [6] these recovered sections yield a history whose pervasiveness and completeness cannot be matched on land. The oceanic record is not, however, entirely complete. Generally more than half of the stratigraphic record is missing in deposits older than the Late Oligocene and as much as 90% of the Early Paleocene record is represented by hiatuses (Fig. 1). In this compilation [7] a hiatus is defined as the absence of one or more biostratigraphic zones or an estimated accumulation rate of less than 1 m/m.y.

Distinct maxima in the abundance of hiatuses may be related to major changes in continental relief and in the boundaries of the ocean basins [7]. Thus, the Cenozoic-Mesozoic maximum has been attributed to a lack of erosional debris during an interval of low continental relief [8] as well as to the rapid

opening of the North Atlantic and closure of the Arctic-Pacific seaway. The maximum near the Oligocene-Eocene boundary has been related to the closure of the Tethian seaway [9], to the development of a circum-Antarctic current, and to the associated development of a source of deep water in high southern latitudes [7,10,11].

The maxima and minima in Fig. 1 are superimposed on a trend of more or less exponentially increasing abundance of hiatuses with increasing age. If we consider the complement of this curve – the percent of recovered sections represented by sediments (Fig. 2) – then these data are somewhat comparable to those compiled from the land record [12,13] which Garrels and Mackenzie [1] used in their model for the recycling of sediments. Because the ocean basins are the final catchment for the mechanical and chemical erosion products of the continents, it is somewhat paradoxical that recycling of sediments is also prominent within this catchment. To better understand this process and its history, we have developed a series of models with which we attempt to simulate the principal features of Fig. 2.

Fig. 1. Percent of sampled DSDP sections containing hiatuses (Legs 1–32). Data from Moore et al. [7] have been corrected for over-presentation of areas which have been densely sampled (see text). Vertical shading indicates the 80% confidence intervals of the estimates of hiatus abundance for each 1-m.y. interval.

2. The models

Fig. 1 represents the proportion of the stratigraphic record represented by hiatuses (DSDP Legs 1–32; [7]). Stratified sampling of these data has been employed to correct for the over-representation of areas such as the Caribbean Sea, Gulf of Mexico, and the Shatsky Rise area of the Pacific Ocean. The sampling protocol involved the division of the ocean into 300 nautical mile squares then, if two or more sites were located within a square, the selection of one as representative according to the following sequential criteria: (1) completeness of sampling; (2) length of stratigraphic record; and (3) absence of gaps in the stratigraphic record.

If the percentage of some interval of the stratigraphic record that is still present ($100 - \text{percentage represented by hiatuses}$) is indicative of the mass of sediment of that age that has survived, then the assump-

tions of the Garrels and Mackenzie [1] recycling model can be applied to our data set. Their linear rather than constant-mass model is applicable, because the ocean floor is barren of sediments at the crests of the oceanic ridges and can be considered as a world which is continually renewing itself. In addition to linear growth of the sediment mass, Garrels' and Mackenzie's model assumes that: (1) deposition, destruction and preservation of sediment (defined so that preservation equals deposition minus destruction) operate at constant rates; and (2) the probability of destruction of sediment of any age during a given period is constant (regardless of the age of deposition) and is proportional to the mass of sediment of that age. This assumption implies that the crust of the earth is so mobile that burial (and therefore age) affords no protection from destruction. To test these assumptions for deep-sea sediments we used several ratios of mass preserved to mass deposited to generate age-mass curves for a 200 m.y. old ocean using the Garrels and Mackenzie [1, p. 263] equation:

$$A_n = \frac{M}{M + M_e} \times \frac{M - M/T}{(M + M_e) - M/T} \times \frac{M - 2M/T}{(M + M_e) - 2M/T} \times \dots \times \frac{M - (n-1)M/T}{(M + M_e) - (n-1)M/T} \quad (1)$$

where M is the total mass accumulated during T time increments (we used 200 increments of 1 m.y.), M_e is the mass destroyed during each 1 m.y. interval, and A_n is the fraction of surviving sediment deposited during the period n to $n-1$ m.y. M_e is given by:

$$M_e = (R - 1)M/T \quad (2)$$

where R is the ratio of mass deposited to mass preserved. These curves can be compared to the DSDP results in Fig. 2. Although data for the last 10 m.y. seem to match closely the model representing 1 unit of sediment preserved for every 15 units deposited (93% destroyed), the full data set is better fitted by the model curve corresponding to 1 unit of sediment preserved for every 8 units deposited. This value, which represents about 88% destruction of deposited material, is very close to estimates for the dissolution of modern biogenic carbonate (80%, [14,15]) and opal (96%, [16]) reaching the sea floor. The relatively

Fig. 3. Cumulative distribution of hiatus duration as used for the variable P_n in equations (3) through (5). P_n is the proportion of hiatuses with a duration equal to or greater than age n . Upper diagram: proportion of hiatuses with duration of 1–100 m.y.; lower diagram: proportion of hiatuses with durations of 100–200 m.y. Data for hiatus durations are from the same set of sections used to compile the distribution of hiatus abundance as a function of time (Fig. 1) and include all hiatuses in this group which terminate in the Cenozoic.

where A_n is the relative mass of sediment of age n surviving today. M is the relative mass of sediment deposited during the interval $n+1$ to n (initially assumed to be constant through time and set to 1), P_n is the proportion of hiatuses of duration equal to or greater than n (Fig. 3), and K is a proportionality constant. K is a measure of the intensity of processes causing hiatuses, or of the area over which hiatuses occur. If the main cause of gaps in the deep-sea record is the dissolution of biogenic debris, then the intensity of dissolution and the areal extent of hiatuses are likely to be directly related. Because of the biogenic origin of most deep-sea sediments, M is primarily a measure of the net rate at which biogenic debris is delivered to the sea floor. Thus, both K and M represent processes which are likely to vary over geologic time.

Fig. 4 shows the output from this model for n

ranging from 1 to 65, M equal to one, and K equal to 0.06, 0.07 and 0.08. From the general shape of the calculated curves, a value of $K = 0.07$ seems to best fit the general trend of the data. Although this smooth curve more closely approximates the observed deep-sea pattern than does the Garrels and Mackenzie model, marked differences between the observed and calculated curves still remain; the minimum at the Cenozoic-Mesozoic boundary is the most prominent example, but maxima in the Eocene and Miocene, and minima in the Eocene and at the Oligocene-Miocene boundary are also of global extent [7] and represent real deviations from the smooth curve. A better fit is achieved by allowing M to vary through time, that is:

$$A_n = (1 - KP_1)(1 - KP_2) \dots (1 - KP_{n+1})M_n \quad (4)$$

Because a change in M affects the pattern of survival only for the interval of change, a series of such

Fig. 4. Percent of sampled DSDP sections surviving (Fig. 2) compared to section survival equation (3) proposed in this paper. The curves shown are for a constant M , the sediment mass deposited per 1-m.y. increment, equal to 1.0; and K , the proportionality or erosion factor equal to 0.06, 0.07, and 0.08, as labeled for each of the three curves.

Fig. 7. Percent of surviving DSDP sections (shown as dots) compared to calculated values using the proposed recycling model in which both M , the mass of sediment per 1-m.y. increment and K , the proportionality or erosion factor, are allowed to vary. The fit of the observed data is achieved by allowing K to vary between 0.06 and 0.3 (numbers above the line). M is held equal to 1.0 (numbers below the line) in all intervals except the Late Paleocene to Early Eocene where a value of 1.3 is used.

in the 47–58-m.y. B.P. interval. Such a solution is not unique, but does demonstrate that the 65 data points can be fitted using only 2 values of M and 9 values of K .

3. Discussion

The parameters derived from our model offer a modicum of comfort to marine stratigraphers. More older marine deposits than predicted by the simple linear model of Garrels and Mackenzie [1] are preserved, suggesting that burial of sediments does provide some protection from destruction. However, the model also implies that deep-sea deposits are never buried deeply enough to be totally immune

from destruction, even though the short duration of most hiatuses (less than 10 m.y.) decreases the likelihood of destruction rapidly with time. The chance of Paleocene sediment being eroded now is finite. Furthermore, the way in which the model is calculated allows the surviving portion of Paleocene section to be affected by changes in K , the area factor, during any subsequent epoch.

Our model contrasts with Garrels' and Mackenzie's concept of depositional cycles [21], in which the probability of destruction is constant through a cycle, but decreases markedly when the cycle ends (presumably due to shielding of older deposits by tectonic or diagenetic processes). We have not used their model because it fits the older Cenozoic and Mesozoic parts of the deep-sea record poorly, and because the distribution of hiatuses [7] gives no indication of a simple cyclicity in erosional events.

Using our model with the constant values of K (0.07) and M (1) that best approximate the observed data (Fig. 4), some very general statements can be made about the proportion of sections remaining for any given age at any given time. For example, the surviving proportion of the oldest section that remains in the ocean can be estimated. Using the values of P (Fig. 3) for the distribution of all hiatuses terminating after 65 m.y. B.P. and assuming this distribution has remained unchanged with time, it is estimated that only 31% of 200 m.y. old sections have survived to modern times. Likewise, about 31% of the late Jurassic (140 m.y. B.P.) sections and 32% of the late Cretaceous (70 m.y. B.P.) sections remain. Thus, in sections older than Late Cretaceous the proportion of surviving sections is approximately constant.

If the average age of oceanic crust being consumed at the trenches is (and has been) about 60 m.y. [20], the model indicates that about half of the pelagic section deposited on this crust has been destroyed by the time it reaches the trench ($\sum_{n=1}^{60} [A_n/60]$; using $K = 0.07$ from Fig. 4). Of the remaining section, about half is younger than 20 m.y. old. Considering the large volume of volcanogenic and hemipelagic sediments that are associated with trenches, it is clear that a great proportion of the sediment being scraped off at the trenches must be young relative to the age of the subducted crust.

Although the number of hiatuses in DSDP sections is striking, their creation (i.e. the total destruc-

tion of portions of the sedimentary section) is a minor contributor to the recycling of the biogenic materials that dominate pelagic sediments. Estimates of dissolution of calcium carbonate [14,15] and opal [16] in the water column and on the sea floor indicate that at least 80% of the carbonate and 96% of the opal used in the tests of planktonic organisms redissolves before it can be incorporated in the stratigraphic record. This, if hiatuses in this record are mainly the result of the further destruction of the biogenic components, their average contribution toward the recycling of these components is only another 10% of the supply of carbonate and 2% of the supply of opal (half of the remaining 20% and 4% respectively).

Given the shifting boundaries of the ocean basins, it seems unlikely that the M and K variables in the model have remained perfectly constant with time. Thus, it is not surprising that there are large excursions in the DSDP data from the general curve where $M = 1$ and $K = 0.07$ (Fig. 7). It is these deviations from the simplified model that are of prime interest to the geologist and paleoceanographer. The model presented here allows us to evaluate these deviations in terms of changes in the area of erosion and rate of accumulation. The question arises, however, as to whether the values of M and K , chosen on the basis of best fit to the data, are realistic? The changes in accumulation rates required to fit the observed curve are small — a factor of 2–4. Some indication of the reasonableness of this figure is given by the fact that the variation in the average sediment accumulation rate in the equatorial Pacific [11] is of the same order. A map of hiatus distributions in the Quaternary-Pliocene ocean [7, fig. 28] suggests that hiatuses dominate a relatively small area of the oceans and that the magnitude of K is also approximately correct. The amount of variation in K indicated by fitting the model to the observed data is almost precisely equal to the Cenozoic variation in the vertical gradient of the calcite dissolution rate — a factor of 30 [11, chapter 7; 22]. Thus, the magnitude of the variation in K also appears realistic.

What is more difficult to evaluate is whether any given maximum or minimum in sediment preservation is due primarily to changes in the rate of sediment deposition (M) or to changes in the rates of dissolution and erosion (K). The distinction is important, because a change in M implies a change in

the input of Ca and Si to the oceans. Such variations will be reflected in M instantaneously on our time scale, because the oceanic resident times of these elements are much less than 1 m.y. In contrast, a change in K implies a change in the dissolution required to bring the rate of accumulation of Si and Ca into balance with the rate of input to the oceans. Such a change will occur if the productivity of the ocean varies in response to circulation changes (even though the net input is unchanged), and can affect all older sediments as well as those deposited at the time of the productivity change.

At present, we lack objective criteria by which to assign preservation anomalies to changes in K or M . In the future, such criteria may be derivable from opal/carbonate ratios or microfossil preservation indices. Our model has, however, identified intervals which deviate from the general trend, and which should be examined for evidence of supply or dissolution changes.

The changes in oceanographic boundaries used to explain the observed distribution of hiatus abundances [7] can also account for the timing of changes in M and K of the model (Fig. 7). The use of the model allows us to consider these changes with a clearer perception of their relative magnitudes and importance, independent of the long-term effects of the duration of hiatuses. For example, of the major peaks in section survival occurring in the Late Paleocene-Early Eocene and near the Oligocene-Miocene boundary (Fig. 4), the older appears to be of much greater magnitude. In terms of K and M in the model, however, these two intervals were very similar (Figs. 5 and 6) although the older one was longer. The relatively high proportion of surviving sections in the Late Paleocene through Middle Eocene is best fitted by the model (Fig. 7) with values of M that are 30% greater than the post-Oligocene values, but with K approximately the same as for most of the Neogene. The intervals with high K values during the Late Oligocene and the Late Eocene-Early Oligocene (Fig. 6) correspond to times of rapid change in the carbonate dissolution rate in the equatorial Pacific [11], and to periods of expansion of the area of the ocean floor covered by hiatuses [7, figs. 20–24].

The Oligocene-Eocene and Paleocene-Maestrichtian minima in section survival are the most noticeable deviations from the model. These minima (maxima

in hiatus abundance) are present in all ocean basins [7]. Such pervasive changes in section survival require marked changes in the mode or intensity of sedimentary recycling. According to our present understanding of such recycling [14–16,23], a global change requires either a change in the supply of test-building materials to the sea floor, a change in their partitioning between the sediments of the deep and shallow seas, or a change in their partitioning between the regions sampled to date (mostly low and mid-latitudes) and those not sampled (the Arctic Ocean and most of the high southern latitudes). The late Cretaceous–Paleocene interval with a minimum in surviving sections is thought to reflect widespread peneplanation and consequent reduction in nutrient leaching from continental land masses during the Late Cretaceous. At the end of the Cretaceous the initial uplift of mountains in the Alpine, Himalayan, Andean and Rocky Mountain regions disrupted the extensive Cretaceous peneplains and shallow seas. This uplift of the continents and their subsequent erosion brought a renewed supply of nutrients and dissolved materials to the oceans [8,24,25].

The Eocene–Oligocene increase in surviving sections more likely resulted from a change in the partitioning of carbonate sediments between shallow and deep seas. The further loss of many shallow areas, particularly in the tropical regions, was reinforced by a marked change in the surface and deep circulation of the oceans, leading to enhanced carbonate preservation in the deep sea. The opening of the Antarctic–Australian Passage (and possibly the Drake Passage), at the close of the Eocene and the subsequent development of a circum-Antarctic current, caused the formation of very cold bottom waters in high southern latitudes [10]. This source is thought to have fed a more vigorous bottom circulation of waters that were “younger”, therefore contained less oxidative dissolved carbon dioxide and were less corrosive with respect to calcite [7,11]. Coupled with reduced input of oxidizable organic material to deep waters, due to decreased surface biological productivity in the Oligocene [26], this accelerated circulation served to greatly depress the calcite compensation depth and decrease the areas of non-deposition at the close of the Eocene.

It is also important to note that only global changes in the occurrence of hiatuses markedly

affect the average proportion of surviving sections (Fig. 2). Thus, in the Atlantic and Indian Oceans a distinct hiatus maximum is found at about 15 m.y. B.P., but on the global average curve, this is counteracted by a minimum in hiatus abundance in the eastern Pacific and Southern Oceans. At about 10 m.y. B.P. the Atlantic, Pacific, and Southern Oceans have many hiatuses, but the Indian Ocean has few [7]. The integration of these data results in a broad mid-Miocene shoulder on the hiatus abundance curve (Fig. 1), which can be accounted for by relatively small changes in K (20%) or M (5%) in the model (Figs. 5 and 6).

4. Conclusion

The Garrels and Mackenzie [1] linear model of sedimentary recycling does not fit observations on the proportion of surviving deep-sea sections as well as does a model which takes into account the distribution of the duration of hiatuses. In addition to hiatus duration, our model points to the influence of two depositional variables: sediment deposition rate (M); and the area over which dissolution and erosion completely destroy the section (K). The cumulative distribution of hiatus durations is based on observations and is held constant in the model. If the two variables are held constant at $M = 1$, $K = 0.07$, the resulting model curve parallels the general trend of the observations. The presence of large deviations from this general trend, however, indicate that M and K have almost certainly varied with time. The amount of variation required to approximate the observed curve is compatible, in terms of direction, magnitude, and timing, with recorded changes of carbonate dissolution gradients and biogenic accumulation rates. The proportion of recycled carbonate and opal provided by hiatus formation is small relative to that dissolved at and just below the sea floor, but large relative to the net influx of Ca and Si to the oceans. In fact, the simple model with $M = 1$ and $K = 0.07$ suggests that more than half the sediment currently accumulating in the deep sea is recycled from within the ocean basins, rather than added from the continents or other external sources.

The four major departures from the general trend of the section survival curve occurred during the

Early Paleocene, and the Late Eocene-Early Oligocene (minima in surviving sections), and the Late Paleocene-Middle Eocene, and Late Oligocene-Early Miocene (maxima in surviving sections). Based on the magnitude of changes in the model variables necessary to mimic these deviations, it appears that the oldest event was the most dramatic, requiring changes in M and K about 30% greater than the Eocene-Oligocene changes. The changes required to mimic the youngest event are about half the magnitude of those required for the Eocene-Oligocene event, and about the same as those for the Late Paleocene-Middle Eocene interval.

This model implies that little further destruction of sediments is likely after about 70 m.y. Thus, maxima in survival of sections within the Mesozoic can be compared directly with regard to the magnitude of possible changes in dissolution and deposition rates. It is possible, however, that in these older, more deeply buried sections, diagenetic processes, which are of little importance in Cenozoic sections, may effectively destroy some of the surviving sediments. This would reduce the apparent proportion of surviving sections below that estimated by our model, and might bring the trend of the survival curve into closer agreement with the Garrels and Mackenzie [1] model. The extension of this study to older sections awaits the refinement of Mesozoic stratigraphy and its correlation with the absolute time scale.

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APPENDIX N

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Interstitial Nitrate Profiles and Oxidation of Sedimentary Organic Matter in the Eastern Equatorial Atlantic

Abstract. *Pore-water nitrate concentrations in six pelagic eastern equatorial Atlantic cores increase from bottom water values (22 micromolar) to 40 micromolar at a depth of about 5 centimeters, then decrease to undetectable levels at depths as shallow as 40 centimeters. These nitrate concentrations and concentration gradients reflect zones of oxygen reduction, nitrate reduction, and sulfate reduction in the sediments. The estimated benthic flux of nitrate to the ocean from our data is much less than the total global flux of nitrate to deep waters, even though these equatorial sediments underlie a productive upwelling zone. The estimated denitrification rate in our study area suggests that pelagic sediments may be important sites of marine denitrification.*

Inorganic carbon, nitrogen, and phosphorus are fixed into organic matter at the sea surface during photosynthesis. A small portion of the particulate organic matter is delivered to the deep sea and incorporated into marine sediments. The organic matter thus buried is partly oxidized and regenerated within the sediment by oxidants (O_2 , NO_3^- plus NO_2^- , and SO_4^{2-}) which are either derived from pore waters, provided by diffusion from the overlying water, or produced by diagenetic reactions within the sediment column (NO_3^- plus NO_2^- only). Metabolites, oxidants, and reductants are all present in pore waters. Concentrations of these products are controlled by C : N : P ratios in the organic matter undergoing diagenesis, by relative rates of diffusion, and by rates of reaction, sedimentation, and bioturbation (1).

The purpose of this report is to discuss the fate of nitrate produced by diagenetic

reactions in a suite of cores from the Guinea Basin in the eastern equatorial Atlantic, to show that pore-water nitrate profiles can provide much information about the early diagenesis of deep-sea sediments, and to make preliminary assessments of the global significance of the pelagic benthic flux of nitrate and pelagic denitrification.

Before discussing the pore-water data, it is worthwhile to review a simple model of organic diagenesis (2-4). In doing so we will make the following simplifying assumptions: (i) all the organic matter undergoing oxidation has C : N : P atom ratios of 106 : 16 : 1 (the Redfield ratios); (ii) there are no solid-phase reactions (other than the breakdown of organic matter itself) releasing metabolites to or consuming them from pore waters; (iii) ammonia released by deamination during oxidation of organic matter by dissolved oxygen is immediately con-

Table 1. Gravity core locations.

Identification	Location	Water depth (m)	Length (cm)
G76-5-7GC1	4°59.5'N, 5°09.2'W	55	60
G76-5-10GC1	1°05.1'N, 8°11.6'W	4956	65
G76-5-11TW1*	0°01.8'N, 9°03.9'W	4980	89
G76-5-12GC1, G76-5-12GC2	0°04.1'N, 10°33.8'W	3880	63, 90
G76-5-14GC1	0°00.1'S, 12°19.3'W	4170	63
G76-5-16GC1, G76-5-16GC2	0°02.5'S, 16°07.1'W	3310	48, 63
G76-5-23GC1	1°06.0'N, 8°12.5'W	4901	55
G76-5-27GC1	4°59.1'N, 5°06.0'W	80	64
G76-5-28GC1	4°55.9'N, 5°05.4'W	229	43

*Trigger weight core.

verted to nitrate; and (iv) the initial pore fluids (before any reactions commence) contained the same metabolite concentrations as local bottom water (ΣCO_2 , 2185 μM ; O_2 , 250 μM ; NO_3^- , 22 μM ; PO_4^{3-} , 1.45 μM ; and SO_4^{2-} , 28.81 mM; see Fig. 1, point A).

In oxygenated sediments, the degradation of organic matter can be described by the relation

This reaction proceeds until virtually all the O_2 has been consumed (Fig. 1, point B). At this point, if there were no diffusion, NO_3^- would rise to 51 μM , PO_4^{3-} to 3.26 μM , and ΣCO_2 to 2380 μM .

After oxygen has been depleted, oxidation by NO_3^- commences according to the general relation

A mole of NO_3^- oxidizes 46 percent more organic matter than does a mole of O_2 , and by the completion of reaction 2 nitrate reduction is responsible for 25 percent of the metabolites produced. Reaction 2 proceeds until all 51 μM of NO_3^- are consumed, producing 57 μM of CO_2 and 0.54 μM of PO_4^{3-} . By point C (Fig. 1), 250 μM of O_2 and a net of 22 μM of NO_3^- have been consumed, whereas 249 μM of CO_2 and 2.35 μM of PO_4^{3-} have been produced.

Following NO_3^- exhaustion, oxidation continues by SO_4^{2-} reduction, according to the general relation

In sediments where SO_4^{2-} reduction is significant, this process is responsible for most of the oxidation of organic matter, because the SO_4^{2-} available can oxidize

56,000 μM of CH_2O —roughly 225 times as much as oxygen and nitrate combined.

There are several ways in which a real system may deviate from the ideal reactions 1, 2, and 3 (5). First, NO_3^- may be removed in ways other than by oxidizing organic matter (reaction 2). For example, it is possible that nitrate-reducing bacteria will only oxidize either ammonia produced in the sulfate reduction zone or organic nitrogen according to the following idealized reaction (in which NH_3 can represent either ammonia or organic nitrogen)

Although there is no known bacterial species which mediates this reaction, we cannot rule out the possibility that such a species exists. Note that reaction 4 pro-

duces 2.28 times as much N_2 per mole of NO_3^- consumed as reaction 2. Second, NH_3 produced in the sulfate reduction zone may diffuse upward into the oxidizing zone and react with O_2 to produce nitrate. The nitrate maxima observed by Vanderborgh and Billen (6) may be due to this effect. On the other hand, some ammonia produced as an intermediate in reaction 1 may not be oxidized to nitrate, resulting in the production of less nitrate than predicted. Third, intermediate steps in reaction 2 may produce NO_2^- , NO , N_2O , and so on, which may not be further reduced. Fourth, organic nitrogen liberated in reaction 2 may be released as ammonia rather than N_2 . Fifth, the C/P and C/N ratios of organic matter in pelagic sediments may, as a result of selective fractionation during oxidation, differ from the Redfield ratios. In this case the reaction stoichiometry will differ from that in reactions 1 to 3, but the sense of the covariations will remain the same. In particular, the nitrate concentration, $[\text{NO}_3^-]$, will increase during O_2 reduction and decrease to zero during NO_3^- reduction. Thus, although our arguments assume that the thermodynamically stable products are produced in each case, and that the C/N and C/P ratios of the organic matter are equal to the Redfield ratios, we acknowledge that the situation in the real world may be more complex (4, 7).

The preceding discussion emphasizes the role of NO_3^- in the diagenesis of organic matter. Measurements of NO_3^- in pore waters of marine sediments provide information on the oxidation of organic matter above the SO_4^{2-} reduction zone and yield qualitative estimates of O_2 concentrations in pore waters. Of course, estimating $[\text{O}_2]$ from $[\text{NO}_3^-]$ in real pore-water systems is more complicated than in our simple model because of differences in O_2 and NO_3^- diffusion coefficients and uncertainties in the C/N ratio of oxidized organic matter. Nitrate data also identify the onset of SO_4^{2-} reduction, which can begin only below the depth at which nitrate is exhausted. Finally, pore-water nitrate data can contribute to a better understanding of fixed-nitrogen regeneration from various sediment types, and of rates of denitrification during nitrate reduction.

Results. We have determined NO_3^- plus NO_2^- in pore waters from sediments underlying relatively productive shelf, slope, and equatorial waters in the Guinea Basin (Fig. 2). All cores (except piston cores; discussed later) were obtained with a Benthos gravity corer, which was used without the core cutter, catcher, or barrel to prevent distortion of the sediment surface. Cores were ex-

Fig. 1. Concentrations of metabolites (PO_4^{3-} , NO_3^-) and oxidants (O_2 , SO_4^{2-} , NO_3^-) in a closed system as a function of metabolic CO_2 production. The curves were calculated from assumptions in the text. (Point A) North Atlantic deep water; (point B) composition at end of O_2 consumption; and (point C) composition at end of NO_3^- consumption.

truded at in situ temperatures under a helium atmosphere. Pore waters were expressed at in situ temperatures with modified Reeburgh squeezers (8). The NO_3^- plus NO_2^- concentrations were determined in undiluted 1-ml samples by an AutoAnalyzer (Technicon method 158-71W), 1 hour to 1 day after squeezing. Details of procedures and concentrations of other dissolved species will be reported elsewhere (9).

The NO_3^- profiles shown in Fig. 3 can be divided into two types. The first type includes cores 7, 27, and 28, which display nitrate concentrations of less than 3 μM throughout. These cores are from hemipelagic muds on the Ivory Coast shelf. Surface biological productivity is high and a permanent boundary layer of nutrient-rich, oxygen-poor water covers the shelf below a depth of about 30 to 40 m (10). Both oxygen and nitrate must be consumed in the upper centimeter, as sulfate reduction begins at this depth. Such a thin oxidizing layer is typical of nearshore, organic-rich sediments overlain by oxygen-depleted waters (11).

The second type of profile (cores 10, 11, 12, 14, and 16 in Fig. 3) resembles that generated by our simple model (Fig. 1) with the ΣCO_2 axis replaced by the depth axis. However, the subbottom NO_3^- maximum is 35 to 40 μM , rather than the predicted value of 51 μM . In part, this difference reflects both upward and downward diffusion of NO_3^- in the sediment column. The difference may also reflect a high C/N ratio in the oxidized organic matter, incomplete ammonia oxidation in the O_2 reduction zone, or one of several other possible deviations from our ideal model.

The NO_3^- profile for core 14 provides

Table 2. Comparison of nitrate and ammonia gradients in adjacent gravity cores and piston cores. The nitrate gradient is for the zone of linear decrease of concentration with depth.

Core	Location	Water depth (m)	$\delta[\text{NO}_3^-]/\delta z$ ($10^{-3} \mu\text{mole cm}^{-1}$)	$\delta[\text{NH}_4^+]/\delta z$ ($10^{-3} \mu\text{mole cm}^{-1}$)	$\delta[\text{NH}_4^+]/\delta z$ $\delta[\text{NO}_3^-]/\delta z$
24SC1	2°50.9'N, 6°41.0'W	4572	-0.93		
8PC1	2°55.1'N, 6°41.4'W	4535		0.23	-0.25
12GC2	0°04.1'N, 10°33.8'W	3880	-0.43		
20PC1	0°02.4'N, 10°35.9'W	3870		0.16	-0.37
11TW1	0°01.8'N, 9°03.9'W	4980	-0.97		
21PC1	0°02.4'N, 9°06.7'W	5029		0.33	-0.34

an example of the use, suggested earlier, of NO_3^- as an indicator of the diagenetic status of sediments. This core consisted of tan carbonate ooze (85 percent CaCO_3) down to a depth of about 40 cm, with dark gray, carbonate-poor terrigenous sediment below 40 cm. We can write the following equation (12) for the rate of change of the NO_3^- concentration of pore water at a depth z below the sediment-water interface

$$\frac{d\phi[\text{NO}_3^-]}{dt} = I(\text{NO}_3^-) \left(\phi D_a \frac{d[\text{NO}_3^-]}{dz} \right) - \frac{d(\phi W[\text{NO}_3^-])}{dz} + I(\text{NO}_3^-) \delta J \quad (5)$$

where t is time, z is depth relative to the sediment-water interface, ϕ is porosity, $I(\text{NO}_3^-)$ is a term to account for adsorption of nitrate onto sediment, D_a is the apparent diffusion coefficient (13) of nitrate, W is the upward flux of water due to compaction, and J is the production rate ($J > 0$) or consumption rate ($J < 0$) of nitrate. We assume that there is no absorption of NO_3^- [hence $I(\text{NO}_3^-) = 1$]; that the pore-water nitrate profile is a steady state feature ($d[\text{NO}_3^-]/dt = 0$), and that the advective flux term $d(\phi W[\text{NO}_3^-])/dz$ is negligible; and we

note that in the critical depth range of 2 to 31 cm the porosity (and hence the diffusion coefficient) is constant (the mean and total range of nine porosity measurements in this depth range is 0.74 ± 0.02 by volume). With these assumptions and observations, Eq. 5 simplifies to

$$J = -D_a \frac{d^2[\text{NO}_3^-]}{dz^2} \quad (6)$$

Near the top of the core, where $d^2[\text{NO}_3^-]/dz^2 < 0$ (0 to 5 cm), $J > 0$ and nitrate is being produced; oxygen is presumably present. Where $d^2[\text{NO}_3^-]/dz^2 = 0$ and $[\text{NO}_3^-] > 0$ (5 to 34 cm), $J = 0$ and we infer that no detectable oxidation of organic matter is occurring. Where $d^2[\text{NO}_3^-]/dz^2 > 0$ (somewhere between 34 and 41 cm), $J < 0$ and nitrate reduction is occurring. The oxidation zone at 0 to 5 cm presumably reflects the presence of O_2 and labile organic matter in the young sediments; the relatively rapid rate of nitrate reduction at 34 to 41 cm probably reflects an increase in the reactive organic carbon content below the 40-cm lithologic break. Finally, where $[\text{NO}_3^-] = 0$ (depths > 41 cm), diagenesis of organic matter is occurring (if at all) by SO_4^{2-} reduction.

Fig. 2. Map showing core locations. Depth contours are in meters.

Fig. 3. Nitrate concentration as a function of depth in eastern equatorial Atlantic gravity cores. Where the cores in group 2 were raised, the bottom water nitrate concentration is about 22 μM .

In the introductory discussion, we suggested that significant NO_3^- could be consumed in oxidizing ammonia. We can check this possibility by comparing the downward flux of NO_3^- in our gravity cores with the upward flux of NH_3 in nearby piston cores, and calculating whether ammonia is diffusing to the NO_3^- reduction zone sufficiently rapidly to consume all the NO_3^- . Ammonia increases linearly with depth in the piston cores, so there is little uncertainty in the gradient or flux estimates.

Estimated NO_3^- and NH_4^+ gradients are compared in Table 2. According to reaction 4, if diffusion alone transports NO_3^- and NH_3 to the reaction sites, and if all NO_3^- is consumed by NH_3 oxidation, then it must hold that

$$\frac{\text{NH}_4^+ \text{ flux}}{\text{NO}_3^- \text{ flux}} \leq \frac{-5}{3}$$

Since flux = $D_a \, dC/dz$, then

$$\frac{(dC/dz)_{\text{NH}_4^+}}{(dC/dz)_{\text{NO}_3^-}} \leq \frac{-5}{3} \frac{D_a(\text{nitrate})}{D_a(\text{ammonia})}$$

where dC/dz is the observed interstitial gradient and D_a is the apparent interstitial diffusion coefficient. Since the aqueous diffusion coefficients of nitrate and ammonia at infinite dilution are nearly equal (13), we assume that the ratio of $D_a(\text{nitrate})$ to $D_a(\text{ammonia})$ is one. From Table 2, it is clear that the observed NH_3 flux below the nitrate reduction zone is insufficient to consume more than 15 to 25 percent of the NO_3^- sink. Our NH_3 data for the O_2 reduction and NO_3^- reduction zones are too uncertain to reveal NH_3 behavior in these portions of the sediment column.

We may estimate both the benthic flux of NO_3^- and the consumption rates of fixed nitrogen (denitrification) at the pelagic sediment sites (cores 10 to 16) from the data of Fig. 3 and Table 2. The average NO_3^- gradient at the sediment-water interface is taken as $20 \times 10^{-3} \, \mu\text{M cm}^{-1}$ (this gradient is calculated assuming that the $[\text{NO}_3^-]$ in the top centimeter of the sediment is $32 \, \mu\text{M}$, compared with $22 \, \mu\text{M}$ in the bottom water, and that the gradient increases linearly in the top centimeter: it is the minimum gradient necessary to account for the observation that the nitrate concentration of the top centimeter of the sediment is approximately $10 \, \mu\text{M}$ higher than the bottom water value). Note that, if we consistently lost material at the sediment-water interface during coring, the real gradient must be less than our assumed value. The gradient in the zone of linear decrease of nitrate with depth is taken as $-0.9 \times 10^{-3} \, \mu\text{M cm}^{-1}$.

Apparent diffusion coefficients of NO_3^- and NH_4^+ were estimated by multiplying the value at 0°C and infinite dilution (13) by the product of the tortuosity factor of 0.55 (14) and a porosity of 0.75 (porosities measured in duplicates of cores 12 and 16 averaged 0.76 ± 0.05 and 0.74 ± 0.02 , respectively). This gives a value of D_a for both NO_3^- and NH_4^+ of $4.0 \times 10^{-6} \, \text{cm}^2 \text{sec}^{-1}$.

From these diffusion coefficients and the concentration gradients given above, we estimate that the benthic flux of NO_3^- across the sediment-water interface is about $2.5 \, \mu\text{M cm}^{-2} \text{year}^{-1}$. This flux integrates the total nitrate production between the sediment-water interface and the depth of the nitrate maximum. The downward flux of NO_3^- in the zone of linear decrease is about $0.11 \, \mu\text{M cm}^{-2} \text{year}^{-1}$; this flux integrates the nitrate production below the depth of the nitrate maximum. Thus, of the NO_3^- produced by oxidative regeneration in these cores, about 96 percent is returned to the overlying ocean and 4 percent is consumed by denitrification.

These calculated fluxes can be compared to the global rate of input of NO_3^- to the deep ocean, which can be estimated from the nitrate content of a 1-cm² column of North Pacific deep water. Assuming an "age" of 1600 years (15), an average depth of 3500 m (and therefore a volume of 350 liter cm⁻²), and an NO_3^- concentration of $40 \, \mu\text{M}$, the rate of input of nitrate is

$$\frac{(40 \, \mu\text{M liter}^{-1})(350 \, \text{liter cm}^{-2})}{1600 \, \text{years}} = 8.8 \, \mu\text{M cm}^{-2} \text{year}^{-1}$$

This is more than three times the benthic flux of nitrate at our eastern equatorial Atlantic stations. Inasmuch as our stations underlie a productive upwelling area, the benthic flux we have calculated is likely to be much higher than the global average value. These results are consistent with the view that most phosphorus and fixed nitrogen input to deep waters occurs in the upper part of the deep-water column rather than at the deep-sea floor (16).

According to reaction 2, 1.17 moles of N are freed for every mole of NO_3^- reduced. If this reaction accurately describes the mode and stoichiometry of NO_3^- consumption, the rate of denitrification is 1.17 times the downward NO_3^- flux, or about $0.13 \, \mu\text{M}$ of N per square centimeter per year. Alternately, if reaction 4 is responsible for NO_3^- reduction, then 2.67 moles of N are freed for every mole of NO_3^- reduced, and the calculated denitrification rate is $0.29 \, \mu\text{M}$ of N per square centimeter per year.

On the basis of published estimates of marine denitrification and considerations of the global nitrogen balance, it has been concluded (17) that oceanic denitrification is of the order of 10 to 70 megatons of N per year. If NO_3^- reduction is occurring in all marine pelagic sediments at the same rate as in our Guinea Basin cores (and assuming the stoichiometry is as indicated in reaction 2), it could account for a total denitrification of about 5 megatons of N per year. In the eastern tropical North Pacific, the most important site of marine denitrification yet identified, denitrification is occurring at the rate of about 20 megatons of N per year (18). While denitrification is undoubtedly occurring less rapidly over the deep ocean as a whole than at our study site underlying a tropical upwelling area, our results suggest that pelagic sediments cannot be dismissed as possible significant sites of marine denitrification. In other words, while pelagic denitrification has not been proved to be a major global sink of fixed nitrogen, it cannot be neglected in light of existing uncertainties in the nitrogen balance.

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Cullen, and the crew of R/V. *Gyre*, cruise 76-05, for support in carrying out the shipboard measurements. We are indebted to M. Pilson for criticism and discussions. This research was supported by NSF grant OCE-76-02318 to M.L.B. and G.R.H. and by NSF grants GA 41200 and OCE 76-82416 to K.A.F.

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APPENDIX 0

Properties of the oceanic crust relevant to the Seabed Disposal

Program.

The following abstracts summarize results presented at a recent symposium in New York. Full reports will be published early in 1979. These results, based on the latest studies of Deep Sea Drilling Project basalt sections, support our view that the high permeability of the oceanic crust, combined with its great lateral variability, even on scales of hundreds of meters, make it much less attractive than sediment as a potential disposal option.

Freshly erupted basalt is so fractured that it offers essentially no barrier to free communication with the ocean (see following abstracts by Spooner, Donnelly, and Edmond). Even though the fractures slowly fill with secondary minerals over geologic time (see following Salisbury and Stephen abstract), crust that is 110 million years old has permeabilities of darcies ($>10^{-3}$ cm/sec) compared to values in the 10^{-7} cm/sec range for MPG-I and II sediments.

THE EWING SYMPOSIUM

SUPPORTED BY THE GRANGER VETTERSEN FOUNDATION

IMPLICATIONS OF DEEP DRILLING RESULTS IN THE ATLANTIC OCEAN

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PROGRAM

PART I

"Ocean Crust"

Matthew H. Salisbury and Ralph A. Stephen, *Scripps Institution of Oceanography*

**The Physical State of the Upper Levels of Cretaceous Basement
from the Results of Logging, Laboratory Studies and the
Oblique Seismic Experiment at DSDP Site 417D**

The combined results of logging, physical properties studies and the oblique seismic experiment conducted during DSDP Legs 51-53 at Site 417D in Cretaceous crust at the southern end of the Bermuda Rise allow the first detailed evaluation of the physical state of the upper levels of old oceanic basement.

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From first arrival and synthetic seismogram analysis of the results of the oblique seismic experiment, it is clear the V_p increases linearly from 4.8 ± 0.2 km/sec at the top of layer 2 to 6.7 ± 0.4 km/sec at the top of layer 3 at a sub-basement depth of approximately 1.5 km, while V_s increases from 2.6 ± 0.1 to 3.7 ± 0.1 km/sec over the same interval.

The average value of V_p (4.8 km/sec) measured by logging in the upper basement is in excellent agreement with the value obtained from the oblique seismic experiment, but is lower than the formation velocity (5.4 to 5.5 km/sec) reconstructed for the site from laboratory measurements of velocity through recovered core material. This requires that the formation contain cracks on a scale finer than the resolution of the logging and oblique seismic experiments but greater than that of laboratory samples. From the Wyllie Relationship and petrologic constraints imposed by the core, the upper basement at Site 417D consists of 90% basalt with an average grain boundary porosity of 8%, 2% inter-pillow limestone, 3% smectite consisting of about 50% water, and 5% open cracks filled with standing water. The formation porosity thus resides in two domains, grain boundaries and open cracks, and totals 13-14%. This value is confirmed by electrical resistivity logs which indicate, in addition, that the cracks are interconnected, giving the formation a permeability in the darcies.

A comparison of this data with logging data obtained in young crust at Site 332B on the Mid-Atlantic Ridge indicates that although the porosity and permeability of the upper levels of the crust at Site 417D are much lower than at the ridge crest, the formation is still not entirely sealed.

Ophiolitic Rocks and Evidence for Hydrothermal Convection of Sea Water Within Oceanic Crust

A significant amount of evidence in support of the general hypothesis of sea-water circulation within oceanic crust has now been obtained from examination of ophiolitic sequences. For example, non-isochemical hydrothermal metamorphism of ocean-floor origin has been documented from ophiolitic rocks in Cyprus (Gass and Smewing, 1973; Spooner et al., 1977), Newfoundland (Williams and Malpas, 1972; Coish, 1977), E. Liguria, Italy (Spooner and Fyfe, 1973) and S. Chile (Stern et al., 1976). Zeolite to amphibolite facies metamorphic assemblages have been observed in metabasic pillow lavas, sheeted dykes, the upper parts of layered plutonic sequences, and associated lithologies. Examination of the hydrogen, oxygen, carbon and strontium isotopic composition of the altered rocks has confirmed that metamorphism was a result of sea water-rock interaction at elevated temperatures (Spooner et al., 1974; Heaton and Sheppard, 1977; Spooner et al., 1977). Observations suggest that sea-water penetrated to depths of $\sim 2\frac{1}{2}$ -5 km.

Perhaps the most significant point concerning hydrothermal circulation to come from studies of ophiolitic rocks is that formation of economically significant (on land) cupriferous pyrite ore deposits appears to be a natural consequence of sea water convection. In general terms the deposits consist of lenses of massive sulphide ore which are intercalated conformably within pillow lavas, and which are underlain by approximately pipe-shaped stockworks and alteration zones. Examination of fluid inclusions and the hydrogen oxygen and strontium isotopic composition of ore deposit material from Cyprus has shown that the sulphides were precipitated from a hydrothermal fluid of sea water origin (Heaton and Sheppard, 1977; Spooner and Bray, 1977; Chapman and Spooner, 1977; Spooner, 1977).

Two main points resulting from these studies would appear to be particularly relevant to modelling convective heat and mass transfer within oceanic crust:

(a) Examination of the homogenisation temperatures of fluid inclusions from ore deposits in Cyprus suggests that hydrothermal fluid discharged hot into overlying sea water at temperatures of $\sim 200^{\circ}\text{C}$ — $\sim 300^{\circ}\text{C}$ (Spooner and Bray, 1977).

(b) The geometry of circulation consisted of approximately axially symmetric "cells" with hot water rising as a plume within the centre of each cell (Spooner, 1977). Observations from Cyprus show that the half-spacing between rising plumes was similar to the thickness of the permeable layer (Spooner, 1977). Preliminary modelling of circulation in an open-top permeable layer by finite difference approximations suggests that this geometry of flow is semi-quantitatively reasonable (Parmentier and Spooner, in preparation). Although this appears to have been the dominant mechanism of flow in Cyprus, it is clear

from observations in Cyprus and elsewhere (e.g. Oman — unpublished research by the Dept. of Earth Sciences, Open University, U.K.: J. D. Smewing, personal communication) that major fractures acting as high permeability paths can, as would be expected, control water discharge and mineralization.

Preliminary information on the isotopic composition of sulphur in ophiolitic ore deposits suggests that the sulphide is mainly of reduced sea water sulphate origin (Spooner, 1977; Bachinski, 1977). Hence, large quantities of sulphide, in association with hydroxyl and chloride, may be added to oceanic crust. Release of water from the descending slab at subduction zones may cause wet melting of mantle material, and could produce volatile rich siliceous magmas enriched in chlorine and sulphur. Such a simple model could explain the amounts of magmatically released water, chlorine and sulphur required for the formation of porphyry Cu±Mo±Au deposits. Water is needed as the transport medium, chloride for metal complexing and sulphur for fixing the metals as solid phases.

Low Temperature Alteration of the Oceanic Crust: An Exceptionally Well Developed Case from the DSDP Megaleg

Drilling of two holes into 110 m.y.-old crust on Leg 51, DSDP, has given us a superb opportunity to examine low-temperature alteration of the oceanic crust. Holes 417A and 417D, 440 meters apart, encountered highly altered and strikingly fresh basalts, respectively. Hole 417A encountered basalt about 150 meters more shallow than 417D, and lacks most of the Cretaceous sediments deposited at the latter site. The altered basalt was evidently a topographic high that remained unburied approximately 20 million years after eruption, while 417D represents eruption in a topographically low area with immediate burial. The altered and fresh basalts were apparently originally very similar, homogeneous plagioclase-rich MORB.

The altered basalt has the original plagioclase replaced by K-feldspar and zeolites, and the pyroxene by smectites and iron hydroxide. The rock is veined by calcite and smectites. Interpillow glass fragments (hyaloclastite) are altered dominantly to smectite.

Chemically the alteration consists of the uptake of prodigious amounts of potassium and the loss of calcium, magnesium, and minor sodium. Iron is thoroughly oxidized. The uptake of potassium is about 680 grams K per cm² for the 190 meter column drilled. A complete consideration of the chemical budget, however, shows that the uptake of H⁺ is far greater than that of K⁺ and is, in fact, the limiting chemical variable. If all the H⁺ is ultimately derived from HCO₃⁺, and if we assume an initial formation porosity of 20%, then we can show that approximately 2000 volumes of the pore fluid were moved through the column. If this water was driven by a thermally induced convection from a cooling crust, then the heat must have been derived from a mass of basalt far larger than the "hill" itself. We might regard the "hill" as a sort of upside-down drain, which, lacking an impermeable sedimentary cap, becomes the principal conduit for convective effluent water.

A somewhat surprising result of the budgetary calculations is that the oxygen (for oxidation of iron) is not consumed, but produced in excess during the overall alteration reaction. A further conclusion is that iron and manganese are not released during low-temperature alteration; thus, sources of these elements remain elusive.

A review of other drilled sites shows that hole 417A is exceptional only in degree; similar chemical tendencies exist to lesser degrees at other sites. An important question is how wide-spread are sites such as 417A; if they make up a significant fraction of the crust, then crustal alteration would play a signifi-

cant role in the budget of potassium in the ocean. Several lines of reasoning and observations, however, lead to the conclusion that such sites are probably scarce.

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Chemistry of the Hot Springs on the Galapagos Ridge Axis

Four distinct fields of hot springs were discovered on the ridge axis each about fifty meters across. The chemical properties of the samples recovered by ALVIN fall on dilution lines generated by mixing with ambient, oxygenated seawater during the subsurface circulation in the basalts and to a lesser degree during collection. The highest temperatures observed were about 17°C (15°C above ambient) and waters of 15°C were sampled successfully. Helium, hydrogen sulphide, silica, barium, manganese and lithium increase rapidly with temperature. Calcium, potassium and ΣCO_2 increase by 1, 3, and 15% respectively. Strontium and fluoride are constant to within the analytical uncertainty. Magnesium decreases by 3.5% and alkalinity by 15%. The sulphide forming elements copper, nickel, and cadmium drop by over a factor of two. The manganese-iron ratio is highly variable between 10 and 1000.

The Si-T line intersects the quartz solubility curve at about 300°C. The Mg-T trend extrapolates to zero at 280°C.

The ^3He -T relationship has a slope of 220×10^{-15} moles Cal^{-1} . If it is assumed that the flux of ^3He necessary to maintain the observed water column saturation anomaly is derived entirely from hot springs in constant ratio to heat then the associated heat loss is 5×10^{19} cal yr^{-1} . Similar calculations for the other measured species result in fluxes of silica and barium equivalent to about one third of the river input. For lithium the hydrothermal flux is greater by a factor of ten, for potassium it is about the same as it is also for magnesium removal. For calcium and alkalinity the values are +25 and -5% respectively. The manganese input is equivalent to the global sedimentary accumulation rate.

The extent of sub-surface mixing determines the chemical (and hence biological) properties of the hot springs. Low dilution allows hot, acid waters to debouch directly into sea water — the precipitation of sulphides is minimized and the ridge crest becomes a direct source of Fe, Cu, Ni, Cd, etc. At very high dilutions sulphide precipitation and oxidation are complete and the food chain base for the communities observed at the GSC is eliminated. This and the accompanying low temperatures will make such hot spring activity very difficult to detect. At high dilution, also, manganese oxidation will be well advanced leading to the spectacularly pure MnO_2 crusts recovered from some ridge crests but not seen in the hot spring areas visited where the reducing conditions and high flow rates precluded local precipitation.

APPENDIX P

Abstracts of talks presented to the Annual Meeting of the Geological Society of America, Seattle, Nov. 1977. Geol. Soc. Amer. Abstracts with Programs, Vol. 9, No. 7, p.1009 and 1134-1135.

RED CLAY SEDIMENTATION IN THE CENTRAL NORTH PACIFIC OCEAN

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1009

A series of piston cores at 33°N, 151°W in a water depth of 5500m show 1 to 2 meters of quartz- and illite-rich clay of inferred eolian origin grading down to authigenic smectite-rich clay containing ferromanganese oxyhydroxides and scattered ash layers. Paleomagnetic measurements suggest that the illitic clays accumulated several times faster than the smectites. Correlation of cores by lithology and natural remanent magnetization stratigraphy indicates factor-of-two variations in accumulation rates over distances of a few kilometers. In general, the ratio of accumulation rates between cores has remained constant for the 20 to 30 million years represented by the cores, suggesting control by topographically steered or tidal circulation rather than the mean flow characteristics or sediment load of bottom waters.

PALEOMAGNETIC STRATIGRAPHY USING PAIRED SAMPLES FROM NORTH PACIFIC GIANT PISTON CORE LL44-GPC3

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452 pairs of undisturbed 6cc oriented samples were taken every 5 cm from a 24.4 m long, 11.4 cm diameter core (GPC-3) collected in a red clay area north of Hawaii (30°20'N, 157°49'W) for magnetic studies. Stable detrital remanent magnetization (DRM) allows the upper 4.5 m to be dated by correlation with the standard geomagnetic time scale. The accumulation rate for this interval increased from 1.1 m/my 2my ago to 2.5 m/my at the surface. Most older samples lack the consistently stable DRM required for similar dating, but stable DRM paleoinclination measurements for 6 sample pairs between 2230 and 2255 cm suggest deposition at a paleolatitude between 7.6° and 13.1°N. Current estimates of the absolute drift of the crust of the Pacific imply an age of deposition of 61-71 my for these samples. This range is consistent with biostratigraphic age estimates based on ichthyolith assemblages by P. Doyle of Scripps Institute of Oceanography. Correlation coefficients for the 3 components D, I and J, of the NRM's of the 452 paired samples are 0.80, 0.88 and 0.96 respectively. Differences between some of the paired samples are larger than can be accounted for by measuring error alone. The differences are random, however, suggesting that they represent differences in the amount and

orientation of magnetic minerals at a given depth. Correlation coefficients (in the above order) for the stable DRM for the upper 775 cm (126 pairs) are 0.81, 0.88 and 0.96, and the interval 2155-2345 cm (35 pairs) are 0.63, 0.86 and 0.84. The differences between the paired samples after a.f. demagnetization are larger but are still random.

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