31. MAJOR AND MINOR ELEMENT GEOCHEMISTRY OF INTERSTITIAL WATERS OF SITE 808, NANKAI TROUGH: AN OVERVIEW¹

Joris M. Gieskes,² Toshitaka Gamo,³ and Miriam Kastner²

ABSTRACT

Detailed concentration depth profiles of a number of major and minor dissolved constituents of the interstitial waters retrieved from sediments of Site 808 (Nankai Trough) have revealed that a complex set of processes has affected these distributions. Because the major purpose of the drilling program was to evaluate the role of fluids in the accretionary prism of the Nankai Trough, only the results directly relevant to this problem are summarized in this abstract. (1) Interstitial water concentrations of a number of dissolved components indicate that there is no evidence for fluid flow associated with the recent (Holocene?) fault between 340–390 m below seafloor (mbsf). (2) In the Shikoku Basin deposits, directly underlying the trench fill section (below 620 mbsf), the interstitial water profiles are characterized by a large decrease in dissolved chloride (depletion with respect to ocean water at ~1150 mbsf is about 18%). The decrease in chloride concentration is interpreted to be the result of dehydration of clays. Only a small part of this process appears to occur in situ. The major part of the chloride decrease, however, must be due to dehydration further into the accretionary complex with the subsequent seaward advection of these fluids. Such an advection of low chloride fluids would be consistent with similar observations made in the Barbados Accretionary Prism (ODP Leg 110) and off Chile-Peru (ODP Leg 112). (3) Maxima in components associated with diagenesis of organic matter in the vicinity of the décollement suggest that an input of fluids has occurred along the zone of décollement, probably originating from the accretionary prism rather than from the deeper sediment layers.

INTRODUCTION

Fluid expulsion as a result of compaction and shortening of sediments in accretionary prisms has been shown to be of importance by various authors (Bray and Karig, 1985, 1986; Fowler et al., 1985; Moore and Biju-Duval, 1984; Von Huene and Scholl, 1991). Associated with this fluid expulsion is the venting of nutrient-rich fluids at the seafloor along fault zones and through carbonate or barite chimneys, leading to the observation of unusual biotic communities along the coast of Oregon (Kulm et al., 1986; Ritger et al., 1987) and in the Japan Trench and the Nankai Trough (Boulegue et al., 1987; Gamo et al., 1992; LePichon et al., 1987; Swinbanks, 1985). The mode of fluid expulsion has been modeled theoretically (Screaton et al., 1990; Shi and Wang, 1985; 1988; Foucher et al., 1990; LePichon et al., 1990) and has been inferred also from considerations of geochemical and geothermal anomalies (Vrolijk et al., 1991). Investigations of the fluid geochemistry have been shown to be of great usefulness in setting limitations to the mode of fluid expulsion as well as to the processes involved in the generation of observed geochemical anomalies in the fluid chemistry (Gieskes et al., 1989, Gieskes, Blanc, et al., 1990; Gieskes, Vrolijk, and Blanc, 1990; Kastner et al., 1990, 1991; Vrolijk et al., 1990, 1991).

In this paper a discussion is presented of the major- and minorelement geochemistry of pore fluids obtained at various sites in the Nankai Trough and the Shikoku Basin, with particular reference to Site 808 drilled during Leg 131 of the Ocean Drilling Program (ODP). Particular attention is given to possible changes in the geochemistry of the fluids, which may indicate the presence of fluid flow.

PREVIOUS WORK

Drilling of Site 808 occupied all available time of Leg 131, and for these reasons no direct nearby reference site is available to make comparisons of observed geochemistries of the interstitial waters. For these reasons, therefore, it may be useful to present a brief description of the observations on interstitial fluid chemistry in the various sites drilled previously in the Nankai Trough: Site 297 (Karig, Kagami, et al., 1975) and Sites 582 and 583 (Kagami, Karig, et al., 1986).

Interstitial Water Chemistry of Site 297

Site 297 was drilled in the Shikoku Basin, south of the sites drilled during Legs 87 and 131 (Karig et al., 1975; Fig. 1). Notwithstanding the relatively great distance from Site 808, Site 297 can serve as a potential reference for the following reasons. Sedimentation rates at this site are similar to those in the Shikoku Basin section of Site 808 (Taira, Hill, Firth, et al., 1991), and the sediment section shows many similarities, including the presence of volcaniclastic sediments below 570 mbsf. The upper section between 0 and 330 mbsf indicates sedimentation rates in excess of 100 m/Ma, and this is expected to be reflected in the distribution of alkalinity and sulfate, which show extremes at ~125 mbsf (White, 1975; Fig. 2). This is principally the result of more intensive diagenesis of organic matter in this rapidly deposited section with the simultaneous effects of diminished diffusive communication with the overlying ocean. Below 300 mbsf sulfate concentrations increase to about 8 mM. The concentration of calcium shows a minimum in the upper zone (CaCO₃ precipitation), below which a small but gradual increase occurs toward the base of the hole. Magnesium and potassium concentration profiles indicate sinks at depth, and strontium appears to have a deep source to reach concentrations about two times that of seawater. No strontium isotopes were studied in order to determine the possible source of this strontium. Site 297 is characterized by a relatively high heat flow, with temperatures at the base of the hole of 75°-100°C (cf. heat-flow discussion in Site 297 report, Karig et al., 1975). Calculated Na/Cl ratios in this hole are elevated above that of seawater.

Interstitial Water Chemistry of Sites 582 and 583

During Leg 87 two sites were drilled in the Nankai Trough, and in both sites only the rapidly deposited trench fill section of the sediment column was penetrated (Kagami, Karig, et al., 1986).

¹ Hill, I.A., Taira, A., Firth, J.V., et al., 1993. Proc. ODP, Sci. Results, 131: College Station, TX (Ocean Drilling Program).

² Scripps Institution of Oceanography, La Jolla, CA 92093, U.S.A.

³ Ocean Research Institute, University of Tokyo, Japan.



Figure 1. Location map of the Nankai Trough.

Site 582 was located about 2 km seaward from the deformation front. The upper 120 mbsf are characterized by sedimentation rates of ~340 m/Ma, below which the rates increase to ~1000 m/Ma to a depth of 570 mbsf. Below this depth much lower sedimentation rates occur (210-320 m/Ma) and the deepest penetrated sediments (~749 mbsf) were ~1.8 m.y. old. Interstitial water data (Kawahata et al., 1986; Matsuhisa and Matsumoto, 1986) indicate a rapid decrease in dissolved sulfate with depth, reaching a minimum at about 150 mbsf, accompanied by a maximum in alkalinity (Fig. 3). The increase in sulfate toward the bottom of the hole appears remarkably high, especially because the entire sediment column is characterized by high sedimentation rates, which in turn most often leads to the complete removal of sulfate by sulfate-reducing bacteria. Magnesium depletion is pronounced in the upper sediment section, with a minimum at ~20 mbsf. This constituent, however, continues to decrease with depth below ~200 mbsf. The decreases in magnesium can be understood best in terms of uptake of magnesium during clay mineral formation associated with the alteration of volcanic matter.

Site 583 is located at the boundary of the deformation front, with a fault zone intersecting Holes 583B, -C, and -D (seaward side). Holes 583, -F, and -G, on the other hand, are located in the accretionary part. Though the depth distributions of alkalinity, $\delta^{18}O(H_2O)$, calcium, and magnesium (Matsuhisa and Matsumoto, 1986) do indicate some scatter in the data, the concentration depth profiles indicate a much steeper decrease in $\delta^{18}O(H_2O)$ and magnesium in the shallow part of the section in the accretionary prism (Fig. 4). This could possibly be related to a slow upward expulsion of fluids in this upper part of the accretionary prism. Unfortunately, the concentration depth profiles are not detailed enough to allow an estimate of the upward advection rate. Changes in magnesium and $\delta^{18}O(H_2O)$ are well correlated, but the cause of this correlation is undetermined, though alteration of volcanic matter would lead to these changes.

It is apparent from the above data on Sites 297, 582 and 583, that in order to determine the nature of concentration depth profiles in this area, very detailed concentration depth profiles must be obtained, covering as many components as possible. One of the aims of the inorganic geochemistry program of Leg 131 was to obtain such detailed profiles, including major and minor constituents and isotope studies. The former are discussed here, whereas an accompanying overview paper (Kastner et al., this volume) emphasizes the results of the isotopic studies.

OBSERVATIONS ON INTERSTITIAL WATERS AT SITE 808

Site 808 consisted of three holes in which interstitial waters were obtained in great detail. The holes (808A, -B, -C) are located within ~200 m from each other, with Hole 808A and 808B about 150 m distant (Taira et al., 1991). A major thrust fault is observed in Hole 808C from 340 to 390 mbsf, and this fault is located at a somewhat shallower depth in Hole 808B. The lithology of the hole is summarized in Figure 5. The upper 620 m of the sediments accumulated at a very high sedimentation rate (>1000 m/Ma), and they consist of trench fill turbidites. Volcanic contents increase in the section below 410 mbsf, and ash layers become important in the section between 620 and 820 mbsf (Unit IVa), below which the volcanic components decrease drastically. The lower Shikoku Basin deposits are characterized by a zone of décollement between 945 and 964 mbsf. Unit V (1243–1289.9 mbsf) overlies oceanic basement and is characterized by acidic volcaniclastic deposits.



Figure 2. Interstitial water data, Site 297, DSDP Leg 31. Alkalinity: open circles; Ca: open circles; Mg: closed circles.

Silica

Dissolved silica concentrations (all samples obtained during room temperature squeezing) show considerable complexity (Fig. 6). However, because of the strong dependence of dissolved silica on the temperature at which the samples are extracted from the sediments (Manheim and Sayles, 1974) and because temperatures below 1000 m reach to over 100°C, the actual in-situ dissolved silica concentrations may have been considerably higher. Notwithstanding this effect, relative concentration changes can still be considered as a measure of changes in lithology. Peaks and valleys in dissolved silica below 400 mbsf and to a depth of 820 mbsf are probably the result of the presence or absence of volcanic ash in the squeezed samples, the ash layers probably having somewhat higher glass contents and thus higher dissolved silica concentrations.

Especially noteworthy are the elevated concentrations in the overpressurized zone just below the décollement. It appears that this overpressured state has led to increased silica concentrations, there being little difference in the sediment lithology just above and below the décollement.

Constituents Influenced by Organic Carbon Diagenesis

The complete depth distributions of interstitial water constituents, which are primarily affected by the decomposition of organic carbon in the sediment column, are presented in Figure 7.

Dissolved sulfate decreases rapidly in the upper 10 mbsf to reach zero concentrations. The sediments below the sulfate reduction zone are characterized by methane generation. Sulfate remains essentially undetectable (<1 mM) to a depth of ~820 mbsf, below which a gradual increase to about 7 mM is observed. This increase is similar to that observed in Site 297 (Fig. 2). Slightly elevated sulfate concentrations around 400 mbsf are probably the result of a minor seawater contamination, the sediments in this depth range being characterized by low porosities and small interstitial water yields (cf. Taira, Hill, Firth, et al., 1991). Some of the variability in the sulfate data below 820 mbsf is probably also due to minor amounts of surface seawater (drilling fluid) contamination.

Alkalinity increases are large in the first 100 mbsf, i.e., in the zone of rapid deposition of the trench apron and trench wedge sand layers (Units I and IIa). This is also the zone in which dissolved iodide,



Figure 3. Interstitial water data, Site 582, DSDP Leg 87. Alkalinity: open circles.

bromide, and organic carbon (humic substances or yellow substance, YS) production are the largest (You et al., this volume).

Dissolved ammonium reaches a maximum at ~ 150 mbsf and rapidly diminishes toward a depth of ~ 600 mbsf (Unit III). The concentration reversals around the major thrust fault will be discussed below.

Below 820 mbsf alkalinity reaches a second maximum, apparently around the zone of décollement. In this depth range slightly elevated concentrations in iodide and bromide, as well as other constituents, are observed (You et al., this volume).

Chloride and Alkalies

Because of the large number of interstitial water samples it became possible to demonstrate a detailed structure in the concentration depth profile of dissolved chloride (Fig. 8). After an initial rapid increase below the surface, dissolved chloride shows a minimum at ~120 mbsf. This phenomenon may be associated with the decomposition of dispersed gas hydrates, as has been observed previously in Leg 64 (Gieskes et al., 1982), Leg 66 (Gieskes et al., 1985), Legs 67 and 84 (Harrison et al., 1982; Hesse et al., 1985), and Leg 112 (Kastner et al., 1990). The gradual increase with depth in the upper 600 m of the sediment column is followed by a steady decrease to well below seawater concentrations, with an apparent minimum around 1100 mbsf. Below this depth an increase occurs, presumably as a result of hydration reactions in the volcanics of Unit V.

The dissolved sodium concentration pattern follows that of dissolved chloride, though concentration reversals associated with the thrust fault at ~365 mbsf mirror other anomalies associated with this zone (see below). Of interest, however, is that sodium indicates an increase that is relatively larger than the increase of chloride, thus leading to substantially higher Na/Cl ratios (0.92 vs. 0.86) when



Figure 4. Interstitial water data, Site 583, DSDP Leg 87. Closed circles: 583; closed diamonds: 583B; closed squares: 583F; open circles: 583C; open squares: 583D; crosses: 583G.

compared to seawater. Only below ~1150 mbsf does a decrease in Na/Cl reflect a steep increase in calcium (see below), probably again associated with alteration reactions in Unit V, characterized by volcaniclastic deposits.

Dissolved potassium decreases rapidly below an initial shallow maximum, again showing anomalous behavior around the zone of the frontal thrust. Below 600 mbsf, concentrations rapidly diminish to concentrations <1 mM.

Lithium concentration profiles usually indicate a behavior totally different from those of the heavier alkali metals, and Site 808 is no exception. Lithium concentrations in Holes 808A and -B will be discussed presently, but the large increases and the variability in the concentration depth profile below 400 mbsf are evident. The data suggest distinct maxima, particularly around 750 mbsf, but also at 520 mbsf and 1020 mbsf.

Alkaline Earth Elements

The concentration-depth profiles of calcium, magnesium, and strontium indicate considerable structure (Fig. 9). Details of the profiles in the upper 600 mbsf will be discussed in the following sections, especially the variability around the thrust fault between 340 and 390 mbsf. It is evident that below 620 mbsf magnesium disappears as a significant interstitial water component. Whether the minor concentrations of 1-2 mM Mg are real or due to slight seawater contamination is difficult to determine. Below 620 mbsf, on the other hand, dissolved calcium and strontium show increases. The largest increase in calcium occurs below 1150 mbsf toward the volcaniclastic sediments of Unit V. The latter increase is mirrored in an equally steep increase in strontium, but dissolved strontium shows much more detail, with minima at 760 mbsf and at ~1050 mbsf. To some extent these minima are reflected in maxima in dissolved lithium, though generally the complications in the lithium profile do not mirror those of strontium.

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DISCUSSION

In this section we discuss the observations in various depth horizons of the drill site. For this purpose it is convenient to discuss first the upper few hundred meters (Holes 808A and -B); then the observations between 300 and 620 mbsf, with particular reference to the thrust fault zone; and finally the zone below 620 mbsf, with special attention to the evidence for advection of fluids into this section of the site.

Holes 808A and 808B

Though some of the concentration depth profiles in Figure 10 have already been mentioned before, the detail in the profiles of Figure 10 warrants further discussion. The dashed horizontal line in Figure 10 indicates the bottom of the trench-fill sandy turbidites (bottom of Unit IIa).

The rapidly increasing alkalinity profile indicates a small minimum at ~20 mbsf. This minimum is accompanied by a minimum in calcium, as well as in magnesium and strontium. The chloride concentration indicates a maximum at this depth, with an increase of about 4% over that of the overlying ocean waters. Similarly sodium and Na/Cl indicate maxima at ~20 mbsf. On the other hand, lithium shows a very rapid decrease to very low concentrations in the upper sediments. The combination of these observations suggests that not only carbonate precipitation (decrease in Ca), but also alteration of igneous (volcanic?) material is involved in causing the observed concentration changes. This is particularly evident from the low values of $\delta^{180}(H_2O)$ as well as of the 87Sr/86Sr ratio of dissolved strontium in this interval (Kastner et al., this volume). The chloride concentration increases also suggest the formation of hydrated minerals (sink for Mg and Sr, as well as for Li?). The rapid rise in the Na/Cl ratio would then imply the release of sodium during these alteration reactions.

The data for most constituents indicate extremes around 120 mbsf, which also constitutes the transition of Hole 808A to 808B. The relatively long distance between these holes (~150 m) attests to the lateral homogeneity of the interstitial water concentrations in this area. It is tempting to explain the minimum in chloride at about 120 mbsf in terms of decomposition of dispersed hydrates during the core retrieval process. Such chloride decreases have been observed in the sediments of the Mid-American Trench, where chloride decreases were accompanied by increases in δ^{18} O of the interstitial waters (Harrison et al., 1982; Hesse et al., 1985). This, of course, would not necessarily explain the relatively large decreases in calcium and strontium in this zone, unless carbonate precipitation would be the cause. The latter process, however, is not reflected in the alkalinity profile.

The data for dissolved silica (Fig. 10) indicate a distinct increase in dissolved silica below 180 mbsf. Associated with this is a sharp maximum in lithium, and both dissolved calcium and magnesium indicate potential inputs and removals in the same depth horizon. This is probably related to a diagenetic front in the sediments, in which silica transformations are associated with reactions involving igneous materials (Kastner and Gieskes, 1976).

Thrust Fault between 340 and 390 mbsf

Many of the concentration depth profiles depicted in Figs. 7, 8, and 9 indicate concentration reversals in the depth range of 340–390 mbsf, e.g., NH4, I, Br (Fig. 7), Na, K, Li (Fig. 8), and Ca and Mg (Fig. 9). This phenomenon is demonstrated for Ca, Mg, and Li in Figure 11. At a depth of 350 mbsf concentrations of the various constituents are equal to those at about 440 mbsf, suggesting a vertical displacement of about 90 m associated with the frontal thrust in Hole 808C. The concentration depth profiles show strong symmetries, which suggest that in-situ reactions have only a small effect on the profiles. The concentration reversals are the result not only of the emplacement of

Epoc

Pleistocene

Pliocene

Miocene



Figure 5. Structure and lithology, Site 808.

deeper sediments above ~365 mbsf, but also of the associated folding processes (Taira, Hill, Firth, et al., 1991). Emplacement of the deeper sediments above the sediments at ~350 mbsf has been recent enough not to allow diffusive exchange to eradicate the concentration anomalies (with a diffusion coefficient of $5.10-6 \text{ cm}^2$ /s and a time of folding of 50,000 yr, the diffusive pathlength (2Dt)^{1/2} is about 40 m, i.e., the thickness of the thrust zone). In addition, porosity depth changes between 300 and 500 mbsf are minimal (Taira, Hill, Firth, et al., 1991; Bruckmann et al., this volume), so that there is no large-scale expulsion of fluids associated with the thrusting process at this location. The absence of any anomaly in dissolved chloride in this zone also suggests that no contribution of fluid flow from deeper in the sediment section is detectable.

Shikoku Basin Sediments

The most important observation below ~600 mbsf is the distinct decrease in chloride concentrations (Fig. 8), indicating a broad minimum of ~450 mM at about 1100 mbsf. In part, this minimum may be induced by reactions associated with the underlying volcaniclastics, whose hydration appears to lead to the increase in dissolved chloride below 1100 mbsf. The cause of the chloride depletion has been

discussed for other accretionary prisms (Gieskes et al., 1989; Vrolijk et al., 1990, 1991; Kastner et al., 1991), and generally it is agreed that clay mineral dehydration is a viable explanation for this phenomenon (Burst, 1969; Perry and Hower, 1970; Yeh and Savin, 1977). Certainly the temperatures prevailing below 600 mbsf ($T > 60^{\circ}C$ to 120 °C at the bottom of the hole) are sufficiently high to allow this process to occur in situ. However, there is only limited evidence for a conversion of smectite to illite (Taira, Hill, Firth, et al., 1991; Underwood et al., this volume), and typically for a sediment with >50% smectite and a porosity of 30%, a recrystallization of more than 50% of the smectite is necessary to lower the chloride concentration to 450 mM from the seawater value of ~550 mM (Vrolijk et al., 1991). Thus an advective input of low chloride fluids from deeper into the accretionary prism or from the subducting sediments appears to be required.

Sodium concentrations decrease with those in chloride below 600 mbsf, but unlike the increase in chloride below 1100 mbsf, no increase in sodium is observed in this depth range. However, a decrease in Na/Cl mirrors the sharp increases in calcium and strontium (Fig. 9) below 1100 mbsf. Of importance is the observation that Na/Cl remains essentially constant to a depth of 1100 mbsf. Any fluid emplaced advectively below the décollement, therefore, must be characterized



Figure 6. Dissolved silica, Site 808. Closed symbols: Holes 808A and 808B; open circles: Hole 808C; dotted line: boundary between trench fill deposits and Shikoku Basin sediments; dashed line: transition to lower Shikoku Basin sediments; broadly dashed lines: zone of décollement, 945–964 mbsf.

by Na/Cl ratios similar to those prevailing in the entire hole. It is of interest to note that calculated Na/Cl ratios in Site 297 are also elevated above seawater values.

Below 820 mbsf an increase in dissolved sulfate is apparent all the way to the bottom of the hole. Again, if the low chloride fluids have been emplaced by horizontal advective flow from further into the accretionary complex, then this fluid must have been characterized by somewhat elevated sulfate concentrations. In Site 297 the deeper sediments are also characterized by elevated sulfate concentrations, suggesting that the source of the low chloride fluid must be located in the deeper part of the accretionary complex, or, more likely, in the sediments below the décollement.

The structure in the concentration depth profiles of calcium, strontium, and lithium is complex in the Shikoku Basin sediment section (Fig. 12). Whereas the most striking feature in the calcium profile is the large concentration increase below 1150 mbsf, the profiles in strontium and lithium indicate pronounced minima and maxima that appear unrelated to each other or to the calcium profile. In the lower part of the volcanic-rich zone between 620 and 820 mbsf, a small maximum in calcium is accompanied by a minimum in strontium and a pronounced maximum in lithium. This could be explained in terms of the alteration of volcanic ash, but this needs corroboration from $\delta^{18}O(H_2O)$ and ${}^{87}Sr/{}^{86}Sr$ data. Between 820 mbsf and about 1150 mbsf, sharp increases in both calcium and strontium are observed, but without significant correlation to each other. Neither the calcium nor the strontium profiles appear to be the result of simple diffusive communication from greater depths and thus the profiles appear to be affected by reactive and/or advective processes, with strontium indicating a broad maximum centering along the décollement. Only below ~1150 mbsf is the correlation between calcium and strontium linear with a slope of $\delta Sr/\delta Ca = 5.3 \times 10^{-3}$.

Isotope information on ⁸⁷Sr/⁸⁶Sr of dissolved strontium as well as on $\delta^{18}O(H_2O)$ and $\delta D(H_2O)$ suggests that a major input of low-chloride fluids below the zone of décollement is due to advection of such fluids and that the chemical signals can best be understood in terms of clay mineral dehydration (Kastner et al., this volume). We submit that the principal input occurred in the 1100 mbsf horizon and that in addition to lateral fluid advection, vertical movement of fluids, with associated mixing, occurred to at least the 850 mbsf level. Typically a minimum in chloride occurs at ~1100 mbsf, and above ~850 mbsf the Cl-profile is essentially diffusive in character. At the same time,



Figure 7. Distribution of biogenically derived constituents, Site 808. Closed circles in alkalinity, sulfate, and ammonia: 808A and -B; horizontal lines as in Figure 6.

however, extremes in the concentration-depth profiles of alkalinity, bromide, iodide(?), boron, laser-induced fluorescence of organic carbon, and manganese (You et al., this volume) occur in the zone of décollement (Figs. 7 and 13). These maxima are not strongly mirrored in chloride, and, therefore, if fluid advection were to be responsible for these maxima as suggested by You et al. (this volume), then the origin of these fluids should be quite different from those below the décollement, which are not associated with similar extremes. The signal in the zone of décollement appears to have a much stronger imprint of reactions involving organic matter. The latter observation suggests a potential origin from within the accretionary wedge rather than from the deeper Shikoku Basin sediments. Within the complexity of fluid expulsions associated with the subduction and accretionary processes it should not be surprising to observe fluids of different origin and nature. Similar conclusions were reached for the advected fluids in the Barbados Accretionary Transect of Leg 110 (Vrolijk et al., 1991).

CONCLUSIONS

Distributions of major and minor constituents of the interstitial waters in Site 808 on the accretionary wedge of the Nankai Trough have revealed a large degree of complexity, but several processes that affect these distributions have been identified:

1. In the upper part of the sediment column the alteration of igneous material explains the increase in dissolved chloride and the simultaneous increase in the Na/Cl ratio—this process is also inferred from the uptake of magnesium and the lowered values of $\delta^{18}O(H_2O)$ and the lower than contemporaneous $^{87}Sr/^{86}Sr$ ratio of dissolved strontium.

2. At a depth of ~190 mbsf subtle changes in calcium, magnesium, lithium, and dissolved silica gradients indicate the presence of a diagenetic front, which may be associated with silica diagenesis and the alteration of volcanic material.

3. Concentration reversals in many of the dissolved constituents occur between 340 and 390 mbsf and are associated with the major thrust fault that occurs in Hole 808C centered at ~365 mbsf. The data suggest that no fluid flow is associated with this fault, at least not in the sections sampled in Holes 808B and 808C.



Figure 8. Chloride and alkali metals in interstitial water, Site 808. Closed circles: 808A and -B; open circles: 808C; horizontal lines as in Figure 6.

4. Lowered chloride concentrations below 620 mbsf, in the Shikoku Basin hemipelagic deposits, are, in part, due to in-situ dehydration of clay minerals, but more importantly to advection of fluids from further beneath the accretionary complex or from the sediments below the décollement. Fluids with similar low-chloride concentrations are also associated with zones of fluid expulsion in other accretionary prisms, such as the northern Barbados accretionary transect and the sediments in the active margin off Peru.

5. Though perhaps the major input of fluids stem from the deeper sediment sections, there is evidence for some fluid input along the zone of décollement, with origins from within the accreted sediment sections.

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Figure 9. Alkaline earths in interstitial waters, Site 808. Closed circles: 808A and -B; open circles: 808C; horizontal lines as in Figure 6.





Figure 10. Interstitial water data, Holes 808A and 808B. Dotted line separates 808A and -B.



Figure 11. Distribution of pore water constituents calcium, magnesium, and lithium in zone of recent thrust fault Hole 808C. Dashed lines represent boundaries to thrust fault zone.



Figure 12. Distribution of calcium, strontium, and lithium in Shikoku Basin sediments. Upper dashed line: transition to lower Shikoku Basin sediments; lower two dashed lines delineate boundaries of décollement zone.



Figure 13. Distribution of alkalinity, boron, and laser-induced fluorescence of organic matter (LIF), Site 808. Note maxima around the zone of décollement. Horizontal lines as in Figure 6.