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PROJECT TITLE: BEHAVIOR OF RARE EARTH ELEMENTS IN GEOTHERMAL SYSTEMS: A NEW EXPLORATION/EXPLOITATION TOOL?

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EXECUTIVE SUMMARY

The goal of this four-year project was to provide a database by which to judge the utility of the rare earth elements (REE) in the exploration for and exploitation of geothermal fields in the United States. Geothermal fluids from hot springs and wells have been sampled from a number of locations, including: 1) the North Island of New Zealand (three sets of samples from three different years) and the South Island of New Zealand (1 set of samples); 2) the Cascades of Oregon; 3) the Harney, Alvord Desert and Owyhee geothermal areas of Oregon; 4) the Dixie Valley and Beowawe fields in Nevada; 5) Palinpiñon, the Philippines; 6) the Salton Sea and Heber geothermal fields of southern California; and 7) the Dieng field in Central Java, Indonesia. We have analyzed the samples from all fields for REE except the last two.

Our results thus far indicate the following: 1) REE contents in geothermal fluids can range over many orders of magnitude, from below detection (10^{-7}-10^{-6} times chondrite) up to almost 10^{0} times chondrite (e.g., Mt. Ruapehu); 2) As previously noted in the literature, pH appears to exert a dominant, first-order control on REE contents, with low-pH, acid-sulfate waters having the highest measured REE concentrations and near-neutral to alkaline chloride-bicarbonate waters having lower REE. However, within the latter category, the pH dependence is not clear, and other factors in addition to pH may play important roles in determining REE content; 3) In acidic thermal waters, the concentrations of REE in filtered and unfiltered aliquots are approximately equal, suggesting that most of the REE are present in solution as dissolved species; 4) Acid-sulfate waters also have a distinctive "gull's wing" chondrite-normalized REE pattern that is not seen in near-neutral or alkaline waters; 5) In many near-neutral to alkaline thermal waters, the REE contents in the unfiltered aliquots can be considerably higher than those in the filtered aliquots, suggesting that the bulk of the REE are present in particulate form; 6) Most near-neutral to alkaline chloride-bicarbonate waters have chondrite-normalized patterns which are generally LREE-enriched (i.e., negatively sloped), the exceptions being fluids from Taupo-Tauhara and Kamo warm springs, both in New Zealand, which have HREE-enriched patterns; 7) Among near-neutral to alkaline waters, some of the ones with higher inferred temperatures at depth have positive Eu anomalies. This feature is seen, e.g., in fluids from the Champagne Pool, Ngawha, and Morere in New Zealand, from one well at Dixie Valley, Nevada, and from Heber, California. Because a positive Eu anomaly in hydrothermal fluids may reflect maintenance of a high temperature during flow to the surface, positive Eu anomalies may reflect a favorable feature of geothermal fluids that may be useful in exploration; 8) In the case of both acid-sulfate and near-neutral to alkaline chloride-bicarbonate waters, the chondrite-normalized REE patterns of the waters often parallel the chondrite-normalized patterns of inferred reservoir rocks. This implies that, in many cases, REE are brought into solution in the same proportion as they existed in the reservoir rock, i.e., without significant fractionation. However, in acid-sulfate fluids, the REE from La to Pr do appear to preferentially remain behind, and Eu does commonly become fractionated during water-rock interaction. Also, there are exceptions to the general rule, notably the fluids that show HREE-enriched patterns; 9) Somewhat surprisingly, even fluids with extremely high concentrations of carbonate (e.g., those at Te Aroha) do not seem to induce notable fractionation between

fluid and reservoir rock, even though carbonate preferentially forms stronger complexes in solution with the HREE than with the LREE; 10) We did not see obvious differences in REE concentrations between geothermal fluids heated by shallow magmatic activity (e.g., those in the Taupo Volcanic Zone of New Zealand) vs. those heated by deep circulation along faults or subduction zones; 11) In many cases there was relatively little variation in REE content over a period of several years (e.g., fluids from the Champagne Pool were nearly identical over three years of sampling). On the other hand, based on samples from the sample library of the Institute for Geological and Nuclear Science at Wairakei, New Zealand, the REE content of some other geothermal fluids can be highly variable (e.g., fluids from Mt. Ruapehu and White Island appear to have changed drastically in both absolute REE content and chondrite-normalized pattern over several years); and 12) There is some evidence that liquid-vapor phase separation (or boiling) may cause the loss of REE from solution, and this may explain the very low REE contents measured in some thermal fluids from producing wells where phase separation has occurred.

Our results indicate that measurement of the REE content of geothermal fluids can result in a wealth of information about water-rock interactions in geothermal systems that we have only just begun to explore. The results also continue to hold promise that such measurements may one day be a useful, routine tool for exploration for geothermal systems. However, additional developmental work will be necessary to realize the full power of the technique.

RELEVANCE OF PROJECT

Geothermal energy development in the U.S. has been hindered by a lack of reliable techniques for exploration for and evaluation of new resources, and for reservoir monitoring. The premise of the project described in this report was that the behavior of the rare earth elements (REE) in geothermal fluids may yield useful information on the state of the geothermal reservoir. Therefore, a better understanding of the behavior of the REE in geothermal systems may result in the development of additional tools for the exploration for and exploitation of geothermal resources.

Until recently, relatively few studies had been conducted on the behavior of the REE in geothermal fluids. The REE concentrations in these fluids are comparatively low, and techniques for their analytical determination were either unavailable, or prohibitively expensive and difficult to carry out. However, with continued improvements in analytical techniques, the number of studies reporting REE concentrations in both continental and seafloor geothermal fluids has increased slowly but steadily (cf. Michard et al., 1983; Piepgras & Wasserburg, 1985; Michard & Albarède, 1986; Michard et al., 1987; Campbell et al., 1988; Sanjuan et al., 1988; Honda et al., 1989a,b; Lepel et al., 1989; Michard, 1989; Oi et al., 1990; Klinkhammer et al., 1994; Lewis et al., 1994; James et al., 1995; Aggarwal et al., 1996; van Middlesworth & Wood, 1997). Data on the REE in continental geothermal fluids from the Salton Sea geothermal system, California (Lepel et al., 1989; Michard, 1989), the Valles Caldera, New Mexico (Michard, 1989), Yellowstone National Park (Lewis et al., 1994), Larderello, Italy (Michard, 1989), Japan (Honda et al., 1989a,b; Oi et al., 1990), France (Michard et al., 1987; Sanjuan et al., 1988), Bulgaria (Michard & Albarède, 1986), Tibet (Michard & Albarède, 1986), Dominica (Michard, 1989), Iceland (Aggarwal et al., 1996) and Idaho (van Middlesworth and Wood, 1997) have been published. However, prior to this project, the number of studies of REE contents in geothermal fluids remained too small to fully assess the potential of using REE contents in geothermal fluids as a potential exploration tool. Moreover, up until the study reported here, data on REE in geothermal fluids from important geothermal areas in New Zealand, the Philippines, and the U.S. were unavailable.

OBJECTIVES OF PROJECT

The objectives of the project were the following: 1) establish baseline information on REE contents in geothermal fluids from around the world to supplement the meager information that previously existed; 2) determine whether there are any distinctions in REE contents of fluids from producing or potentially producing geothermal fields on the one hand, and geothermal fields which are not economically viable on the other; 3) establish any relationships between REE contents and fluid chemistry and temperature which may exist; 4) establish relationships between REE contents and host (aquifer) rocks; 5) determine whether there are temporal changes in REE geochemistry of geothermal fluids; 6) ascertain whether REE geochemistry changes systematically over the production history of a producing geothermal field; and 7) assess the utility of aqueous REE geochemistry as an exploration tool. After almost four years of DOE funding, each of these objectives has been met to some extent. We have amassed a large database of REE contents in geothermal fluids from a variety of geologic settings (Objective 1). In several cases, particularly geothermal systems in New Zealand, we have obtained samples during more than one sampling campaign, which permit some assessment of temporal variations (Objective 5). From this database, we have been able to make a number of observations regarding the relationship of REE contents between fluid chemistry and temperature (Objective 3) and host rocks (Objective 4). Finally, we have made some progress towards Objectives 2, 6 and 7. In brief, the results of our study do suggest that the measurement of REE concentrations in geothermal fluids has considerable potential as a geothermal exploration and exploitation tool, and these results provide a strong basis for further development of this tool. However, as always in such research projects, a number of questions arose during this study that will require additional investigation in the future. In the following, we detail the methods used, results obtained and conclusions derived in our study.

METHODS

Sampling Methods

Before leaving for the field, all bottles that were to be used for containing acidified metal samples were cleaned by soaking overnight in 10% nitric acid. Those bottles that were to receive the unacidified samples for anion and silica analyses were soaked in deionized water (DIW) overnight. All bottles were then rinsed at least three times with DIW. The bottles for anion samples were filled with DIW and transported full until emptied in the field and filled with sample. Many of the hot spring samples from New Zealand had very high concentrations of suspended solids. It was decided that sediments and suspended solids should be excluded from all the cation, anion, and silica samples. For the New Zealand samples taken in 1993, this was accomplished by decanting an aliquot for analysis after allowing the well-mixed sample to settle for a few days. All subsequent samples were filtered in the field directly from a designated sampling bottle into the appropriate sample containers. At each site the following fluid samples were taken:

1) a 1-liter, unfiltered sample, preserved with 2% Seastar Baseline HNO_3 for REE analysis
2) a 1-liter, filtered sample (filtered using a 0.45-µm membrane), preserved with 2% Seastar Baseline HNO_3 for REE analysis
3) a 250-mL filtered sample (filtered using a 0.45-µm membrane), preserved with 1% Fisher trace metal grade HNO_3 for alkali, alkaline earth and transition metal analyses
4) a 250-mL filtered sample (filtered using a 0.45-µm membrane), for anion analysis and alkalinity determinations
5) a 5-mL filtered sample (filtered using a 0.45-µm membrane), diluted with 50 mL of DIW for silica analysis

In all cases, the bottle caps were screwed tightly shut and further sealed with parafilm for transport back to the laboratory.

The following measurements were made in the field at each site: temperature, conductivity, and pH. Determinations of pH and conductivity were made at, or as close to as possible to, the emergence temperature of the fluid. The pH buffers used to calibrate the electrode were also maintained at as close to the emergence temperature of the fluids as possible. Alkalinity measurements were made by titration as soon as possible after collection, although in some cases several days elapsed between sample collection and alkalinity determination. As alkalinity of samples can change on storage, the delay between sampling and alkalinity determination is likely the main reason for any significant charge-balance errors in the analytical data. Emergence temperature, pH, conductivity, and carbonate and bicarbonate alkalinity (in ppm), silica, and cation concentrations are given for each of the samples in the appendix.

Analytical Methods

Sample Preparation

REE Preconcentration Method. The REE concentrations in many geothermal fluid samples were sufficiently low that preconcentration and separation from the matrix was required prior to analysis by ICP-MS. We selected ferric hydroxide co-precipitation as the main preconcentration technique in this study. However, development of the analytical protocol for the REE was complicated by the difficulty of finding a filter medium that had a low blank value and was also capable of collecting ferric hydroxide precipitate without immediately clogging. Previously employed membrane filters were found to be unsuitable for the large number of samples to be processed in this study because they clogged too quickly. The extraction of samples from high-temperature sources resulted in precipitation of abundant silica, which reduced the rate of filtration and caused a serious bottleneck in sample processing. Borosilicate glass-fiber filters have a very high blank for Sc, Y, Zr, REE, Th, and U, and in addition essentially cannot be cleaned. Quartz-fiber filters were procured that have adequate blank values after cleaning, combined with minimization of temperature and exposure time of the sample to the filter media. Two procedural variations and two filter sizes were tried. Method detection limits were established for each variation. The best method is described below.

The procedure below does not involve drying the precipitate nor exposing the filter medium to heat or hot acid. The first samples processed were from New Zealand and they had high dissolved silica contents. These have a larger volume of precipitate upon ferric hydroxide co-precipitation than anticipated, probably due to the formation of silica gel which hardens to translucent silica on drying. When the procedure was first developed, for low dissolved silica waters, these precipitates were dried after filtration to eliminate dilution errors from moisture in the precipitate. The hardened silica gel from high-dissolved silica samples remained insoluble when the attempt was made to redissolve the precipitate. It was necessary to warm the precipitate in the acid solution (see below) to get the iron hydroxides and REE to dissolve or leach out from the insoluble silica. This raised the REE method blank and method detection limits owing to leaching of REE from the filters. Although the detection limit was adequate for those samples, a comparison between the REE contents of the concentrated extracts and the undiluted samples run at a 1X dilution directly by ICP-MS showed that recovery was more variable than it should have been at 17 times the method detection limit. We modified the procedure to eliminate drying the precipitate. This also eliminated the need to heat the samples after the acid solution had been reintroduced to encourage the ferric hydroxides to redissolve. This resulted in lower method blanks and method detection limits.

Quartz-fiber filters were prewashed by assembling the filtration apparatus and aspirating two or more successive aliquots of hot 50% aqua regia through a stack of several filters. The filters were then rinsed with deionized water. The cleaned filters were allowed to dry in a clean, enclosed container for later use.

The REE were concentrated for analysis by addition of ferric iron to the sample container such that the final concentration of ferric iron in the sample was about 60 mg/L (ppm). A 50-mL aliquot of each REE sample was saved for direct analysis in case a more sensitive ICP-MS (which would obviate the need for sample preconcentration) became available in the future (in fact, as discussed below, a more sensitive instrument did become available). The remaining sample was weighed to determine the concentration factor and 50 mL of 22% trace-metal-grade ammonia were added to neutralize the 2% acid and raise the pH to between 8 and 9. The sample was mixed and a pronounced color change was observed as the iron precipitated as a gelatinous flocculate. The sample was allowed to stand for at least an hour and the reddish ferric hydroxide precipitate settled to the bottom of the sample bottle.

The next step was vacuum-filtration of the sample through a 55- to 90-mm quartz-fiber filter. The filter assembly was prewashed and soaked in an acid bath, then rinsed with >17.6-MegOhm-cm deionized water (DIW) immediately prior to filtration. The apparatus was assembled and rinsed successively with 10% (v/v) trace-metal-grade hydrochloric acid solution, which is particularly good for redissolving trace amounts of iron hydroxides. This was immediately followed by rising with DIW, and finally a rinse with a 2% solution of trace-metal-grade ammonia to remove all traces of acid and bring the pH into the same range as the sample about to be filtered. The filtrate was discarded and the sample filtration proceeded. The sample was poured through the filter being careful to decant as much as possible of the clear supernatant, so as to speed up the filtering process before the settled precipitate clogged the filter. The final portion with most of the suspended precipitate was then placed on the filter and allowed to filter to near dryness. The sample container was then rinsed with the 2% trace-metal-grade ammonia solution and this was added onto the filter. The 2% trace-metal-grade ammonia solution was then used to rinse down the sides of the filter holder and the filter surface. The vacuum filtration was allowed to proceed to near dryness. The filter was extracted with the assistance of tweezers but primarily manipulated directly with acid-cleaned latex gloves. The folded filter was used to wipe any precipitate clinging to the support surface of the filtration assembly.

The filter and moist precipitate were placed into a 50-mL pre-labeled polypropylene centrifuge tube and set aside for no more than two hours prior to the next step. When a batch of 4 to 6 processed samples had accumulated, then a calibrated repippetor was used to add 40 mL of Seastar Baseline 4% nitric-1% hydrochloric acid solution. The centrifuge tubes were tightly capped, and rocked gently to disaggregate the precipitate into the solution without doing the same to the glass-fiber filter. The batch was allowed to stand with periodic agitation for one to two hours so that the ferric hydroxide and co-precipitated REE redissolved. Low temperature and minimization of exposure time were critical to keeping the REE blanks to acceptable values. The samples were then centrifuged for one hour to separate the liquid from the quartz fibers. The liquid was decanted into a clean polypropylene centrifuge tube and capped until analysis.

Previously, van Middlesworth and Wood (1998) showed that, when pH was adjusted to between 8 and 9 in the co-precipitation step, recovery of the REE was better than 90%. We have made further improvements to their method over time. Method detection limits and spike recoveries were demonstrated with 300 mg of added Si to simulate the natural samples, and similar recoveries were obtained.

Alternate REE Preconcentration Method. Although the iron hydroxide co-precipitation method is relatively straightforward and was effective in the majority of cases, it was not successful in eliminating isobaric interference from Ba in those samples containing relatively high concentrations of this element. Moreover, as noted above, precipitation of large amounts of silica from higher-temperature geothermal waters is also a problem. Finally, samples containing very high concentrations of total dissolved solids, such as those from the Salton Sea geothermal area, were not amenable to the ferric hydroxide co-precipitation method. This is because addition of ammonium hydroxide caused the precipitation of large quantities of solids containing Fe, Al, Pb, Zn, etc., and so the REE could not be separated effectively from the sample matrix. To reduce interference by silica and barium, and to find a method suitable for analysis of the Salton Sea samples, we tested an extraction method based on the partitioning of the REE between the acidified aqueous solution and a mixture of mono- and bis-2-ethylhexyl phosphate esters (Aggarwal et al, 1996; Shabani et al, 1990, Minczewski et al, 1982). These have the form of $(RO)_n$-PO-$(OH)_{(3-n)}$ where n equals 1 or 2, corresponding to the mono- or bis-2-ethylhexyl phosphate (MEHP and DEHP). The mixed esters are not available in the USA. However, we were able to obtain a supply of mixed ethylhexyl phosphate esters by directly ordering from Merck in Germany. The Merck material is a mixture comprising 45% mono- and 55% bis-ethylhexyl phosphate esters. The ester mixture was dissolved in heptane and shaken with the pH-adjusted (2% nitric acid; $pH \leq 1$) aqueous sample in a separatory funnel. The REE were extracted into the organic phase. The aqueous phase was discarded and the organic phase was transferred into a smaller separatory funnel. The REE were back-extracted into the aqueous phase by addition of n-octanol and 6N hydrochloric acid. A rhodium spike was added to this extract for calculation of the dilution factor upon analysis. The dissolved n-octanol in the extract was removed by shaking with three aliquots of n-heptane. The final cleaned-up volume was approximately 15 mL. An additional evaporation step to eliminate the acid was not deemed necessary. The extract was transferred to a centrifuge tube for storage until analysis.

Using the method outlined above, we encountered difficulties in obtaining a method blank less than 10^{-6} times chondrite. The mixed esters we obtained from two different manufacturers were both contaminated with HREE (Er, Tm, Yb, Lu) as well as Y and U. Cleaning the reagents was difficult and resulted in detection limits no better than the iron hydroxide coprecipitation. Finally, we found the method unsatisfactory for continental chloride brines due to high (1000's mg/kg) concentrations of transition metal cations such as Fe. These saturate the exchange capacity of the phosphate esters and prevent or greatly reduce the recovery of the LREE and MREE (La through Ho). A method where the DEHP esters are added onto a C18 filter disk has potential for lower contamination because it allows the disk and DEHP esters to be acid cleaned prior to extraction (Shabani et al, 1992). However, the saturation of exchange capacity by loading of transition metals remains a problem.

Although the solvent extraction method did not offer a significant improvement over the ferric hydroxide co-precipitation method, a comparison of the two methods was informative. As will be discussed below in the section describing results from geothermal areas of southeast Oregon, results obtained using the two preconcentration methods on the same samples were very similar. This finding lends confidence that the results obtained using the ferric hydroxide co-precipitation method are accurate.

Instrumental Methods

REE: For the first two years of this project, the REE, Y, Th, and U were determined at the Washington State University Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS) laboratory using a Perkin Elmer ICP-MS model Elan 250 which had been retrofitted with an EPT multiplier detector, argon mass-flow controllers for coolant, auxiliary, and nebulizer flows, a water-cooled spray chamber to reduce oxide formation, and a high solids Meinhard-style nebulizer. The autosampler and data acquisition from the detector were under computer control. Five concentration levels and an acid blank were read for initial calibration. Yttrium, Sc, Zr, and the 14 REE were calibrated using 200, 40, 8, 2, and 0.4 µg/L solutions. Thorium and U were calibrated from the same solutions at 100, 20, 4, 1, and 0.2 µg/L. A calibration curve was obtained by linear regression dropping the highest two standards as necessary to improve the fit and zero intercept for lower sample values. Transport, ionization, and space-charge interferences were corrected by use of Co, In, and Bi as internal standards. Typically oxide formation was near or below 10% as measured from $[ThO]^{248}/Th^{232}$ ratios. Correction for isobaric oxide interferences were made for BaO on Eu^{151} and Sm^{152}, PrO on Gd^{157}, and NdO on Tb^{159}. Correction was made by periodically running both a 10 mg/L Ba standard and a standard containing 200 µg/L each of Nd and Pr. Although Nd^{144} and Gd^{157} were monitored, Nd^{146} and Gd^{160} were used exclusively for reporting. Quality control was maintained by periodic analysis of a mid-level calibration standard and blank and by monitoring the internal standard intensities. All data reduction was accomplished off-line using a standardized computer spreadsheet.

Instrument and method detection limits for the REE Y, Th and U were calculated following the procedure recommended in the Federal Register (40 CFR section 136) and numerous other sources. Prepare six to ten spiked samples for analysis following all method procedures for each sample. The Student's t for seven samples (6 degrees of freedom) at 99% confidence (3.143) is multiplied by the standard deviation of the individual determinations and the result is the method detection limit (MDL). The optimal spike amount should result in a concentration of 3 to 5 and no more than 10 times the MDL. This method in 40 CFR section 136 was used to determine estimated instrument detection limits by analyzing multiple blank replicates followed by determination of the true instrument detection limit (IDL) by analyzing multiple replicates of a standard solution of appropriate composition.

The method detection limits for the REE, Sc, Y, Zr, Th, and U were determined by addition of 20 mL Seastar Baseline HNO_3 to one liter of DIW in an HDPE bottle. To this were added 1 mL of a spiking solution containing Sc, Y, Zr, and REE at 4 μg/L and Th and U at 2 μg/L. The final concentrations in the sample were therefore 4 ng/L and 2 ng/L (ppt), respectively. The spiked samples were set aside for at least one week. The iron spike was then added and the precipitation procedure was carried out on each replicate. This made the final concentration to be read at the instrument 100 ng/L and 50 ng/L (ppt), respectively. Seven replicates were spiked and prepared as well as six blanks. The blank sample bottles were carried into the field after addition of the baseline nitric acid and subsequently had deionized water added in the lab and were allowed to age for at least a week before extraction. The extracts were analyzed at the Washington State University ICP-MS lab. The MDL's are summarized in Figure 1.

Samples from higher temperature geothermal source waters had very high dissolved silica contents which made sample extraction slow and complex. We were concerned that silica precipitated during the iron hydroxide precipitation would interfere with recovery of the REE. We decided to re-check the MDL's in December of 1998, by adding 300 mg Si (equivalent to 600 mg/L silica) to the MDL samples along with each spike. The addition of silicon to the MDL samples made several things clear. Silica co-precipitates with the iron and REE hydroxides. Silica produces a severe isobaric interference on Sc determination by ICP-MS and therefore Sc results are not reported. Zirconium is not recovered at low concentrations and probably forms an insoluble oxide on addition of ammonia to raise the pH. The blank levels for Y, La, Ce, U, and Th are detectable but acceptably low. It is clear that contamination is present as minor amounts of Y, La, Ce, and perhaps U. The resulting MDL's, recalculated to original sample concentrations, range from about 8 ng/L for La and 3 ng/L for Ce to less than 2 ng/L for Pr through Lu, and Th and U. Initially, these REE MDL's were considered adequate for this project, based on our prior experience with REE in geothermal fluids from around the Idaho batholith. However, as described below, filtered geothermal fluids from many other areas contain REE at concentrations less than these MDL's.

Fortunately, at the start of the second half of this project (January 2000), the Washington State University Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS) laboratory installed a new, more sensitive ICP-MS, a Hewlett Packard model 4500. Typically, oxide formation as measured by $^{156}[CeO]/^{140}Ce$ was less than 0.5%, equivalent to $^{248}[ThO]/^{232}Th$ of less than 1%. Corrections for isobaric oxide interferences were made for BaO on Eu and Sm, PrO on Gd, and NdO on Tb. Correction was made by periodically running both a 20-mg/L Ba standard and a mixed 200-μg/L Pr-Nd standard. We used Ru, In, and Re as internal standards for the REE and Rh (spiked for a 20-mL volume to equal 50-μg/L) to correct for sample extract volume. Cobalt and Bi were measured as internal standards for Sc, U, and Th. We measured ^{147}Sm (free of $Ba^{16}O$ interference) for comparison with more sensitive ^{152}Sm to evaluate the BaO correction for ^{152}Sm and ^{151}Eu. We corrected ^{160}Gd for ^{160}Dy using ^{163}Dy and measured ^{178}Hf to correct Yb for isobaric ^{174}Hf interference. Calibration verification was monitored by periodic analysis of two or more mid-level calibration standard and the calibration blank. The internal standards were used to compensate for instrument drift. All data reduction was accomplished off-line using a standardized computer spreadsheet. Using this newer instrument, the MDL's were lowered by approximately one order of magnitude (Figure 1). **Thus, a significant effort in the latter half of this project, especially in 2001, was the redetermination of the REE content in many samples collected and analyzed in the first half, and found to be near or below the previous MDL.**

Other cations: The cations Ag, Al, As, B, Ba, Ca, Cd, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Si, Sr, Ti, V, Zn were routinely determined in the sample aliquot reserved for non-REE cations. The cation aliquot analyses represent total dissolved metals as the samples have been filtered through 0.45-µm filters in the field directly into a cleaned, acidified bottle. The analyses were performed on a computer-controlled Perkin Elmer model 3000 XL Inductively Coupled Plasma-Atomic Emission Spectrometer (ICP-AES) which is interfaced to an autosampler. The sample is introduced from the autosampler by a computer-controlled peristaltic pump which incorporates in-line addition of internal standard elements. The instrument has a torch orientation that results in an axial light path from the argon plasma which is dispersed with an Echelle Grating onto a Peltier-effect-cooled charge-coupled device (CCD) detector. The computer interface then records the accumulation of counts from the detector and saves the data.

Calibration of the instrument is performed each time the instrument is run. The calibration standards are analyte mixtures typically comprising four levels of five-fold dilution. Analytes were grouped by typical abundances into three sets: high - 40, 8, 1.6, and 0.32 mg/L; moderate - 4, 0.8, 0.16, and 0.032 mg/L; and silver - 0.4, 0.08, 0.016 and 0.0032 mg/L. The elements Be, Sc, and In were used as internal standards to correct for nebulizer transport interference and instrumental drift. A mid-level standard was run periodically along with the calibration blank for quality assurance. The emission line wavelengths were selected for sensitivity, linearity, and freedom from background interferences and are in common use. Background corrections were made on all line intensities and the spectra were visually inspected during post-analysis reduction of data. This is adequate to correct for Ca and Mg baseline interference. Levels of Al (spectral overlap and baseline), and Fe, Cr, Ni (spectral overlap) are generally low enough in these thermal waters that inter-element interference corrections were not used. Initially, Si was determined on a separate sample aliquot. However, analytical results for the cation aliquot were in agreement so often that we stopped taking a separate sample for silicon to estimate dissolved silica. The objective of determining such a comprehensive cation list was to constrain any variables which might have an effect on the solubility of the REE.

Anions: The anions fluoride, chloride, bromide, nitrate, phosphate, and sulfate were analyzed by a Dionex model AI-450 ion chromatograph equipped with a Dionex 4 x 50 mm AG4A-SC guard column and a 4 x 250 mm AS4A-SC analytical column. An advanced gradient pump (AGP) was used to provide a flow of 2mL/minute using an eluent composition of 1.7 mM $NaH(CO_3)$/1.8 mM $Na_2(CO_3)$ for isocratic elution of the anions. The eluent reservoirs were degassed with helium and the eluent kept under a helium atmosphere during the analytical run. Detection was by suppressed conductivity. A 4-mm ASRS-I (anion self-regenerating suppressor) is used to suppress the baseline conductivity to about 15.2 µS. This combination of apparatus and eluent was optimal for natural samples and is relatively insensitive to contamination of the eluent reservoir by carbonate formed from atmospheric carbon dioxide. Sample introduction is through a nitrogen-switched flow-injection valve body and uses a 50-µL injection loop. In a typical analytical protocol, the target anions elute within 9 minutes from time of injection. The method is programmed to allow eluent to flow through the injection loop in line with the analytical column throughout the duration of the run. Several mL of DI are used to rinse the injection pathway before each new injection.

Fluoride, Cl^-, Br^-, NO_3^-, PO_4^{3-}, and SO_4^{2-} were calibrated using 50, 10, 2, 0.4, and 0.08 mg/L mixed anion solutions, a 100 to 200 ppm chloride-sulfate standard, and a DI water blank. Calibration and instrumental drift were verified by periodic analysis of an appropriate dilution of a certified anion quality control standard mixture (SPEX brand ICMIX2) and a DI water blank. All samples, quality-control standards and blanks were injected using the same syringe which was rinsed with DI water between each use. Typically, analyte carryover was not observed or was not significant.

Alkalinity: Alkalinity was determined by potentiometric titration with a standardized reference acid solution. Gran analysis of the millivolt versus volume data was used to calculate equivalent mg/L of carbonate and bicarbonate.

RESULTS

REE Contents of Geothermal Waters by Study Area

Tables of all the analytical data are given as EXCEL files on the accompanying CD. The REE concentrations obtained are shown in chondrite-normalized form in a series of diagrams in a WORD file on the CD. In general, in the figures, filtered aliquots are denoted by symbols connected by short dotted lines whereas unfiltered aliquots are denoted by symbols connected by solid lines.

New Zealand

Samples were obtained from wells and springs from a wide selection of geothermal areas in the Taupo Volcanic Zone (TVZ), namely Broadlands, Kawerau, Mokai, Mount Ruapehu, Orakei Korako, Rotokawa, Taupo-Tauhara, Te Kopia, Tokaanu, Waikite, Waimangu, Waiotapu, and Wairakei. In addition, samples were taken from seven sites on the North Island outside the TVZ: Ngawha, Tarawera, Puketitiri (Mangatatu), Miranda, Te Aroha, Te Puia and Morere. The sites sampled are located on a map of New Zealand in Figures 2 and 3 (modified after Figures IV, III; Mongillo and Clelland, 1984). Four sites, Tarawera, Puketitiri, Miranda and Te Aroha, were selected because they are thought to result from circulation of fluids along deep regional faults, where heating is predominately derived from the geothermal gradient as opposed to the shallower circulation typical of most of the thermal areas in the Taupo Volcanic Zone, where heating is dominated by subvolcanic magmas (Figure 2). Two other sites, Morere and Te Puia, were sampled because they are associated with dewatering of sediments accompanying the Pacific plate, which is being subducted underneath the Indian plate just off the eastern coast of the North Island of New

Zealand (Figure 2). Waimangu, Wairakei, and Taupo-Tauhara are associated with caldera boundaries (Simmons 1995). We also sampled three geothermal areas from the South Island of New Zealand: Hanmer Springs, Maruia Springs and Lewis River Springs (Figure 29).

North Island, Inside the Taupo Volcanic Zone

The samples from geothermal areas in the Taupo Volcanic Zone, New Zealand, fall into two main groups. Low-pH, acid-sulfate water samples have been found to have elevated REE contents whereas samples having near-neutral pH, represented by neutral-chloride and neutral-bicarbonate waters have much lower REE contents. The details are described below.

Rotokawa: Lake Rotokawa is an acidic lake fed by numerous springs. We were able to sample two surface springs (in both 1998 and 2000) and a number of wells (in 2000). The acid spring waters made access dangerous because of dissolution and undermining near the springs and in the general area. We observed several boiling mud pots which were inaccessible, but we were able to sample Parariki spring. We took a second sample closer to the margin of Lake Rotokawa. The vent was an upwelling eroded into the margin of a larger pool on the lake margin. The waters from these two springs are low-pH (1.51, 2.79) and have high-conductivity due to mixing between chloride (341, 1084 ppm) and sulfate (895, 455 ppm) source waters. The fluids from two of the wells sampled (Rotokawa #4, Western) were also acidic (~2-2.5), whereas those from wells RK-5 and RK-9 had pH values of ~ 6.5. Moreover, the fluids from RK-5 and RK-9 had somewhat higher chloride and much less sulfate than the other well fluids. Deep temperatures and stored heat have been estimated at 335°C and 4500 PJ, respectively, at Rotokawa (Mongillo and Clelland, 1984).

The REE results for Rotokawa are depicted in Figures 4 and 5. The low-pH geothermal fluids from Rotokawa are distinguished by relatively high REE contents (mostly 10^{-3}-10^{-1} times chondrite) and the filtered aliquots of the various samples have nearly identical concentrations to the unfiltered aliquots, suggesting that the REE are probably in true solution (although a colloidal fraction cannot be excluded). However, the near-neutral fluid from RK-9 has REE concentrations near the detection limit (10^{-6} times chondrite) and shows a measurable difference between filtered and unfiltered aliquots. The unfiltered sample of the neutral-chloride fluid from RK-5 also has low REE contents. Also plotted in Figures 4 and 5 are the chondrite-normalized REE patterns for two potential aquifer rocks in the area, the Rotokawa Basalt and the Orakeikorako Basalt (these have been scaled by arbitrary factors so that they plot on the same scale as the waters). Although there are some differences in detail, the general slopes of the REE patterns for the waters parallel those of possible aquifer rocks, suggesting that there is no major fractionation as REE are leached from the aquifer rocks. However, the low-pH fluids have a very distinctive "gull-wing" pattern in which there is a small but noticeable Eu anomaly and a significant depletion of the lightest REE, i.e., La to Pr. The patterns exhibit maxima at Nd and Gd. The left "wing" (LREE) shows significant concavity downward whereas the right "wing" (HREE) is flatter. Finally, there generally is a gentle overall negative slope to the pattern. As will be pointed out below, this "gull-wing" pattern is characteristic of nearly all the low-pH geothermal fluids sampled in New Zealand. Finally, comparison of the pattern for Parariki Spring from

1998 with that from 2000 shows that there was negligible temporal variation for this spring over a period of two years.

Waiotapu Thermal Reserve: The Waiotapu Reserve contains the largest neutral-chloride spring in the region (the Champagne Pool) and a number of acid-sulfate springs. We sampled the acidic (pH = 2-2.5) Oyster pool in both 1998 and 2000, and Frying Pan Flat (pH = 2.5-3.5) in 2000. The Champagne Pool (T = 74.7°C; pH of 5.28) was sampled in 1998, 2000 and 2001. This area has a high maximum deep temperature of 295°C, a high heat flow of 600 MW with an estimated thermal reserve of 6100 PJ, and a surface water flow greater than 250 L/s (Mongillo and Clelland, 1984).

The REE contents for the acid-sulfate features sampled at Waiotapu are summarized in Figure 6. The major features of these acidic fluids are very similar to those observed at Rotokawa, namely: 1) relatively high overall REE contents; 2) a distinctive "gull-wing" chondrite-normalized pattern; 3) patterns generally parallel to potential aquifer rocks; and 4) nearly identical REE contents in filtered and unfiltered aliquots of the same sample. Comparison of REE contents among samples taken in 1998 and 2000 is complicated by the fact that there was considerable spatial variability as seen from the results for Oyster Pool in 1998. However, there was no change in the general form of the patterns between 1998 and 2000.

As can be seen from Figure 7, the REE patterns from the Champagne Pool are significantly different from those of the more acidic features at Waiotapu. First, the overall concentrations of REE are much lower, although generally well above our improved detection limits. Second, the patterns have a very prominent, positive Eu anomaly. Third, the patterns are generally LREE-enriched, exhibiting a relatively steep decrease from La to Gd, and a much flatter slope from Gd to Lu. The pattern for the Champagne Pool can be likened to a "Mexican Hat" and is distinctly different from the "gull-wing" pattern of the acid-sulfate fluids. Finally, unlike the acid-sulfate fluids, the fluids from the Champagne Pool show noticeable differences in REE concentration between filtered and unfiltered aliquots, with the latter generally having higher REE contents. This finding suggests that some of the REE are present as suspended particles. However, the filtered aliquots still have significant REE contents. Like the more acidic fluids, no major temporal changes are observed for the Champagne Pool over a three-year period. From 1998 to 2001, the REE concentrations in the Champagne Pool varied by no more than a factor of three.

With the exception of the prominent Eu anomaly, the patterns of fluids from the Champagne Pool are very similar to those from the Whakaroa Rhyolite and the Oruanui Ignimbrite, potential aquifer rocks for the Waiotapu fluids. The positive Eu anomaly could be the result of the fluids leaching a lithology at depth with a similar Eu anomaly. However, as pointed out by Sverjensky (1984) and Wood (1990), geothermal fluids also can acquire positive Eu anomalies as a result of the increased stability of aqueous Eu^{2+} relative to Eu^{3+} with increasing temperature. Thus, the Eu anomaly observed here could be a reflection of a relatively high temperature at depth and rapid ascent of the fluid to the surface.

Waikite: The Waikite hot springs lie to the north of the Te Kopia Reserve field along the Paeroa fault zone. The Waikite hot springs sampled are fed by a bicarbonate-chloride water with approximately neutral pH of 7.5. Waikite is proximal (~ 5 Km) to Waiotapu and may have a hydrological connection to the Waiotapu field (Mongillo and Clelland, 1984). Quartz saturation thermometry suggests a temperature of last equilibration of approximately 156 °C, which is considerably less than that from Waiotapu. The sampling of Waikite in 1998 was immediately followed by a magnitude 4.1 earthquake which had an epicenter at nearby Rotorua. The proprietor of the Waikite springs told us that earthquakes in the general area are periodic in that activity increases for a few weeks at a time followed by several months of little or no activity. This was confirmed by discussion with our colleagues at IGNS. Seismicity may be significant because Lewis et al. (1997) have attributed temporal variations in REE content in Yellowstone National Park to microseismic events.

The geothermal fluids from Waikite are interesting in that their REE patterns are parallel to those of the Champagne Pool except that the former lack a Eu anomaly and may have somewhat lower overall REE contents. However, if the Eu anomaly is removed from the Champagne Pool results, the patterns are nearly parallel with those from Waikite. This finding may support the idea of a hydrological connection between Waiotapu and Waikite. The lack of the Eu anomaly in the Waikite fluids may be a result of the lower temperature of last equilibration compared with the Champagne Pool. As pointed out in the previous section, Sverjensky (1984) has shown that the relative stability of divalent aqueous Eu is a strong function of temperature.

Te Kopia Reserve: The Te Kopia Reserve is comprised of three large pools fed by acid-sulfate springs. All of the samples taken at Te Kopia were strongly acidic with pH ranging from 2.6 to 1.7. The estimated maximum deep temperature is 241°C with an estimated thermal reserve of 2300 PJ (Mongillo and Clelland, 1984). The Te Kopia field may be connected hydrologically to the Orakeikorako field (Mongillo and Clelland, 1984).

Several of the acidic hot springs at Te Kopia (Figure 8) exhibit "gull-wing" patterns reminiscent of the acid-sulfate fluids at Rotokawa and Waiotapu. However, in both 1998 and 2000, the fluid from Te Kopia #3 exhibited a somewhat different pattern, in spite of having a low pH (pH = 1.9 in 2000). From Nd to Lu, the patterns for Te Kopia #3 and the others are identical, including a slight negative Eu anomaly, but Te Kopia #3 does not show the strong depletion in La-Pr shown by other acidic fluids in the TVZ. The reason for the different behavior of Te Kopia #3 is not yet clear. However, the pattern for this fluid is very similar to the patterns for the Whakaroa Rhyolite and the Oruanui Ignimbrite.

Although primarily acid-sulfate features occur at Te Kopia, a neutral-chloride fluid has been encountered at Murphy's Farm Hot Spring. We were unable to sample this feature safely in any of our trips to New Zealand. However, Figure 9 includes the chondrite-normalized REE pattern for a sample of this neutral-chloride fluid taken in 1992 and stored in the IGNS sample library at Wairakei. It is clear that the REE contents of this sample are much lower than those in the acid-sulfate fluids we sampled. Although we cannot exclude the possibility of loss of REE from the sample during storage in the sample library, its lower REE concentrations compared to the acid-sulfate fluids are consistent with trends observed elsewhere. That is, neutral chloride fluids tend to have orders of magnitude lower REE concentrations than acid-sulfate solutions.

Waimangu: The Waimangu area is similar to Waiotapu in that it comprises both acid-sulfate features and neutral-chloride-bicarbonate features. This hydrothermal system occurs along the southern margin of the Okataina Volcanic Center. The heat source seems to be related to the central rift zone of a nearby volcanic edifice. This volcanic center is the most recently active one in the TVZ. The maximum deep temperature is estimated to be 270°C with stored heat estimated to be 5400 PJ (Mongillo and Clelland, 1984). Samples were obtained from the acidic Frying Pan lake, which had a temperature and pH of 51°C and 5.7, respectively. A sample also was obtained from the neutral-chloride Clamshell Spring which has a higher temperature and pH of 76°C and 8.0, respectively. Finally, Iodine Pool, with a temperature and a pH of 64°C and 8.3, respectively, was sampled.

As demonstrated by Figure 10, the REE patterns of all the fluids we sampled from Waimangu are similar to the "gull-wing" patterns exhibited by the more acidic fluids elsewhere, except that they do not exhibit the extreme depletion in La-Pr shown by more acidic fluids. Thus, all fluids sampled at Waimangu have a slight negative Eu anomaly, show a fairly steep negative slope from La to Nd, and then a much gentler slope (in fact nearly flat) from Gd to Lu. The patterns for the fluids are very similar to those from the Whakaroa Rhyolite and the Oruanui Ignimbrite, suggesting very little fractionation as the REE are leached from aquifer rocks. Unlike more acidic fluids elsewhere, the REE contents of the unfiltered aliquots of fluids from Waimangu are generally much higher than those in the corresponding filtered aliquots. The slightly more acidic fluids from Frying Pan Lake (pH = ~ 5.7) seem to have higher REE concentrations in the filtered aliquots than those from the more alkaline fluids from Clamshell Springs and Iodine Pool (pH = ~ 8.0 and 8.3, respectively). The difference in REE concentrations in the unfiltered aliquots is considerably less, although Frying Pan Lake still seems to have somewhat higher values.

Orakeikorako: The Orakeikorako field is reached by a short ferry trip across the east end of lake Ohakuri on the Waikato river. The sinter terrace system produced by the flow of springs is quite large and mostly lies beneath the present lake level. We sampled the Fred and Maggie Pools which have a moderate temperature (93°C) and pH (6.9), and flow out onto the surface of the largest sinter terrace. We also sampled the large Map of Africa Pool which emerged near the base of the upper sinter terrace and had a temperature of 63°C and a pH of 6.9. Slightly closer to the Waikato river we sampled the vent of the Diamond Geyser which has a strong flow of steam-heated water with a temperature of 93°C and a pH of 8.5. Field conductivity measurements suggest that total dissolved solids content is low, which is in agreement with published data on the field. Temperature at depth is estimated to be 266°C with a stored heat reserve of 1700 PJ (Mongillo and Clelland, 1984). This field was drilled for production tests but the flow of produced water was not adequate for power generation due to low permeability (verbal communication, Greg Arehart, 1998). The only acid-sulfate fluid that we sampled from the Orakeikorako field was that from Ruatapu Cave, which has a temperature of 39°C and a pH of 2.5.

Like acid-sulfate fluids elsewhere in New Zealand, the fluids emerging in Ruatapu Cave have overall high REE concentrations, distinctive "gull-wing" patterns, and identical REE concentrations in unfiltered and filtered aliquots (Figure 11). The near-neutral fluids of the Fred and Maggie Pools and the Map of Africa Pool have REE characteristics very similar to those of the fluids from Waimangu. The Map of Africa Pool appears to have higher REE concentrations than the Fred and Maggie Pools, in spite of identical pH values but a lower emergence temperature. The absolute REE concentrations of these hot springs varied a bit, but the chondrite-normalized patterns are essentially the same, between the two sampling campaigns. The REE concentrations of the outflow from the Diamond geyser were near the detection limit in both 1998 and 2000. These low concentrations are probably a result of three factors: 1) the expected low REE concentrations in fluids of slightly alkaline pH (~ 8.5); 2) the admixture of low-REE steam with liquid in the geyser; and 3) possible loss of REE to solid phases upon steam separation (see below).

Taupo-Tauhara Field (De Bretts Thermal Park): The Tauhara-Taupo field contains both acid-sulfate and neutral-chloride features but we were able to sample only neutral-chloride type fluids. We sampled springs emerging within the De Bretts Thermal Park and along the margins of Lake Taupo, and a well at De Bretts. The waters are neutral-bicarbonate-chloride-type with much lesser amounts of sulfate. Field measurements indicate pH values of 5.5 to 6.5.

Surprisingly, the REE systematics of the fluids from the Taupo-Tauhara are distinctly different from most of those observed anywhere else in this project. These fluids are among the only ones that show strong HREE-enriched chondrite-normalized patterns (Figures 12 and 13). The general pattern is relatively flat from La to Gd, and then has a positive slope from Gd to Lu. Most of the fluids exhibit a small negative Eu anomaly. The same patterns were observed in all three years in which samples were taken, although there is some variation in absolute REE concentration from year to year. Interestingly, in the samples from De Bretts and some of the samples from the margin of Lake Taupo, the unfiltered aliquots have somewhat higher LREE concentrations than the filtered samples, but the HREE concentrations tend to converge in the two aliquots. This finding suggests that the LREE are more likely to be present on suspended particles. Sample NZ302-01 from the margin of Lake Taupo is particularly interesting in this regard because the unfiltered aliquot exhibits a strongly LREE-enriched pattern with a large Eu anomaly (very different from the rest of the fluids from this area) whereas the filtered aliquot shows the HREE-enriched pattern characteristic of this thermal area. This finding raises the possibility that the HREE-enriched patterns observed in the Taupo-Tauhara area are a result of the preferential removal of LREE onto solid particles (perhaps Mn oxides?).

Wairakei geothermal field: The Wairakei fields are famous as the first liquid-phase geothermal field in the world to produce electric power. A number of geothermal production technologies were developed for the first time at Wairakei. The waters are predominately chloride-bicarbonate-type. Downhole temperature maxima are approximately 270°C; total heat flow is estimated to be 600 MW with a stored capacity of 6700 PJ (Mongillo and Clelland, 1984).

A sample was obtained from well W-207 in 2000 at 7.1 b.g. using a Weber sampler. The results for two replicate analyses of this fluid are shown in Figure 14. In general, the REE concentrations are quite low, $< 10^{-4}$ times chondrite, and the filtered aliquot has substantially lower concentrations than the unfiltered aliquot. The chondrite-normalized REE pattern of the unfiltered aliquot is nearly parallel to those of potential reservoir rocks (Whakaroa Rhyolite, Oruanui Ignimbrite), but the filtered aliquot has a much flatter pattern. The reproducibility of the results for the unfiltered aliquot is excellent, and that for the filtered aliquot is good considering the proximity to the detection limit.

Broadlands-Ohaaki Field: Three wells (Br15, Br20 and Br48) were sampled at Broadlands-Ohaaki using a Weber sampler. In addition, Kevin Brown procured downhole samples from two wells (Br9 and Br20); these are all unfiltered aliquots. The waters in our samples are predominately near-neutral to slightly alkaline, chloride-bicarbonate-type with higher bicarbonate than the Wairakei field. Downhole temperature maxima are approximately 308°C with a capacity of 6900 PJ (Mongillo and Clelland, 1984). Few surface springs existed prior to field development and surface heat flow is estimated to be 75 MW (Mongillo and Clelland, 1984).

The results from the Broadlands field are plotted and compared with those from Wairakei in Figures 15-18. The samples obtained using the Weber sampler show characteristics very similar to those from Wairakei. The downhole samples as a group have higher REE contents than the ones obtained with the Weber sampler. Figure 18 shows that, acid washes of the downhole sampler after each sample was taken contain very high REE contents. This finding could possibly suggest that REE were preciptated in or absorbed onto the sampler during sampling. However, blank washes of the sampler indicate that acid washing may be leaching REE out of the ceramic surfaces inside the sampler. Thus, the high REE contents of the acid washes may be an artifact of contamination. This raises the possibility that the higher concentrations observed in down-hole samples may also be an artifact of contamination.

Mokai: At Mokai we sampled wells MK5, MK3, and MK6 with a Weber separator at 18 to 20 bars gauge. In addition, we sampled three natural features, Mokai Spring which is in sight of the Mokai injection wells, Mokai bathing pool, and Mokai stream. Mokai Pool is the only acidic feature sampled, with a pH of 2.9. All other fluids sampled had pH in the range 5.5 to 7.1. This field has a maximum measured temperature at depth of 324°C and a stored heat of 10,000 PJ according to Mongillo and Clelland (1984).

The acidic Mokai Pool exhibits the characteristic "gull-wing" REE pattern of acidic fluids in New Zealand, the unfiltered and filtered aliquots have nearly identical REE concentrations, and the absolute REE concentrations are comparatively high (just under 10^{-2} times chondrite; Figure 19). The unfiltered aliquot of the sample from Mokai Spring (pH = 6.1) has REE concentrations within an order of magnitude of those of Mokai Pool. However, the chondrite-normalized pattern for Mokai Spring does not exhibit depletion in La-Pr like Mokai Pool, and the pattern for the former fluid is nearly parallel to potential aquifer rocks. On the other hand, the filtered aliquot of the sample from Mokai Spring has REE contents almost two orders of magnitude lower than the unfiltered aliquot.

The three wells sampled at Mokai all have similar REE patterns, and their absolute concentrations are much lower than in the surface features (between 10^{-6} and 10^{-5} times chondrite; Figure 20). The HREE concentrations in the filtered and unfiltered aliquots are essentially identical, but the LREE concentrations are somewhat higher in the unfiltered than the filtered aliquots. The patterns from the well fluids are irregular, which may reflect analytical uncertainty at such low concentrations.

Mt. Ruapehu crater lake: The NZ-032-98 sample was taken by Bruce Christianson from Ruapehu crater lake in March 1998. The crater lake is strongly acidic (pH 1.14). The salinity measured in the laboratory was 38 parts per thousand. Only one liter of unfiltered sample was obtained owing to logistical difficulties. The fluid from this crater lake is an acid-chloride-sulfate water with extremely high dissolved solids contents including, in order of decreasing abundance, Mg, Ca, Na, Fe, and Al, at greater than 1000 mg/L each. The extremely high Fe and Al in particular reflect the acidic character of the waters. We also analyzed a series of samples taken from Mount Ruapehu between 1993 and 1999, inclusive, and stored in the IGNS sample library.

The samples from Mount Ruapehu are different from most of the other acidic fluids sampled from New Zealand in that they do not have the distinctive "gull-winged" chondrite-normalized REE pattern (Figure 21). Although only unfiltered aliquots are available from Mount Ruapehu, the very low pH permits us to assume that filtered aliquots would have identical REE concentrations, in analogy with all other acidic fluids investigated in this project. The sample we obtained in 1998 has a slightly positively sloped chondrite-normalized REE pattern, without any significant Eu anomaly. The pattern of this sample is parallel to that of the Ruapehu basalt for the HREE, but appears to be relatively depleted in the LREE compared to this basalt. Interestingly, the fluid appears to reflect a slight positive Nd anomaly possessed by the basalt. Thus, although the Mount Ruapehu fluids do not exhibit the "gull-wing" patterns typical of other acidic fluids in New Zealand, they do have in common the apparent fractionation of the LREE compared to potential host rocks.

The samples from the IGNS sample library suggest significant variability in the REE patterns over the period 1993 to 1999. We cannot rule out the possibility that the IGNS samples have changed on storage. However, some measure of the magnitude of this potential problem is given by comparison of our 1998 sample with IGNS-14 RCL. The latter is a separate aliquot of the same sample that Bruce Christenson took for us in March 1998. The only difference is that IGNS-14 was stored for more than two years prior to analysis. It can be seen from Figure 21 that the two aliquots have essentially identical LREE concentrations, and the HREE concentrations differ by less than a factor of two. This finding suggests that the samples did not change much over a period of two years, but the possibility that changes may have occurred over longer periods of time cannot be discounted. Assuming that the IGNS samples did not undergo significant changes during storage, the data in Figure 21 show a significant temporal variation in the REE content of the crater lake. Samples taken in 1993, 1994 and 1995 exhibit nearly identical, LREE-enriched patterns. From 1996 to 1998, the patterns flatten and then become slightly HREE-enriched. In 1999 there was a sudden change again such that the pattern again became slightly LREE-enriched. If these changes are not artifacts of sample storage, it may be that they are reflective of changes in the chemistry of the crater lake owing to changes of inputs of magmatic volatiles. It is even possible that changes in REE chemistry may represent harbingers of changes in the eruptive status of Mount Ruapehu.

White Island: Samples from the IGNS sample library taken in the years 1993 to 1999 were analyzed for their REE content (Figure 22). White Island is an active andesitic volcano and has a number of hot springs and pools, and fumaroles. The samples analyzed were all taken from the Black Pot feature on White Island, and all but one represent unfiltered samples. The Black Pot spring is reported to be a neutral-chloride feature that is probably reheated sea water with a possible (but unknown) magmatic contribution. The temperatures recorded at the time of sampling were 83-94°C. As was the case of the Mount Ruapehu samples, we cannot rule out the possibility of changes in these samples during storage. However, Figure 22 shows that there is quite a variation in both the absolute REE concentrations and the chondrite-normalized patterns with time. All samples exhibit REE concentrations (between 10^{-1} and 10^{-3} times chondrite) that are comparatively high for neutral-chloride fluids in our experience. The patterns vary from slightly LREE-enriched (IGNS-16) to slightly HREE-enriched (IGNS-28), with most of the samples being apparently MREE-enriched. If these patterns are not artifacts of sample storage, the MREE-enrichment is significant in that these samples are the only ones in which such a chondrite-normalized pattern was observed in New Zealand. Finally, it should be mentioned that the variation in REE of these White Island samples as a function of time does not appear to be regular.

Kawerau: This field is exploited for both direct-use heating and electricity generation, primarily by a pulp and paper company. The maximum temperature encountered in a well is 310°C and the stored heat available is 7,700 PJ (Mongillo and Clelland, 1984). The pH of the fluids in this field ranged from 5.9 to 9.3; they range from chloride-dominated to bicarbonate-dominated. Samples of liquid (after phase separation) from Kawerau wells were obtained for us by Bruce Mountain of IGNS. Two down-hole samples were also obtained from Kawerau.

As can be seen from Figure 23, the REE concentrations for all the samples (both filtered and ulfiltered aliquots) taken from Kawerau wells, except the down-hole samples, are very near the detection limit, especially for the HREE. As a result, the patterns are quite irregular. About all that can be said about these fluids is that they appear to be slightly LREE-enriched. On the other hand, the two down-hole samples have much higher REE concentrations. As mentioned above, the down-hole sampler may be introducing REE contamination or the REE may be lost from the liquid to scale on phase separation. Either or both of these factors could contribute to an apparently higher REE content in samples taken with the down-hole sampler before phase separation.

Tokaanu: We sampled chloride pools at Tokaanu near the south end of Lake Taupo. The first sample at Tokaanu was a steam-heated geyser (Taumata Puhipuhi). We then sampled the Hoani and Takarea pools and a hotter, unnamed pool across from the Takarea pool. The pools are near-neutral in pH and high in chloride, boron, and lithium. According to Mongillo and Clelland (1984) the estimated maximum temperature and thermal capacity are 250°C and 3,200 PJ, respectively, but Tokaanu may be part of a much larger geothermal field incuding Waihi.

The sample from the steam-heated geyser (NZ-141-00) shows somewhat unusual behavior (Figure 24). The unfiltered aliquot of this sample has a LREE-enriched pattern with a slight negative Eu anomaly. The filtered aliquot also has a LREE-enriched pattern but the absolute concentrations are about one order of magnitude lower than in the unfiltered aliquot and the Eu anomaly is positive. For all the other samples from Tokaanu, the patterns are LREE-enriched with slight positive Eu anomalies, and there is not as large a discrepancy between filtered and unfiltered aliquots. The fact that the unfiltered aliquot from the geyser has a higher REE content and the filtered aliquot from the geyser has a lower REE content than any of the other samples (filtered or unfiltered), may be a reflection of the fact that dissolved REE are lost to solid particles on phase separation, as was suggested in the case of the Diamond geyser at Orakeikorako.

North Island, Outside the Taupo Volcanic Zone

Ngawha and Kamo: We sampled two wells at Ngawha, NG-12 and NG-9. Ngawha supports a binary power plant and produces about 10MW from the two wells we sampled. Native antimony has been precipitating from the water in the heat exchangers at Ngawha, and the waters here are also high in chloride, bicarbonate, boron and mercury. We measured pH = 8.6 and 6.6 for NG-12 and NG-9, respectively. The maximum measured temperature at depth is 301°C and the estimated thermal capacity is 15,000 PJ (Mongillo and Clelland, 1984). We also sampled the Kamo soda spring, north of Whangarei. This spring had a temperature of ~ 25°C and is therefore classified by Mongillo and Clelland (1984) as a warm spring. It is a neutral chloride-bicarbonate water with a pH = 6.1 and, according to Mongillo and Clelland (1984), it discharges a considerable amount of CO_2 although we did not note unusual effervescence at the point at which we procured our sample.

The fluid from Kamo is distinctly different from the fluids at Ngawha in that it is one of the few to exhibit HREE-enrichment (Figure 25). In detail, the REE pattern has a negative slope from La to Pr, and then a more or less positive slope from Pr to Lu. Somewhat surprisingly, this lower temperature fluid has higher overall REE contents than the higher temperature fluids from Ngawha, although this could be a result of loss of REE upon liquid-vapor phase separation. Finally, the REE contents in the filtered and unfiltered aliquots from Kamo are very similar, implying the REE are mostly present in dissolved form. The reason for the HREE-enriched trend is not immediately obvious, but it cannot be a result of carbonate complexation because Kamo is not unusually high in bicarbonate compared to some other fluids in New Zealand, including those at Ngawha, none of which show HREE-enrichment.

The REE patterns for the Ngawha fluids bear some resemblance to those from the Champagne Pool. They are generally negatively sloping with a prominent, positive Eu anomaly. However, they differ from the Champagne Pool in that the slope from La-Nd is gentler for the Ngawha fluids.

Miranda hot springs: The Miranda hot springs were sampled because they are heated entirely by the geothermal gradient of a very deep-seated fault system not directly related to magmatic intrusions. The rationale for sampling this type of feature was that there might be significant differences between deeply circulating meteoric waters in contrast to waters that may have a direct magmatic input. The Miranda springs are neutral-chloride-bicarbonate waters and flow at a rate of up to 7 L/s (Mongillo and Clelland, 1984). Field measurements indicate low conductivity, a temperature of 56°C, and a slightly basic pH of 9.1. The REE patterns from Miranda (Figure 26) are similar to those of neutral-chloride fluids from Orakeikorako and Waimangu, among others. There is a slight negative Eu anomaly, and the pattern is gently negatively sloping from La to Nd, and nearly flat from Gd to Lu. The overall concentrations of REE are very low at Miranda, hovering just above our detection limit. Concentrations of REE in filtered and unfiltered aliquots are similar, but this could be an artifact of the proximity to the detection limit. Unfortunately, there is not much that distinguishes this fluid from outside the TVZ with others within the TVZ, in terms of REE contents.

Te Aroha: The Te Aroha hot springs are a second example of deeply circulating meteoric waters heated entirely by the geothermal gradient and brought to the surface by deep-seated faults. These waters were quite different from Miranda hot springs in that the Te Aroha waters have very high bicarbonate contents (almost an order of magnitude more than any other fluid investigated in this project) and conductivities. These near-neutral bicarbonate waters have pH values ranging from 6.9 to 7.8, and also contain significant chloride, sulfate and borate. These waters have very high dissolved solids contents including Na, K, Mg, Li, Sr, As, and Ba, in order of decreasing abundance. We took samples from Mokena Geyser, which is a drillhole, 70 meters deep (drillhole #1; Mongillo and Clelland, 1984), a warm (24°C) spring (spring #8; Mongillo and Clelland, 1984), and a hand-pumped well (spring #15; Mongillo and Clelland, 1984).

The REE patterns of fluids from Te Aroha (except those from Mokena Geyser) resemble those from Miranda (Figure 26). They have a moderately negative slope – steeper from La-Nd and flatter from Gd to Lu – with a weak negative Eu anomaly. Typically, the unfiltered aliquots have higher REE contents than the filtered aliquots. The sample from Mokena geyser has the lowest REE contents of all fluids from Te Aroha, in keeping with our findings from other geysers. On the other hand, the warm spring has the highest REE concentrations of any fluid at Te Aroha, but quartz saturation temperatures (~ 150°C) for this spring are similar to those of the other fluids. The high bicarbonate concentrations in the Te Aroha fluids do not appear to have a significant effect on the REE patterns (compare Te Aroha and Miranda, for example). This is somewhat surprising given that carbonate complexes of the HREE are much stronger than those of LREE and therefore HREE-enrichment of the fluid would be expected when carbonate complexation is important.

Tarawera: A group of hot springs, probably emerging from the Torlesse Greywacke, is located at Tarawera, about 80 km southeast of Taupo. These fluids are neutral-chloride type. The fluid we sampled emerged from a black plastic pipe and had a temperature of 47°C and a pH of 8.3. The fluid from Tarawera exhibits a REE pattern very similar to those from Miranda and Te Aroha (Figure 26).

Puketitiri (Mangatutu): This spring was of interest because of a reported high fluoride content (Mongillo and Clelland, 1984), fluoride being a strong complexing agent for the REE (Wood, 1990). Puketitiri contained the third highest fluoride content (19 mg L^{-1}) in New Zealand after Mt. Ruapehu (158 mg L^{-1}) and Diamond Geyser at Orakeikorako (21 mg L^{-1}). Tarawera also contained a relatively high fluoride content (13.5 mg L^{-1}). Other fluids in New Zealand ranged in fluoride content from < 0.1 up to 12 mg L^{-1}. Figure 26 shows that the high fluoride content of the fluid from Puketitiri does not appear to result in a REE pattern significantly different from those of Miranda, Te Aroha or Tarawera.

All four of the above thermal springs occur outside the TVZ and are thought to be the products of circulation along deep-seated faults, as opposed to shallow magmatic activity as is the case within the TVZ. However, the observed REE pattern common to all four areas, a gently negative slope with a slight negative Eu anomaly, is also seen in thermal springs at Waimangu and Orakeikorako within the TVZ. Similar patterns have also been observed in some of the Wairakei and Broadlands wells and in the 1998 sample from Mt. Ruapehu. These patterns parallel closely those of many of the likely aquifer rocks, e.g., Whakaroa Rhyolite and the Oruanui Ignimbrite. It thus seems that this pattern is a consequence of inheritance from the wall rocks, without significant fractionation.

Morere: The Morere springs are neutral-chloride waters thought to be derived from dewatering of the sedimentary wedge of the underlying subduction zone. Two springs were sampled from small concrete tanks built around the vents. The first spring sampled had temperature, salinity, and pH of 47°C, 28 per mil, and 6.9, respectively. The second spring sampled had temperature, salinity, and pH of 42°C, 27 per mil, and 6.9, respectively. These waters had high contents of Na, Ca, K, B, Mg, Li, and As, in order of decreasing abundance. In addition, the waters were clearly high in iron and were precipitating iron hydroxides upon emergence to the surface.

If the parent fluid for the Morere springs was originally seawater, the REE systematics have been extensively modified by water-rock interaction. Seawater generally has a HREE-enriched pattern with a strong negative Ce anomaly, no Eu anomaly and generally very low overall REE concentrations. In contrast, the fluids from Morere have much higher overall REE concentrations, no Ce anomaly and a LREE-enriched pattern. Finally, the samples from 2000 exhibit strong positive Eu anomalies. There are rather large differences in REE contents of unfiltered vs. filtered aliquots. In gross characteristics, these patterns resemble those from Ngawha and the Champagne Pool. There do not seem to be any obvious REE characteristics that distinguish these subduction-related fluids from thermal fluids from other settings. The chondrite-normalized patterns for Morere fluids do seem to have somewhat steeper slopes than those of the Whakaroa Rhyolite or the Oruanui Ignimbrite.

Te Puia: Like Morere, Te Puia springs may be derived from dewatering of the underlying subduction zone. Field measurements of the waters indicated high conductivity, neutral pH, and reducing Eh, and the spring seemed to be precipitating sulfur. There is a strong presence of natural gas in the area, suggesting that these waters may interact with organic matter at depth. The samples taken here had temperatures ranging from 50 to 60°C and pH ~ 6.6-6.9. There were high contents of Na, Ca, K, B, Mg, Li, Ba, and As, in order of decreasing abundance. Te Puia fluids have LREE-enriched chondrite-normalized patterns that dip somewhat more steeply than those of the Whakaroa Rhyolite or the Oruanui Ignimbrite (Figure 28). Some of the fluids appear to have a positive Eu anomaly, but in Te Puia #1, any Eu anomaly is quite subdued. There are quite substantial differences in the REE content of unfiltered and filtered aliquots. Fluids from both Morere and Te Puia contained significant Ba, and the broad Sm-Eu hump for sample NZ023 is probably an artifact of incomplete correction of isobaric interference from Ba.

South Island

Three geothermal areas on the South Island were sampled, Hanmer Springs, Maruia Springs and Lewis River Springs (Figure 29), primarily to form a contrast with the North Island systems. Although there are a number of thermal springs on the South Island, the geothermal areas tend to be smaller and cooler than those on the North Island. None of the geothermal areas on the South Island have been exploited for power production; most are used solely for balneological purposes.

Hanmer Springs is the only area on the South Island officially designated as a thermal area (Mongillo and Clelland, 1984). Wells drilled in the area produce water at a temperature approaching 50°C. The sample we obtained had a pH of 8.6 and is dominated by chloride and bicarbonate. The Lewis River Springs consisted of three thermal pools, with a temperature of about 40°C (although at the vent the temperature attained 49°C). The measured pH was 8 and the fluid was dominated by bicarbonate. Maruia Hot Springs was a resort containing a number of indoor and outdoor pools. The reported maximum temperature in the area is 60°C (Mongillo and Clelland, 1984), but the sample we procured from an indoor pool had a temperature of 43°C. This sample also had pH = 8.3 and was dominated by nearly equal amounts of chloride and bicarbonate.

The possibility of contamination of all these samples from the South Island is rather high. Both Hanmer Springs and Maruia Springs are highly developed. In the former case, our sample came from a well and was probably in contact with steel, titanium and concrete, whereas the sample from Maruia Springs came from a pool constructed of concrete and wood and probably had been occupied by bathers a relatively short time prior to sampling. The Lewis River Springs is undeveloped, but was a very popular bathing spot. People were bathing immediately prior to and during sampling. However, for completeness we describe the REE results here.

The concentrations of REE in both aliquots of the samples from Hanmer are very low, near the detection limit and indistinguishable from the trip blank (Figure 30). Whether these low concentrations are characteristic of the deep fluid at Hanmer or result from loss of REE in the plumbing system is not known. The fluid from Maruia has moderately high REE contents, with the filtered aliquot having only slightly less REE than the unfiltered aliquot. The chondrite-normalized pattern is relatively flat from La to Sm, and then dips gently from Gd to Lu. There is a weak negative Eu anomaly. The unfiltered aliquot from Lewis River has the highest REE content measured in thermal fluids from the South Island, and exhibits a consistent LREE-enrichment with a weak negative Eu anomaly. On the other hand, the filtered aliquot from Lewis River has much lower REE concentrations, similar in both absolute value and pattern to the unfiltered aliquot from Maruia (Figure 30). The higher concentration of REE in the unfiltered aliquot is probably a result of material suspended by bathing activity.

Oregon Cascades

The sites sampled are located on a map of Oregon in Figures 31 (modified after Figure 9, in Sherrod et al, 1996). As noted by Sherrod et al. (1996), the thermal areas are located between 1500- and 2500-ft elevations at the bottom of major stream valleys. Eight thermal areas within the western Cascade range were sampled. These included Bagby, Breitenbusch, Bigelow, Bellknap, Terwilliger, Wall Creek, McCredie, and Umpqua hot springs. The tectonic setting is one of convergent margin volcanism. There are many recent volcanic centers in the area.

Bagby: The Bagby site is maintained by a non-profit group "The Friends of Bagby". Two vents were present and the higher flow, hotter vent above the cabins was sampled (OR-033-98). The flow rate was 1-3 L/s and the fluid welled up from the sandy bottom of a concrete orifice less than a foot in diameter and about a foot deep. The vent temperature was 45°C. The pH at the vent was 9.5, typical of carbonate-buffered waters. However, conductivity was relatively low as was the titrated carbonate. Chloride and sulfate content are relatively low and the water has an alkaline-bicarbonate-sulfate-chloride character.

Breitenbush: This area is on private land and is the location of a spiritual retreat. We were given access to the hottest pool located between the administrative headquarters and the lodge. The pool is fenced in, approximately 3 meters in diameter, and relatively shallow at less than a meter deep. The sample (OR-034-98) had near-neutral pH = 7.03 and a relatively low conductivity. The water is neutral-chloride in character.

Bigelow (Deer Lick): The Bigelow pool is located on the west side of the river downstream from the bridge. A small pool is located in a grotto by the side of the river. The fluid appears to infiltrate through a conglomeratic river-bank deposit. The pool contained a lot of suspended material making filtration difficult. The sample (OR-035-98) was cool at 31°C, near-neutral pH (7.0) and relatively low conductivity. Relatively high in chloride with moderate sulfate, the water has a neutral-chloride character.

Bellknap: The Bellknap thermal area is a resort. The proprietors gave us permission to sample (OR-036-98) the source pool which is located across the Mackenzie river from the resort directly at the end of a foot bridge. Galvanized chain link fence is placed vertically to block access to a small collection pool in a grotto that is approximately 3 feet long and less than 2 feet wide, and is walled off with concrete. Galvanized chain-link fence is also placed horizontally over the outflow where water is taken through a 3-inch PVC pipe. The pool has a temperature of 68°C, moderate conductivity, and a pH of 7.6. Chloride is relatively high with moderate sulfate giving the water a neutral-chloride character.

Terwilliger/Cougar: The Terwilliger pools are located along the side of Cougar reservoir and are administered by the U.S. Forest Sevice. The pools are formed by a series of small dams built across a creek drainage. The thermal water emerges from a bedrock vent slightly higher than and to the side of the creek, and from there flows into the hottest pool.

The sample (OR-037-98) was taken at the vent which has a temperature of 38°C, a pH of 8.7, and moderate conductivity. This water has a neutral-chloride character.

Wall Creek: The Wall Creek pool is about 15 feet in diameter and less than 2 feet deep with bubbles coming up in the middle. The sample (OR-038-98) was taken from the hottest part of the pool. The temperature was 32°C with low conductivity and near neutral pH (7.4). The water is neutral-chloride in character.

McCredie: The McCredie pools are built on both sides of the stream. The larger pool has a fissure vent which we sampled (OR-039-98). The vent temperature was 60°C and has near-neutral pH (7.3) and relatively high conductivity. This larger vent had a flow of no more than a few liters per minute. The second sampled (OR-040-98) vent was slightly hotter at 63°C and near neutral pH (7.4) and relatively high conductivity. The second vent is a small seep bubbling out of the ground with a very low volume of flow. This spring is relatively higher in both chloride and sulfate than most of the other Cascade waters and the waters may be characterized as neutral-chloride type. These waters had the second highest (in respective order of decreasing abundances) Na, Ca, K, B, Mg, and notably Li and Sr, in the Cascade samples.

Umpqua: The Umpqua pool is located on a bluff at some elevation about the river below. A bathouse is situated at the lower of two pools. We sampled (OR-041-98) the upper pool above the bathhouse. The temperature of this pool was 40°C; the fluid had a near-neutral pH (6.4) and relatively high conductivity. These waters had the highest chloride and bicarbonate concentrations of the Cascade samples as well as moderate sulfate. They are neutral-chloride in character. These waters also had the highest (in order of decreasing abundance) Na, Ca, K, Mg, B, and notably Fe, Li and Sr, in the Cascade samples.

REE in geothermal fluids from the Oregon Cascades are detectable in all the unfiltered samples and in most of the filtered samples as well (Figure 32). Bagby had both the lowest total dissolved solids and the lowest REE content. Umpqua was unusual in having nearly identical chondrite-normalized La and Lu concentrations and a pronounced s-curve REE pattern which reaches a minimum near Nd and a maximum near Er. This same pattern is reproduced in the filtered aliquot (disregarding a possible bump at Sm-Eu from high Ba) about half a log unit lower in REE concentration. However the filtered and unfiltered aliquot have nearly identical La values. In most other cases, the patterns show a gentle negative slope for the LREE, but then flatten out for the HREE. In general there are large differences between the unfiltered and filtered aliquots for each sample.

Alvord Desert, Harney Basin and Owyhee Canyon areas, Southwestern Oregon

Seven thermal areas in southeastern Oregon were sampled in October 1998, including Crane, Mickey, Alvord, North and Middle Borax Lakes, White Horse Ranch, and Snively hot springs (Figure 33). During the same trip, Zims hot springs in southwestern Idaho was also sampled. The areas in southeastern Oregon are part of the Basin and Range extensional tectonic Province. Geothermal anomalies are related both to the higher heat flow of the Basin and Range Province due to crustal thinning and to basaltic volcanism in the area. Many of the hot springs occur near the middle of the basins and may interact with thick sections of basin sediments.

Crystal Crane Hot Springs: Crystal Crane Hot Springs is a privately developed site located in the Harney Basin along highway 78 between the towns of Burns and Crane, Oregon. The hotsprings are comprised of a large pool fed by an artesian well which has the upper portion cased in a concrete riser with PVC plumbing and a smaller pumped well house which feeds the bathhouses and also had PVC plumbing. We were able to sample (OR-042-98) the artesian vent which had a temperature of 61.5°C and a pH of 8.2, typical of bicarbonate-buffered waters. The conductivity was relatively low at 1550 µMhos. We also sampled (OR-051-98) the well, which had a slightly lower temperature of 49.3°C. No conductivity or pH measurements were made at the well. These waters are dominated by bicarbonate with much smaller contributions of chloride and sulfate and are alkaline-bicarbonate-type.

Mickey Hot Springs: The Mickey Hot Springs are located at the north end of the Alvord Valley. Several sinter structures and pools are present at elevations which vary by a few tens of feet. A vigorously bubbling vent had the highest temperature of 95.0°C and was choosen for sampling (OR-043-98). The pH was 8.73 and the conductivity was 6300 µMhos. Alkalinity was fairly high with very low contents of chloride and sulfate. These waters are therefore alkaline-bicarbonate type waters.

Alvord Hot Springs: The Alvord hot springs are located about 20 miles north of Fields, Oregon. Water flows from multiple vents on the East side of the road across a bog into several concrete pools. The hottest flowing vent near the road was selected for sampling (OR-044-98) to avoid mixing with the cooler water in the bog. The respective measured pH and temperature were 6.76 and 72.5°C. The conductivity was moderate at 9600 µMhos. These waters are near-neutral-bicarbonate-chloride-type.

North Borax Lake Hot Springs: The North Borax Lake hot springs are comprised of multiple sinter vents surrounded by abundant white precipitate which covers the ground over a considerable area. The hottest vent sampled (OR-045-98) had a moderate conductivity of 5200 µMhos, a pH of 7.30, and a temperature of 92.3°C. The surface expression of the vents are low, rounded orifices ranging from one to several feet across and appear to be quite deep. The inner walls are rounded smooth by a covering of white precipitates. Chloride and sulfate content are somewhat elevated but alkalinity is also high. These waters are therefore near-neutral-bicarbonate-type.

Middle Borax Lake Hot Springs: The appearance of the Middle Borax Lake hot springs is similar to those of the northern ones but the temperatures are lower at 72.0°C. The conductivity (4800 µMhos) and pH (7.00) of the sample (OR-046-98) are very similar to the northern hot springs. Borax Lake (Hot Lake) to the south (not sampled) was a large lake surrounded by a low sinter lip beyond which were grassy marsh and bog. The lake had an even lower temperature of 36°C, and a much larger flow was evident and appeared to originate near the middle of the lake. Chloride and sulfate content are somewhat elevated but alkalinity is also high. These waters are therefore near-neutral-bicarbonate-type.

Whitehorse Ranch Hot Spring: This consists of two small pools improved by the forest service. The smaller, hotter pool (about 15 feet across) flows into the larger pool. The smaller pool was chosen for sampling (OR-047-98) and the temperature was highest about 3 feet down where the spring flows up from a sandy bottom. The temperature was 35.0°C above the hottest portion of the pool. The pH is slightly above neutral at 7.68 and the conductivity is low at 1370 μMhos. Chloride and sulfate content are moderate to low but alkalinity is relatively high. These waters are therefore near-neutral-bicarbonate-type.

Snively Hot Springs: Several hot springs flow from near the paved road east through a state park and into the Owyhee river. The largest is cased with a sunken, 3-foot diameter, concrete culvert and overflows at a rate of many liters per second. An iron fence post is fixed in the pool but the flow rate is high enough that water composition probably was not significantly affected (OR-048-98). The conductivity was 8300 μMhos, pH was 9.36 and the temperature was 42.4°C. A smaller vent sampled (OR-052-98) at the north end of the park had similar conductivity (8700 μMhos), pH (9.35), and temperature (39.0°C). North and downstream of the park a large aquaduct pipe crosses the river and a small hot spring flows a few liters per minute from the west side of the road north of this pipe. This hot spring sample (OR-049-98) had a lower conductivity (1330 μMhos), similar pH (8.89) and a higher temperature (71.9°C) relative to the higher flow rate hot springs in the park. Chloride and sulfate content are moderate to low but alkalinity is relatively high. These waters are alkaline-bicarbonate in character.

Zims Hot Springs: Zims Hot Springs is a privately owned resort located west of highway 95 about 4 miles north of New Meadows, Idaho. Flow is artesian at 90 gallons per minute into a concrete holding pool which is approximately 30 feet long by 15 feet wide by about 15 feet deep. There was about 3 feet of water in the pool at the time of sampling. The conductivity is relatively low at 1690 μMhos, pH is 9.00, and the temperature is 52.4°C (ID-050-98). Chloride and sulfate content are moderate to low but alkalinity is relatively high. These waters are alkaline-bicarbonate-sulfate type.

The REE in geothermal fluids from Southeastern Oregon are detectable in all the unfiltered samples and in most of the filtered samples as well (Figure 34). Normalized REE concentrations range from $1x10^{-3}$ chondritic La to around < 10^{-6} chondritic Lu. The REE patterns have a negative slope which tends to be steeper for the LREE than the HREE, and most exhibit slight negative Eu anomalies. The highest REE contents are in the unfiltered aliquots.

Figure 35 provides a comparison of results obtained using the ferric hydroxide co-precipitation method, and the solvent extraction method. With the exception of the unfiltered sample from Sniveley #2, the results are very similar.

Dixie Valley and Beowawe, Nevada

In December, 1998 we obtained samples from Dixie Valley, Nevada (see Figure 36). Wells DV76-A7, 37-33, 28-33,73-B7, and 82A-7, 74-7, 63-7, 73-7, 62-21, 66-21, and 45-14 were sampled, respectively, as NV-053-98 through NV-057-98 and NV-059-98 through NV-064-98. The production well DV76-A7 was sampled (NV-053-98) down stream of the cyclone separator from the brine return line. The wells 37-33 (sample NV-054-89), 28-33 (sample NV-055-98), 73-B7 (sample NV-056-98), 82A-7 (sample NV-057-98), 74-7 (sample NV-059-98), 63-7 (sample NV-060-98), and 73-7(NV-061-98) were sampled from the 2-phase line prior to steam separation. The pH for these wells ranged from 8.92 to 9.20. The fluids in the above wells are alkaline-chloride to alkaline-chloride-bicarbonate in character. Sampling of these wells was done through coiled stainless steel lines that were cooled in barrels of water to give a liquid-phase sample. These are the same sample points used by Oxbow Corporation for routine well monitoring. Also sampled were the Goeringer well (sample NV-058-98) used to supplement re-injection flow at 900 gallons per minute at 58 psig. The Goeringer well had a low temperature of 23.7°C and a near-neutral pH of 7.44. The injection brine was sampled (NV-065-98) downstream of the second flash, had a pH of 9.62 and is alkaline-chloride in character. The steam condensate sample (NV-066-98) had a pH of 6.90.

Wells 62-21, 66-21 and 45-14 are not currently being used as production wells and were capped. These wells are situated in and produce from a slice of different lithology along the Dixie Valley Fault. Well 62-21 is artesian and hot enough to self flash but was capped so the sample (NV-062-98) is from the standing water column. Well 62-21 water is neutral-bicarbonate in character. The water column is 9000 feet with a shut-in pressure of 55.5 psig. The pH was 6.70 and sample had an oily odor which we were told accumulates in the wells when they are completely shut in. Well 66-21 is artesian and was sampled (NV-063-98) from the outflow. We measured a temperature of 37.0°C and a pH of 6.04 at the sample location. Well 66-21 water is neutral-chloride in character. Well 45-14 was capped but had a bleed-off line from which steam and water were escaping but no water was available at the well head. The bleed-off line was closed and the well was vented for about 10 minutes before sampling (NV-064-98) at the wellhead. There was a strong odor of hydrogen sulfide. This well is the only one hosted in shale, is adjacent to a gold mine, and has gold values in the well scale. We measured a pH of 6.73 on this sample at the end of sample collection. Well 45-14 water is neutral-chloride in character. All the Dixie Valley well samples are characterized by high Na and K along with significant B, As, and Al, low Ca, and relatively high fluoride.

Out in the valley a few miles to the northeast of the Dixie Valley power plant is a very large carbonate mound on which are situated many pools of varying temperatures. The higher temperature pools are situated on the southern side of the mound. We sampled (NV-067-98) from an outlet feeding into several pools which had been carved into the carbonate sinter near the lower southwest edge of the mound. The temperature at the vent was 66.5°C and we measured a pH of 6.66. There was abundant carbonate sinter forming on the margins of the pools. A second sample (NV-068-98) was obtained from one of several vents on the south near the highest elevation of the carbonate mound. This vent was hotter with a temperature of 71.2°C and we measured a pH of 6.99. These are near-neutral-bicarbonate waters.

The Beowawe geothermal field (Figure 36) was sampled at three production wells from the 2-phase lines prior to steam separation. Beowawe wells 77-13, Ginn#1-13, and Ginn#2-13 were sampled as NV-069-98 through NV-071-98. We measured respective pH values of 9.71, 9.82, and 9.78 for the three wells. Well head temperatures provided by the operator are 143, 144, and 145 °C, respectively. The water is alkaline-bicarbonate in character. Conductivities were relatively low, indicating low total dissolved solids. Sampling for these wells was done through coiled stainless steel lines that were cooled in barrels of water to give a liquid-phase sample. These are the same sample points used by Oxbow Corporation for routine well monitoring.

The geothermal fluids from Dixie Valley and Beowawe Nevada are uniformly low in REE as are those from the carbonate mounds (Figures 37-41). This may be due to a combination of relatively high pH and relatively low concentrations of sulfate and chloride.

The three samples with the highest REE, NV-062-98, NV-063-98 and NV-064-98 (Figure 38), also have near-neutral pH. The only sample taken downstream of steam separation (NV-053-98) had mostly undetectable REE in both filtered and unfiltered aliquots. The 7 alkaline-chloride-bicarbonate wells sampled show uniformly flat REE patterns (Figure 37) slightly lower than those of the near-neutral-bicarbonate wells. The distinctive elevated La and Lu relative to depressed middle REE in the near-neutral-bicarbonate wells is likely real.

The near-neutral-bicarbonate fluids from the Carbonate Mound in Dixie Valley have low REE contents and generally flattened patterns (Figure 40). Sample NV-067-98 taken from a lower southwestern exposure in the carbonate mound seems to have a higher REE content than the fluids sampled at NV-068-98. Possibly the difference is due to the slightly lower pH (6.66 and 6.99, respectively) of the sample with the higher REE content.

The fluids sampled from the wells at Beowawe have low REE content and exhibit a decrease in chondrite-normalized concentration from La to Dy, with fairly constant concentrations from Dy to Lu (Figure 41). These alkaline-bicarbonate fluids have the highest pH values and the lowest REE of any of the fluids sampled from Nevada.

Salton Sea and Heber, California

Salton Sea: As described in previous reports, we obtained a number of samples from the Salton Sea geothermal system in California, and anion and non-REE cation determinations have been completed on these samples. However, we were unable to overcome difficulties in the determination of the REE engendered by the very high total dissolved solids content of these fluids (143,000-201,000 mg L^{-1} chloride). The addition of ammonium hydroxide during ferric hydroxide co-precipitation resulted in the precipitation of silica and other solids containing high concentrations of Al, Zn, Pb and other metals in addition to the ferric hydroxide and REE. Thus, ferric hydroxide co-precipitation was incapable of effecting preconcentration and separation of the REE from matrix elements. The solvent extraction procedure was also unsuccessful because the high concentrations of other metals in the Salton Sea brines insured a lack of selectivity of the extractant for the

REE. Dilution followed by direct analysis by ICP-MS was not a viable option because the dilution factor required to eliminate matrix effects would have reduced the REE concentrations below the instrumental detection limits. The best technique for the accurate determination of the REE in these brines may be neutron activation analysis of the evaporated residue. However, this technique does not permit determination of all naturally occuring REE and the added expense was not permitted by the budget. Thus, the Salton Sea samples remain unanalyzed for REE.

Heber: Although the Heber fluids also contain quite high concentrations of dissolved solids (salinity = 13-15 per mil; 7800-9200 mg L^{-1} chloride), they are not as concentrated as the Salton Sea brines and we were able to determine their REE contents. It was possible to sample nine wells and the combined injection-brine return at Heber, thanks to the assistance of Sergio Cabanas. Samples were taken after liquid-vapor phase separation, i.e., they were not down-hole samples. The pH of the samples ranged from 6.7 to 8.1, and they were dominated by chloride, making these waters neutral-chloride type.

Most of the Heber fluids are characterized by a "Mexican-hat" type REE pattern (Figure 42), similar to those observed in the fluids from the Champagne Pool in New Zealand. The patterns are concave upward, with a strong positive Eu anomaly. The LREE side of the "brim" of the "hat" is more steeply turned upward than the HREE side. The overall REE contents are also of about the same order of magnitude as those of the Champagne Pool. The REE concentrations of the unfiltered aliquots are distinctly higher than those of the filtered aliquots, but the latter are well above the detection limit. The unfiltered aliquots from samples CA-087-99 and CA-088-99 do not exhibit Eu anomalies, but the filtered aliquots have positive Eu anomalies of the same magnitude as the samples from all the other wells. The REE systematics of the re-injection brine (CA-096-99) are indistinguishable from those of the fluids from production wells.

Palinpiñon, Philippines

Down-hole samples from Palinpiñon in the Philippines were provided by Kevin Brown and Andrew Rae. These samples had been acidified in the field. They were run at a 1X dilution and had sufficiently high levels of the REE that it was unnecessary to proceed with an extraction. The blanks are however, indistinguishable from the 1X detection limit and the Philippine samples are distinctly above the detection limit. The REE for the Philippines are within the range of REE concentrations found for some of the acid-sulfate fluids from New Zealand (Figures, 4-6) despite being near-neutral chloride in character (personal communication, Andrew Rae, October, 1999). The available data for these wells are summarized in the appendix. The Palinpiñon REE patterns bear some resemblence to those of Wairakei and Broadlands in having a slightly positive slope for the lowest REE pattern (Figures 8, 9, 20). The samples from well N1 and PN14 have similar REE patterns with an offset in magnitude which is progressively more depleted in the light REE as one views from heavy to light REE.

Well PN14 has a total depth of 3077.7 meters and is placed to take advantage of the upwelling thermal anomaly. PN14#1 and PN14#2 were sampled at 2300 and 2306 meters with quartz saturation temperatures of 296 and 310 °C, respectively. The pre-exploitation maximum temperature for well PN14 was 312 °C at 2700 meters depth. The post-exploitation maximum temperature dropped to 261 °C at 2900 meters depth. The quartz saturation temperatures reflect the pre-exploitation maximum temperatures for the PN14 well and show a temperature drop over 6 meters which is reflected in the REE as a 3-fold decrease of light REE from PN14#1 to PN14#2. The magnitude of the REE decrease becomes progressively larger from the heavy toward the light REE. The chloride contents of these samples increases only slightly in the PN14 well between the 2306 meter and 2300 depth from 8506 to 8608 mg/kg, respectively. This is in the appropriate direction for a conserved element if flashing is occurring over the interval.

Well N1 has a total depth of 603.3 meters and is placed to sample the outflow from the upwelling thermal anomaly. N1#1 and N1#3 were both sampled at 500 meters depth with quartz saturation temperatures of 233 and 270 °C, respectively. The pre-exploitation maximum temperature was 199 °C at 400 meters depth. The maximum post-exploitation temperature increased to 206 °C at 300 meters depth. The quartz saturation temperatures reflect somewhat higher temperatures than the pre-explotation maximum temperatures. Although the N1 well samples are taken at identical depths, the drop in quartz saturation temperature between N1#1 and N1#3 is matched by a depletion of REE which becomes progressively larger from the heavy to the light REE. Using chloride as a conserved element to track the amount of flashing does not seem to be appropriate for the N1 well. The chloride of sample fluid N1#3 is 7040 mg/kg and decreases to 5379 mg/kg in sample fluid N1#1. Because the N1 well is situated over the outflow the decrease in in both quartz saturation temperature and chloride content may be indicative of dilution by a cooler, low-chloride fluid.

The final interpretation of the chemical and thermal history of these fluids must wait for a more complete analysis of cations and anions. This analysis of down hole samples demonstrates that REE are apparently in solution at relatively shallow depths and are easily peturbed by relatively small changes in fluid conditions or depth in the same wells.

Dieng, Central Java, Indonesia

Will Osborne of Cal Energy arranged for us to receive fluid samples from two newly completed wells from the Dieng geothermal field in Java. These were obtained using a Weber separator, and consist of a mixture of unfiltered and filtered samples. Samples were obtained over the space of several days for each well. Unfortunately, the relatively small volume of these samples precluded an effective preconcentration and they were analyzed directly without pre-treatment. None of the samples contained REE above the instrumental detection limit.

EFFECT OF VAPOR-LIQUID PHASE SEPARATION ON REE

We have a number of reasons to suspect that steam loss may be causing loss of REE from the liquid phase to some sort of solid phase. These reasons include: 1) It is well known that release of acid volatiles such as CO_2 and H_2S during steam separation can cause pH to increase in the residual liquid. It is also well known that increased pH should lead to decreased solubility of REE-containing phases and/or increased adsorption or REE onto solid phases. Thus, from a purely theoretical standpoint, we might expect steam-loss to result in loss of REE; 2) All samples obtained using the Weber sampler (such samples have undergone phase separation) tended to have low absolute REE concentrations. Also, all samples from geysers, which have obviously also undergone phase separation, had low REE contents; 3) Down-hole samples, which were obtained prior to phase separation, tended to have higher REE concentrations than samples obtained using a Weber sampler. However, in the latter case the higher concentrations may result from contamination of the samples by REE-bearing ceramic material from which the sampler is constructed.

As a partial test of the hypothesis that REE might be lost to scale upon vapor-loss, we extracted REE from several scale samples. First, about a gram of scale was ground to a fine powder in an agate mortar and pestle. Then about 0.1 grams of the powdered scale were weighed out and leached with 20 mL of dilute acid (4% HNO_3:1% HCl) for an hour. The solid-liquid mixture was centrifuged, and the liquid decanted and saved for analysis. The solid residue was leached again in an additional 20-mL aliquot of the acid mixture overnight, and the liquid was then separated by centrifugation and analyzed. The acid mixture used for the leaching was the same one used to dissolve the ferric hydroxide co-precipitate during extraction of REE from water samples. We chose a relatively weak leachant so that the only REE that would be extracted from sinter would be the proportion that co-precipitated with relatively soluble minerals in the scale. We did not want to leach REE from minerals in particles of wall rock that had been entrained by the fluid and subsequently trapped in the scale. The results are reported in the EXCEL file Table_REE.xls on the accompanying CD. When expressed in terms of REE concentration in the original scale sample, the scale has typically 3 to 5 orders of magnitude higher concentrations of REE than the corresponding fluids. Also, the concentration of REE in the fluid from the first, shorter leach were typically higher, often by nearly an order of magnitude, than the concentration of REE in the fluid from the overnight leach. These results are consistent with the presence of significant REE in a readily soluble form in the scale samples. Thus, there does seem to be some support for the idea that REE may be lost via co-precipitation and/or adsorption onto scale during liquid-vapor phase separation.

Further development of the REE as an exploration/exploitation tool will require that the possibility of REE loss on phase separation be taken into account when sampling. Ideally, all samples from wells would be taken using a down-hole sampler. However, as noted above, the sampler used by Kevin Brown so successfully to sample fluids for precious metal (Ag, Au) analysis may be introducing REE contamination. The next logical step would be the development of a new down-hole sampler that would be contamination-free for the REE.

DISSEMINATION OF RESULTS OF THE STUDY

In addition to the quarterly reports to DOE, the results of this study have been reported in the following:

Refereed Conference Proceedings

Shannon, W.M., Wood, S.A., Brown, K., and Arehart, G. (2001) REE contents and speciation in geothermal fluids from New Zealand. In Cidu, R., ed., *Water-Rock Interaction.* Proceedings of the Tenth International Symposium on Water-Rock Interaction WRI-10, Villasimus, Italy, 10-15 July 2001. A.A. Balkema, Lisse, the Netherlands, p. 1001-1004.

Shannon, W.M., Wood, S.A., Brown, K., and Arehart, G. (1999) Preliminary measurements of concentrations of lanthanide elements in geothermal fluids from the Taupo Volcanic Zone, New Zealand. Proceedings, Twenty-Fourth Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, January 25-27, 1999. Stanford Geothermal Program Workshop Report SGP-TR-162, p. 227-235.

Published Conference Abstracts

Shannon, W.M., Wood, S.A., Brown, K. and Arehart, G. (2000) REE contents and speciation in geothermal fluids from New Zealand and the Philippines. Geol. Soc. Amer. Prog. w. Abstr., v. 32(7), p. A-188.

Wood, S.A., Shannon, W.M., Brown, K. and Arehart, G. (2000) Rare earth element (REE) contents of geothermal fluids from selected geologic environments. 31st International Geological Congress, Rio de Janeiro, Brazil, August 6-17, 2000. Abstracts volume (CD-ROM).

Shannon, W.M., Wood, S.A., Brown, K., Arehart, G., and Wright, M. (1999) REE contents of geothermal fluids from selected geologic environments. EOS (Trans. Amer. Geophys. Union), v. 80, p. F1187.

Shannon, W.M., Wood, S.A., Brown, K. and Arehart, G. (1999) REE contents of geothermal fluids from several geologic environments. Geol. Soc. Amer. Prog. w. Abstr., v. 31, p. A-351-A-352.

Unpublished oral presentations

Wood, S.A. (2000) The geochemistry of the rare earth elements in geothermal systems from New Zealand, the Philippines, and the western U.S. Presentation at the University of Nevada-Reno, November 9, 2000.

Wood, S.A. (2000) The geochemistry of the rare earth elements in geothermal systems from New Zealand, the Philippines, and the western U.S. Presentation at the University of Auckland, New Zealand, March, 2000.

In addition to the publications listed above, a number of manuscripts are in preparation for submission as refereed book chapters and refereed journal articles.

PERSONNEL

The key personnel on the project were the following: the PI, Scott A. Wood; co-PI's Kevin Brown and Greg Arehart; and postdoctoral researcher William Shannon. In addition, several undergraduate and graduate laboratory assistants have been employed as irregular help throughout the project (Chad Ross, Brittany Brown, Shara Leavitt, Erik Makus, Xiaoping Jin, Kate Fulcher, Anne Taunton, and Bethany Armstrong).

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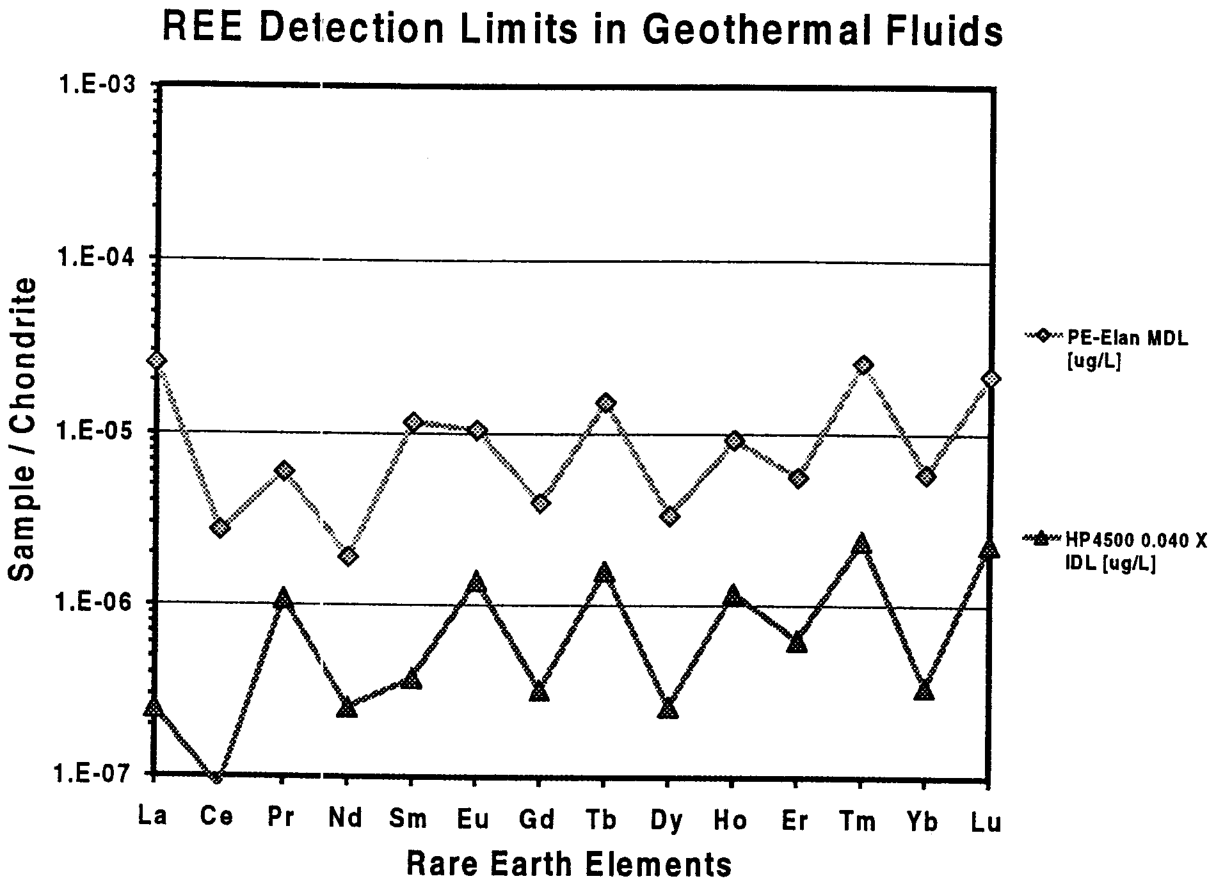
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1.E-04
1.E-05
1.E-06
1.E-07
Sample / Chondrite
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
PE-Elan MDL [ug/L]
HP4500 0.040 X IDL [ug/L]

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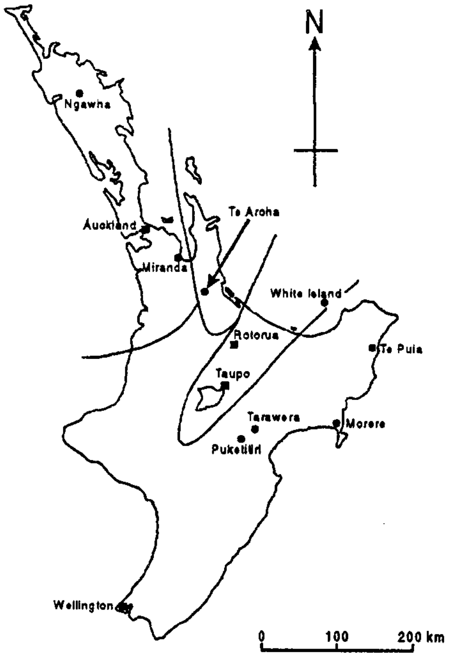

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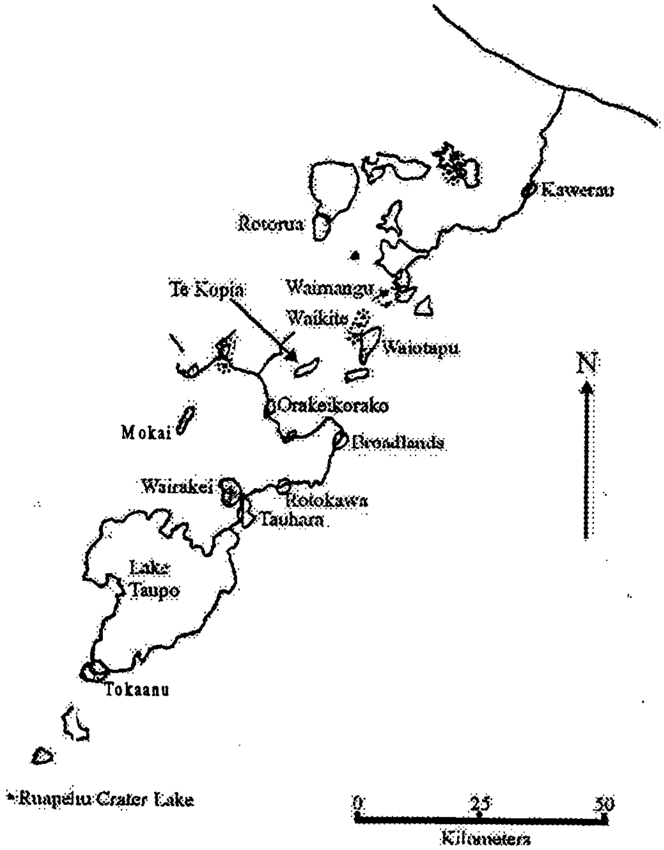

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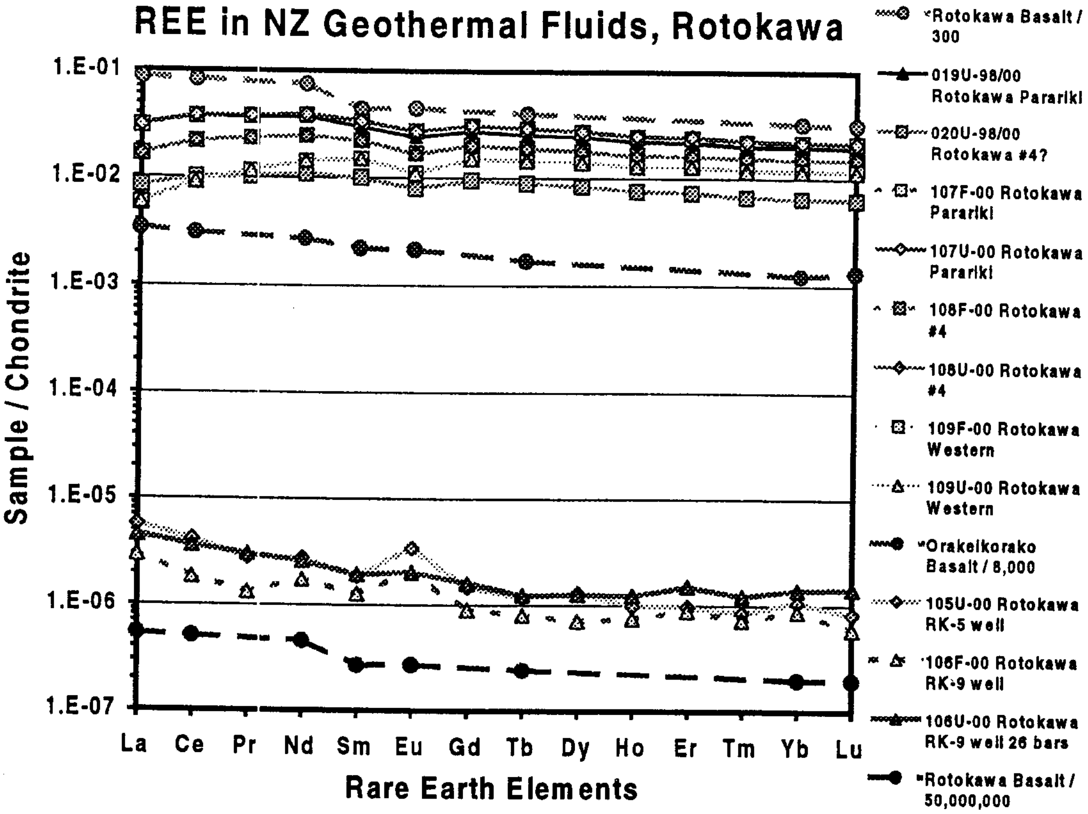
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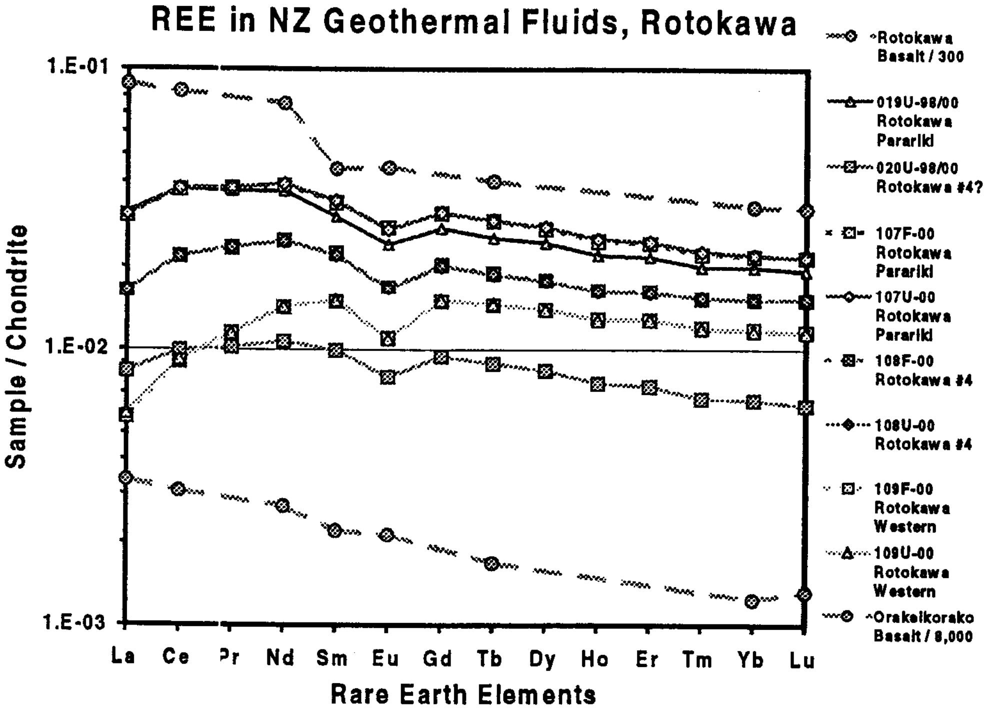
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
Sample / Chondrite
La Ce Pr Nd Sm Eu Gd Tb Dy Ho Er Tm Yb Lu
Rare Earth Elements
Rotokawa Basalt / 300
019U-98/00 Rotokawa Parariki
020U-98/00 Rotokawa #4?
107F-00 Rotokawa Parariki
107U-00 Rotokawa Parariki
108F-00 Rotokawa #4
108U-00 Rotokawa #4
109F-00 Rotokawa Western
109U-00 Rotokawa Western
Orakeikorako Basalt / 8,000
105U-00 Rotokawa RK-5 well
106F-00 Rotokawa RK-9 well
106U-00 Rotokawa RK-9 well 26 bars
Rotokawa Basalt / 50,000,000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1.E-02
1.E-03
Sample / Chondrite
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Rare Earth Elements
Rotokawa Basalt / 300
019U-98/00 Rotokawa Parariki
020U-98/00 Rotokawa #4?
107F-00 Rotokawa Parariki
107U-00 Rotokawa Parariki
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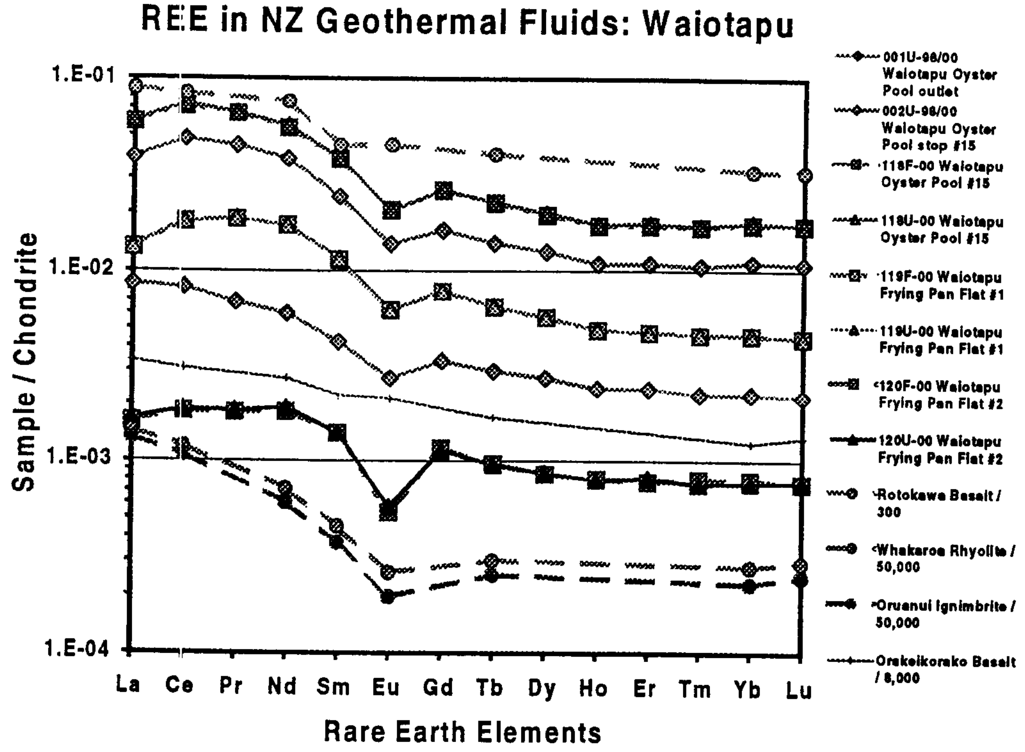
Orakeikorako Basalt / 8,000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1.E-03
1.E-04
Sample / Chondrite
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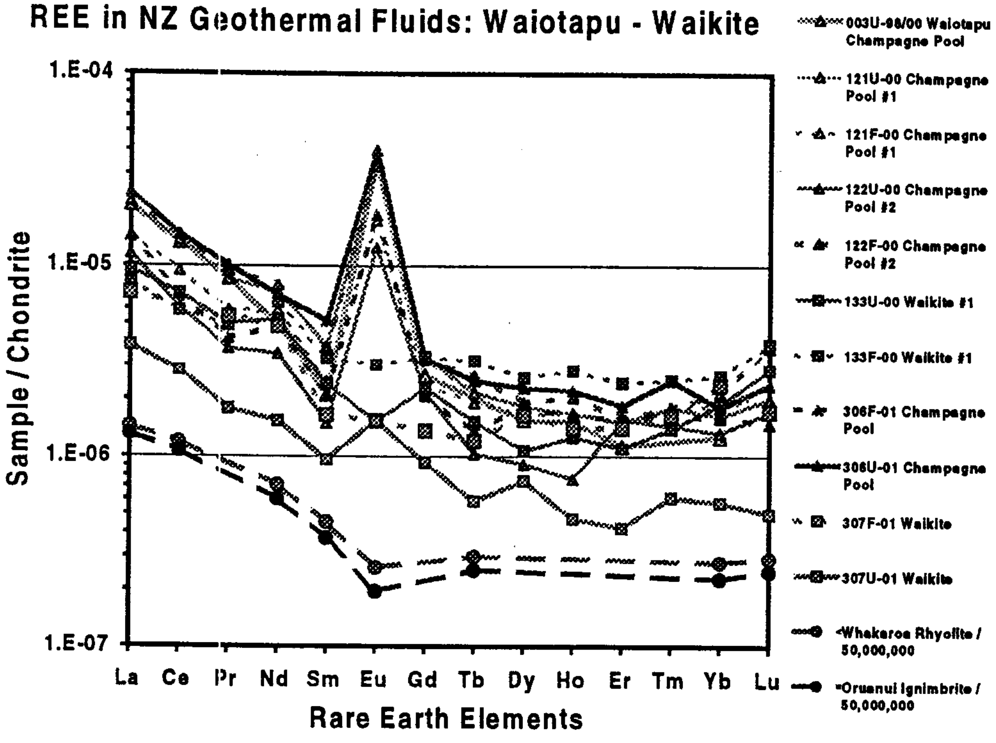
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
001U-98/00 Waiotapu Oyster Pool outlet
002U-98/00 Waiotapu Oyster Pool stop #15
118F-00 Waiotapu Oyster Pool #15
118U-00 Waiotapu Oyster Pool #15
119F-00 Waiotapu Frying Pan Flat #1
119U-00 Waiotapu Frying Pan Flat #1
120F-00 Waiotapu Frying Pan Flat #2
120U-00 Waiotapu Frying Pan Flat #2
Rotokawa Basalt / 300
Whakaroa Rhyolite / 50,000
Oruanui Ignimbrite / 50,000
Orakeikorako Basalt / 8,000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1.E-06
1.E-07
Sample / Chondrite
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Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
003U-98/00 Waiotapu Champagne Pool
121U-00 Champagne Pool #1
121F-00 Champagne Pool #1
122U-00 Champagne Pool #2
122F-00 Champagne Pool #2
133U-00 Waikite #1
133F-00 Waikite #1
306F-01 Champagne Pool
306U-01 Champagne Pool
307F-01 Waikite
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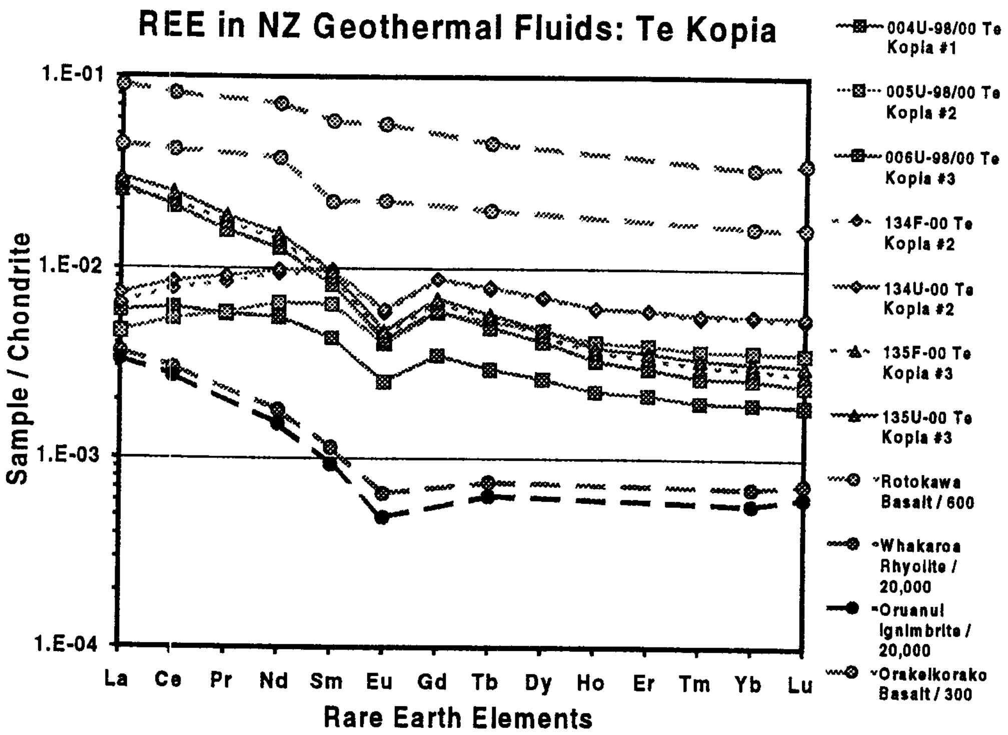
Whakaroa Rhyolite / 50,000,000
Oruanui Ignimbrite / 50,000,000



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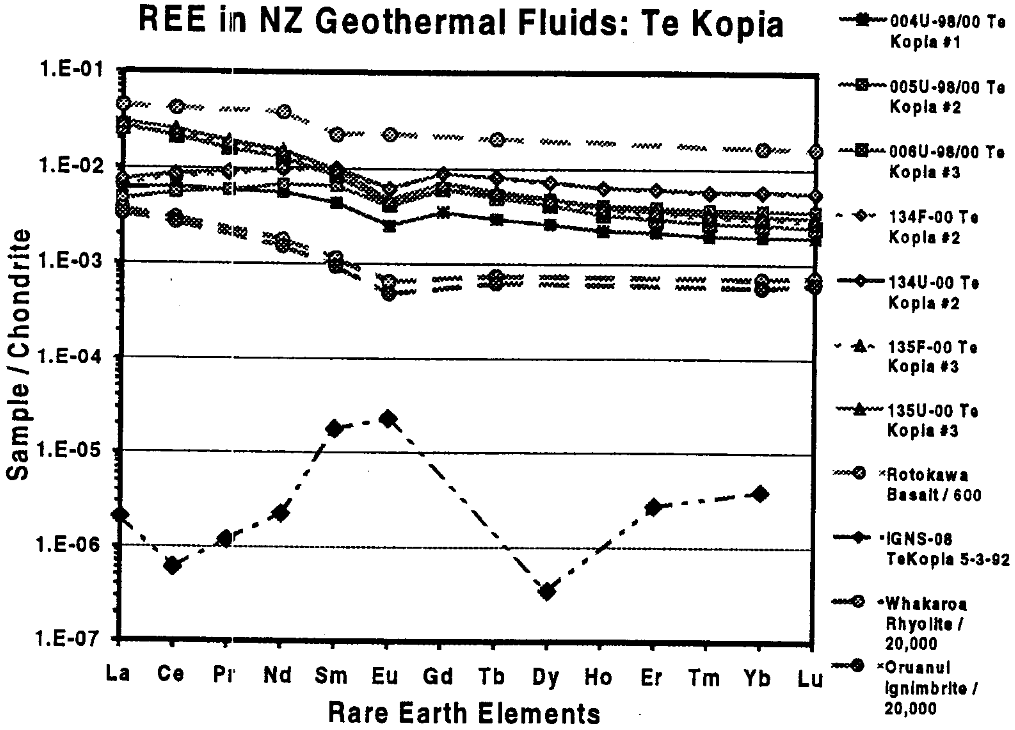

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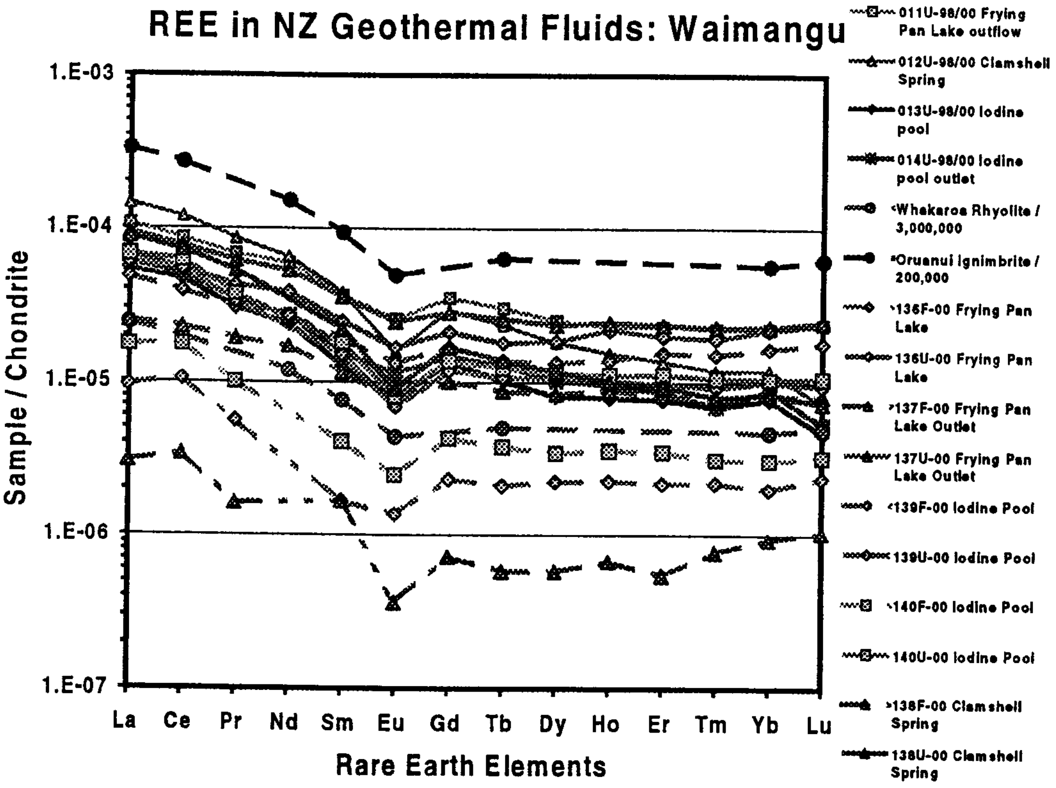
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1.E-04
1.E-05
1.E-06
1.E-07
Sample / Chondrite
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
011U-98/00 Frying Pan Lake outflow
012U-98/00 Clamshell Spring
013U-98/00 Iodine pool
014U-98/00 Iodine pool outlet
Whakaroa Rhyolite / 3,000,000
Oruanui Ignimbrite / 200,000
136F-00 Frying Pan Lake
136U-00 Frying Pan Lake
137F-00 Frying Pan Lake Outlet
137U-00 Frying Pan Lake Outlet
139F-00 Iodine Pool
139U-00 Iodine Pool
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140U-00 Iodine Pool
138F-00 Clamshell Spring
138U-00 Clamshell Spring

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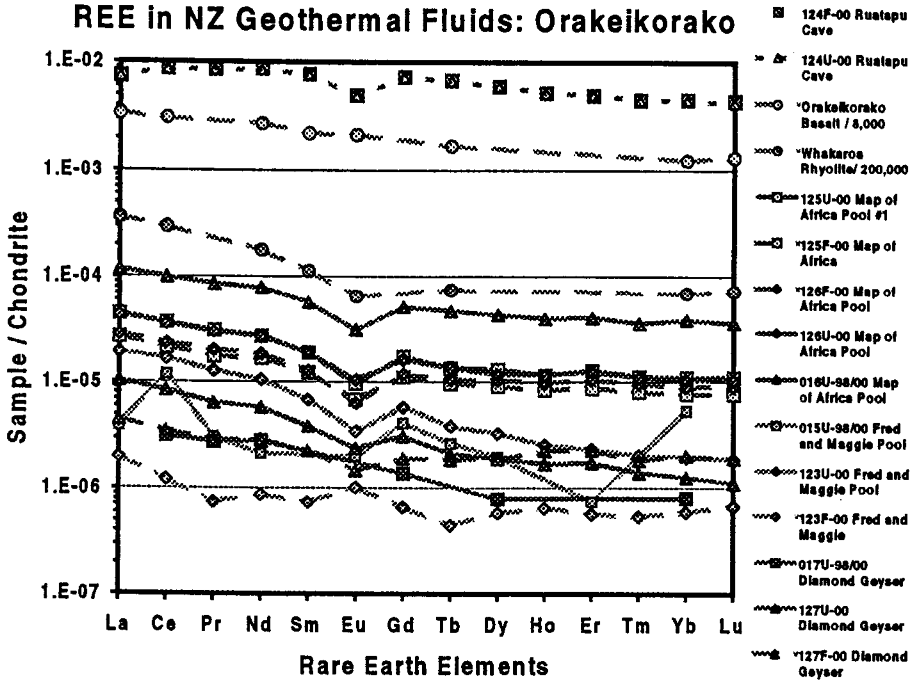
REE in NZ Geothermal Fluids: Orakeikorako
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1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
Sample / Chondrite
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
124F-00 Ruatapu Cave
124U-00 Ruatapu Cave
Orakeikorako Basalt / 8,000
Whakaroa Rhyolite/ 200,000
125U-00 Map of Africa Pool #1
125F-00 Map of Africa
126F-00 Map of Africa Pool
126U-00 Map of Africa Pool
016U-98/00 Map of Africa Pool
015U-98/00 Fred and Maggie Pool
123U-00 Fred and Maggie Pool
123F-00 Fred and Maggie
017U-98/00 Diamond Geyser
127U-00 Diamond Geyser
127F-00 Diamond Geyser

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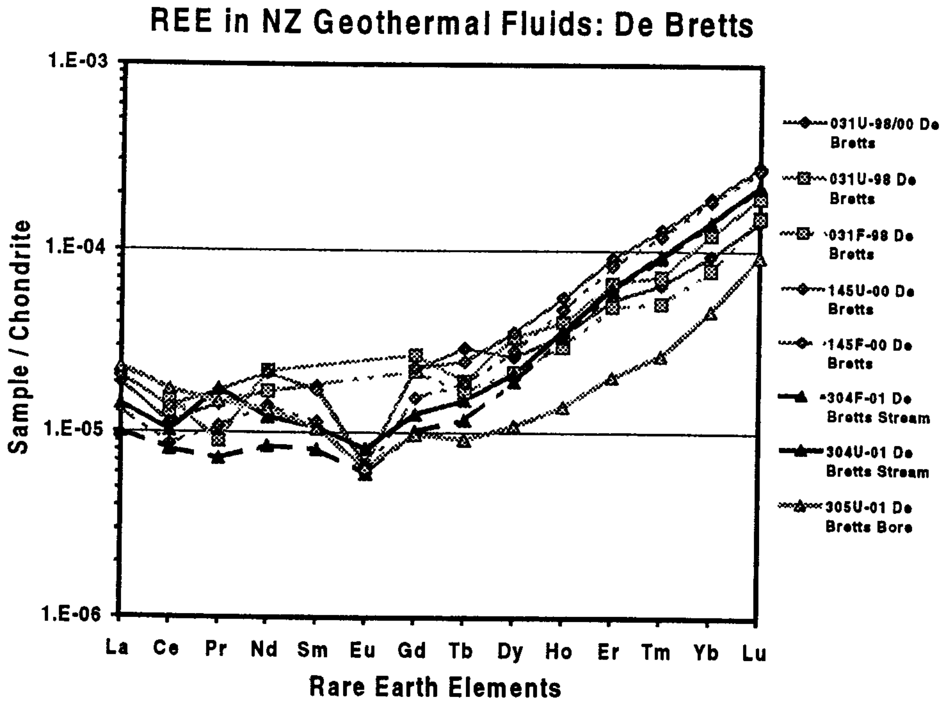
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Sample / Chondrite
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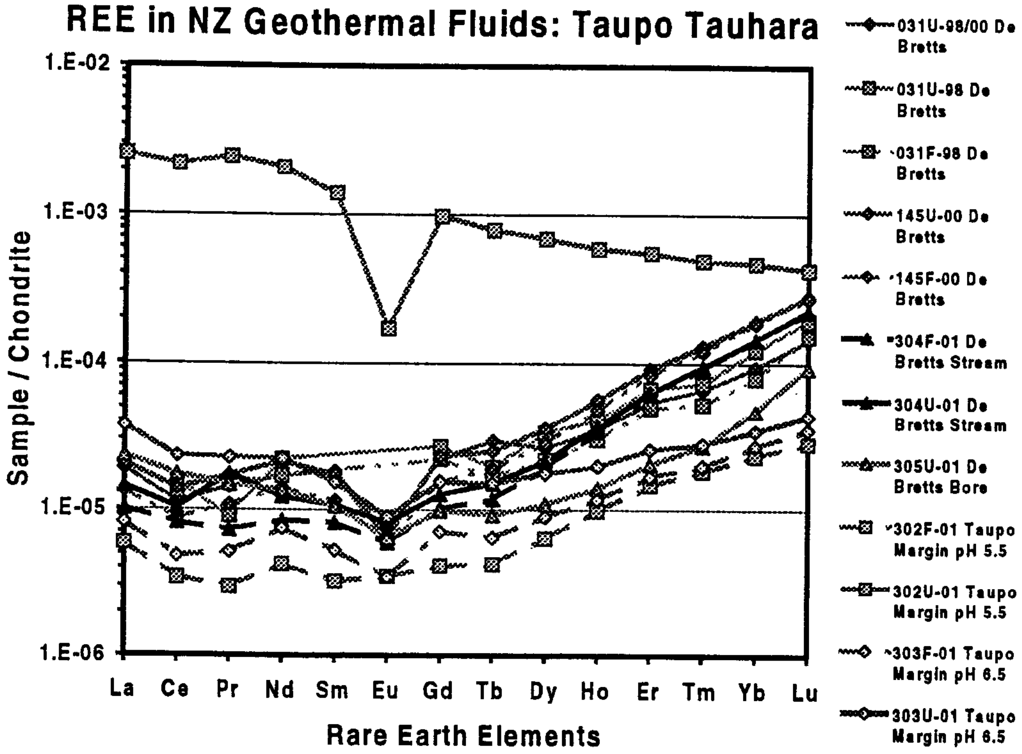
1.E-04
1.E-05
1.E-06
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
031U-98/00 De Bretts
031U-98 De Bretts
031F-98 De Bretts
145U-00 De Bretts
145F-00 De Bretts
304F-01 De Bretts Stream
304U-01 De Bretts Stream
305U-01 De Bretts Bore


REE in NZ Geothermal Fluids: Taupo Tauhara
Sample / Chondrite
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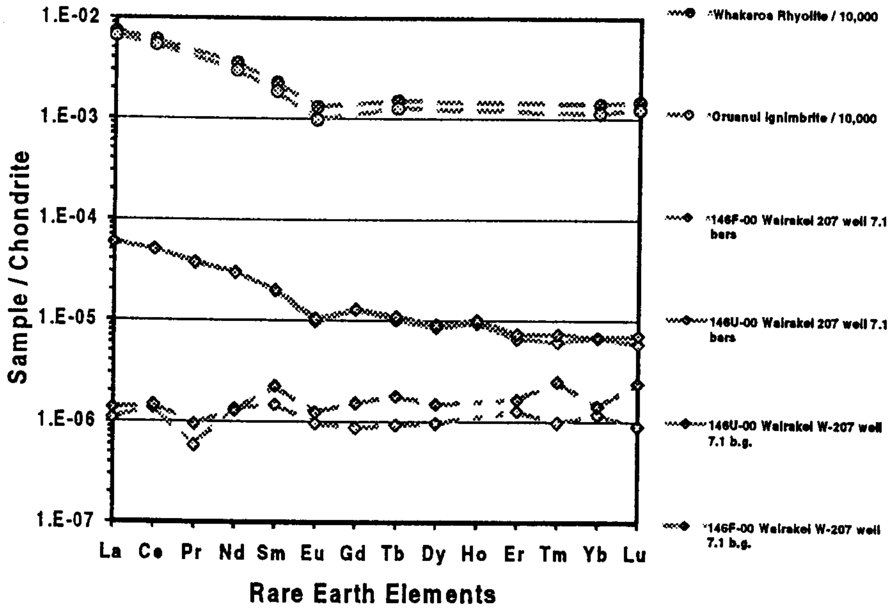
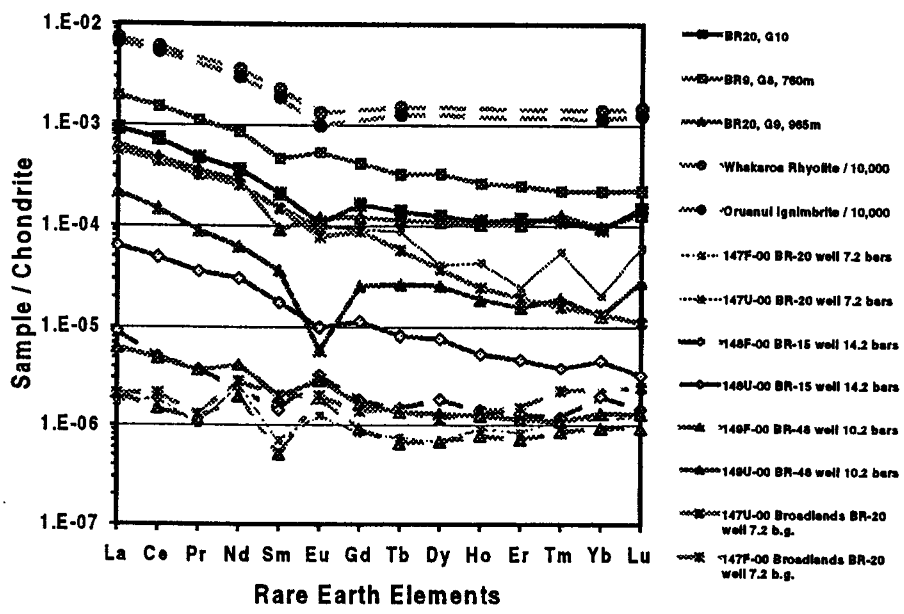
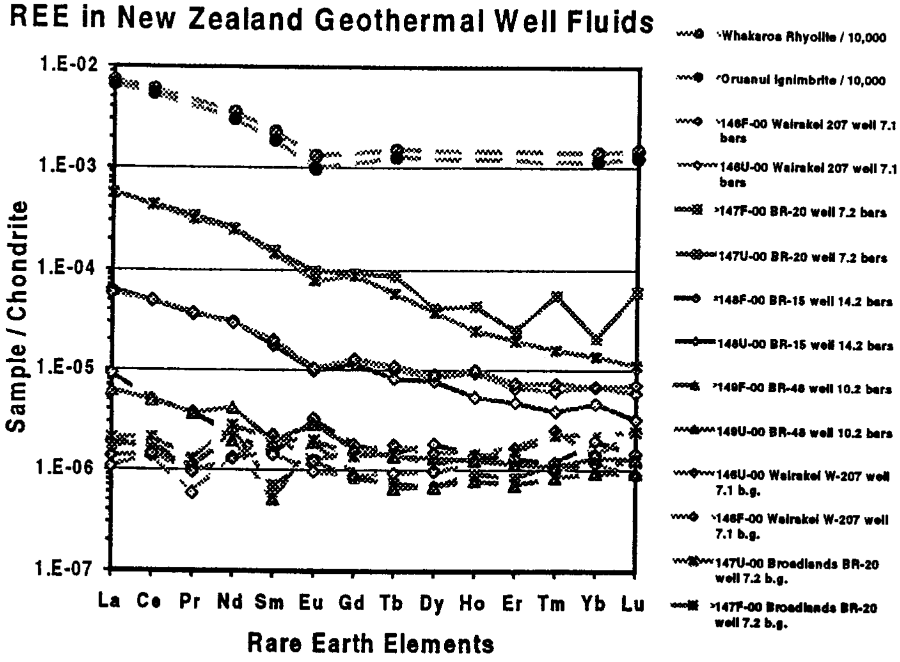
1.E-04
1.E-05
1.E-06
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
031U-98/00 De Bretts
031U-98 De Bretts
031F-98 De Bretts
145U-00 De Bretts
145F-00 De Bretts
304F-01 De Bretts Stream
304U-01 De Bretts Stream
305U-01 De Bretts Bore
302F-01 Taupo Margin pH 5.5
302U-01 Taupo Margin pH 5.5
303F-01 Taupo Margin pH 6.5
303U-01 Taupo Margin pH 6.5

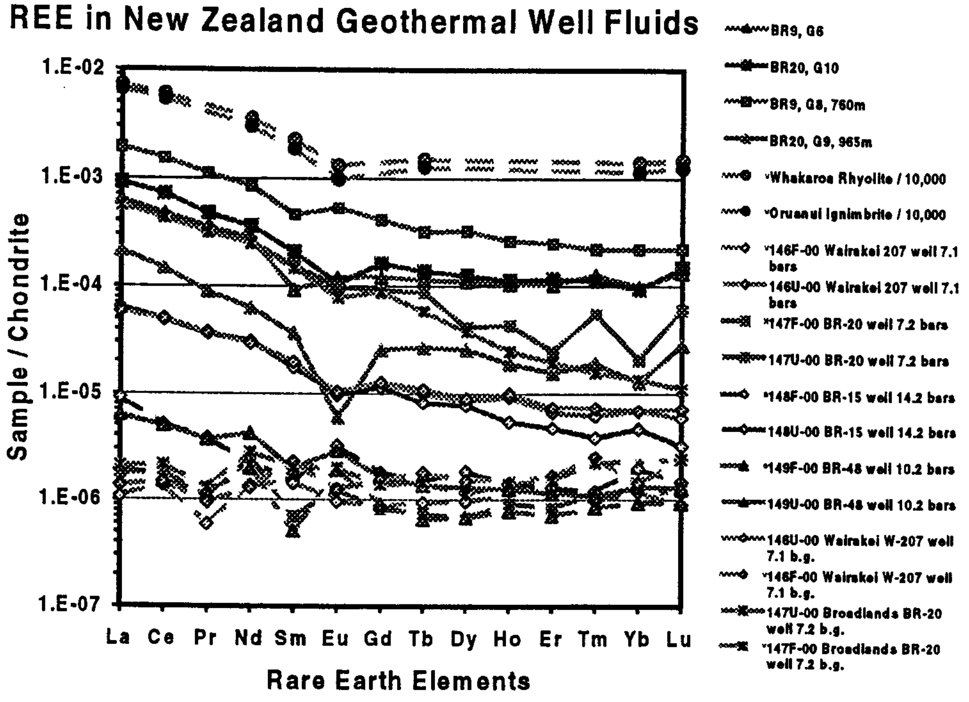
REE in New Zealand Geothermal Well Fluids

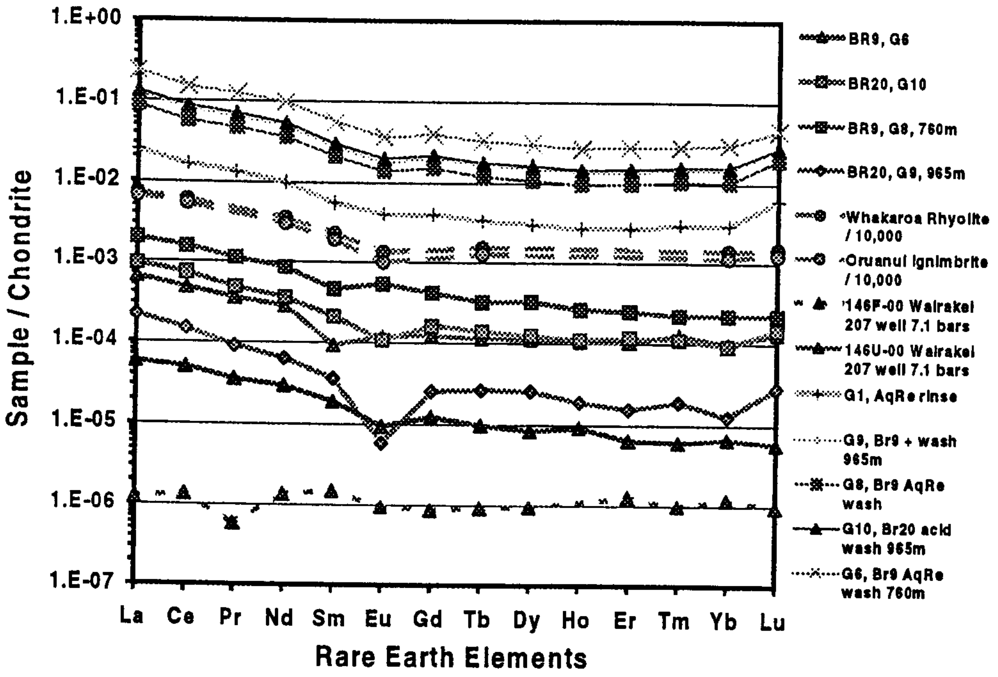


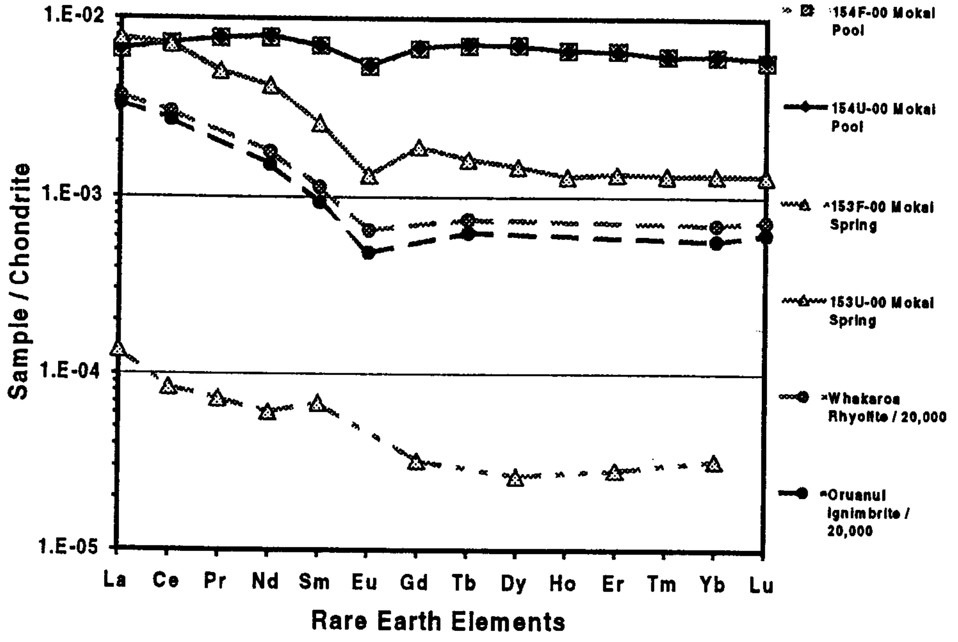
REE in New Zealand Geothermal Well Fluids

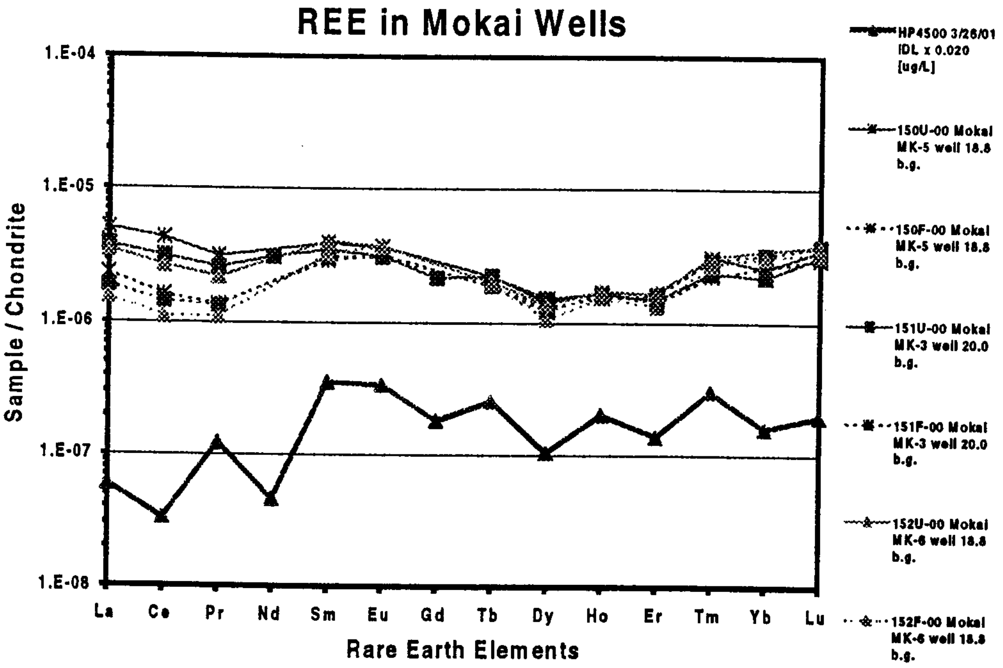


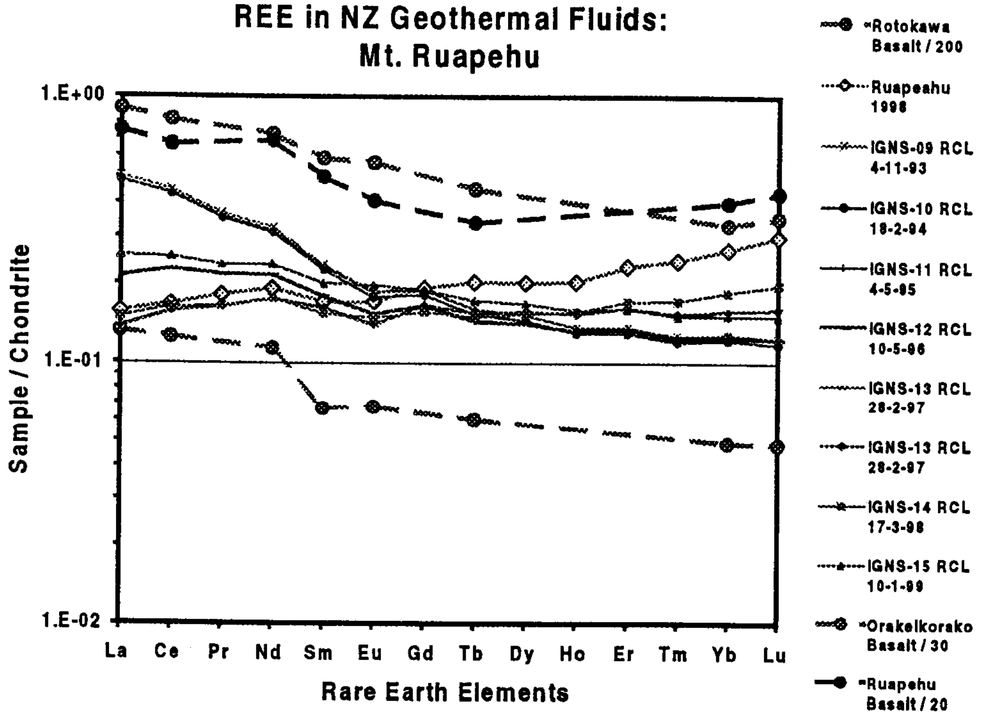

REE in New Zealand Geothermal Well Fluids
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
Sample / Chondrite
La Ce Pr Nd Sm Eu Gd Tb Dy Ho Er Tm Yb Lu
Rare Earth Elements
Whakaroa Rhyolite / 10,000
Oruanui Ignimbrite / 10,000
146F-00 Wairakei 207 well 7.1 bars
146U-00 Wairakei 207 well 7.1 bars
147F-00 BR-20 well 7.2 bars
147U-00 BR-20 well 7.2 bars
148F-00 BR-15 well 14.2 bars
148U-00 BR-15 well 14.2 bars
149F-00 BR-48 well 10.2 bars
149U-00 BR-48 well 10.2 bars
146U-00 Wairakei W-207 well 7.1 b.g.
146F-00 Wairakei W-207 well 7.1 b.g.
147U-00 Broadlands BR-20 well 7.2 b.g.
147F-00 Broadlands BR-20 well 7.2 b.g.


REE in New Zealand Geothermal Well Fluids
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
Sample / Chondrite
La Ce Pr Nd Sm Eu Gd Tb Dy Ho Er Tm Yb Lu
Rare Earth Elements
BR9, G6
BR20, G10
BR9, G8, 760m
BR20, G9, 965m
Whakaroa Rhyolite / 10,000
Oruanui Ignimbrite / 10,000
146F-00 Wairakei 207 well 7.1 bars
146U-00 Wairakei 207 well 7.1 bars
147F-00 BR-20 well 7.2 bars
147U-00 BR-20 well 7.2 bars
148F-00 BR-15 well 14.2 bars
148U-00 BR-15 well 14.2 bars
149F-00 BR-48 well 10.2 bars
149U-00 BR-48 well 10.2 bars
146U-00 Wairakei W-207 well 7.1 b.g.
146F-00 Wairakei W-207 well 7.1 b.g.
147U-00 Broadlands BR-20 well 7.2 b.g.
147F-00 Broadlands BR-20 well 7.2 b.g.

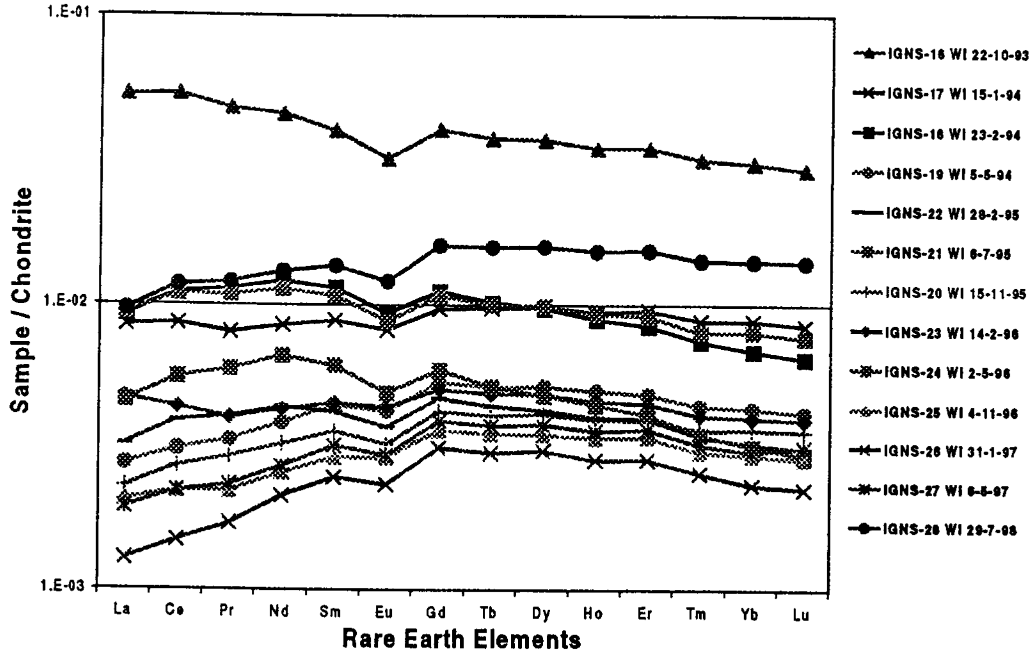

REE in New Zealand Geothermal Well Fluids

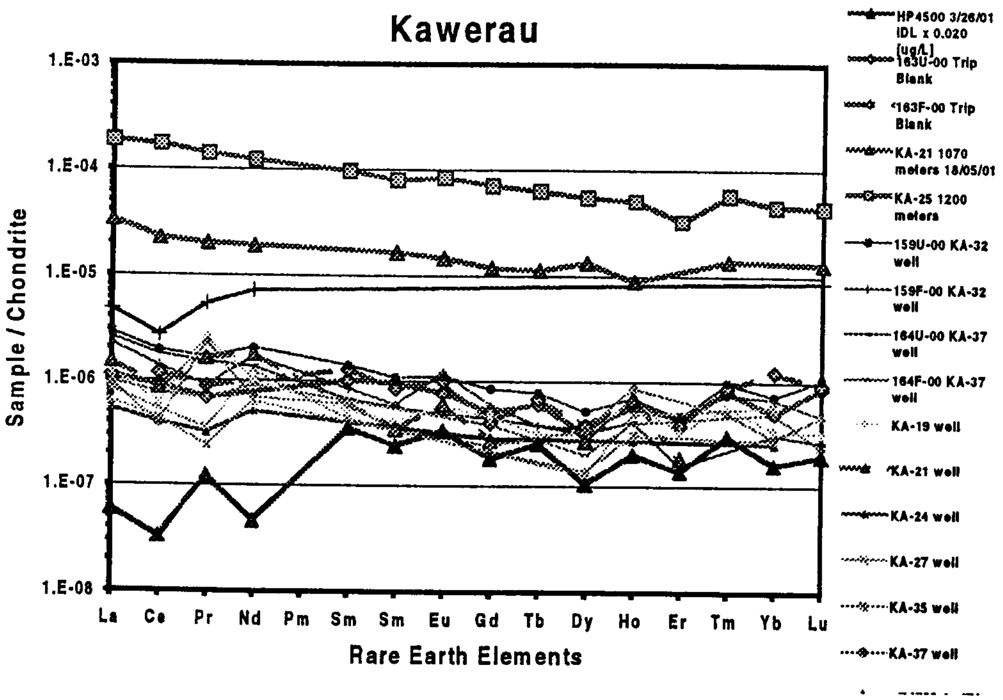

REE in NZ Geothermal Fluids: Mokai


REE in Mokai Wells

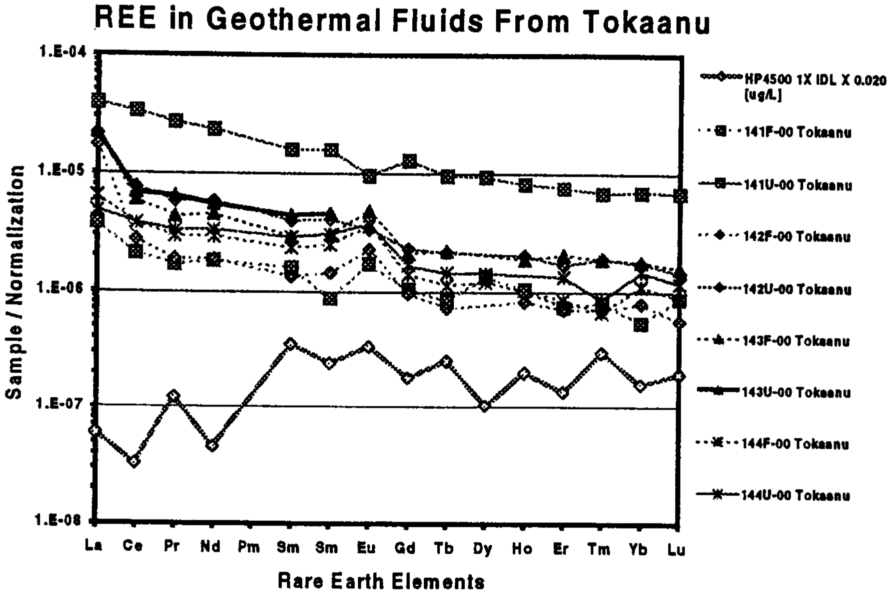

REE in NZ Geothermal Fluids: Mt. Ruapehu

REE in IGNS Library Geothermal Fluid Samples From White Island

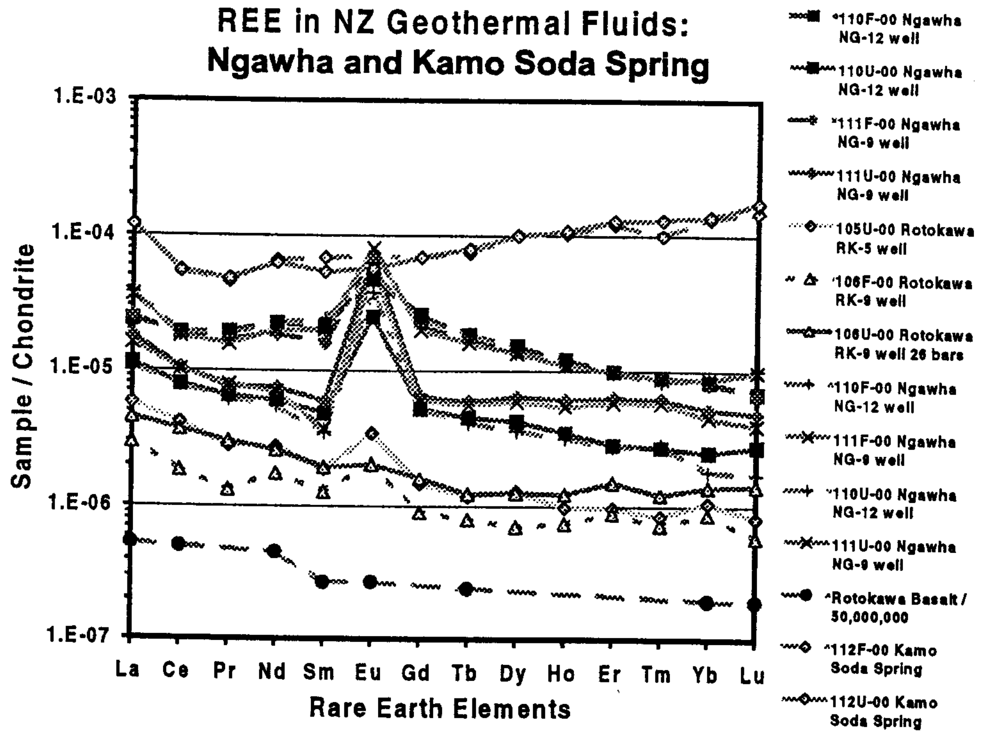


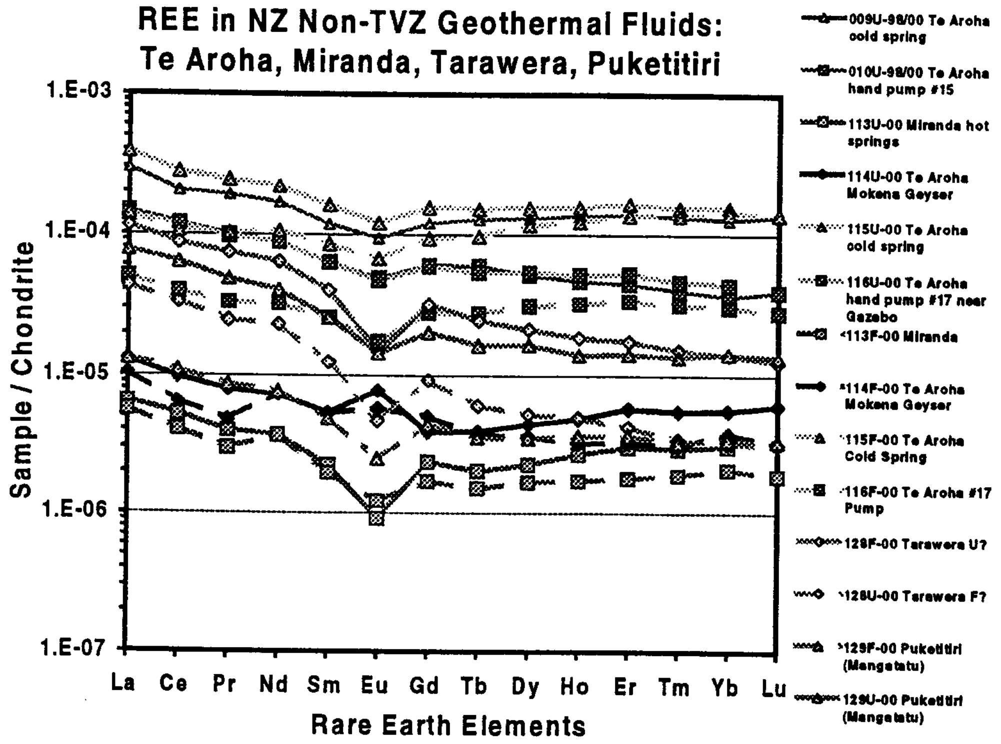

Kawerau
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
1.E-08
Sample / Chondrite
La
Ce
Pr
Nd
Pm
Sm
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
HP4500 3/26/01 IDL x 0.020 [ug/L]
163U-00 Trip Blank
163F-00 Trip Blank
KA-21 1070 meters 18/05/01
KA-25 1200 meters
159U-00 KA-32 well
159F-00 KA-32 well
164U-00 KA-37 well
164F-00 KA-37 well
KA-19 well
KA-21 well
KA-24 well
KA-27 well
KA-35 well
KA-37 well

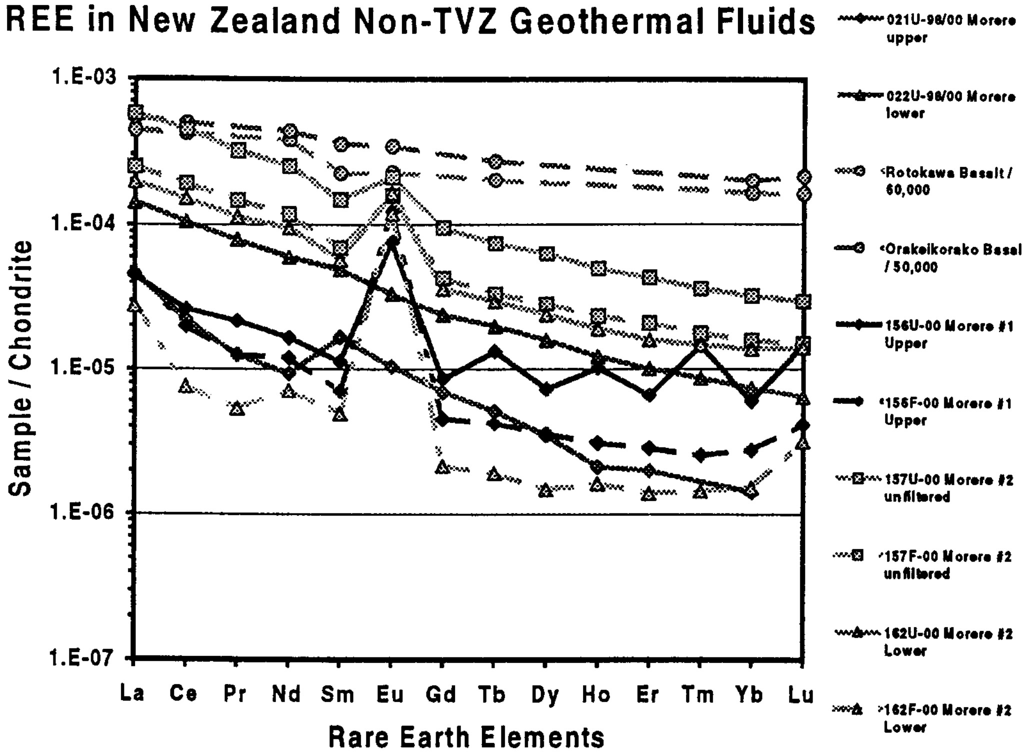
[illegible]

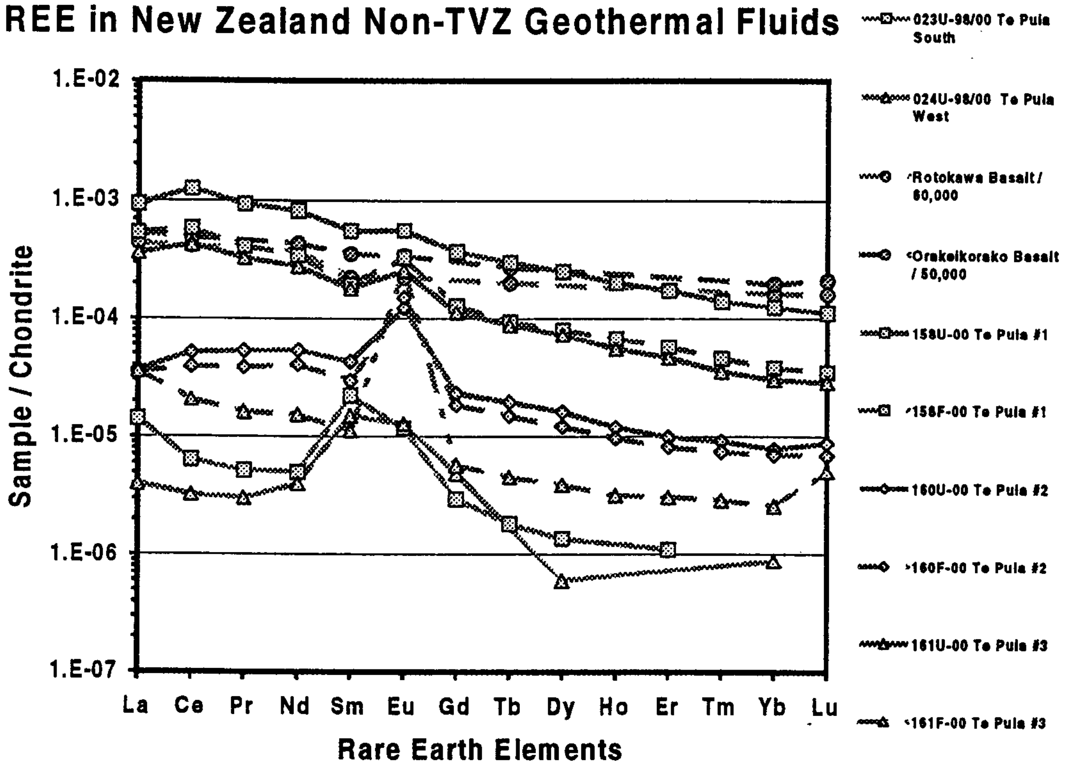

REE in Geothermal Fluids From Tokaanu
1.E-04
1.E-05
1.E-06
1.E-07
1.E-08
Sample / Normalization
La
Ce
Pr
Nd
Pm
Sm
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
HP4500 1X IDL X 0.020 [ug/L]
141F-00 Tokaanu
141U-00 Tokaanu
142F-00 Tokaanu
142U-00 Tokaanu
143F-00 Tokaanu
143U-00 Tokaanu
144F-00 Tokaanu
144U-00 Tokaanu

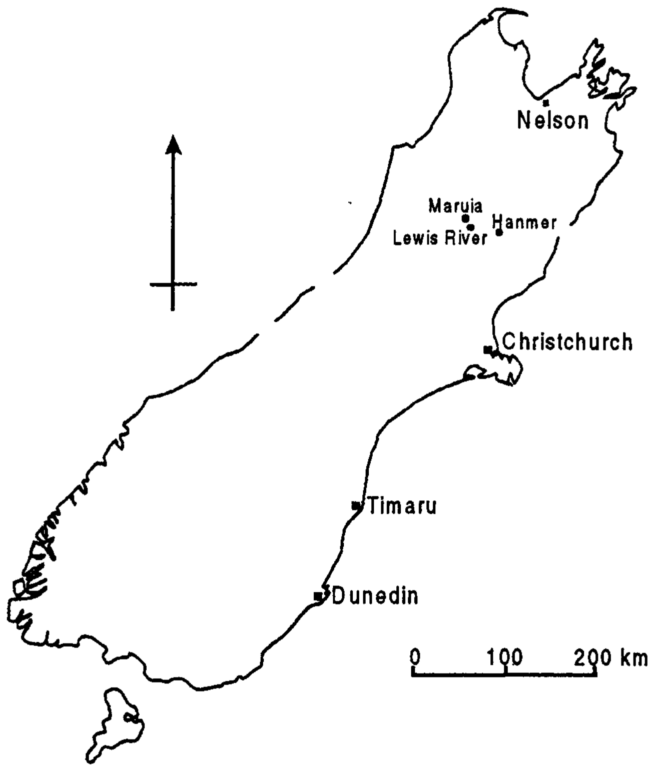
[illegible]

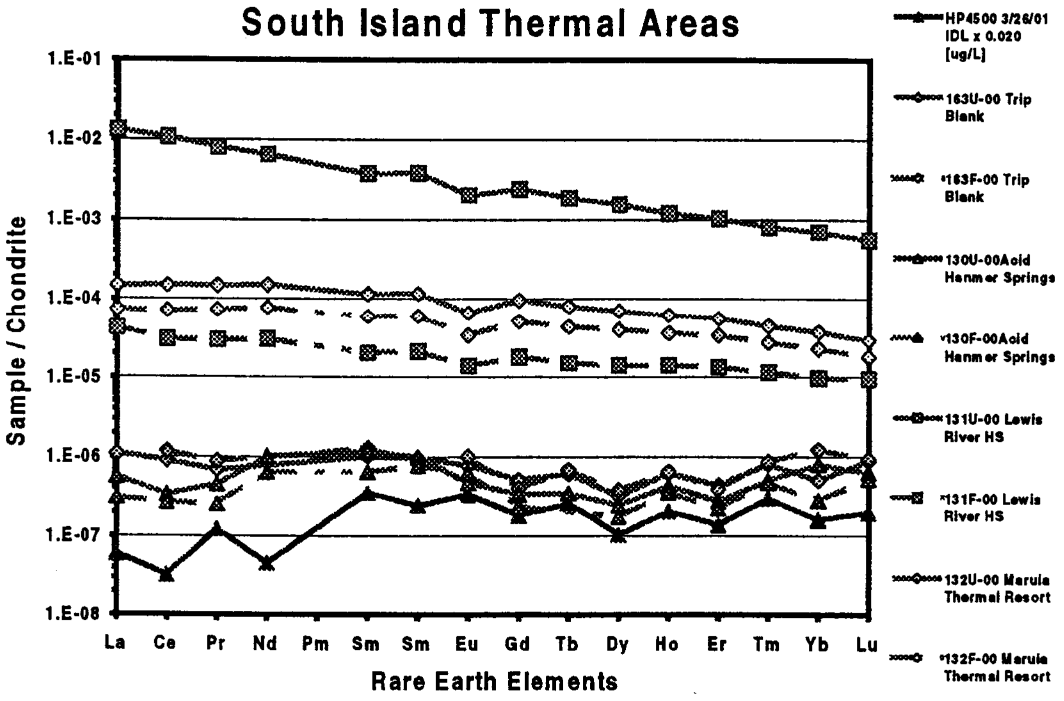

REE in NZ Geothermal Fluids: Ngawha and Kamo Soda Spring

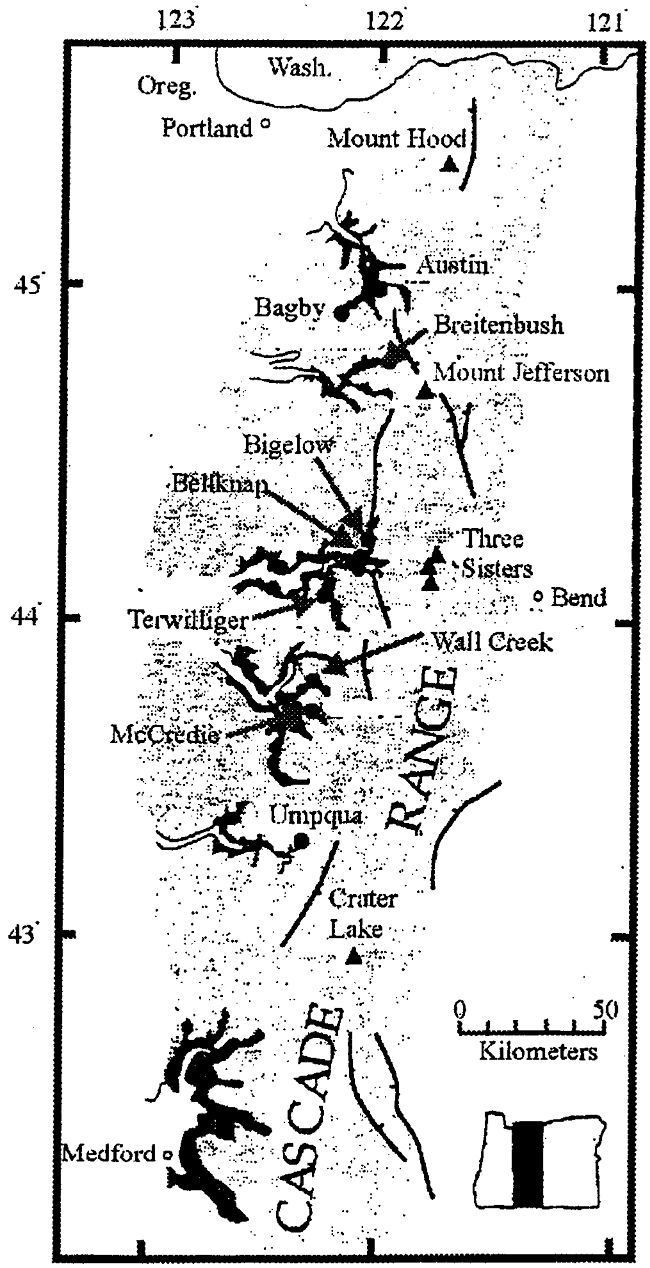

REE in NZ Non-TVZ Geothermal Fluids: Te Aroha, Miranda, Tarawera, Puketitiri


REE in New Zealand Non-TVZ Geothermal Fluids
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
Sample / Chondrite
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
021U-98/00 Morere upper
022U-98/00 Morere lower
Rotokawa Basalt / 60,000
Orakeikorako Basalt / 50,000
156U-00 Morere #1 Upper
156F-00 Morere #1 Upper
157U-00 Morere #2 unfiltered
157F-00 Morere #2 unfiltered
162U-00 Morere #2 Lower
162F-00 Morere #2 Lower

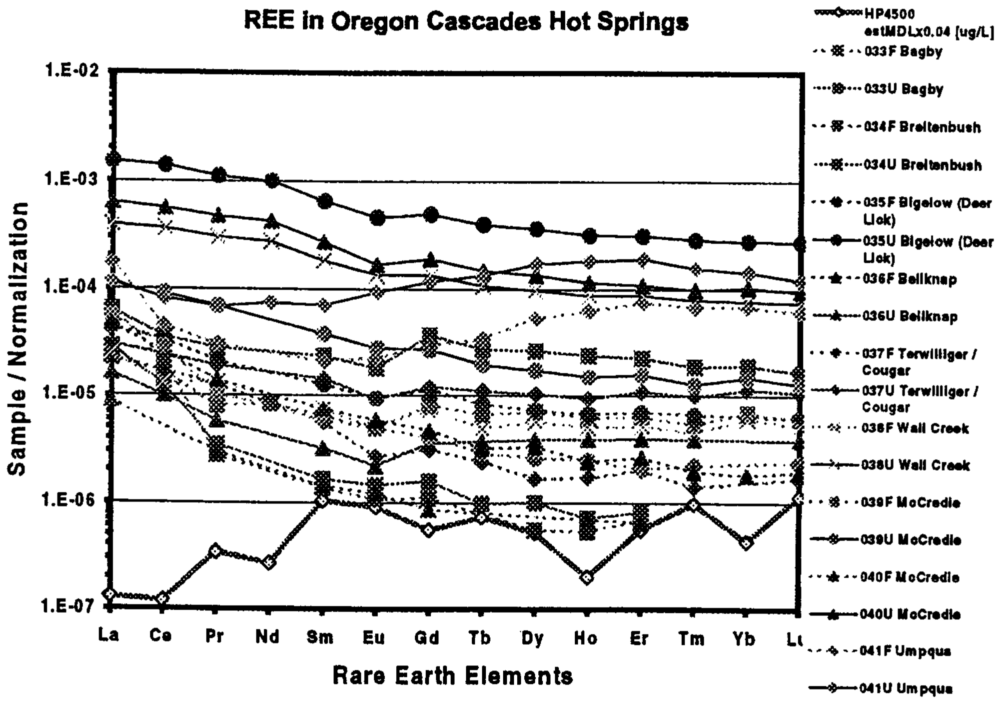

REE in New Zealand Non-TVZ Geothermal Fluids
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
Sample / Chondrite
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
023U-98/00 Te Pula South
024U-98/00 Te Pula West
Rotokawa Basalt / 60,000
Orakeikorako Basalt / 50,000
158U-00 Te Pula #1
158F-00 Te Pula #1
160U-00 Te Pula #2
160F-00 Te Pula #2
161U-00 Te Pula #3
161F-00 Te Pula #3

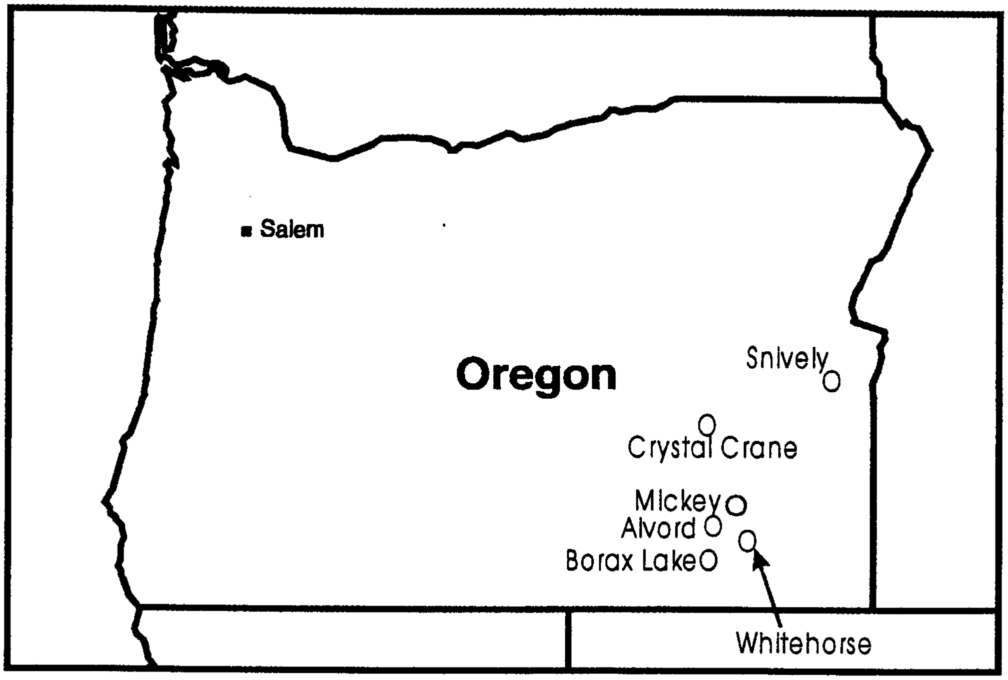

Nelson
Maruia
Hanmer
Lewis River
Christchurch
Timaru
Dunedin
0
100
200 km

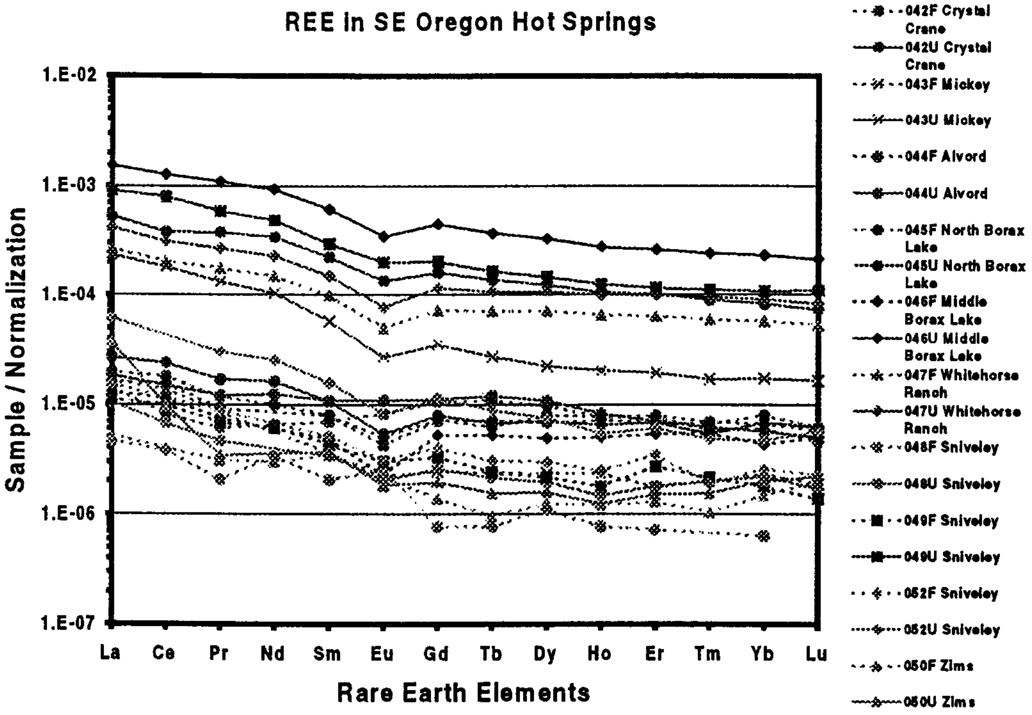

South Island Thermal Areas
1.E-01
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
1.E-08
Sample / Chondrite
La
Ce
Pr
Nd
Pm
Sm
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
HP4500 3/26/01 IDL x 0.020 [ug/L]
163U-00 Trip Blank
163F-00 Trip Blank
130U-00Acid Hanmer Springs
130F-00Acid Hanmer Springs
131U-00 Lewis River HS
131F-00 Lewis River HS
132U-00 Maruia Thermal Resort
132F-00 Maruia Thermal Resort

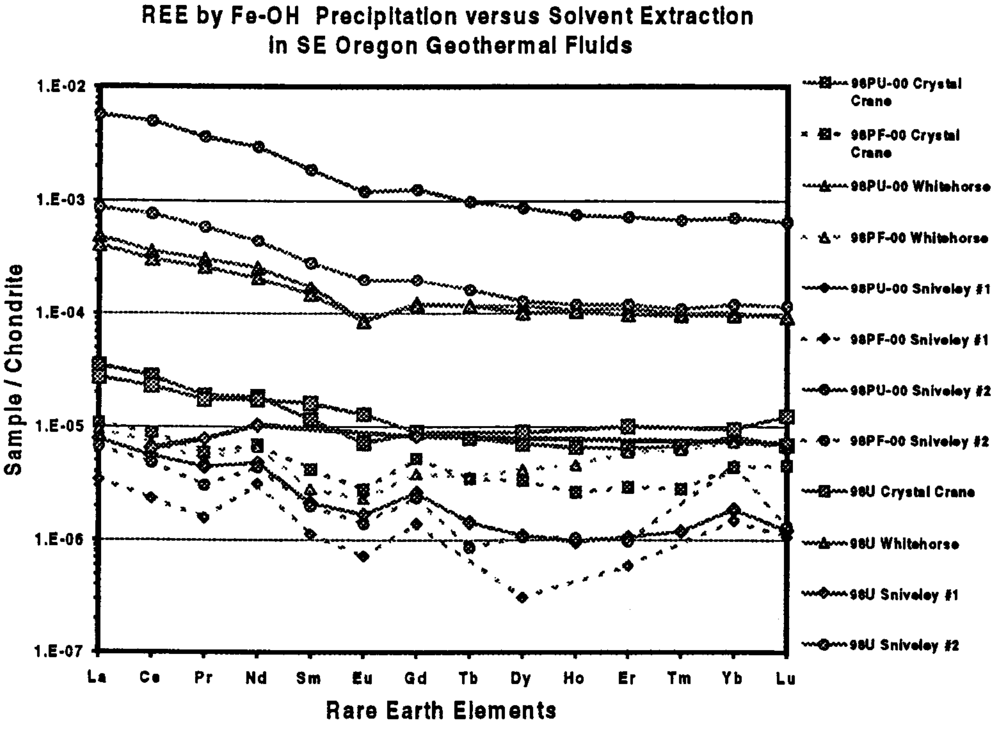

123°
122°
121°
45°
44°
43°
Wash.
Oreg.
Portland
Mount Hood
Austin
Bagby
Breitenbush
Mount Jefferson
Bigelow
Belknap
Three Sisters
Bend
Terwilliger
Wall Creek
McCredie
Umpqua
Crater Lake
CASCADE RANGE
0 50
Kilometers
Medford

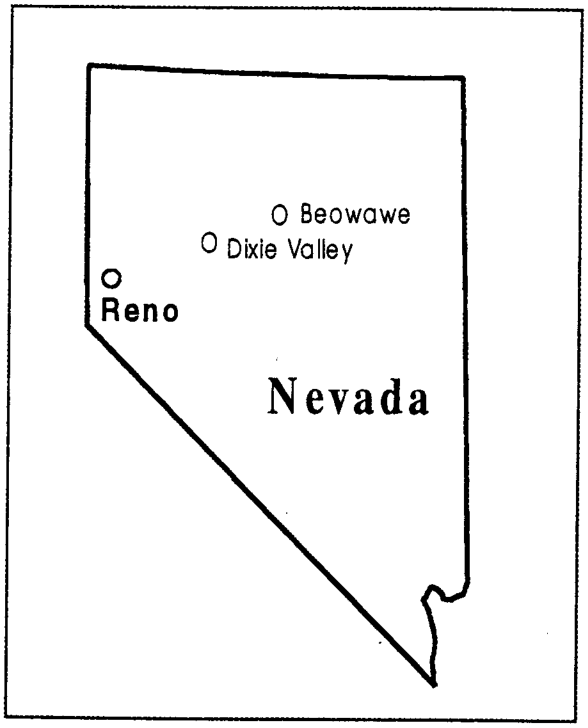
D

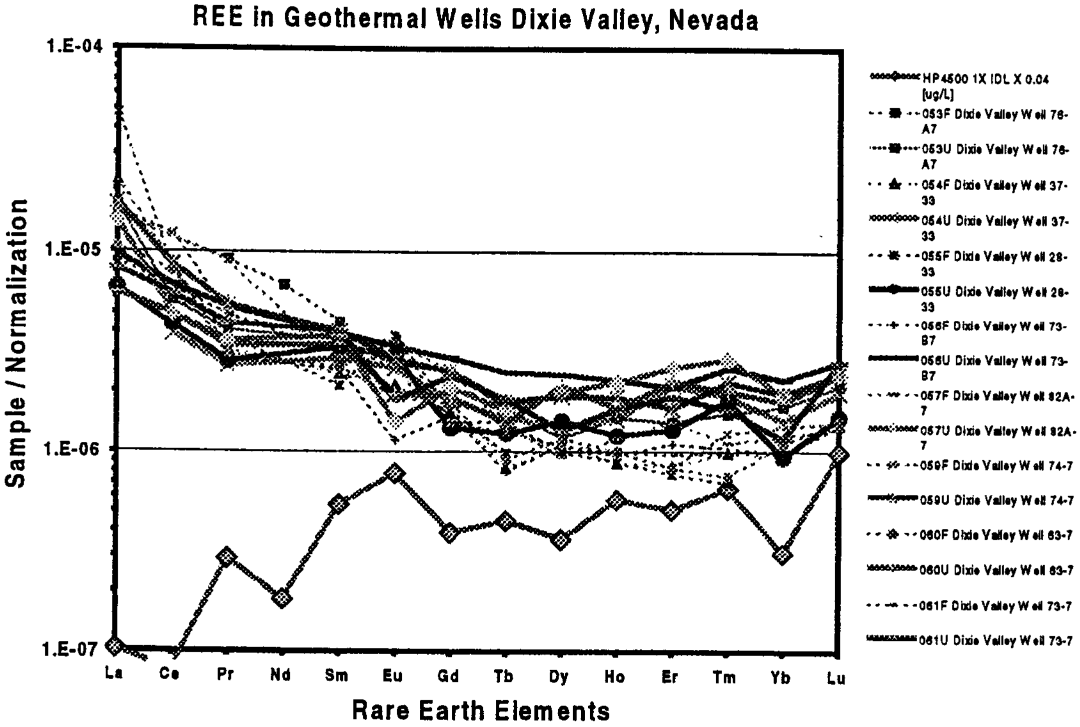

REE in Oregon Cascades Hot Springs
Sample / Normalization
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
HP4500 estMDLx0.04 [ug/L]
033F Bagby
033U Bagby
034F Breitenbush
034U Breitenbush
035F Bigelow (Deer Lick)
035U Bigelow (Deer Lick)
036F Bellknap
036U Bellknap
037F Terwilliger / Cougar
037U Terwilliger / Cougar
038F Wall Creek
038U Wall Creek
039F McCredie
039U McCredie
040F McCredie
040U McCredie
041F Umpqua
041U Umpqua

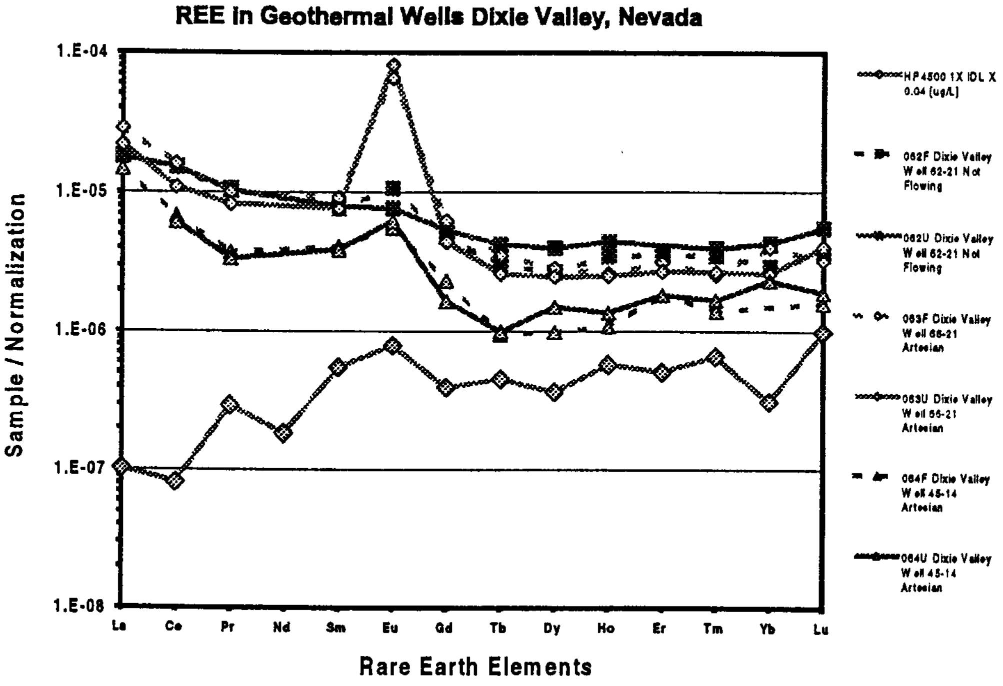

Salem
Oregon
Snively
Crystal Crane
Mickey
Alvord
Borax Lake
Whitehorse

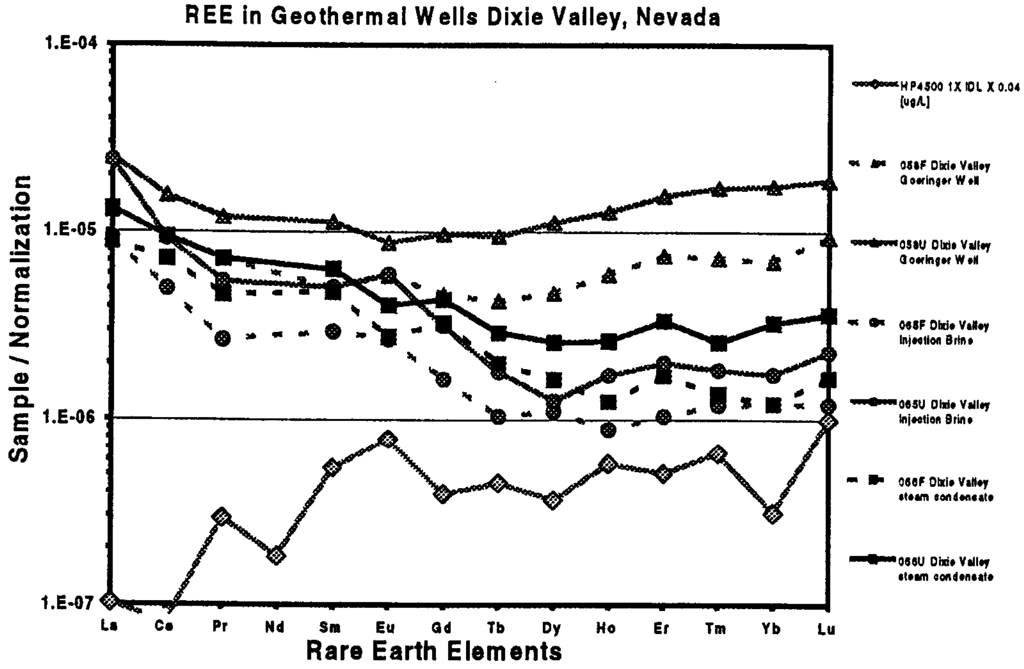

REE in SE Oregon Hot Springs
Sample / Normalization
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
042F Crystal Crane
042U Crystal Crane
043F Mickey
043U Mickey
044F Alvord
044U Alvord
045F North Borax Lake
045U North Borax Lake
046F Middle Borax Lake
046U Middle Borax Lake
047F Whitehorse Ranch
047U Whitehorse Ranch
048F Sniveley
048U Sniveley
049F Sniveley
049U Sniveley
052F Sniveley
052U Sniveley
050F Zims
050U Zims


REE by Fe-OH Precipitation versus Solvent Extraction
in SE Oregon Geothermal Fluids
Sample / Chondrite
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
98PU-00 Crystal Crane
98PF-00 Crystal Crane
98PU-00 Whitehorse
98PF-00 Whitehorse
98PU-00 Sniveley #1
98PF-00 Sniveley #1
98PU-00 Sniveley #2
98PF-00 Sniveley #2
98U Crystal Crane
98U Whitehorse
98U Sniveley #1
98U Sniveley #2

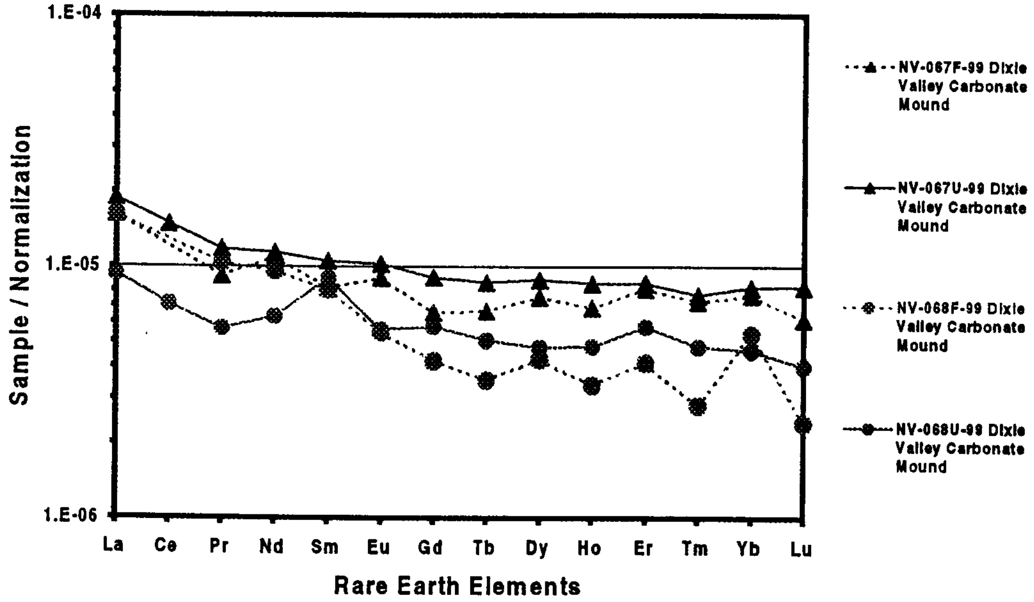

Beowawe
Dixie Valley
Reno
Nevada


REE in Geothermal Wells Dixie Valley, Nevada
1.E-04
1.E-05
1.E-06
1.E-07
Sample / Normalization
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
HP4500 1X IDL X 0.04 [ug/L]
053F Dixie Valley Well 76-A7
053U Dixie Valley Well 76-A7
054F Dixie Valley Well 37-33
054U Dixie Valley Well 37-33
055F Dixie Valley Well 28-33
055U Dixie Valley Well 28-33
056F Dixie Valley Well 73-B7
056U Dixie Valley Well 73-B7
057F Dixie Valley Well 82A-7
057U Dixie Valley Well 82A-7
059F Dixie Valley Well 74-7
059U Dixie Valley Well 74-7
060F Dixie Valley Well 63-7
060U Dixie Valley Well 63-7
061F Dixie Valley Well 73-7
061U Dixie Valley Well 73-7

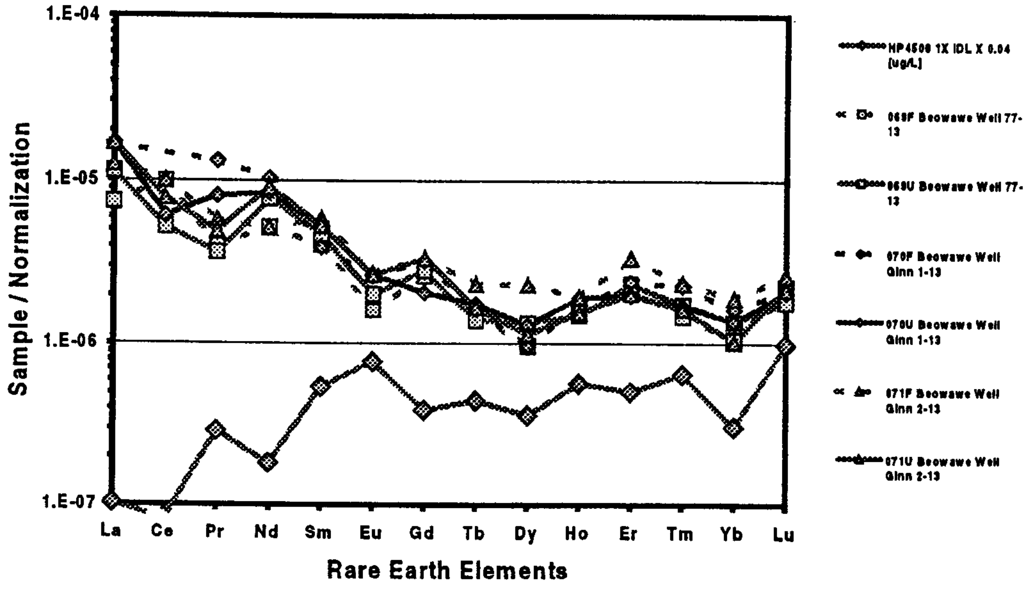

REE in Geothermal Wells Dixie Valley, Nevada
Sample / Normalization
1.E-04
1.E-05
1.E-06
1.E-07
1.E-08
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
HP4500 1X IDL X 0.04 (ug/L)
062F Dixie Valley Well 62-21 Not Flowing
062U Dixie Valley Well 62-21 Not Flowing
063F Dixie Valley Well 66-21 Artesian
063U Dixie Valley Well 66-21 Artesian
064F Dixie Valley Well 45-14 Artesian
064U Dixie Valley Well 45-14 Artesian

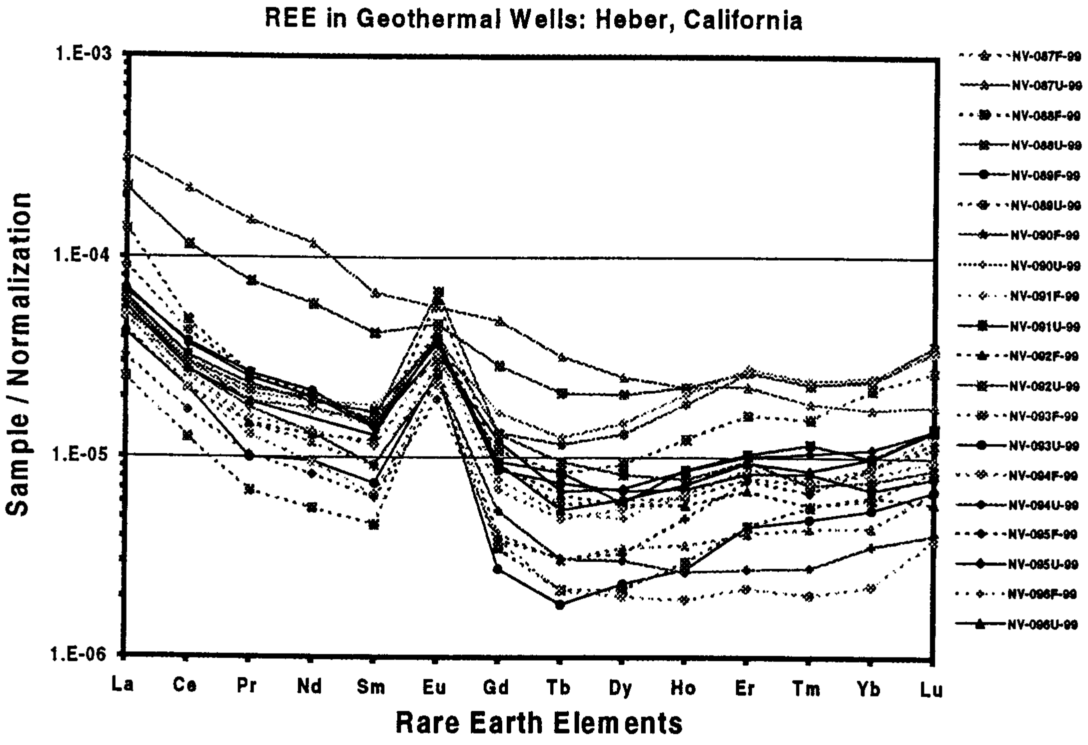

REE in Geothermal Wells Dixie Valley, Nevada
Sample / Normalization
1.E-04
1.E-05
1.E-06
1.E-07
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
HP4500 1X IDL X 0.04 (ug/L)
058F Dixie Valley Goeringer Well
058U Dixie Valley Goeringer Well
065F Dixie Valley Injection Brine
065U Dixie Valley Injection Brine
066F Dixie Valley steam condensate
066U Dixie Valley steam condensate

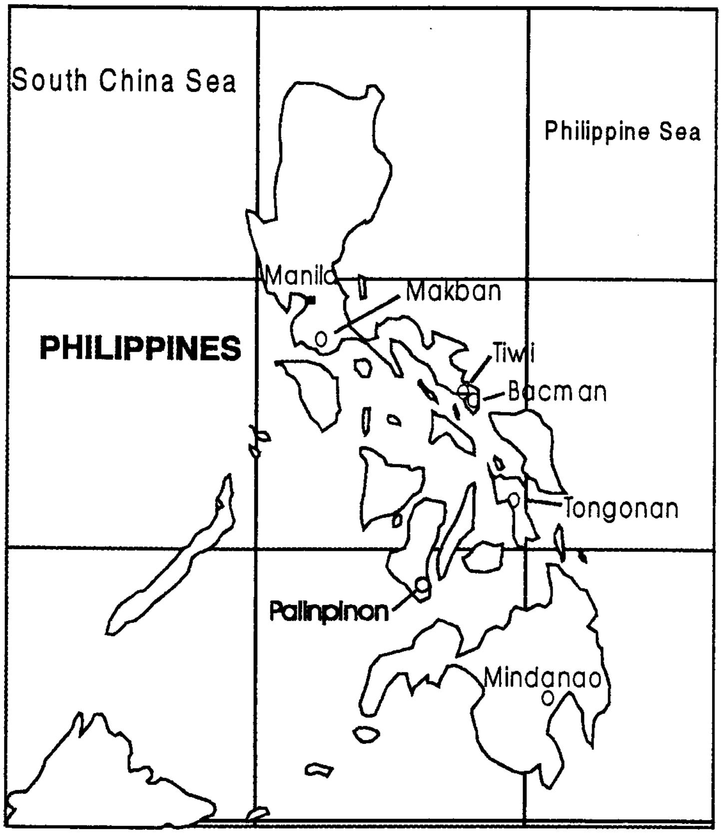
Carbonate Mounds, Dixie Valley, Nevada



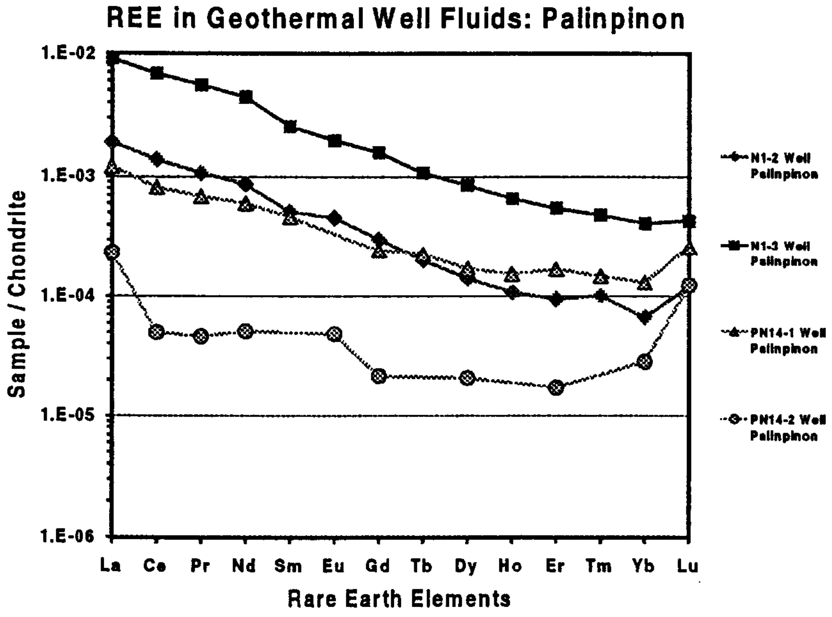
REE in Geothermal Wells - Beowawe, Nevada




REE in Geothermal Wells: Heber, California
Sample / Normalization
1.E-03
1.E-04
1.E-05
1.E-06
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
NV-087F-99
NV-087U-99
NV-088F-99
NV-088U-99
NV-089F-99
NV-089U-99
NV-090F-99
NV-090U-99
NV-091F-99
NV-091U-99
NV-092F-99
NV-092U-99
NV-093F-99
NV-093U-99
NV-094F-99
NV-094U-99
NV-095F-99
NV-095U-99
NV-096F-99
NV-096U-99


South China Sea
Philippine Sea
PHILIPPINES
Manila
Makban
Tiwi
Bacman
Tongonan
Palinpinon
Mindanao

[illegible]


REE in Geothermal Well Fluids: Palinpinon
Sample / Chondrite
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
La
Ce
Pr
Nd
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Rare Earth Elements
N1-2 Well Palinpinon
N1-3 Well Palinpinon
PN14-1 Well Palinpinon
PN14-2 Well Palinpinon

[illegible]

REE, Th, and U in Geothermal Fluids

Quality	Analysis Date d-m-y	Sample ID	Sample Description	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Y	Th	U
good	23-Feb-01	OR-033F-98	033F Bagby	19.8	16.9	0.335	<	0.268	0.078	0.286	<	0.177	0.0381	0.145	<	<	<	1.37	0.5	0.329
good	23-Feb-01	OR-033U-98	033U Bagby	8.8	10.2	0.423	<	0.322	0.106	0.411	0.0466	0.321	0.0518	0.17	<	<	<	1.58	1.32	0.386
good	23-Feb-01	OR-034F-98	034F Breitenbus	6.95	13.4	0.972	4.99	1.27	0.362	2.11	0.313	2.26	0.448	1.34	0.175	1.44	0.195	23.8	0.926	0.741
good	23-Feb-01	OR-034U-98	034U Breitenbus	19.6	28.3	3.4	<	4.54	1.32	9.49	1.29	8.41	1.71	4.74	0.607	4.04	0.534	81.4	3.31	0.884
good	23-Feb-01	OR-035F-98	035F Bigelow (De	13.3	26	2.57	<	2.47	0.684	2.96	0.394	2.35	0.481	1.47	0.216	<	0.199	15.9	1.55	2.29
good	23-Feb-01	OR-035U-98	035U Bigelow (D	460	1120	137	599	126	33.8	128	18.8	117	22.8	65.3	9.2	58.2	8.8	586	61.8	16
good	23-Feb-01	OR-036F-98	036F Bellknap	2.75	<	0.362	<	0.277	0.0895	0.221	<	<	0.0492	0.136	<	<	<	1.69	0.527	0.817
good	23-Feb-01	OR-036U-98	036U Bellknap	5.01	8.02	0.707	<	0.62	0.161	0.933	0.176	1.24	0.277	0.826	0.125	<	0.122	12.8	6.25	1.76
good	23-Feb-01	OR-037F-98	037F Terwilliger /	7.07	13.7	1.53	<	1.1	0.196	0.8	0.114	0.535	0.123	0.42	0.045	<	0.0538	3.56	3.62	0.521
good	23-Feb-01	OR-037U-98	037U Terwilliger /	9.3	<	2.31	<	2.81	0.683	3.09	0.522	3.34	0.674	2.28	0.32	2.38	0.347	22.9	8.51	1.64
good	23-Feb-01	OR-038F-98	038F Wall Creek	7.64	10.8	1.62	<	1.44	0.374	1.88	0.236	1.82	0.363	1.09	0.14	1.27	0.169	14	2.88	4.14
good	23-Feb-01	OR-038U-98	038U Wall Creek	122	293	37	164	35.6	9.81	34	5.1	31.4	6.25	18.2	2.55	16.1	2.42	167	13.9	6.56
good	23-Feb-01	OR-039F-98	039F McCredie	17.2	23.1	1.27	<	1.14	<	1	0.136	0.838	0.177	0.434	0.0717	<	0.076	7.64	1.43	0.491
good	23-Feb-01	OR-039U-98	039U McCredie	<	72.9	8.41	<	7.3	2.04	6.98	0.937	5.6	1.08	3.31	0.414	3.11	0.408	34.9	25	3.73
good	23-Feb-01	OR-040F-98	040F McCredie	14.3	<	1.69	<	1.4	0.433	1.22	0.15	1.07	0.173	0.55	0.0627	0.378	0.062	6.93	0.886	0.572
good	23-Feb-01	OR-040U-98	040U McCredie	195	449	57.1	253	52.7	12.3	49.2	7.01	43.3	8.28	22.8	3.2	21.9	3.03	220	19.1	6.53
good	23-Feb-01	OR-041F-98	041F Umpqua	53.7	36.1	3.63	<	4	1.6	7.68	1.6	17.1	4.49	15.6	2.21	14.3	1.97	311	1.92	200
good	23-Feb-01	OR-041U-98	041U Umpqua	35.7	65.3	8.26	44.4	13.5	6.8	30	6.33	54.3	12.9	39.6	5.03	30.1	3.91	652	4.43	209
good	23-Oct-00	Newberry Crate	Newberry Crater,	17.5	46.6	11.6	44.3	30.1	14.9	27	4.27	20.7	4.61	12.3	2.88	12.4	2.37	77.9	28.5	25.4
fair	30-Aug-99	OR-033U-98	U33 Bagby	<	8.03	<	7.18	<	<	<	<	1.49	<	<	<	<	<	10.4	1.29	<
fair	30-Aug-99	OR-034U-98	U34 Breitenbush	20	26.2	3.41	25.9	<	1.21	10.6	1.69	9.48	2	5.71	<	4.6	0.881	96	3.24	<
fair	30-Aug-99	OR-035U-98	U35 Bigelow	452	1080	130	627	<	35.4	117	18.3	110	21.9	61.6	8.82	56.6	8.59	621	58.2	15.4
fair	30-Aug-99	OR-036U-98	U36 Bellknap	<	7.9	<	7.2	<	<	2.68	<	2.71	<	1.98	<	2	<	20.4	6.27	1.77
fair	30-Aug-99	OR-037U-98	U37 Terwilliger	9.97	38.7	2.29	24.2	<	1.13	4.46	0.854	4.25	0.894	3.61	<	2.8	<	30.9	8.01	1.6
fair	30-Aug-99	OR-038U-98	U38 Wall Creek	120	285	35.5	170	<	10.4	32.8	5.21	32.3	6.42	18.3	2.8	17	2.65	177	13.6	5.79
fair	30-Aug-99	OR-039U-98	U39 McCredie	38500	73.2	8.13	120	<	2.95	32.9	1.28	6.1	1.43	3.64	<	4.59	0.796	46.4	24.8	3.63
fair	30-Aug-99	OR-040U-98	U40 McCredie	210	466	57.8	264	<	12.1	50.4	7.45	41.2	8.42	23.1	3.28	22.5	3.41	238	18.4	6.06
fair	30-Aug-99	OR-041U-98	U41 Umpqua	41.5	68.8	9	47.8	<	7.4	30.5	6.81	54	13.3	40	5.48	32.3	4.52	693	4.49	193
fair	12-Apr-99	OR-033F-98	F33 Bagby	18.1	15.7	<	3.83	<	<	<	<	1.23	<	<	<	<	<	<	<	<
fair	12-Apr-99	OR-034F-98	F34 Breitenbush	<	11.5	<	7.98	<	1.25	3.45	<	2.71	<	<	<	1.66	<	25	0.74	<
fair	12-Apr-99	OR-035F-98	F35 Bigelow	10.9	23	1.83	11.8	<	1.4	1.89	<	3.32	<	1.2	<	2.11	<	17.7	1.15	1.98
fair	12-Apr-99	OR-036F-98	F36 Bellknap	<	15.7	<	3.07	<	1.71	1.29	<	1.31	<	1.26	<	<	<	<	0.501	<
fair	12-Apr-99	OR-037F-98	F37 Terwilliger	<	11.4	1.01	9.21	<	<	2.61	<	1.78	<	<	<	<	<	6.6	3.64	<
fair	12-Apr-99	OR-038F-98	F38 Wall Creek	<	8.87	<	8.9	<	1.51	2.36	<	1.89	<	1.49	<	<	<	14.8	2.6	4.2
fair	12-Apr-99	OR-039F-98	F39 McCredie	15.3	20	<	8.67	<	1.6	2.04	<	1.25	<	<	<	<	<	11	1.46	<
fair	12-Apr-99	OR-040F-98	F40 McCredie	10.3	36.9	0.85	9.29	<	1.58	1.81	<	<	<	<	<	<	<	9.48	0.678	<
fair	12-Apr-99	OR-041F-98	F41 Umpqua	48.1	30.6	2.7	18.1	<	2.88	8.07	0.888	17.8	3.93	15.3	2.15	15.3	1.48	295	2.14	225
good	23-Feb-01	OR-042F-98	042F Crystal Cra	6.11	14.6	1.42	5.96	1.56	0.312	1.83	0.337	2.21	0.513	1.4	0.216	1.66	0.202	20.1	3.34	4.62
good	23-Feb-01	OR-042U-98	042U Crystal Cra	8.34	19.3	2.06	9.72	2.07	0.396	2.07	0.322	2.28	0.467	1.4	0.174	1.43	0.201	14.8	1.78	2.82
good	23-Feb-01	OR-043F-98	043F Micky	5.2	11.1	1	<	0.702	0.16	0.636	0.112	0.759	0.169	0.368	0.0655	0.483	0.06	6.77	4.5	4.31
good	23-Feb-01	OR-043U-98	043U Micky	73	147	16.2	62.1	11.2	1.98	9.19	1.29	7.14	1.46	4.08	0.548	3.59	0.533	40.8	35.9	6.56
good	23-Feb-01	OR-044F-98	044F Alvord	4.52	6.53	0.748	3.94	1.35	0.606	2.76	0.511	3.16	0.55	1.61	0.188	1.2	0.14	24	1.33	27
good	23-Feb-01	OR-044U-98	044U Alvord	5.7	12.1	1.48	7.41	2.11	0.8	2.89	0.566	3.48	0.597	1.48	0.202	1.18	0.162	22.8	1.31	22.2
good	23-Feb-01	OR-045F-98	045F North Bora	4.87	12	1.12	<	1.54	0.368	1.89	0.295	2.56	0.55	1.67	0.224	1.39	0.184	22.8	2.33	3.33
good	23-Feb-01	OR-045U-98	045U North Bora	166	308	46.1	204	43.2	9.92	41.2	6.52	39.7	7.53	21.2	2.88	17.1	2.37	217	37.9	6.81
good	23-Feb-01	OR-046F-98	046F Middle Bor	4.03	9.19	0.922	<	0.935	0.166	1.36	0.246	1.57	0.359	1.13	0.175	0.904	0.16	18.2	0.611	2.11
good	23-Feb-01	OR-046U-98	046U Middle Bor	480	1020	132	559	119	25.4	116	17.4	100	19.8	54.6	7.76	48.2	6.89	552	117	24

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REE, Th, and U in Geothermal Fluids

Quality	Analysis Date d-m-y	Sample ID	Sample Description	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Y	Th	U
good	23-Feb-01	OR-047F-98	047F Whitehorse	82	163	21.4	89.2	19.3	3.67	18.7	3.34	22.9	4.7	13.3	1.92	11.9	1.72	150	25.5	6.82
good	23-Feb-01	OR-047U-98	047U Whitehorse	129	250	32.7	137	29.3	5.66	30	5.07	34.5	7.12	20.8	3.04	18.9	2.68	225	39.5	9.61
good	23-Feb-01	OR-048F-98	048F Sniveley	1.43	3.1	0.251	2.02	0.401	0.18	0.201	0.0367	0.348	0.0557	0.152	<	0.133	<	1.62	0.818	0.332
good	23-Feb-01	OR-048U-98	048U Sniveley	3.2	5.48	0.567	<	0.664	0.15	0.66	0.102	0.62	0.1	0.376	<	0.459	0.0548	3.81	1.07	0.374
good	23-Feb-01	OR-049F-98	049F Sniveley	3.47	8.03	0.831	3.69	0.836	0.222	0.853	0.113	0.699	0.127	0.57	0.069	0.373	0.0443	4.17	0.899	161
good	23-Feb-01	OR-049U-98	049U Sniveley	283	647	71.7	293	57.2	14.7	52	7.79	47.1	8.93	24.4	3.62	22	3.52	242	59.4	254
good	23-Feb-01	OR-052F-98	052F Sniveley	4.73	<	1.08	<	0.996	0.23	1.04	0.144	0.953	0.176	0.73	0.0614	0.538	0.0732	5.29	1.49	12
good	23-Feb-01	OR-052U-98	052U Sniveley	19	<	3.7	15.2	3.09	0.601	2.92	0.42	2.43	0.391	1.27	0.155	0.982	0.182	14	4.32	12.9
good	01-Sep-00	OR-042PF-98	OR-042PF-98 Cry	3.37	7.27	0.739	3.8	0.959	0.212	1	0.16	1.08	0.189	0.619	0.0915	0.918	0.147	7.16	0.0432	0.0844
good	01-Sep-00	OR-042PU-98	OR-042PU-98 Cry	11.1	23.2	2.36	9.78	2.36	0.541	2.56	0.378	2.29	0.476	1.36	0.222	1.7	0.222	14	0.0458	0.142
good	01-Sep-00	OR-047PF-98	OR-047PF-98 Whi	3	5.91	0.637	3.43	0.644	0.172	0.977	0.172	1.36	0.333	1.2	0.2	1.54	0.213	12	0.0412	0.0968
good	01-Sep-00	OR-047PU-98	OR-047PU-98 Wh	156	299	38.7	144	33.9	6.54	34	5.63	38.4	7.89	23.3	3.3	21.4	3.04	244	<	0.314
good	01-Sep-00	OR-048PF-98	OR-048PF-98 Sni	1.07	1.88	0.193	1.8	0.315	0.0543	0.393	<	0.101	<	0.124	<	0.31	<	0.785	0.0444	0.0789
good	01-Sep-00	OR-048PU-98	OR-048PU-98 Sni	2.44	4.52	0.54	2.53	0.498	0.124	0.776	0.0682	0.358	0.07	0.224	<	0.388	0.0396	2.09	0.043	0.0553
good	01-Sep-00	OR-049PF-98	OR-049PF-98 Sni	2.12	3.94	0.372	2.38	0.477	0.1	0.428	0.041	0.348	0.0752	0.208	<	0.941	0.042	1.32	<	2.48
good	01-Sep-00	OR-049PU-98	OR-049PU-98 Sni	1820	4120	453	1600	368	90.3	335	47.3	287	55.1	155	22.4	152	21.4	1400	<	16.3
fair	30-Aug-99	OR-042U-98	U42 Crystal Cran	8.48	18	2.12	12.8	<	0.949	3.64	<	2.86	<	2.1	<	1.98	<	22.6	1.96	2.73
fair	30-Aug-99	OR-043U-98	U43 Micky	75.2	153	16.7	60.2	<	3.64	10	1.55	8.46	1.46	5.71	<	5.04	0.844	51.1	36.1	6.56
fair	30-Aug-99	OR-044U(1+2)-9	U44(1+2) Alvord	11.9	14.8	1.79	12.3	<	9.38	5.36	1.04	4.71	0.953	2.22	<	2.57	0.932	34.8	2.87	25.3
fair	30-Aug-99	OR-044U1-98	U44 Alvord	<	12.8	1.54	8.68	<	9.19	5.17	0.808	4.21	0.766	1.89	<	1.87	0.813	29.2	1.53	22.7
fair	30-Aug-99	OR-044U2-98	44U2 Alvord	<	3.8	<	5.14	<	1.28	<	<	<	<	<	<	<	<	9.75	1.7	5.66
fair	30-Aug-99	OR-045U-98	U45 North Borax	175	318	49.2	192	<	16.8	46	6.99	39.7	7.83	21.6	3.44	18.3	3.14	216	39.6	7.29
fair	30-Aug-99	OR-046U-98	U46 Middle Bora	473	1010	135	498	<	31.9	125	17.3	99.8	19.7	52.9	7.72	51.5	7.94	528	118	25.6
fair	30-Aug-99	OR-047U-98	U47 Whitehorse	127	251	32.4	124	<	6.27	32.1	5.56	32	7.42	20	3.1	20	3	229	40.7	9.7
fair	30-Aug-99	OR-048U-98	U48 Sniveley	<	5.21	0.956	5.45	<	<	2.92	<	<	<	<	<	<	<	12.3	1.18	<
fair	30-Aug-99	OR-049U-98	U49 Sniveley	271	626	72.1	260	<	14.8	53.7	7.69	41.3	8.63	25.3	3.53	25	3.7	228	58.4	247
fair	30-Aug-99	OR-052U-98	U52 Sniveley	18.8	49.9	4.01	17.2	<	0.909	3.67	<	3.04	<	1.88	<	1.6	<	21.8	4	11.7
fair	12-Apr-99	OR-042F-98	F42 Crystal Cran	<	13.6	1.07	7.74	<	<	2.34	<	3.75	<	<	<	1.39	<	21.4	3.09	4.05
fair	12-Apr-99	OR-043F-98	F43 Micky	<	8.68	<	7.25	<	<	1.39	<	1.75	<	<	<	<	<	8.7	4.24	3.88
fair	12-Apr-99	OR-044F-98	F44 Alvord	<	5.39	<	5.35	<	2.29	2.59	<	3.8	<	<	<	<	<	26.4	1.03	28
fair	12-Apr-99	OR-045F-98	F45 North Borax	<	10.7	<	10.5	<	1.2	2.56	<	2.47	<	1.32	<	<	<	21.4	2.53	2.69
fair	12-Apr-99	OR-046F-98	F46 Middle Borax	<	8.24	<	6.22	<	1.9	<	<	2.42	<	<	<	<	<	19.8	<	1.83
fair	12-Apr-99	OR-047F-98	F47 Whitehorse	74	150	19.9	85.5	<	4.15	20.4	2.37	22.7	4.03	15.1	1.72	13.9	1.2	137	26.4	6.42
fair	12-Apr-99	OR-048F-98	F48 Sniveley	<	<	<	2.32	<	<	2.52	<	<	<	<	<	<	<	4.97	0.611	<
fair	12-Apr-99	OR-049F-98	F49 Sniveley	<	6.09	<	4.41	<	<	<	<	<	<	<	<	<	<	5.24	0.623	167
fair	12-Apr-99	OR-052F-98	F52 Sniveley	<	15.7	<	5.11	<	<	1.82	<	1.72	<	<	<	<	<	6.77	1.17	11.6
good	23-Feb-01	ID-050F-98	050F Zims	1.61	<	0.378	1.78	0.673	0.161	0.359	0.0453	0.397	0.0871	0.272	0.0336	0.31	0.0646	2.27	0.528	0.61
good	23-Feb-01	ID-050U-98	050U Zims	11.7	7.98	0.422	<	0.718	0.134	0.5	0.0732	0.507	0.0887	0.319	0.05	0.416	0.0707	3.39	1.2	0.935
good	23-Oct-00	ID-01F-00	ID-01F-00 Jerry J	14.4	21.6	6.15	32.4	11.5	6.53	15.2	<	13	3.27	8.65	2.56	9.36	2.41	27.1	60.1	1610
good	23-Oct-00	ID-01U-00	ID-01U-00 Jerry J	9.03	11.9	4.57	19.6	11.8	8.01	12.8	2.41	7.55	2.7	8.72	<	7.02	2.61	7.29	37.1	1590
good	23-Oct-00	ID-02F-00	ID-02F-00 Jerry J	24.7	48.8	9.36	36	15.7	7.45	12.7	3.82	25.9	7.17	22.2	4.43	24.2	4.14	117	28.2	1680
good	23-Oct-00	ID-02U-00	ID-02U-00 Jerry J	215	420	50.1	182	44.1	13.6	35.1	7.82	41.6	7.67	20	3.42	16	4.01	152	39	1930
fair	30-Aug-99	OR-050U-98	U50 Zims	12	8.48	<	8.97	<	1.07	2.2	<	1.67	<	<	<	1.41	<	11.2	1.39	1.09
fair	12-Apr-99	OR-050F-98	F50 Zims	<	4.01	<	2.74	<	<	<	<	<	<	<	<	<	<	<	<	<
good	25-May-01	NV-053F-98	053F-98 Dixie Val	4.35	<	0.578	<	0.442	0.363	0.506	0.0493	0.329	0.062	0.249	0.0333	0.315	0.0546	3.58	0.943	1.26
good	12-Feb-01	NV-053F-98	053F Dixie Valley	4.56	<	1.11	4.13	0.879	<	<	<	<	<	<	<	<	<	3.62	1.22	1.34
good	12-Feb-01	NV-053U-98	053U Dixie Valley	5.29	4.6	0.492	<	0.71	0.203	0.648	0.078	0.376	0.106	0.295	0.0502	0.353	0.0687	3.87	1.76	0.848

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REE, Th, and U in Geothermal Fluids

Quality	Analysis Date d-m-y	Sample ID	Sample Description	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Y	Th	U
good	12-Feb-01	NV-054F-98	054F Dixie Valley	6.88	<	0.398	<	0.476	0.159	0.405	0.0389	0.346	0.0628	0.178	0.0319	0.2	<	2.04	0.893	1.28
good	12-Feb-01	NV-054U-98	054U Dixie Valley	<	3.13	0.328	<	0.57	0.192	0.467	0.0699	0.429	0.1	0.449	0.061	0.298	0.0633	4.19	1.51	1.19
good	12-Feb-01	NV-055F-98	055F Dixie Valley	14.8	6.6	0.458	<	0.417	0.279	0.422	0.0468	0.321	0.0638	0.162	0.022	<	<	2.05	1.64	6.93
good	12-Feb-01	NV-055U-98	055U Dixie Valley	2.06	3.48	0.347	<	0.649	0.223	0.341	0.0585	0.46	0.0864	0.27	0.0587	0.198	0.0481	3.93	0.671	1
good	12-Feb-01	NV-056F-98	056F Dixie Valley	5.5	6.6	0.362	<	0.503	0.0838	0.392	0.0378	0.347	0.068	0.229	<	0.206	0.0432	2.48	1.69	0.98
good	12-Feb-01	NV-056U-98	056U Dixie Valley	2.97	5.55	0.654	<	0.764	0.246	0.762	0.118	0.783	0.163	0.44	0.0844	0.477	0.0907	7.84	0.783	0.796
good	12-Feb-01	NV-057F-98	057F Dixie Valley	4.82	<	1.09	<	0.553	0.263	0.643	0.0644	0.304	0.0834	0.296	0.0357	0.251	0.0422	3.62	0.97	1.6
good	12-Feb-01	NV-057U-98	057U Dixie Valley	4.37	3.98	0.436	<	0.74	0.105	0.541	0.0764	0.642	0.159	0.552	0.0937	0.404	0.0783	7.89	0.852	0.744
good	12-Feb-01	NV-058F-98	058F Dixie Valley	4.01	<	0.876	<	0.98	0.431	1.21	0.2	1.54	0.43	1.57	0.235	1.46	0.304	18.6	0.922	1090
good	12-Feb-01	NV-058U-98	058U Dixie Valley	7.73	12.6	1.46	<	2.21	0.64	2.53	0.45	3.63	0.918	3.27	0.554	3.6	0.608	45.5	1.32	2000
good	12-Feb-01	NV-059F-98	059F Dixie Valley	4.9	9.81	0.592	<	0.7	0.189	0.363	0.0597	0.344	0.0712	0.175	0.0401	<	0.0459	3.28	0.957	8.39
good	12-Feb-01	NV-059U-98	059U Dixie Valley	5.29	7	0.672	<	0.78	0.214	0.656	0.084	0.61	0.134	0.34	0.0721	0.406	0.0787	7.39	0.632	0.532
good	12-Feb-01	NV-060F-98	060F Dixie Valley	3.28	6.45	0.377	<	0.519	0.138	0.45	0.0432	0.376	0.0723	0.174	0.0244	0.229	0.0463	2.88	0.8	0.933
good	12-Feb-01	NV-060U-98	060U Dixie Valley	1.95	3.98	0.412	<	0.66	0.144	0.489	0.0661	0.684	0.118	0.471	0.064	0.371	0.0782	6.34	0.571	0.719
good	12-Feb-01	NV-061F-98	061F Dixie Valley	2.81	<	0.594	<	0.603	0.275	0.36	0.0673	0.324	0.0706	0.204	0.0318	<	<	2.72	0.95	1.29
good	12-Feb-01	NV-061U-98	061U Dixie Valley	2.57	4.99	0.54	<	0.779	0.134	0.622	0.0863	0.412	0.118	0.395	0.0526	0.242	0.0905	6.47	0.632	0.699
good	12-Feb-01	NV-062F-98	062F Dixie Valley	5.55	<	1.28	<	1.48	0.776	1.25	0.143	0.864	0.25	0.744	0.114	0.616	0.115	11.9	1.27	7.09
good	12-Feb-01	NV-062U-98	062U Dixie Valley	5.49	12.1	1.2	<	1.56	0.564	1.38	0.2	1.28	0.317	<	0.128	0.892	0.178	17.8	1.2	6.28
good	12-Feb-01	NV-063F-98	063F Dixie Valley	8.8	12.9	1.21	<	1.78	4.81	1.62	0.167	0.913	0.188	0.66	0.0826	0.843	0.104	15.5	0.705	0.517
good	12-Feb-01	NV-063U-98	063U Dixie Valley	6.75	8.77	1.01	<	1.48	6.01	1.14	0.124	0.801	0.181	0.57	0.0868	0.547	0.131	18.7	0.771	0.308
good	12-Feb-01	NV-064F-98	064F Dixie Valley	4.56	5.4	0.45	<	0.789	0.408	0.6	0.0449	0.316	0.0776	0.384	0.0452	<	0.0516	5.07	0.723	0.396
good	12-Feb-01	NV-064U-98	064U Dixie Valley	<	4.97	0.409	<	0.757	0.458	0.43	0.0471	0.481	0.0975	0.385	0.0542	0.488	0.0616	7	10.1	0.372
good	12-Feb-01	NV-065F-98	065F Dixie Valley	2.8	4.04	0.32	<	0.576	0.198	0.42	0.0495	0.357	0.0636	0.219	0.0387	<	0.0388	3.01	0.601	1.83
good	12-Feb-01	NV-065U-98	065U Dixie Valley	7.47	7.4	0.668	<	0.996	0.437	0.818	0.0852	0.405	0.124	0.422	0.0595	0.364	0.0739	5.66	5.76	1.06
good	12-Feb-01	NV-066F-98	066F Dixie Valley	2.75	5.82	0.571	<	0.944	0.204	0.849	0.0949	0.528	0.0898	0.359	0.0445	0.254	0.0536	2.82	0.893	1.87
good	12-Feb-01	NV-066U-98	066U Dixie Valley	4.09	7.62	0.88	<	1.24	0.301	1.14	0.138	0.834	0.189	0.709	0.0837	0.68	0.118	6	0.998	2.11
good	12-Feb-01	NV-069F-98	069F Beowawe W	2.28	7.98	0.492	3.13	0.803	0.119	0.68	0.072	0.314	0.122	0.474	0.0476	0.223	0.0736	3.43	0.827	5
good	12-Feb-01	NV-069U-98	069U Beowawe W	3.49	4.26	0.449	4.64	0.92	0.15	0.743	0.0662	0.436	0.108	0.495	0.0571	0.28	0.0584	4.08	0.698	4.96
good	12-Feb-01	NV-070F-98	070F Beowawe W	5.01	<	1.59	6.19	0.771	0.196	0.847	0.0779	0.313	0.122	0.512	0.0749	0.343	0.0701	4.16	0.8	6.11
good	12-Feb-01	NV-070U-98	070U Beowawe W	5.19	4.93	0.98	5.02	1.04	0.197	0.543	0.0848	0.419	0.14	0.422	0.0554	0.286	0.0679	4.56	2.6	5.53
good	12-Feb-01	NV-071F-98	071F Beowawe W	3.84	8.09	0.7	3.11	1.15	0.203	0.878	0.112	0.755	0.141	0.711	0.0776	0.403	0.0858	6.24	1.01	9.47
good	12-Feb-01	NV-071U-98	071U Beowawe W	5.2	6.29	0.61	5.4	1.04	0.197	0.881	0.0798	0.36	0.112	0.436	0.0528	0.215	0.0707	4.57	0.742	8.8
good	26-Jan-01	NV-067F-99	NV-067F-99 Dixie	5	<	1.12	6.52	1.6	0.659	2.01	0.315	2.43	0.491	1.71	0.234	1.6	0.198	20.2	0.697	12
good	26-Jan-01	NV-067U-99	NV-067U-99 Dixie	5.81	11.9	1.44	6.84	2	0.754	2.33	0.409	2.84	0.614	1.8	0.249	1.72	0.267	23.7	1.31	12.8
good	26-Jan-01	NV-068F-99	NV-068F-99 Dixie	4.98	<	1.2	5.76	1.57	0.402	1.3	0.168	1.38	0.244	0.871	0.0913	1.12	0.0774	12.4	0.776	9.11
good	26-Jan-01	NV-068U-99	NV-068U-99 Dixie	2.89	5.74	0.691	3.81	1.75	0.413	1.51	0.241	1.54	0.34	1.21	0.155	0.966	0.129	16.7	1	10
fair	03-Sep-99	NV-060U-99	U60 Dixie Valley	<	3.91	0.95	18.8	<	<	6.24	<	2.39	<	2.01	<	<	<	27.7	0.712	1.13
fair	03-Sep-99	NV-061U-99	U61 Dixie Valley	<	6.28	0.99	21.8	<	<	6.05	<	4.1	<	1.58	<	<	1.07	31.5	0.901	1.04
fair	03-Sep-99	NV-062U-99	U62 Dixie Valley	10.3	12.4	1.21	23.7	<	<	9.92	<	4.88	<	1.69	<	1.4	1.53	61	1.49	7.19
fair	03-Sep-99	NV-063U-99	U63 Dixie Valley	15.3	7.79	1.53	22.2	<	<	19.2	<	4.4	<	3.15	<	2.68	2.77	69.7	1.32	<
fair	03-Sep-99	NV-064U-99	U64 Dixie Valley	62.8	5.24	1.1	104	<	1.65	6.5	1.07	4.94	0.782	3.08	<	<	1.22	52	12	<
fair	03-Sep-99	NV-065U-99	U65 Dixie Valley	12	6.48	1.62	38	<	8.47	12.2	<	3.38	<	1.6	<	<	<	56.1	7.03	1.37
fair	03-Sep-99	NV-066U-99	U66 Dixie Valley	<	6.43	0.828	8.96	<	<	<	<	2.25	<	<	<	<	<	22.5	1.03	2.44
fair	03-Sep-99	NV-067U-99	U67 Dixie Valley	9.49	12.8	1.6	15.5	<	<	4.36	<	4.27	<	2.04	<	2.01	<	52.2	1.72	15.2
fair	03-Sep-99	NV-068U-99	U68 Dixie Valley	<	4.91	<	11.7	<	<	4.4	<	2.97	<	<	<	<	<	44	1.16	10.7
fair	03-Sep-99	NV-069U-99	U69 Beowawe 9/3	<	3.4	0.852	18	<	<	2.09	<	2.94	<	1.38	<	<	<	33.1	1.14	6.01
fair	03-Sep-99	NV-070U-99	U70 Beowawe	<	3.94	1.41	23	<	<	2.64	<	2.23	<	<	<	<	<	36.1	3.11	6.6

n.a. Not Analyzed
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REE, Th, and U in Geothermal Fluids

Quality	Analysis Date d-m-y	Sample ID	Sample Description	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Y	Th	U
fair	03-Sep-99	NV-071U-99	U71 Beowawe	<	6.04	1.03	22.2	<	<	2.1	<	3.06	<	1.47	<	<	<	34.9	1.15	10.8
fair	31-Aug-99	NV-053U-99	U53 Dixie Valley	<	3.93	0.873	9.4	<	14.8	4.81	<	2.23	<	<	<	1.92	<	24.5	2.23	<
fair	31-Aug-99	NV-054U-99	U54 Dixie Valley	20.9	3.83	1.19	14.3	<	2.74	4.8	<	2.09	<	<	<	2.28	<	20.4	2.14	<
fair	31-Aug-99	NV-055U-99	U55 Dixie Valley	<	4.18	1.25	4.69	<	2.89	2.82	<	1.68	<	<	<	1.83	<	17.6	0.724	<
fair	31-Aug-99	NV-056U-99	U56 Dixie Valley	<	5.24	1.45	10.5	<	17.9	7.17	<	3.37	<	1.95	<	1.91	0.85	21.4	1.06	<
fair	31-Aug-99	NV-057U-99	U57 Dixie Valley	10.8	4.2	1.57	16.2	<	16.9	4.87	<	2.8	<	1.8	<	2.22	1.01	24.3	0.92	<
fair	31-Aug-99	NV-058U-99	U58 Goeringer W	<	7.36	1.6	11	<	9.15	7.89	<	2.42	0.73	2.63	<	4.29	<	37.8	1.17	1170
fair	31-Aug-99	NV-059U-99	U59 Dixie Valley	9.55	7.14	1.76	12.3	<	14.1	5.11	<	2.81	<	<	<	2.92	0.886	22	1.23	<
fair	31-Aug-99	NV-068U-99	U68 Dixie Valley	<	5.61	1.17	6.08	<	3.2	4.25	<	3.37	<	<	<	3.09	<	36	1.29	11.5
fair	31-Aug-99	NV-069U-99	U69 Beowawe	<	4.56	1.3	10.4	<	1.42	4.77	<	2.23	<	1.39	<	1.88	<	21.4	1.18	6.24
fair	12-Apr-99	NV-069F-98	F69 Beowawe	<	6.6	<	3.96	<	<	<	<	<	<	<	<	<	<	5.4	0.817	5
fair	12-Apr-99	NV-070F-98	F70 Beowawe	<	195	1.29	7.3	<	<	<	<	<	<	<	<	<	<	5.64	<	5.74
fair	12-Apr-99	NV-071F-98	F71 Beowawe	<	6.08	<	4.28	<	<	<	<	<	<	<	<	<	<	7.74	1.07	9.52
fair	24-Mar-99	NV-053F-98	F53 Dixie Valley	<	24.1	<	4.71	<	<	2.4	<	<	<	<	<	<	<	4.17	<	<
fair	24-Mar-99	NV-054F-98	F54 Dixie Valley	<	15.5	<	2.59	<	<	1.44	<	<	<	<	<	<	<	4.17	<	<
fair	24-Mar-99	NV-055F-98	F55 Dixie Valley	10.8	3.42	<	9.66	<	<	2.42	<	<	<	<	<	<	<	<	<	5.92
fair	24-Mar-99	NV-056F-98	F56 Dixie Valley	<	4.4	<	4.92	<	<	2.92	<	1.52	<	<	<	<	<	<	<	<
fair	24-Mar-99	NV-057F-98	F57 Dixie Valley	<	92.4	<	4.31	<	<	2.67	<	<	<	<	<	<	<	4.51	<	<
fair	24-Mar-99	NV-058F-98	F58 Goeringer W	<	11.4	<	4.11	<	<	2.85	<	1.74	<	1.52	<	1.97	<	17.6	<	1080
fair	24-Mar-99	NV-059F-98	F59 Dixie Valley	<	7.48	<	4.09	<	<	2.08	<	<	<	<	<	<	<	5.61	<	7.57
fair	24-Mar-99	NV-060F-98	F60 Dixie Valley	<	4.2	<	1.81	<	1.02	1.51	<	<	<	<	<	<	<	6.13	<	<
fair	24-Mar-99	NV-061F-98	F61 Dixie Valley	<	29.8	<	5	<	1.08	1.94	<	<	<	<	<	<	<	4.32	<	<
fair	24-Mar-99	NV-062F-98	F62 Dixie Valley	<	20.8	0.884	4.95	<	<	4.57	<	1.59	<	<	<	<	<	10	<	5.52
fair	24-Mar-99	NV-063F-98	F63 Dixie Valley	11.8	10.1	0.934	15.3	<	<	4	<	2.19	<	1.3	<	1.8	0.8	13.8	<	<
fair	24-Mar-99	NV-064F-98	F64 Dixie Valley	<	4.09	<	6.15	<	<	2.41	<	1.23	<	1.76	<	5.8	<	7.32	<	<
fair	24-Mar-99	NV-065F-98	F65 Dixie Valley	<	2.55	<	5.71	<	<	1.8	<	<	<	<	<	<	<	6.59	<	0.984
fair	24-Mar-99	NV-066F-98	F66 Dixie Valley	<	3.41	<	3.53	<	<	1.76	<	<	<	<	<	<	<	4.31	<	0.896
fair	24-Mar-99	NV-067F-98	F67 Dixie Valley	<	25.4	<	5.73	<	<	3.83	<	2.62	<	2.37	<	1.77	<	18.8	<	11.9
fair	24-Mar-99	NV-068F-98	F68 Dixie Valley	<	28.1	0.758	6.25	<	<	3.13	<	1.8	<	<	<	<	<	12	<	8.49
good	26-Jan-01	CA-087F-99	Heber HGU#7, Zo	16.9	21.1	1.79	7.13	1.76	2.09	2.14	0.145	1.14	0.259	0.868	0.142	0.927	0.218	16	0.335	0.268
good	26-Jan-01	CA-087U-99	Heber HGU#7, Zo	97.7	176	18.7	70.3	13.1	4.18	14.1	1.52	8.18	1.62	4.74	0.6	3.63	0.58	73.3	0.78	20.2
good	26-Jan-01	CA-088F-99	Heber HGU#9, Zo	43	39.5	3.18	<	3.18	2.27	4.13	0.393	2.98	0.89	3.42	0.501	4.58	0.868	34.8	1.24	2.56
good	26-Jan-01	CA-088U-99	Heber HGU#9, Zo	68.8	93.4	9.28	35.4	8.2	3.45	8.46	1	6.71	1.62	5.65	0.74	5.11	1.18	65.2	1.22	6.87
good	26-Jan-01	CA-089F-99	Heber HGU#11, Z	13.1	18	1.22	5.76	1.45	1.95	1.8	0.0872	0.752	0.197	0.941	0.158	1.15	0.22	16.7	0.339	0.393
good	26-Jan-01	CA-089U-99	Heber HGU#11, Z	27.8	34.7	3.2	11.8	2.8	3.22	3.11	0.275	1.98	0.451	1.6	0.239	1.9	0.359	27.3	0.647	0.465
good	26-Jan-01	CA-090F-99	Heber HGU#13, Z	16.5	24.5	2.34	10	2.89	3.03	5.04	0.55	4.21	1.33	5.56	0.756	5	1.11	52.1	0.439	0.216
good	26-Jan-01	CA-090U-99	Heber HGU#13, Z	18.6	23.3	2.57	11.4	3.58	2.77	4.92	0.598	4.78	1.49	5.83	0.782	5.3	1.07	56.4	0.489	0.301
good	26-Jan-01	CA-091F-99	Heber HGU#16, Z	17.4	26.7	2.5	10.2	2.82	2.71	3.2	0.248	1.6	0.47	1.81	0.254	1.7	0.313	29.2	0.263	0.205
good	26-Jan-01	CA-091U-99	Heber HGU#16, Z	20	26.2	2.8	11.3	3.29	2.91	3.92	0.399	1.91	0.622	2.19	0.376	2.08	0.451	32.8	0.481	0.315
good	26-Jan-01	CA-092F-99	Heber HGU#14, Z	13.6	18	1.81	7.8	2.36	4.53	3.41	0.309	1.86	0.416	1.43	0.18	1.33	0.19	28.4	0.22	0.212
good	26-Jan-01	CA-092U-99	Heber HGU#14, Z	19.1	24.4	2.69	12	2.98	5	4.37	0.454	2.6	0.558	2.02	0.233	1.58	0.284	36.7	1.31	0.523
good	26-Jan-01	CA-093F-99	Heber HGU#12, Z	7.84	10.2	0.829	3.34	0.901	1.93	2.97	0.103	0.7	0.215	0.947	0.184	1.3	0.278	30.8	0.254	0.234
good	26-Jan-01	CA-093U-99	Heber HGU#12, Z	21.2	30.7	3.24	12.9	2.81	2.75	3.69	0.351	2.21	0.499	1.75	0.268	1.43	0.256	31.3	0.54	0.372
good	26-Jan-01	CA-094F-99	Heber HGU#10, Z	16.2	18	1.59	5.68	1.27	1.7	2.19	0.102	0.648	0.139	0.46	0.0661	0.473	0.123	19.3	0.175	0.111
good	26-Jan-01	CA-094U-99	Heber HGU#10, Z	20	22.1	2.16	7.92	1.79	1.88	2.75	0.146	0.978	0.19	0.578	0.0902	0.753	0.132	21.6	0.344	0.202
good	26-Jan-01	CA-095F-99	Heber HGU#8, Zo	10	13.9	1.2	4.94	1.23	1.43	1.8	0.148	1	0.358	1.61	0.215	1.84	0.38	19	0.197	0.23
good	26-Jan-01	CA-095U-99	Heber HGU#8, Zo	22	29.9	3.07	12.1	2.73	2.47	3.71	0.321	2.25	0.618	2.13	0.34	2.31	0.44	40.3	0.969	0.642

n.a. Not Analyzed
< Less Than MDL

REE, Th, and U in Geothermal Fluids

Quality	Analysis Date d-m-y	Sample ID	Sample Description	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Y	Th	U
good	26-Jan-01	CA-096F-99	Heber Injection B	15.7	21.4	1.93	8.19	2.22	2.4	2.8	0.234	1.78	0.474	1.8	0.244	1.83	0.423	29.7	0.171	0.212
good	26-Jan-01	CA-096U-99	Heber Injection B	17.7	22.4	2.32	<	2.51	2.92	3.43	0.258	1.97	0.526	1.97	0.279	2.07	0.438	31.1	0.441	0.328
fair	18-Dec-99	CA-087F-99	Heber HGU#7, Zo	21	26.9	1.94	10.3	<	<	3.54	<	<	<	<	<	<	<	7.32	<	<
fair	18-Dec-99	CA-087U-99	Heber HGU#7, Zo	91.5	162	19.4	66	<	<	11.5	<	7.37	1.17	3.99	<	3.87	<	62.3	0.612	22.8
fair	18-Dec-99	CA-088F-99	Heber HGU#9, Zo	48	44.7	5.21	22.1	<	<	6.99	<	4.36	2.06	3.73	1.6	8.53	2.1	28	2.05	4.5
fair	18-Dec-99	CA-088U-99	Heber HGU#9, Zo	70.8	93.2	11.6	36.6	<	<	9.48	<	8.97	2.55	6.2	1.79	6.76	1.72	55.3	1.7	9.03
fair	18-Dec-99	CA-089F-99	Heber HGU#11, Z	15.2	20	0.76	7.91	<	<	<	<	<	<	<	<	<	<	9.7	<	<
fair	18-Dec-99	CA-089U-99	Heber HGU#11, Z	26.2	32.9	2.77	13.5	<	<	1.97	<	<	<	1.84	<	<	<	13.8	<	<
fair	18-Dec-99	CA-090F-99	Heber HGU#13, Z	17.6	26.2	1.99	13.6	<	<	3.7	<	2.92	<	3.06	<	4.84	<	39.5	<	<
fair	18-Dec-99	CA-090U-99	Heber HGU#13, Z	19.6	24.7	2.2	11.6	<	<	3.6	<	4.75	0.977	5.2	<	5.11	<	48.2	<	<
fair	18-Dec-99	CA-091F-99	Heber HGU#16, Z	19.2	27.2	3.31	15.7	<	<	1.43	<	<	<	<	<	1.8	<	20.4	<	<
fair	18-Dec-99	CA-091U-99	Heber HGU#16, Z	20.9	27.7	6.44	16.8	<	<	2.99	<	1.73	<	1.38	<	1.72	<	19.6	0.553	<
fair	18-Dec-99	CA-092F-99	Heber HGU#14, Z	15.1	19.7	1.23	9.33	<	<	2.39	<	<	<	<	<	<	<	20.1	<	<
fair	18-Dec-99	CA-092U-99	Heber HGU#14, Z	20.9	26.9	2.4	14.5	<	<	7.57	<	1.87	<	<	<	<	<	25.7	0.741	<
fair	17-Dec-99	CA-093F-99	Heber HGU#12, Z	20.8	6.2	<	2.89	<	<	4	<	<	<	1.32	<	2.07	3.14	24.2	0.587	<
fair	17-Dec-99	CA-093U-99	Heber HGU#12, Z	23.7	21.7	2.79	9.9	<	<	4.8	<	2.21	<	1.83	<	1.96	2.17	27	0.835	<
fair	17-Dec-99	CA-094F-99	Heber HGU#10, Z	21.8	13.8	1.66	5.28	<	0.889	3.76	<	1.2	<	<	<	<	2.05	14.1	0.497	<
fair	17-Dec-99	CA-094U-99	Heber HGU#10, Z	21.8	16.2	1.93	7.11	<	<	3.23	<	1.27	<	1.3	<	<	1.94	18.2	0.803	<
fair	17-Dec-99	CA-095F-99	Heber HGU#8, Zo	13.2	10.2	0.92	4.7	<	<	2.55	<	1.35	<	1.74	<	2.16	1.87	15	0.485	<
fair	17-Dec-99	CA-095U-99	Heber HGU#8, Zo	26.6	23.5	2.88	11.9	<	<	5.22	<	2.17	<	2.96	<	3.14	2.47	37.2	1.72	0.925
fair	17-Dec-99	CA-096F-99	Heber Injection B	21.2	16	1.77	6.2	<	<	3.47	<	2.49	<	2.4	<	2.69	2.13	22	<	<
fair	17-Dec-99	CA-096U-99	Heber Injection B	23	17.1	2.11	11.6	<	<	4.2	<	1.9	<	2.59	<	2.43	2.22	28.3	0.851	<
good	27-Aug-01	NZ-163F-00	Trip Blank	<	0.942	0.106	<	0.248	0.0733	0.103	0.0321	0.121	0.0462	0.0804	0.0281	0.256	0.0301	0.486	0.59	0.0981
good	27-Aug-01	NZ-163U-00	Trip Blank	0.34	0.727	0.0826	<	0.197	0.056	0.132	0.0286	0.103	0.0442	0.0921	0.026	0.104	0.0281	0.387	0.643	0.0737
good	10-Aug-01	NZ-163F-00	Trip Blank	<	0.852	0.0784	<	0.137	0.0519	0.12	<	0.0778	0.0331	0.0604	0.0161	<	0.0155	0.476	0.337	0.0972
good	10-Aug-01	NZ-163U-00	Trip Blank	0.365	0.743	0.0647	<	0.1	0.0517	<	0.0173	0.103	0.0276	0.0549	<	<	0.0136	0.389	0.46	0.0723
good	25-May-01	NZ-117F-00	Trip Blank	0.357	0.607	0.104	0.619	0.298	0.0843	0.16	0.0496	0.171	0.044	0.119	0.0437	0.163	0.0444	0.94	0.252	0.0967
good	25-May-01	NZ-117U-00	Trip Blank	0.738	1.3	0.282	1.38	0.528	0.168	0.28	0.0985	0.238	0.139	0.315	0.125	0.289	0.142	1.51	0.91	0.169
good	25-May-01	NZ-300F-01	Trip Blank	0.432	0.618	0.0942	0.864	0.47	0.0935	0.26	0.03	0.175	0.0483	0.156	0.0327	0.163	0.0322	1	0.308	0.106
good	25-May-01	NZ-300U-01	Trip Blank	0.324	0.583	0.0695	0.493	0.328	0.0878	0.162	0.0303	0.147	0.034	0.115	0.021	0.141	0.0267	0.779	0.252	0.0839
good	07-May-01	NZ-117F-00	Trip Blank	0.409	0.693	0.138	0.628	0.134	0.12	0.169	0.0653	0.253	0.0858	0.119	0.0652	0.136	0.0588	0.895	0.255	0.109
good	07-May-01	NZ-117U-00	Trip Blank	0.476	0.825	0.0797	0.971	0.202	0.111	0.0881	0.012	0.29	0.0278	0.134	0.0174	0.148	0.0395	1.19	0.732	0.0797
good	07-May-01	NZ-300F-01	Trip Blank	<	<	<	<	<	<	<	<	<	<	<	<	<	<	1.11	0.491	0.15
good	07-May-01	NZ-300U-01	Trip Blank	0.32	0.595	0.161	0.459	0.118	0.0674	0.0726	0.0187	0.102	0.0353	0.0623	0.0233	0.111	0.0222	0.702	0.374	0.064
good	20-Apr-01	NZ-117U-00	Trip Blank	0.4	0.833	0.0953	0.882	0.166	0.0662	0.123	0.0276	0.163	0.0309	0.164	0.016	0.198	0.038	1.2	0.83	0.0989
good	26-Mar-01	NZ-117F-00	Trip Blank	0.344	0.554	0.0553	0.562	0.224	0.0669	0.112	0.0235	0.142	0.0311	0.0994	0.0179	0.119	0.021	0.83	0.203	0.0962
good	23-Oct-00	NZ-000U-98	Trip Blank	20.9	4.83	0.693	4.68	0.858	0.257	3.87	4.53	1.4	0.261	0.444	0.0833	0.677	1.53	81.8	2.19	0.311
good	17-Dec-99	CA-072U-99	Trip Blank	<	<	<	<	<	<	<	<	<	<	<	<	<	<	4.75	0.552	<
fair	17-Dec-98	NZ-000U-98	U0 Trip Blank	20.1	<	<	3.87	<	<	3.05	3.5	<	<	<	<	<	1.78	71.3	<	<
good	16-Jul-01	Ngawha 1hr	8 Ngawha 1hr	29900	60000	7080	31100	8900	267000	10600	1830	11700	<	6090	939	6950	898	162000	6630	7950
good	16-Jul-01	Ngawha overnig	8 Ngawha overni	11800	25000	2910	10800	4140	7380	2560	512	3000	<	1620	260	1810	261	21900	8650	3510
good	25-May-01	NZ-110F-00	110F-00 Ngawha	7.24	15.3	2.35	13.3	4.07	3.14	6.63	0.86	4.91	0.86	2.09	0.29	1.87	0.219	31.7	1.09	6.74
good	25-May-01	NZ-110U-00	110U-00 Ngawha	3.62	6.34	0.791	3.6	0.941	3.01	1.35	0.215	1.36	0.25	0.595	0.0877	0.674	0.088	15.5	0.695	1.11
good	25-May-01	NZ-111F-00	111F-00 Ngawha	7.75	14	2.04	11.1	3.11	5.38	5.46	0.801	4.35	0.796	2.08	0.286	1.82	0.217	34.3	1.09	2.08
good	25-May-01	NZ-111U-00	111U-00 Ngawha	5.41	8.36	0.925	4.41	1.16	4.48	1.6	0.278	2	0.435	1.32	0.198	1.31	0.156	31.1	1.16	0.906
good	20-Apr-01	NZ-110U-00	110U-00 Ngawha	3.2	6.23	0.743	3.25	0.685	2.76	1.34	0.195	1.15	0.228	0.576	0.0911	0.38	0.0555	14	0.681	1
good	20-Apr-01	NZ-111U-00	111U-00 Ngawha	4.89	8.21	0.95	4.18	0.72	4.18	1.54	0.263	1.89	0.389	1.22	0.186	0.944	0.127	28.3	1.11	0.867

n.a. Not Analyzed
< Less Than MDL

REE, Th, and U in Geothermal Fluids

Quality	Analysis Date d-m-y	Sample ID	Sample Description	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Y	Th	U
good	26-Mar-01	NZ-110F-00	110F-00 Ngawha	7.75	15.7	2.26	12	3.92	3.77	6.3	0.884	4.63	0.813	2.04	0.275	1.68	0.192	29.1	0.924	5.81
good	26-Mar-01	NZ-111F-00	111F-00 Ngawha	8.07	14.7	1.92	11.2	3.31	5.85	5.18	0.765	4.36	0.798	2.09	0.288	1.71	0.208	31.8	0.963	1.84
good	11-Oct-00	NZ112F-00	NZ-112F-00 Kam	19.9	43.8	5.57	29.7	<	<	21.4	3.53	32.4	7.45	25.2	3.21	27.7	3.93	340	5.5	<
good	11-Oct-00	NZ112U-00	NZ-112U-00 Kam	19.7	45.2	5.96	30.7	<	<	25.9	3.76	32.8	7.9	27.3	4.2	29.4	4.84	362	2.47	<
good	20-Apr-01	NZ-113U-00	113U-00 Miranda	2.02	4.26	0.482	2.2	0.436	0.067	0.61	0.0959	0.732	0.192	0.637	0.094	0.64	0.0928	8.95	0.721	0.255
good	26-Mar-01	NZ-113F-00	113F-00 Miranda	1.77	3.33	0.36	2.21	0.426	0.092	0.44	0.0727	0.547	0.12	0.383	0.0622	0.438	0.0611	5.47	0.535	0.268
good	23-Oct-00	NZ-007U-98	NZ-007U-98 Mira	<	1.41	0.155	0.167	<	0.132	0.374	<	0.152	<	<	<	0.186	<	3.42	<	<
poor	17-Dec-98	NZ-007U-98	U7 Miranda	<	4.73	<	2.02	<	<	1.66	<	<	<	<	<	<	<	8.59	0.54	<
poor	20-Oct-98	NZ-007F-98 1X	F7 Miranda	<	9.41	<	3.81	<	<	67.4	13.2	34	31.5	53.1	6.92	40.7	17.3	7.53	<	<
good	07-May-01	NZ-114U-00	114U-00 Te Aroh	3.76	8.12	0.995	4.1	0.955	<	1	0.194	1.49	0.357	1.2	0.185	1.18	0.168	17.2	1.73	14.9
good	20-Apr-01	NZ-114U-00	114U-00 Te Aroh	3.57	7.47	1.12	4.35	1.09	0.439	<	<	<	<	<	<	<	<	17.1	1.52	15.5
good	20-Apr-01	NZ-115U-00	115U-00 Te Aroh	121	224	30	132	31.5	8.82	40.5	7.2	50.3	11.3	34	5.02	32.9	4.83	332	7.35	48
good	20-Apr-01	NZ-116U-00	116U-00 Te Aroh	42.5	95	11.8	52.5	12.3	3.47	15.4	2.55	17.2	3.75	11	1.49	9.26	1.3	116	5.8	9.21
good	26-Mar-01	NZ-114F-00	114F-00 Te Aroh	2.75	5.32	0.58	4.3	0.959	0.401	1.32	0.178	1.17	0.233	0.695	0.1	0.772	0.0875	9.01	1.13	14.3
good	26-Mar-01	NZ-115F-00	115F-00 Te Aroh	43.9	87.1	12.6	64.4	16.9	5.12	24.7	4.6	37.7	8.97	29.1	4.49	29.9	4.58	307	4.8	87.8
good	26-Mar-01	NZ-116F-00	116F-00 Te Aroh	15	32.3	4.08	19.5	4.95	1.29	7.37	1.33	10.2	2.36	7.21	1	6.45	0.903	80.1	1.36	8.12
good	23-Oct-00	NZ-008U-98	NZ-008U-98 Te A	<	1.49	0.286	0.17	<	<	0.259	<	0.265	0.102	0.252	<	0.248	<	6.37	<	13.5
good	23-Oct-00	NZ-009U-98	NZ-009U-98 Te A	90.8	167	23.5	93.4	22.1	6.83	31.3	5.9	42.2	9.78	28.9	4.33	26.4	4.2	321	2.54	10.2
good	23-Oct-00	NZ-010U-98	NZ-010U-98 Te A	43	96.8	12.1	47.2	11.6	3.57	15.4	2.62	16	3.34	9.23	1.3	7.57	1.19	115	3.05	6.77
poor	17-Dec-98	NZ-008U-98	U8 Te Aroha Gey	<	2.71	<	2.51	<	<	<	<	<	<	<	<	<	0.91	17.1	<	17.6
good	17-Dec-98	NZ-009U-98	U9 Te Aroha cold	80.3	159	22.1	103	<	<	35.1	5.53	42.4	10	33	4.71	32	5.52	319	4.98	13
good	17-Dec-98	NZ-010U-98	U10 Te Aroha har	39.9	95.9	11.1	50.4	<	<	17.7	2.33	19.7	3.62	10.8	1.46	9.91	2.18	127	5.9	8.51
fair	20-Oct-98	NZ-008F-98 1X	F8 Te Aroha Gey	14.1	12.3	<	1.98	<	<	81.4	15.2	34.1	70.3	62	7.74	45.6	19.3	559	7.73	6.12
fair	20-Oct-98	NZ-009F-98 1X	F9 Te Aroha cold	737	1380	180	832	<	21.1	288	49.6	243	97.4	202	26.1	160	37.3	1800	43.9	134
fair	20-Oct-98	NZ-010F-98 1X	F10 Te Aroha har	18.5	30.9	<	16.4	<	<	113	17.8	48	63.5	71	8.93	58.2	20.8	558	3.06	2.53
fair	30-Sep-98	NZ-009F-98	F9 Te Aroha cold	561	1070	148	654	<	36	164	29.2	184	38.3	115	15.2	100	15.2	1010	40.1	56.8
fair	30-Sep-98	NZ-010F-98	F10 Te Aroha har	14.3	28.2	3.57	18.8	<	4.06	7.69	2.74	9.22	2.61	6.16	<	5.63	1.17	81.4	3.59	5.1
good	10-Aug-01	NZ-156F-00	156F-00 Morere #	13.1	16	1.53	6.9	1.08	0.756	1.17	0.199	1.15	0.222	0.596	0.0825	0.576	0.0842	17	0.23	1.18
good	10-Aug-01	NZ-156U-00	156U-00 Morere	13.1	21	2.63	9.73	2.03	1.06	2.21	<	<	<	<	<	<	<	16.3	1.47	1.58
good	10-Aug-01	NZ-157F-00	157F-00 Morere #	75.4	153	17.7	69.7	13.2	3.34	11.1	1.58	9.1	1.67	4.34	0.571	3.29	0.432	51.5	17.3	3.67
good	10-Aug-01	NZ-157U-00	157U-00 Morere	176	359	38.9	150	28.4	7.21	24.4	3.5	20.1	3.56	9.04	1.16	6.74	0.895	96.9	40	4.04
good	10-Aug-01	NZ-162F-00	162F-00 Morere #	7.28	6.09	0.654	4	0.703	0.55	0.555	0.0907	0.476	0.116	0.293	0.0468	0.319	0.0571	12.4	0.276	1.37
good	10-Aug-01	NZ-162U-00	162U-00 Morere	59	121	13.8	56	10.9	2.95	9.31	1.39	7.63	1.36	3.34	0.477	2.87	0.402	44.9	14.1	2.69
good	23-Oct-00	NZ-021U-98	NZ-021U-98 More	12.4	17.8	1.54	5.32	1.72	0.758	1.31	0.241	1.17	0.178	0.478	<	0.36	<	14.5	<	<
good	23-Oct-00	NZ-022U-98	NZ-022U-98 More	41.2	84.1	9.5	31.4	7.51	2.39	6.62	0.799	5.07	0.894	2.14	0.295	1.58	0.181	29.7	4.97	0.623
poor	17-Dec-98	NZ-021U-98	U21 Morere	15.1	19.3	2.73	13.3	<	25.9	19.9	1.23	7.9	1.2	8.21	1.4	6	4.14	24	1.08	<
poor	17-Dec-98	NZ-022U-98	U22 Morere	40	76	13.6	43.7	<	19.6	55.8	7.14	34.2	8.85	28.9	8.05	40.3	11.5	45.2	36.5	20
poor	29-Sep-98	NZ-021F-98	F21 Morere	20.2	49.8	5.54	26.2	<	5.62	7.29	1.5	8.17	1.88	6.5	<	4.88	<	47.5	4.01	2.19
poor	29-Sep-98	NZ-022F-98	F22 Morere	26.4	34.2	3.77	14.9	<	24.9	5.96	2.6	4.39	1.52	3.38	<	2.81	3.09	48.9	1.98	1.51
good	10-Aug-01	NZ-158F-00	158F-00 Te Pula	164	471	50.1	200	37.5	8.97	33.3	4.4	25.9	4.83	12	1.48	7.92	1.03	170	7.42	14.8
good	10-Aug-01	NZ-158U-00	158U-00 Te Pula	286	998	113	487	107	26.1	95.6	14.2	80.8	14	36.7	4.54	26.3	3.52	405	288	17.2
good	10-Aug-01	NZ-160F-00	160F-00 Te Pula	9.16	31.4	4.69	23.8	5.4	1.18	4.76	0.7	3.92	0.691	1.71	0.239	1.45	0.168	28.1	1.18	5.28
good	10-Aug-01	NZ-160U-00	160U-00 Te Pula	10.2	41.2	6.41	31.7	8	2.06	5.96	0.919	5.17	0.86	2.06	0.294	1.64	0.242	27.4	3.6	2.95
good	10-Aug-01	NZ-161F-00	161F-00 Te Pula	8.28	16.6	1.97	8.57	1.62	0.904	1.47	0.214	1.26	0.228	0.644	0.0935	0.54	0.0647	17.7	1.13	1.35
good	10-Aug-01	NZ-161U-00	161U-00 Te Pula	110	345	39.8	160	34.8	7.89	29.1	4.18	23.3	3.93	9.89	1.14	6.27	0.863	104	88.6	6.08
good	23-Oct-00	NZ-023U-98	NZ-023U-98 Te P	<	4.68	0.603	1.69	0.851	0.918	0.983	<	0.386	<	0.26	<	0.0819	<	6.03	<	0.417

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REE, Th, and U in Geothermal Fluids

Quality	Analysis Date d-m-y	Sample ID	Sample Description	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Y	Th	U
good	23-Oct-00	NZ-024U-98	NZ-024U-98 Te P	<	2.57	0.402	1.78	0.669	0.9	0.431	<	0.261	0.1	0.212	<	0.261	<	12	<	1.37
poor	17-Dec-98	NZ-023U-98	U23 Te Pula	23.9	25.4	13.5	46.1	<	<	104	12.2	54.3	13.3	49.3	12	36.4	19.8	48.8	31.7	23
poor	17-Dec-98	NZ-024U-98	U24 Te Pula	40.3	41.6	39.3	93.3	<	29	240	26.7	90.6	30	108	38.1	116	54.4	89.8	57.6	86.7
poor	29-Sep-98	NZ-023F-98	F23 Te Pula	15.4	13.7	<	21.3	<	27.5	3.24	1.45	<	<	<	<	<	2.27	28.5	0.581	<
poor	29-Sep-98	NZ-024F-98	F24 Te Pula	11.1	11	1.13	2.79	<	20.8	2.98	1.69	<	<	<	<	<	1.48	34.1	2.59	5.33
good	20-Apr-01	NZ-129F-00	129F-00 Puketitiri	4.11	8.88	1.07	4.65	0.949	0.182	1.14	0.167	1.13	0.26	0.76	0.106	0.723	0.107	9.39	1.83	2.04
good	20-Apr-01	NZ-129U-00	129U-00 Puketitir	24	51.4	5.9	24.3	5.02	1.07	5.28	0.785	5.35	1.01	3	0.442	3.02	0.437	26.8	11	3.15
good	20-Apr-01	NZ-128F-00	128F-00 Tarawera	35.5	69.8	9.04	38.2	7.8	1.09	8.2	1.17	6.86	1.34	3.7	0.497	2.93	0.405	45	2.01	4.28
good	20-Apr-01	NZ-128U-00	128U-00 Tarawera	13.4	26.8	3.02	13.9	2.4	0.342	2.41	0.285	1.68	0.354	0.881	0.111	0.673	0.0998	12.5	0.996	0.789
good	27-Aug-01	NZ-130F-00	130F-00Acid Han	0.0951	0.216	0.0309	0.384	0.124	0.0458	0.0612	<	0.0559	0.0256	0.0471	0.0152	0.0579	0.0168	0.136	0.246	0.0296
good	27-Aug-01	NZ-130F-00	130F-00 Hamner	1.47	2.69	0.341	<	0.436	0.0551	0.479	0.073	0.574	0.232	1.2	0.31	3.19	0.738	5.79	0.64	0.591
good	27-Aug-01	NZ-130U-00	130U-00Acid Han	0.173	0.273	0.0549	0.6	0.228	0.0345	0.0871	0.0163	0.078	0.0305	0.0573	0.0161	0.166	0.0201	0.213	0.324	0.0419
good	27-Aug-01	NZ-130U-00	130U-00 Hamner	13.9	24.9	3.38	14.4	2.54	0.434	2.1	0.292	1.67	0.4	1.67	0.357	3.39	0.756	10.4	2.88	0.747
good	27-Aug-01	NZ-131F-00	131F-00 Lewis Ri	13.1	24	3.62	18.3	3.98	1.03	4.72	0.717	4.6	1.02	2.87	0.372	2	0.312	37.7	3.46	28.7
good	27-Aug-01	NZ-131U-00	131U-00 Lewis Ri	4070	8630	982	3900	743	149	624	88	498	85.5	218	26.3	148	18	2230	1080	122
good	27-Aug-01	NZ-132F-00	132F-00 Marula T	22.6	58.3	8.94	46.7	11.6	2.51	13.2	2.08	12.8	2.61	7.12	0.89	4.81	0.59	84.1	0.961	4.09
good	27-Aug-01	NZ-132U-00	132U-00 Marula T	45.7	120	17.9	88.8	22.4	4.86	24.8	3.78	22.7	4.42	11.7	1.45	7.87	0.944	132	2.63	4.36
good	27-Aug-01	KA-21 1070 met	KA-21 1070 meter	10.2	17.9	2.43	11.4	<	1.07	3.09	0.539	4.3	0.638	<	0.45	<	0.422	11.4	7.61	1.67
fair	27-Aug-01	KA-19	KA-19 well	0.379	0.49	0.314	0.604	0.102	0.0422	0.12	0.0148	0.0982	0.0484	0.0682	0.0188	0.0717	0.0103	1.02	0.275	0.0704
fair	27-Aug-01	KA-21	KA-21 well	0.462	0.69	0.198	1.06	<	0.0443	0.0702	<	0.0863	0.0496	0.0392	<	<	<	0.72	0.38	0.129
fair	27-Aug-01	KA-24	KA-24 well	0.166	0.32	0.0386	0.303	<	<	0.073	<	<	0.0194	<	<	0.0532	<	0.29	0.118	0.0271
fair	27-Aug-01	KA-25 1200 met	KA-25 1200 meter	57.6	139	17.1	72.8	18.6	6.09	18.2	2.97	17.7	3.65	6.77	1.84	9.3	1.41	100	21.7	10
fair	27-Aug-01	KA-27	KA-27 well	0.255	0.423	0.0427	0.739	0.0841	<	<	<	0.0412	0.0342	<	<	0.12	<	0.67	0.185	0.0417
fair	27-Aug-01	KA-35	KA-35 well	0.198	0.346	0.0292	0.376	<	<	<	<	0.0445	0.0218	<	<	0.0569	<	0.42	0.122	0.034
fair	27-Aug-01	KA-37	KA-37 well	0.288	0.313	0.28	0.413	0.118	<	0.063	<	0.111	0.0626	<	0.0162	0.0603	0.0151	0.728	0.16	0.0607
fair	27-Aug-01	KA-BLANK DDI	BLANK DDI water	1.47	2.17	0.658	4.32	<	<	<	<	<	<	<	<	<	0.282	1.63	<	0.856
fair	27-Aug-01	NZ-159F-00	159F-00 KA-32 w	0.69	1.1	0.109	1.01	0.16	0.0878	0.154	0.0178	0.114	0.0395	0.0937	0.024	0.141	0.0154	0.895	0.292	0.0882
fair	27-Aug-01	NZ-159U-00	159U-00 KA-32 w	0.89	1.55	0.203	1.22	0.272	0.0809	0.219	0.0368	0.167	0.0497	0.094	0.0315	0.152	0.0339	1.27	0.411	0.104
fair	27-Aug-01	NZ-164F-00	164F-00 KA-37 w	0.299	0.618	0.0812	0.541	<	<	0.0989	<	0.0643	0.0283	<	<	0.103	0.0076	0.46	0.17	0.045
fair	27-Aug-01	NZ-164U-00	164U-00 KA-37 w	0.791	1.41	0.183	0.81	0.13	0.0353	0.115	<	0.102	0.0297	0.032	<	0.0641	0.0085	0.444	0.182	0.0316
good	16-Jul-01	KA-21 Low pres	2 KA-21 Low pres	29100	68500	8750	68700	7400	4740	6970	1190	7200	<	6260	658	4060	642	41200	8800	22300
good	16-Jul-01	KA-21 LowPres	2 KA-21 LowPres	24900	54700	7560	65200	6340	3900	5750	1130	7520	<	7440	860	5390	889	42100	19800	39000
good	16-Jul-01	KA-21 throttle 1	3 KA-21 throttle 1	198000	426000	49300	207000	45900	22100	37900	5610	<	<	16600	2200	14000	2130	248000	16000	56400
good	16-Jul-01	KA-21 Throttle c	3 KA-21 Throttle	3170	7230	720	5310	639	354	460	<	329	<	418	<	<	<	1180	834	342
fair	01-Sep-00	NZ-100F-00	NZ-100F-00 Kawe	4.97	7	0.627	3.66	0.697	0.222	1.24	0.219	1.6	0.437	1.32	0.27	1.95	0.36	19.5	1.41	0.086
fair	01-Sep-00	NZ-100U-00	NZ-100U-00 Kawe	5.36	7.82	0.736	3.92	0.901	0.278	1.44	0.252	1.7	0.454	1.54	0.26	2.11	0.379	20.8	1.2	0.0554
fair	01-Sep-00	NZ-101F-00	NZ-101F-00 Kawe	0.943	2.04	0.151	1.15	0.207	0.113	0.379	0.046	0.0914	0.0421	0.0907	0.0388	0.327	0.12	0.928	0.615	0.115
fair	01-Sep-00	NZ-101U-00	NZ-101U-00 Kawe	2.57	5.71	0.572	2.6	0.51	0.191	0.523	0.0969	0.304	0.105	0.187	0.0644	0.454	0.122	1.88	0.861	0.0739
fair	01-Sep-00	NZ-102F-00	NZ-102F-00 Kawe	0.822	1.69	0.142	0.991	0.132	0.0412	0.249	0.0419	0.089	<	<	0.0373	0.281	0.0599	0.538	0.214	0.0674
fair	01-Sep-00	NZ-102U-00	NZ-102U-00 Kawe	0.949	2.11	0.178	1.08	0.185	0.0735	0.372	<	0.0924	<	0.0751	<	0.19	0.0549	0.82	0.332	0.0833
fair	01-Sep-00	NZ-103F-00	NZ-103F-00 Kawe	0.632	1.49	0.094	0.8	0.137	0.0458	0.286	<	0.0811	<	0.0711	<	0.191	0.0421	0.477	0.102	0.0692
fair	01-Sep-00	NZ-103U-00	NZ-103U-00 Kawe	1.18	2.53	0.243	1.17	0.214	0.0674	0.278	0.0347	0.14	0.0389	0.0728	<	0.214	0.0464	0.783	0.141	0.0611
good	16-Jul-01	NZ-138F-00	138F-00 Clamshe	0.759	2.8	0.206	<	0.131	0.118	0.196	0.0276	0.194	0.0501	0.119	0.026	0.202	0.0252	1.6	0.514	13.1
good	16-Jul-01	NZ-138U-00	138U-00 Clamshe	28.3	60	6.74	<	5.03	0.829	4.52	0.666	3.93	0.743	2.02	0.267	1.78	0.232	18.9	9.02	14.9
good	16-Jul-01	NZ-139F-00	139F-00 Iodine P	2.98	8.77	0.7	<	0.605	0.157	0.626	0.1	0.741	0.167	0.473	0.0729	0.429	0.075	3.7	5.27	23.4
good	16-Jul-01	NZ-139U-00	139U-00 Iodine P	19.2	46	4.21	<	3.28	0.569	3.16	0.521	3.5	0.755	2.12	0.307	2.17	0.31	17.1	16.2	24.9
good	16-Jul-01	NZ-140F-00	140F-00 Iodine P	5.5	14.8	1.27	<	1.14	0.241	1.14	0.184	1.15	0.26	0.759	0.104	0.664	0.104	5.81	7.16	23.9

n.a. Not Analyzed
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REE, Th, and U in Geothermal Fluids

Quality	Analysis Date d-m-y	Sample ID	Sample Description	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Y	Th	U
good	16-Jul-01	NZ-140U-00	140U-00 Iodine P	21.7	52.4	4.74	<	3.81	0.665	3.67	0.602	3.78	0.825	2.43	0.356	2.2	0.347	19.5	18	28
good	25-May-01	NZ-136F-00	136F-00 Frying P	14.9	31.5	3.74	16.2	3.69	0.96	4.32	0.64	4.25	0.988	3.21	0.482	3.43	0.57	34.4	4.38	4.64
good	25-May-01	NZ-136U-00	136U-00 Frying P	21.2	43.6	5.18	23	4.8	1.22	5.45	0.85	5.89	1.56	4.15	0.614	4.57	0.762	43.7	5.8	6.68
good	25-May-01	NZ-137F-00	137F-00 Frying P	7.67	18.4	2.34	10.2	2.23	0.572	2.59	0.411	2.67	0.634	1.71	0.249	1.71	0.261	21	3.31	1.71
good	25-May-01	NZ-137U-00	137U-00 Frying P.	28.7	62.3	7.53	31.7	6.96	1.8	7.33	1.21	7.58	1.74	4.92	0.732	4.8	0.789	50.2	10.1	7.53
good	23-Oct-00	NZ-011U-98	NZ-011U-98 Fryin	31.7	69.2	8.34	30.4	6.8	1.89	8.11	1.32	8.03	1.63	4.79	0.724	4.62	0.788	52.2	5.81	6.77
good	23-Oct-00	NZ-012U-98	NZ-012U-98 Clam	44	95.9	10.5	35.4	7.12	1.17	6.86	1.07	5.8	1.11	2.8	0.393	2.51	0.298	32	12.7	13.8
good	23-Oct-00	NZ-013U-98	NZ-013U-98 Iodin	16	37.3	3.68	13.2	2.49	0.604	2.32	0.448	2.59	0.579	1.62	0.232	1.64	0.228	14.8	9.48	20
good	23-Oct-00	NZ-014U-98	NZ-014U-98 Iodin	18.1	40.8	4.18	15.2	2.98	0.869	3.08	0.58	3.29	0.708	1.82	0.238	1.89	0.253	17.2	9.56	20.8
fair	17-Dec-98	NZ-013U-98	U13 Iodine Pool	11.2	36.1	2.53	12.7	<	<	4.11	<	2.34	<	1.4	<	1.4	<	22	13.8	23.1
fair	17-Dec-98	NZ-014U-98	U14 Iodine Pool	12.1	39.9	3.2	16	<	<	4.95	<	2.21	<	1.42	<	<	<	20.1	13.7	24.6
fair	17-Dec-98	NZ-011U-98	U11 Frying Pan L	24.1	65.1	6.88	35.3	<	<	10	<	6.79	1.39	4.87	<	5.04	0.911	49.5	8.6	8.05
fair	17-Dec-98	NZ-012U-98	U12 Clamshell S	36	90.1	8.94	38.4	<	<	9.33	<	5.1	0.868	3.05	<	2.32	<	33.4	17.7	16.2
poor	30-Sep-98	NZ-012F-98	F12 Clamshell Sp	<	8.66	<	2.87	<	<	<	<	<	<	<	<	<	<	<	1.51	11.7
poor	30-Sep-98	NZ-013F-98	F13 Iodine Pool	<	18	1.88	4.97	<	<	<	<	<	<	<	<	<	<	8.2	3.24	19
poor	30-Sep-98	NZ-014F-98	F14 Iodine Pool	<	11.5	<	5.75	<	<	<	<	<	<	7.64	<	<	<	6.67	3.53	20.4
fair	30-Sep-98	NZ-011F-98	F11 Frying Pan L	25.5	47.9	2.63	21.6	<	2.22	9.68	<	2.81	<	<	<	<	<	33.2	3.41	1.4
good	07-May-01	NZ-306F-01	306F-01 Champa	4.46	5.77	0.52	2.95	0.415	1.39	0.557	0.0662	0.615	0.116	0.345	0.0551	0.337	0.0464	4.36	0.86	0.854
good	07-May-01	NZ-306U-01	306U-01 Champa	7.49	12	1.24	4.28	1.02	2.99	0.862	0.12	0.748	0.16	0.393	0.0818	0.381	0.0753	4.89	1.82	0.42
good	23-Oct-00	NZ-001U-98	NZ-001U-98 Waio	2620	6580	820	3200	808	195	872	138	864	171	497	71.6	460	69.9	4990	474	101
good	23-Oct-00	NZ-002U-98	NZ-002U-98 Waio	11900	39200	5420	21300	4800	1010	4310	653	4030	779	2280	341	2300	348	21200	10400	1570
good	23-Oct-00	NZ-003U-98	NZ-003U-98 Waio	5.16	10.5	1.03	3.24	0.476	2.56	0.601	<	0.461	0.109	0.245	<	0.273	<	<	0.88	0.162
good	11-Oct-00	NZ-118F-00	NZ-118F-00 Waio	18800	59900	8200	31400	7330	1520	6760	1050	6450	1260	3690	558	3740	560	31200	17300	2610
good	11-Oct-00	NZ-118U-00	NZ-118U-00 Waio	19000	60300	8170	31500	7390	1520	6830	1000	6470	1270	3710	552	3740	555	31600	17100	2610
good	11-Oct-00	NZ119F-00	NZ-119F-00 Waio	4090	14000	2260	9300	2220	458	2020	302	1820	349	980	140	935	141	8600	3120	394
good	11-Oct-00	NZ119U-00	NZ-119U-00 Waio	4130	14600	2270	9360	2200	460	2020	300	1820	350	980	146	942	140	8600	3070	455
good	11-Oct-00	NZ-120F-00	NZ-120F-00 Waio	501	1490	222	993	272	39.6	303	45.3	276	58	162	25.6	164	24.4	1700	28	33.3
good	11-Oct-00	NZ-120U-00	NZ-120U-00 Waio	520	1530	226	1020	274	42.1	296	45	278	57.6	170	24.3	159	24.6	1700	52.3	43.4
good	01-Sep-00	NZ-121F-00	NZ-121F-00 Chan	4.46	7.66	0.722	3.23	0.527	1.28	0.648	0.0913	0.533	0.123	0.315	0.0572	0.393	0.0632	4.39	0.0951	0.0454
good	01-Sep-00	NZ-121U-00	NZ-121U-00 Chan	6.35	11.2	1.05	4.2	0.788	2.5	0.829	0.104	0.594	0.121	0.322	0.0587	0.343	0.0651	3.76	0.101	0.0424
good	01-Sep-00	NZ-122F-00	NZ-122F-00 Chan	6.67	11.8	1.14	4.2	0.76	2.42	0.76	0.125	0.617	0.146	0.333	0.0586	0.446	0.12	3.96	0.0934	0.0926
good	01-Sep-00	NZ-122U-00	NZ-122U-00 Chan	3.54	4.91	0.45	1.84	0.336	0.911	0.44	0.049	0.295	0.0551	0.325	<	0.278	0.0549	2.55	0.099	0.0913
poor	17-Dec-98	NZ-003U-98	U3 Waiotapu, Ch	<	15.4	<	4.39	<	0.928	1.75	<	1.84	<	<	<	<	<	<	3.65	<
good	17-Dec-98	NZ-001U-98	U1 Waiotapu, Oy	2240	6040	785	3300	<	187	832	123	864	176	519	73.2	514	78	4170	517	128
good	17-Dec-98	NZ-002U-98	U2 Waiotapu, Oy	10200	35800	5230	21500	<	1020	3990	562	4020	810	2390	355	2590	389	16900	10500	2120
poor	20-Oct-98	NZ-003F-98 1X	F3 Waiotapu, Ch	<	17.1	<	2.64	<	<	75.3	16	34.2	41.6	55.9	8.13	48.3	18	59.7	<	<
good	20-Oct-98	NZ-001F-98 1X	F1 Waiotapu, Oy	2630	6630	827	3650	<	190	960	159	978	224	551	82	555	90.8	5640	130	76
good	20-Oct-98	NZ-002F-98 1X	F2 Waiotapu, Oy	14200	47400	6670	27800	<	1280	5340	828	5010	1030	2910	445	3030	461	25900	12200	1940
good	07-May-01	NZ-307F-01	307F-01 Waikite	2.21	<	0.675	2.93	0.311	0.111	0.364	0.0588	0.543	0.103	0.303	0.054	0.501	0.0528	4.71	0.528	21.3
good	07-May-01	NZ-307U-01	307U-01 Waikite	1.14	2.33	0.221	0.912	0.171	0.103	0.249	0.0284	0.247	0.0344	0.0908	0.0203	0.122	0.0128	1.84	0.338	20.8
good	23-Oct-00	NZ-018U-98	NZ-018U-98 Waik	<	0.93	0.2	0.432	<	<	<	<	<	<	<	<	<	<	<	<	20.8
good	01-Sep-00	NZ-133F-00	NZ-133F-00 Waik	2.55	4.72	0.596	3.56	0.691	0.22	0.851	0.151	0.836	0.203	0.512	0.0817	0.553	0.127	7.27	0.0871	0.575
good	01-Sep-00	NZ-133U-00	NZ-133U-00 Waik	2.94	5.8	0.609	3.08	0.516	0.113	0.542	0.0723	0.348	0.0908	0.232	0.0455	0.393	0.0916	2.31	0.088	0.554
poor	17-Dec-98	NZ-018U-98	U18 Waikite	<	<	<	2	<	4.38	<	<	<	<	<	<	<	<	<	<	20
poor	29-Sep-98	NZ-018F-98	F18 Waikite	<	6.6	<	7.78	<	<	1.63	1.3	<	<	<	<	<	<	15	0.698	20.4
good	23-Oct-00	NZ-004U-98	NZ-004U-98 Te K	1810	4960	683	2980	817	178	887	135	824	159	440	62.8	404	60.4	4660	140	98.3

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REE, Th, and U in Geothermal Fluids

Quality	Analysis Date d-m-y	Sample ID	Sample Description	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Y	Th	U
good	23-Oct-00	NZ-005U-98	NZ-005U-98 Te K	1400	4300	696	3600	1240	288	1530	243	1500	289	821	118	755	114	8370	621	400
good	23-Oct-00	NZ-006U-98	NZ-006U-98 Te K	8270	16900	1890	6930	1600	302	1550	227	1310	231	612	85.2	540	77.6	6770	3600	680
good	11-Oct-00	NZ-134F-00	NZ-134F-00 Te K	2040	6420	1000	5260	1840	431	2280	368	2270	440	1200	177	1160	172	11900	1160	710
good	11-Oct-00	NZ-134U-00	NZ-134U-00 Te K	2310	7030	1130	5510	1920	450	2320	380	2320	452	1270	185	1190	180	12100	1340	792
good	11-Oct-00	NZ135F-00	NZ-135F-00 Te K	7970	18400	2150	7760	1760	327	1740	257	1400	263	710	98.1	619	88.9	7190	3930	1130
good	11-Oct-00	NZ135U-00	NZ-135U-00 Te K	9230	20400	2310	8260	1880	340	1830	269	1540	276	748	100	658	98	7500	4880	1820
good	17-Dec-98	NZ-004U-98	U4 Te Kopia	1640	4700	670	3160	<	167	919	130	860	173	502	71	479	73.9	4250	153	120
good	17-Dec-98	NZ-005U-98	U5 Te Kopia	1250	4020	675	3720	<	272	1530	243	1590	319	924	132	904	138	7290	695	512
good	17-Dec-98	NZ-006U-98	U6 Te Kopia	7420	15900	1850	7200	<	244	1630	214	1380	256	691	96.4	661	96.1	5930	3400	772
good	20-Oct-98	NZ-004F-98 1X	F4 Te Kopia	1820	5200	701	3400	<	170	949	159	900	191	531	72	471	84.7	4630	130	88.6
good	20-Oct-98	NZ-005F-98 1X	F5 Te Kopia	1390	4340	712	3940	<	275	1600	267	1570	336	893	131	857	138	8300	595	404
good	20-Oct-98	NZ-006F-98 1X	F6 Te Kopia	5480	12900	1490	6080	<	274	1510	228	1200	266	662	93.3	597	99.5	6320	2430	514
good	20-Apr-01	NZ-123U-00	123U-00 Fred anc	5.92	13.4	1.56	6.3	1.34	0.249	1.51	0.184	1.06	0.18	0.494	0.0664	0.411	0.06	6.17	2.2	0.47
good	20-Apr-01	NZ-125U-00	125U-00 Map of A	13.8	29.4	3.71	16.3	3.6	0.723	4.46	0.642	4.24	0.835	2.68	0.36	2.32	0.358	25.8	3.8	3.38
good	20-Apr-01	NZ-126F-00	126F-00 Map of A	8.76	18.9	2.45	11	2.5	0.467	3	0.5	3.36	0.709	2.2	0.309	1.89	0.291	23.3	2.4	2.99
good	20-Apr-01	NZ-126U-00	126U-00 Map of A	13.4	28.8	3.6	15.9	3.6	0.773	4.18	0.644	3.78	0.847	2.63	0.358	2.19	0.339	25.7	3.81	3.3
good	20-Apr-01	NZ-127F-00	127F-00 Diamond	1.4	2.83	0.35	1.74	0.44	0.108	0.5	0.0882	0.609	0.163	0.482	0.0596	0.423	0.0616	6.38	1.67	1.74
good	20-Apr-01	NZ-127U-00	127U-00 Diamonc	3.2	6.8	0.787	3.48	0.754	0.177	0.809	0.101	0.616	0.122	0.365	0.0456	0.265	0.0361	3.81	1.09	1.82
good	26-Mar-01	NZ-123F-00	123F-00 Fred and	0.551	0.994	0.0911	0.512	0.131	0.0736	0.174	0.0216	0.189	0.0471	0.121	0.0177	0.121	0.0199	2.07	0.878	0.303
good	26-Mar-01	NZ-125F-00	125F-00 Map of A	8.2	17.5	2.14	10.1	2.43	0.515	2.93	0.464	2.99	0.611	1.88	0.265	1.63	0.25	20.1	2.2	2.77
good	23-Oct-00	NZ-015U-98	NZ-015U-98 Fred	1	9.58	0.404	1.45	0.337	0.336	1.01	0.194	0.706	0.0955	0.213	<	1.2	<	5.57	<	0.0896
good	23-Oct-00	NZ-016U-98	NZ-016U-98 Map	35.6	79.3	10.4	41.1	10	2.2	13.3	2.09	13.7	2.87	8.41	1.16	8.06	1.22	83.3	5.09	3.89
good	23-Oct-00	NZ-017U-98	NZ-017U-98 Diam	<	2.49	0.362	1.97	<	0.16	0.367	<	0.321	0.102	<	<	0.244	<	0.851	<	1.16
good	11-Oct-00	NZ124F-00	NZ-124F-00 Orak	2320	7000	1040	4800	1500	360	1890	322	1950	385	1050	146	962	144	10000	308	443
good	11-Oct-00	NZ124U-00	NZ-124F-00 Orak	2300	7000	1040	4750	1490	363	1900	318	1950	383	1070	146	945	137	10400	288	430
fair	17-Dec-98	NZ-015U-98	U15 Fred and Ma	<	12.4	<	2.7	<	<	1.78	<	<	<	<	<	1.96	<	19.2	<	<
fair	17-Dec-98	NZ-016U-98	U16 Map of Afric	31.4	77.2	10.3	47.7	<	<	16	1.78	14.2	3.01	10.2	1.63	9.8	1.69	96.2	8.37	3.8
fair	17-Dec-98	NZ-017U-98	U17 Diamond Ge	<	2.94	<	4.97	<	1.8	5.25	<	1.32	<	2.48	<	1.8	<	<	0.578	<
poor	30-Sep-98	NZ-015F-98	F15 Fred and Ma	<	4.87	<	2.41	<	<	<	<	6.63	<	<	<	6.56	<	10.2	0.651	<
fair	30-Sep-98	NZ-016F-98	F16 Map of Afric	16.3	51.9	6.62	33.2	<	<	8.59	1.04	9.5	1.17	5.03	<	4.74	<	63.6	6.08	3.49
poor	29-Sep-98	NZ-017F-98	F17 Diamond Ge	<	5.62	<	2	<	<	<	0.8	<	<	<	<	<	<	16	0.874	1.01
fair	25-May-01	NZ-105F-00	105F-00 Rotokaw	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
good	20-Apr-01	NZ-106U-00	106U-00 Rotokaw	1.41	2.95	0.368	1.55	0.377	0.163	0.416	0.0589	0.406	0.0888	0.316	0.0393	0.291	0.0457	3.55	0.44	0.155
good	26-Mar-01	NZ-105F-00	105F-00 Rotokaw	<	<	<	5.18	1.03	<	<	<	<	<	<	<	<	<	3.15	0.76	0.423
good	26-Mar-01	NZ-105U-00	105U-00 Rotokaw	1.79	3.39	0.343	1.65	0.449	0.257	0.38	0.0568	0.418	0.0713	0.2	0.0276	0.223	0.0261	2.2	0.537	0.182
good	26-Mar-01	NZ-106F-00	106F-00 Rotokaw	0.907	1.5	0.162	1.05	0.318	0.153	0.237	0.0382	0.229	0.0542	0.187	0.0236	0.182	0.018	1.78	0.29	0.152
good	23-Oct-00	NZ-019U-98	NZ-019U-98 Roto	9740	30800	4540	21000	6080	1770	7330	1200	7890	1580	4570	645	4170	622	45100	3670	202
good	23-Oct-00	NZ-020U-98	NZ-020U-98 Roto	2570	8030	1240	5930	1960	581	2500	417	2700	541	1540	215	1370	202	14700	601	140
good	11-Oct-00	NZ107F-00	NZ-107F-00 Roto	9400	30400	4610	21400	6590	2040	8160	1370	8820	1770	5060	711	4550	692	48200	3490	210
good	11-Oct-00	NZ107U-00	NZ-107U-00 Roto	9530	30700	4600	21600	6680	2010	8280	1380	8930	1800	5130	724	4590	691	48700	3600	218
good	11-Oct-00	NZ-108F-00	NZ-108F-00 Roto	5090	17700	2800	13700	4350	1200	5390	899	5780	1180	3400	488	3150	480	31400	1030	228
good	11-Oct-00	NZ-108U-00	NZ-108U-00 Roto	5130	17800	2870	13600	4300	1230	5340	890	5740	1170	3340	494	3120	484	31100	1040	242
good	11-Oct-00	NZ-109F-00	NZ-109F-00 Roto	1770	7320	1400	7830	2910	817	4020	683	4500	929	2680	386	2400	372	24900	160	18.9
good	11-Oct-00	NZ-109U-00	NZ-109U-00 Roto	1830	7460	1410	7880	2940	810	3980	690	4500	928	2690	382	2430	368	24900	192	28.5
good	01-Sep-00	IGNS-03 RK9 8-7	IGNS-03 RK9 8-7-	25.4	46	5.76	22.9	7.23	<	10.8	<	8.54	2.55	7.07	<	7.17	<	58.1	11.2	11.1
good	17-Dec-98	NZ-019U-98	U19 Rotakawa P	8540	28100	4320	20400	<	1710	6760	1040	7010	1400	4230	608	4230	618	37000	4100	289

n.a. Not Analyzed
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REE, Th, and U in Geothermal Fluids

Quality	Analysis Date d-m-y	Sample ID	Sample Description	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Y	Th	U
good	17-Dec-98	NZ-020U-98	U20 Rotakawa #4	2300	7380	1180	5980	<	560	2400	389	2570	536	1560	221	1500	220	13000	703	186
good	20-Oct-98	NZ-019F-98 1X	F19 Rotakawa Pa	10600	33600	5050	24000	<	2030	7990	1370	8690	1800	5190	740	4770	718	49900	4040	227
good	20-Oct-98	NZ-020F-98 1X	F20 Rotakawa #4	2470	8100	1280	6580	<	639	2810	465	2850	633	1760	252	1560	249	16000	425	85.3
good	29-Sep-98	NZ-019F-98	F19 Rotakawa Pa	10800	31800	4970	24300	<	1960	7800	1640	10000	2030	5840	838	5400	829	42300	4030	230
good	29-Sep-98	NZ-019F-98 10X	F19 Rotakawa Pa	10500	32300	4750	23200	<	1810	7150	1410	8540	1710	4950	703	4700	694	42800	3470	199
good	29-Sep-98	NZ-020F-98	F20 Rotakawa #4	2790	8710	1370	7140	<	650	2640	572	3500	696	1980	280	1790	268	14100	404	86.2
good	29-Sep-98	NZ-020F-98 10X	F20 Rotakawa #4	2640	8320	1280	6730	<	575	2350	504	2880	613	1650	224	1410	212	14900	348	71.6
good	05-Sep-01	NZ-150F-00	150F-00 Mokai Mi	0.727	1.31	0.168	<	0.572	0.239	<	0.0901	0.391	0.122	0.297	0.0737	<	0.0973	1.49	0.302	0.213
good	05-Sep-01	NZ-150U-00	150U-00 Mokai M	1.59	3.51	0.38	<	0.772	0.273	<	0.107	0.46	0.123	0.356	0.101	0.534	0.112	2.1	0.569	0.26
good	05-Sep-01	NZ-151F-00	151F-00 Mokai Mi	0.592	1.17	0.164	<	0.611	0.228	<	0.0914	0.421	0.112	0.341	0.0979	0.676	0.121	1.44	0.314	0.21
good	05-Sep-01	NZ-151U-00	151U-00 Mokai M	1.19	2.56	0.318	1.87	0.692	0.234	0.562	0.107	0.497	0.12	0.313	0.0774	0.465	0.102	1.69	0.383	0.221
good	05-Sep-01	NZ-152F-00	152F-00 Mokai Mi	0.483	0.891	0.135	<	0.642	0.276	<	0.0956	0.342	0.111	0.279	0.0897	0.654	0.107	0.951	0.296	0.194
good	05-Sep-01	NZ-152U-00	152U-00 Mokai M	1.1	2.18	0.269	<	0.793	0.274	<	0.0967	0.442	0.12	0.352	0.102	<	0.122	1.41	0.57	0.294
good	10-Aug-01	NZ-150F-00	150F-00 MK-5 we	0.658	1.07	0.138	<	0.215	0.129	0.301	0.0429	0.117	0.055	0.136	0.0404	<	0.0401	1.27	0.291	0.182
good	10-Aug-01	NZ-150U-00	150U-00 MK-5 we	1.48	3.24	0.353	<	0.37	0.195	0.405	0.0649	0.178	0.0804	0.222	0.0405	<	0.034	1.78	0.498	0.225
good	10-Aug-01	NZ-151F-00	151F-00 MK-3 we	0.491	1.02	0.117	<	0.273	0.115	0.278	0.0374	0.231	0.0432	0.136	0.029	<	0.0285	1.34	0.309	0.153
good	10-Aug-01	NZ-151U-00	151U-00 MK-3 we	1.13	2.2	0.286	<	0.27	0.123	0.282	0.0651	0.258	0.0708	0.222	0.0335	0.237	0.047	1.57	0.502	0.175
good	10-Aug-01	NZ-152F-00	152F-00 MK-6 we	0.41	0.661	0.066	<	0.23	0.108	0.123	0.041	0.163	0.0515	0.127	0.027	<	0.0341	0.798	0.273	0.161
good	10-Aug-01	NZ-152U-00	152U-00 MK-6 we	1.01	1.97	0.216	<	0.302	0.124	0.291	0.0378	0.335	0.0481	0.144	0.032	<	0.036	1.31	0.684	0.253
good	10-Aug-01	NZ-153F-00	153F-00 Mokai Sp	28.2	44.5	6.23	25.7	5.04	1.56	5.58	0.897	6.3	1.49	4.59	0.718	5.11	0.862	50.1	1.27	11.3
good	10-Aug-01	NZ-153U-00	153U-00 Mokai Sp	2580	6420	664	2630	555	108	521	81.1	505	101	297	44.5	304	46.2	2570	1000	195
good	10-Aug-01	NZ-154F-00	154F-00 Mokai Pc	1710	5070	780	3950	1150	335	1540	281	1930	397	1170	167	1070	157	10700	195	380
good	10-Aug-01	NZ-154U-00	154U-00 Mokai Pc	2180	6460	993	4990	1400	422	1950	355	2440	501	1470	211	1370	198	13700	532	524
good	10-Aug-01	NZ-155F-00	155F-00 Mokai St	2.4	3.8	0.594	<	0.797	0.256	0.894	0.136	0.931	0.223	0.623	0.0999	<	0.135	7.35	0.736	78.2
good	10-Aug-01	NZ-155U-00	155U-00 Mokai St	1440	3530	358	1420	292	52.7	276	43.1	260	51.1	146	20.8	133	19.2	1290	501	294
good	11-Oct-00	NZ-153F-00	NZ-153F-00 Moka	38.9	66.9	8.74	28	<	<	7.31	<	8.28	<	5.78	<	6.58	<	66.7	19.2	14.4
good	11-Oct-00	NZ-153U-00	NZ-153U-00 Moka	2380	5760	616	2220	501	97.8	511	76.2	470	92.8	277	41.6	271	41.6	2360	111	199
good	11-Oct-00	NZ154F-00	NZ-154F-00 Moka	2040	5870	943	4340	1380	399	1840	336	2280	478	1370	197	1260	183	12600	211	530
good	11-Oct-00	NZ154U-00	NZ-154U-00 Moka	2070	5940	947	4360	1370	403	1850	341	2290	480	1370	195	1280	189	12600	355	576
good	05-Sep-01	NZ-147F-00	147F-00 Broadlar	0.68	1.79	0.16	1.76	0.411	0.154	0.374	0.0714	0.381	0.1	0.333	0.0758	<	0.0809	2.28	0.39	0.827
good	05-Sep-01	NZ-147U-00	147U-00 Broadlar	178	357	39.5	155	29.6	5.92	23.6	2.8	12	1.84	4.22	0.52	2.93	0.368	47.4	13.9	1.74
good	29-Aug-01	BR-08 well	BR-08 well	5.89	13.1	1.96	15.2	4.21	3.16	7.47	1.2	7.14	1.23	2.69	0.315	1.99	0.226	61.1	0.807	0.225
good	29-Aug-01	BR-09 well	BR-09 well	1.15	1.9	0.253	1.39	<	0.0894	0.387	0.066	0.488	0.135	0.355	0.0828	0.507	0.0198	10.4	0.489	0.174
good	29-Aug-01	BR-14 well	BR-14 well	2.24	2.43	0.549	2.1	0.331	0.169	0.374	0.0596	0.492	0.0881	0.24	0.0463	0.2	0.0484	3.03	0.529	0.236
good	29-Aug-01	BR-18 well	BR-18 well	239	500	57.7	228	47.6	10.7	46.7	6.42	32.4	5.41	12.8	1.65	10.1	1.48	160	44.3	4.43
good	29-Aug-01	BR-24 well	BR-24 well	48.1	108	12.7	52.3	12.7	6.09	14.6	2.48	15.2	2.7	6.97	0.982	5.88	0.861	82.9	8.53	1.59
good	29-Aug-01	BR-31 well	BR-31 well	3.52	6.43	1.11	5.17	0.98	0.378	0.824	0.119	0.632	0.183	0.304	0.0694	0.36	0.0732	3.61	1.86	0.517
good	29-Aug-01	BR-42 well	BR-42 well	10.1	20.4	2.41	9.54	2.04	0.505	1.91	0.316	1.84	0.328	0.836	0.149	0.783	0.121	9	3.83	1.41
good	29-Aug-01	BR-48 well 19/3/	BR-48 well 19/3/9	16.3	32.2	4.98	15.9	3.34	0.807	3	0.5	2.73	0.597	1.56	0.208	1.19	0.16	14.1	7.8	2.73
good	29-Aug-01	BR-48 well 7/3/9	BR-48 well 7/3/97	28	56	6.33	27.4	5.4	1.16	4.8	0.698	4.4	0.782	2.08	0.279	1.5	0.232	20.1	13.5	4.38
good	29-Aug-01	BR-48 wier box	BR-48 wier box	76.2	160	18.2	74.7	16	3.86	15.7	2.42	13.9	2.62	6.89	0.888	4.59	0.664	69.5	18.9	6.03
good	29-Aug-01	BR-Blank	BR-Blank	0.242	0.585	0.0777	0.884	0.189	0.0897	0.129	0.0187	0.12	0.0386	0.0733	0.0298	0.0864	0.0277	0.42	0.404	0.093
fair	29-Aug-01	BR-10 well	BR-10 well	0.296	0.545	0.0766	0.897	<	0.0698	0.101	<	0.0764	0.024	0.0413	0.0107	0.133	0.0141	0.68	0.291	0.0558
fair	29-Aug-01	BR-15 well	BR-15 well	0.417	0.607	0.1	0.884	0.108	0.0817	0.0688	<	0.112	<	0.0644	0.0164	0.115	0.0218	0.805	0.322	0.114
fair	29-Aug-01	BR-20 well	BR-20 well	0.448	0.532	0.352	0.756	0.162	0.084	0.0941	<	0.11	0.0373	0.0814	0.024	0.115	0.0228	1.01	0.298	0.133
fair	29-Aug-01	BR-22 well	BR-22 well	0.628	0.76	0.278	1.11	0.159	0.117	0.167	0.0296	0.166	0.075	0.08	0.0241	0.188	0.0297	1.13	0.353	0.233
fair	29-Aug-01	BR-25 well	BR-25 well	0.469	0.587	0.392	0.651	0.142	0.0864	0.125	<	0.13	0.0338	0.0996	0.0201	0.102	0.0208	0.963	0.281	0.175

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REE, Th, and U in Geothermal Fluids

Quality	Analysis Date d-m-y	Sample ID	Sample Description	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Y	Th	U
fair	29-Aug-01	BR-36 well	BR-36 well	1.6	0.916	0.169	1.81	0.211	0.188	0.13	0.0292	0.339	0.0987	0.122	0.0293	0.262	0.0295	1.27	0.352	0.22
fair	29-Aug-01	BR-43 well	BR-43 well	0.311	0.567	0.0698	1.29	0.121	0.0727	0.123	<	0.0955	0.028	0.048	0.0144	0.16	0.0223	0.507	0.246	0.122
fair	29-Aug-01	BR-43B well	BR-43B well	0.76	0.86	0.501	1.13	0.218	0.137	0.247	0.0333	0.175	0.0918	0.129	0.044	0.148	0.0499	1.71	0.303	0.184
fair	29-Aug-01	BR-44 well	BR-44 well	0.612	0.944	0.116	2.56	0.257	0.155	0.156	0.0223	0.138	0.0889	0.0927	0.0326	0.216	0.0318	1.2	0.273	0.156
fair	29-Aug-01	BR-44B well	BR-44B well	0.236	0.368	0.0528	1.07	0.103	0.072	0.0987	<	<	0.0396	0.0411	0.016	0.136	0.0243	0.222	0.192	0.21
good	10-Aug-01	BR-48 19-3-97	BR-48 s.p. 5.7 b.g	17.3	33	5.4	16	3.35	0.576	2.95	0.475	2.98	0.574	1.4	0.179	1.08	0.141	14.5	7.76	2.64
good	10-Aug-01	BR-48 s.p. 5.7 b	BR-48 s.p. 5.7 b.g	29	56.4	6.81	27.2	5.08	0.969	4.36	0.676	4.31	0.82	1.92	0.263	1.68	0.217	20.6	13.2	4.03
good	10-Aug-01	BR-48 Wierbox	BR-48 Wierbox	87.6	208	23	86.7	17.8	3.83	14.9	2.34	13.7	2.4	6.03	0.741	4.24	0.507	63.6	18.2	6.18
good	10-Aug-01	BR-Bottle Blank	BR-Bottle Blank	0.189	0.42	0.0456	<	0.131	0.0379	0.0608	<	0.0699	0.029	0.0618	<	0.0771	0.0125	0.327	0.219	0.0525
fair	10-Aug-01	BR-15	BR-15	0.302	0.384	0.0741	0.679	<	<	0.0715	<	0.078	<	0.0465	<	0.0817	0.0104	0.533	0.234	0.0777
fair	10-Aug-01	BR-20	BR-20	0.337	0.424	0.396	0.633	<	<	0.0496	<	0.045	0.0177	0.0295	<	0.0357	<	0.581	0.438	0.133
good	16-Jul-01	BR-11 calcite sc	7 BR-11 calcite s	149000	382000	36700	161000	30200	78700	27600	4050	22400	<	10900	1400	8000	1310	153000	46200	60800
good	16-Jul-01	BR-11 calcite sc	7 BR-11 calcite s	21000	44700	4380	15200	3140	1410	2030	244	1380	<	733	<	532	104	5090	11500	1720
good	16-Jul-01	BR-22 1hr30min	4 BR-22 1hr30mi	24500	41900	2620	11000	2200	827	2200	364	4800	<	1210	160	846	155	8420	2390	1870
good	16-Jul-01	BR-22 New up s	4 BR-22 New up	33300	30000	8110	18400	6390	5510	6200	4680	9800	<	4610	3400	<	3220	10700	5280	2690
good	16-Jul-01	BR-22 Oct99 1h	6 BR-22 Oct99 1h	32300	64200	8040	38800	17700	28100	27700	6890	54200	<	32800	4910	33200	4450	598000	3730	2250
good	16-Jul-01	BR-22 Oct99 ov	6 BR-22 Oct99 ov	4630	3730	517	2370	887	557	998	219	916	<	690	173	572	175	4620	1100	318
good	16-Jul-01	BR-22-2theta lin	5 BR-22-2theta li	12800	27700	2990	14000	2720	1370	3110	426	2960	<	1340	271	1200	177	13300	4460	2490
good	16-Jul-01	BR-22-2theta lin	5 BR-22-2theta li	6240	12500	1190	6790	902	827	950	165	1460	<	902	<	<	<	4200	2370	1290
good	16-Jul-01	NZ-147F-00	147F-00 BR-20 w	0.549	1.58	0.131	1.54	0.236	0.1	0.222	0.0364	0.22	0.0682	0.183	0.0373	<	0.04	2.09	0.293	0.76
good	16-Jul-01	NZ-147U-00	147U-00 BR-20 w	179	363	43.1	157	31.2	7.45	24.4	4.26	13.8	3.22	5.37	1.87	4.44	2.02	48	14.8	2.52
good	16-Jul-01	NZ-148F-00	148F-00 BR-15 w	2.92	4.24	0.478	<	0.409	0.257	0.485	0.0722	0.612	0.1	0.283	0.0401	0.426	0.048	3.4	0.423	1.22
good	16-Jul-01	NZ-148U-00	148U-00 BR-15 w	20.4	41.2	4.54	19	3.59	0.761	3.05	0.399	2.55	0.396	1.03	0.129	0.995	0.106	10.9	5.6	1.3
good	16-Jul-01	NZ-149F-00	149F-00 BR-48 w	0.66	1.2	0.14	1.22	0.22	0.156	0.246	0.0321	0.228	0.0582	0.156	0.0284	0.201	0.0305	2.14	0.262	0.18
good	16-Jul-01	NZ-149U-00	149U-00 BR-48 w	1.98	4.12	0.46	2.6	0.409	0.228	0.44	0.0666	0.436	0.0937	0.249	0.0366	0.28	0.042	3.04	0.514	0.221
fair	23-Oct-00	NZ-028U-98	NZ-028U-98 Broa	<	0.6	0.178	0.223	0.264	0.638	0.248	<	<	<	<	<	0.107	<	<	<	<
fair	23-Oct-00	NZ-029U-98	NZ-029U-98 Broa	4.97	5.43	0.651	2.33	0.33	0.531	0.436	<	1.03	0.113	0.372	<	0.0965	<	2.38	<	0.475
fair	23-Oct-00	NZ-030U-98	NZ-030U-98 Broa	<	0.819	0.171	0.372	<	0.211	0.46	<	0.148	<	<	<	<	<	0.103	<	0.52
poor	17-Dec-98	NZ-028U-98	U28 Broadlands	<	2.83	<	2.12	<	15.8	2.49	<	<	<	<	<	<	<	<	<	<
poor	17-Dec-98	NZ-029U-98	U29 Broadlands	57.5	11.4	2.6	9.99	<	7.94	23.1	2.81	26.3	3.43	12.6	3.38	11.9	3.27	<	12.9	6.22
poor	17-Dec-98	NZ-030U-98	U30 Broadlands	<	29.1	7.4	31.6	<	30.4	95	12.3	59.4	14	35.2	12.4	49.8	20.3	4.82	34.5	39.8
poor	29-Sep-98	NZ-028F-98	F28 Broadlands	<	15.9	1.43	6.45	<	<	37.1	5.27	1.46	<	<	<	<	<	26.8	3.55	<
poor	29-Sep-98	NZ-029F-98	F29 Broadlands	<	5.18	<	3.72	<	7.1	<	0.994	<	<	<	<	<	<	13.7	<	<
poor	29-Sep-98	NZ-030F-98	F30 Broadlands	<	21	<	3.91	<	<	<	<	<	<	<	<	<	<	22.6	0.695	<
good	05-Sep-01	NZ-146F-00	146F-00 Wairakei	0.42	1.2	0.117	0.78	0.443	0.0924	0.398	0.0854	0.48	<	0.351	0.0816	0.302	0.0752	6.37	0.332	0.137
good	05-Sep-01	NZ-146U-00	146U-00 Wairakei	18.6	41.5	4.67	18.1	3.95	0.787	3.43	0.533	2.96	0.733	1.59	0.243	1.47	0.232	14.3	4.22	0.911
good	25-May-01	NZ-146F-00	146F-00 Wairakei	0.334	1.11	<	0.811	0.287	0.0711	0.227	0.0444	0.311	<	0.269	0.0318	0.248	0.0291	6.47	0.143	0.116
good	25-May-01	NZ-146U-00	146U-00 Wairakei	18	40.3	4.43	17.9	3.78	0.709	3.24	0.474	2.74	0.671	1.37	0.198	1.41	0.189	14.2	4.39	0.942
fair	23-Oct-00	NZ-025U-98	NZ-025U-98 Wair	<	<	<	<	<	<	0.48	<	<	<	<	<	<	<	<	<	<
fair	23-Oct-00	NZ-026U-98	NZ-026U-98 Wair	0.728	4.16	0.594	2.01	0.545	0.3	0.795	<	0.2	<	<	<	0.089	<	0.974	<	0.0565
fair	23-Oct-00	NZ-027U-98	NZ-027U-98 Wair	<	<	<	<	<	0.147	<	<	<	<	<	<	<	<	<	<	<
poor	17-Dec-98	NZ-025U-98	U25 Wairakei #22	<	2.89	<	3.15	<	3.41	10.7	<	5.16	0.981	3.83	0.949	3.91	1.18	<	1.74	1
poor	17-Dec-98	NZ-026U-98	U26 Wairakei #22	<	5.19	<	3.31	<	<	1.97	<	<	<	<	<	<	<	<	<	<
poor	17-Dec-98	NZ-027U-98	U27 Wairakei #21	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
poor	29-Sep-98	NZ-025F-98	F25 Wairakei #22	<	4.29	<	2.15	<	5.78	<	1.32	<	3.91	<	<	<	<	18.9	1.95	<
poor	29-Sep-98	NZ-026F-98	F26 Wairakei #22	17.8	4.44	<	22	<	7.16	24.8	1.3	<	<	<	<	<	<	14.7	0.836	<
poor	29-Sep-98	NZ-027F-98	F27 Wairakei #21	<	<	<	1.52	<	<	23.6	3.83	<	<	11.4	<	<	<	17.7	<	<

n.a. Not Analyzed
< Less Than MDL

REE, Th, and U in Geothermal Fluids

Quality	Analysis Date d-m-y	Sample ID	Sample Description	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Y	Th	U
good	16-Jul-01	De Bretts NZ-14	De Bretts NZ-145	151000	175000	44400	269000	67700	7530	101000	14500	101000	<	70400	9250	60100	9420	844000	6110	212000
good	16-Jul-01	De Bretts NZ-14	De Bretts NZ-145	18300	29700	5410	43300	7910	1190	9740	1540	11700	<	8720	1180	7580	1370	77800	994	39700
good	07-May-01	NZ-302F-01	302F-01 Taupo M	1.56	2.87	0.371	2.35	0.566	0.0612	1.14	0.213	2.16	0.724	3.19	0.616	4.95	0.917	24.5	0.512	11.2
good	07-May-01	NZ-302U-01	302U-01 Taupo M	808	1810	300	1320	290	13.3	268	39	234	43.4	120	16	100	14	1070	147	36.6
good	07-May-01	NZ-303F-01	303F-01 Taupo M	2.37	4	0.643	4.4	1.03	0.265	1.94	0.32	3.02	0.86	3.64	0.663	5.76	1.14	26.5	0.534	8.4
good	07-May-01	NZ-303U-01	303U-01 Taupo M	11.4	19	2.81	13.6	2.99	0.651	4.17	0.739	5.89	1.44	5.54	0.937	7.31	1.42	45.1	2.81	9.18
good	07-May-01	NZ-304F-01	304F-01 De Brett	2.75	6.69	0.9	4.86	1.4	0.387	2.75	0.575	6.4	2.48	13.4	3.07	30.3	7.26	62.4	0.771	274
good	07-May-01	NZ-304U-01	304U-01 De Brett	4.02	8.43	2.16	7.13	1.97	0.538	3.39	0.735	7.04	2.7	13.6	3.15	30.5	7.32	67.4	1.1	260
good	07-May-01	NZ-305U-01	305U-01 De Brett	6.75	14.2	1.83	8.02	1.92	0.416	2.62	0.447	3.62	1.02	4.36	0.893	9.98	3.02	31	1.12	5.71
good	23-Oct-00	NZ-031U-98	NZ-031U-98 De B	2.98	8.46	1.69	8.2	2.56	0.533	5.4	1.04	8.2	2.5	11.2	2.12	19.5	4.55	85.4	<	228
good	01-Sep-00	NZ-145F-00	NZ-145F-00 De B	4.09	6.96	1.32	7.62	2.27	0.454	4.39	0.89	9.16	3.47	17.5	3.87	38.7	8.76	93.1	0.0604	11.3
good	01-Sep-00	NZ-145U-00	NZ-145U-00 De B	6.25	11.1	2	11.7	3.38	0.492	6.31	1.18	11.5	4.02	19.1	4.18	39.9	9.05	110	0.0757	6.9
fair	17-Dec-98	NZ-031U-98	U31 De Bretts	<	11.5	1.04	10.4	<	<	7.82	0.862	10.2	2.77	13.3	2.22	23.9	5.8	88.3	0.602	295
fair	29-Sep-98	NZ-031F-98	F31 De Bretts	<	10.3	<	4.83	<	1.63	3	0.771	6.81	2.09	10.2	1.65	16	4.73	100	<	264
good	16-Jul-01	L.S.N.T NZ-143	9 L.S.N.T NZ-143-	104000	229000	25900	104000	21700	4810	21800	3140	17100	<	10200	1330	8430	1150	89300	14300	4640
good	16-Jul-01	L.S.N.T. NZ-143	9 L.S.N.T. NZ-143	159000	370000	49500	220000	46900	9830	43300	8220	38700	<	22300	4440	25200	3890	200000	21200	14000
good	25-May-01	NZ-141F-00	141F-00 Tokaanu	1.17	1.68	0.206	1.09	0.311	0.12	0.27	0.0396	0.432	0.0745	0.155	0.0259	0.113	0.0278	3.77	0.22	1.94
good	25-May-01	NZ-141U-00	141U-00 Tokaanu	12.1	26.9	3.29	14.1	3.08	0.7	3.31	0.455	3.01	0.587	1.59	0.222	1.45	0.221	16.9	3.35	1.34
good	25-May-01	NZ-142F-00	142F-00 Tokaanu	5.33	2.23	0.231	1.13	0.259	0.166	0.249	0.0339	<	0.0587	0.146	0.0222	0.164	0.0179	4.31	0.21	1.4
good	25-May-01	NZ-142U-00	142U-00 Tokaanu	6.72	6.16	0.712	3.49	0.771	0.24	0.595	0.102	<	0.144	0.351	0.0614	0.362	0.0468	6.21	0.668	1.18
good	25-May-01	NZ-143F-00	143F-00 Tokaanu	6.8	4.8	0.531	2.7	0.564	0.353	0.543	0.104	<	0.134	0.431	0.0602	0.373	0.0506	9.49	0.193	1.2
good	25-May-01	NZ143U-00	143U-00 Tokaanu	6.81	5.58	0.791	3.3	0.858	<	<	<	<	<	<	<	<	<	9.07	0.278	1.04
good	25-May-01	NZ-144F-00	144F-00 Tokaanu	1.99	3.08	0.358	1.75	0.455	0.262	0.36	0.0537	0.388	<	0.178	0.0215	0.232	0.0283	5.71	0.551	1.59
good	25-May-01	NZ-144U-00	144U-00 Tokaanu	1.5	3.06	0.4	1.99	0.557	0.273	0.431	0.0678	0.46	<	0.279	0.027	0.307	0.0378	5.1	0.333	0.677
good	01-Sep-00	IGNS-09 RCL 4-	IGNS-09 RCL 4-1	155000	362000	44000	177000	46000	13700	49100	7590	48800	9740	28400	4000	26000	3970	240000	63200	13800
good	01-Sep-00	IGNS-10 RCL 18	IGNS-10 RCL 18-	150000	348000	42900	169000	44000	13100	46700	7210	46400	9280	27100	3870	25300	3770	235000	61100	13300
good	01-Sep-00	IGNS-11 RCL 4-	IGNS-11 RCL 4-5	149000	350000	43500	173000	45500	13600	49100	7570	48700	9740	28500	4060	26700	3970	240000	64100	13700
good	01-Sep-00	IGNS-12 RCL 10	IGNS-12 RCL 10-	65900	182000	26400	119000	34900	11300	42700	6790	45200	9430	28100	3970	26100	3950	263000	14700	7380
good	01-Sep-00	IGNS-13 RCL 28	IGNS-13 RCL 28-	42600	128000	20100	97100	31500	10300	44100	7310	50000	11000	33800	4940	32800	5130	321000	7080	7260
good	01-Sep-00	IGNS-13 RCL 28	IGNS-13 RCL 28-	41900	120000	19800	96500	31300	10100	43800	7280	50000	11000	33800	4970	32900	5150	319000	7200	7370
good	01-Sep-00	IGNS-14 RCL 17	IGNS-14 RCL 17-	46100	131000	20000	95800	30000	10800	41700	7040	49500	11200	35800	5540	38700	6350	317000	11900	14100
good	01-Sep-00	IGNS-15 RCL 10	IGNS-15 RCL 10-	79200	203000	28700	130000	39100	14400	49800	8150	54100	11300	33600	4800	31400	4810	302000	17500	6910
good	29-Sep-98	NZ-032U-98 1X	Mt Ruapehu Crat	48700	135000	22100	117000	<	12000	43200	9610	65000	14000	48700	7800	55900	9650	412000	21900	25800
good	29-Sep-98	NZ-032U-98 25X	Mt Ruapehu Crat	44300	128000	20600	102000	<	8800	38300	8360	57200	13500	44000	6800	44500	9940	421000	20000	19500
good	11-Oct-00	NZ-104F-00	NZ-104F-00 White	146	684	179	1470	879	327	1760	311	2090	457	1310	180	1000	160	13800	11.6	33.1
good	11-Oct-00	NZ-104U-00	NZ-104U-00 White	1290	3160	460	2470	1120	437	2020	359	2470	534	1560	218	1350	202	15600	471	76.2
good	01-Sep-00	IGNS-16 WI 22-1	IGNS-16 WI 22-10	16500	43100	5810	25100	7750	2350	10000	1780	11900	2490	7280	1020	6420	938	65700	1010	573
good	01-Sep-00	IGNS-17 WI 15-1	IGNS-17 WI 15-1	2630	6940	980	4740	1720	601	2550	461	3150	674	2000	284	1830	272	18300	1110	135
good	01-Sep-00	IGNS-18 WI 23-2	IGNS-18 WI 23-2	2800	8920	1390	6680	2230	685	2880	479	3120	637	1770	241	1440	209	16000	280	122
good	01-Sep-00	IGNS-19 WI 5-5-	IGNS-19 WI 5-5-0	863	2530	411	2190	876	313	1390	240	1670	360	1030	143	908	135	10100	221	52.4
good	01-Sep-00	IGNS-20 WI 15-1	IGNS-20 WI 15-11	716	2210	360	1830	700	239	1110	195	1340	285	831	118	763	116	8160	91.4	26.8
good	01-Sep-00	IGNS-21 WI 6-7-	IGNS-21 WI 6-7-9	2880	8780	1320	6290	2080	641	2850	473	3160	664	1910	259	1670	246	18100	413	58.9
good	01-Sep-00	IGNS-22 WI 28-2	IGNS-22 WI 28-2	1010	3200	499	2440	823	275	1200	211	1380	291	838	112	678	101	8360	26.4	45.9
good	01-Sep-00	IGNS-23 WI 14-2	IGNS-23 WI 14-2	1470	3560	493	2400	886	324	1340	233	1570	332	949	133	842	128	8990	754	65.9
good	01-Sep-00	IGNS-24 WI 2-5-	IGNS-24 WI 2-5-0	1440	4520	729	3600	1200	363	1540	247	1560	322	869	114	669	95.6	8810	340	45.5
good	01-Sep-00	IGNS-25 WI 4-11	IGNS-25 WI 4-11	642	1790	271	1430	572	215	955	168	1130	240	721	99.3	621	93.3	7110	197	26.9
good	01-Sep-00	IGNS-26 WI 31-1	IGNS-26 WI 31-1	397	1210	208	1160	485	172	842	144	997	200	603	83.4	487	72.8	6350	51.7	25.7

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REE, Th, and U in Geothermal Fluids

Quality	Analysis Date d-m-y	Sample ID	Sample Description	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Y	Th	U
good	01-Sep-00	IGNS-27 WI 6-5-	IGNS-27 WI 6-5-9	603	1800	280	1520	628	219	1000	179	1230	260	769	105	640	102	7510	239	30
good	01-Sep-00	IGNS-28 WI 29-7	IGNS-28 WI 29-7-	2980	9440	1460	7170	2600	882	4200	746	5080	1090	3220	459	2940	450	29400	576	42
good	22-Sep-00	NZBR-00-01	BR9, G6	196	391	43.9	162	34.4	9.09	36	5.42	35.3	7.46	21.2	4.03	21.2	3.5	241	1360	57.2
good	22-Sep-00	NZBR-00-02	BR20, G10	282	604	59.3	218	53.7	8.1	48.4	6.55	40	8.02	23.9	3.55	21.3	3.55	255	885	88.2
good	22-Sep-00	NZBR-00-03	G1, AqRe rinse	7200	12900	1570	5330	955	289	1070	157	962	190	565	95.3	643	180	5800	2210	1000
good	22-Sep-00	NZBR-00-04	BR9, G8, 760m	580	1210	132	455	92.3	37.6	105	15	104	18.7	52	7.2	49	6.78	640	388	129
good	22-Sep-00	NZBR-00-05	G9, Br9 + wash 9	35700	62300	7670	26200	4690	1230	5430	760	4800	940	2800	460	3090	815	28900	7280	4940
good	22-Sep-00	NZBR-00-06	BR20, G9, 965m	59.2	116	10.7	32.3	10.7	<	9.54	<	8.34	<	3.34	<	3.71	<	50.9	136	66.7
good	22-Sep-00	NZBR-00-07	DDI Field Bank	9.6	5.64	<	<	11.4	<	<	<	<	<	<	<	<	<	<	73	<
good	22-Sep-00	NZBR-00-08	G8, Br9 AqRe wa	25800	44800	5600	19200	3570	969	4030	549	3400	689	2070	333	2230	587	20900	5410	3600
good	22-Sep-00	NZBR-00-09	G10, Br20 acid w	39200	68400	8390	28700	5320	1400	5810	823	5200	1030	3110	503	3300	831	31200	7220	4800
good	22-Sep-00	NZBR-00-10	G6, Br9 AqRe wa	69200	119000	14900	51300	10200	2530	10800	1530	9640	1910	5860	921	6280	1390	58200	12200	9600
good	11-Oct-00	N1-2 Well Palinp	N1-2 Well Palinpl	579	1120	130	455	99.6	33.2	82.6	9.18	45.5	7.69	20.4	3.34	14.6	3.15	335	25.8	12.2
good	11-Oct-00	N1-3 Well Palinp	N1-3 Well Palinpl	2890	5640	682	2430	495	143	400	48.9	276	47.5	118	16	90.9	13.7	1440	169	86.2
good	11-Oct-00	Palinpinon DDI	Palinpinon DDI B	24.6	2.83	<	5.48	<	<	2.92	<	<	<	<	<	<	<	<	2.12	<
good	11-Oct-00	PN14-1 Well Pal	PN14-1 Well Palir	323	681	86.4	317	90	<	81.3	10.4	57	11.3	37.5	5.01	30.9	5.41	460	56.5	66.8
good	11-Oct-00	PN14-2 Well Pal	PN14-2 Well Palir	22	40.8	5.64	19.6	<	<	24.4	<	<	<	<	<	<	<	159	7.12	4.02
good	11-Oct-00	U.Tas. DDI Blan	U.Tas. DDI Blank	29	1.83	<	5.46	<	<	3.62	<	2.36	<	<	<	<	<	<	4.08	<
poor	12-Apr-99	Palinpinon DDI	Palinpinon DDI	39.2	<	6.7	30.8	<	<	37.8	0.825	<	<	<	2.48	13	0.883	<	<	<
poor	12-Apr-99	U.Tas.BlankDDI	U.Tas.BlankDDI	41.1	<	5.09	15	<	<	29.2	<	<	<	<	6.15	18.1	1.63	<	<	<
poor	12-Apr-99	Well N1 #1	Well N1 #1	635	1070	161	568	<	<	334	35.7	133	36.8	85.7	31.8	83.6	37	378	44.8	23.9
poor	12-Apr-99	Well N1 #3	Well N1 #3	2860	5340	684	2620	<	56	762	91.4	404	90.9	217	50	195	52.4	1550	221	102
poor	12-Apr-99	Well PN14 #1	Well PN14 #1	423	736	104	461	<	<	347	40.4	172	44.3	82.5	36.9	155	80.7	501	63.8	72
poor	12-Apr-99	Well PN14 #2	Well PN14 #2	138	78.3	34.5	76.2	<	<	220	18.8	86.4	23.3	42	30.6	117	60.8	182	13	14.8
poor	11-Oct-00	HCE 30A-1	HCE 30A-1	2.38	8.6	<	<	<	<	13.2	<	5.8	<	3.86	<	3.43	<	70.8	<	1.25
poor	11-Oct-00	HCE 30A-2	HCE 30A-2	<	4.96	<	5.23	<	4.73	11.6	<	6.27	<	4.74	<	2.54	<	66.7	1.15	<
poor	11-Oct-00	HCE 30A-3	HCE 30A-3	2.68	8.09	<	4.87	<	5.49	16.1	2.27	6.37	<	5.34	<	4.5	<	75.4	<	1.36
poor	11-Oct-00	HCE 30A-4	HCE 30A-4	13.7	14.2	3.44	8	<	3.79	11.7	<	5.34	<	4.35	<	5.63	<	74.1	1.72	1.58
poor	11-Oct-00	HCE 30A-5	HCE 30A-5	2.88	8.49	3.6	5.72	<	5.27	17.1	<	7.73	<	5.49	<	4.42	<	66.7	<	<
poor	11-Oct-00	HCE 30A-6	HCE 30A-6	11.2	10.9	3.67	3.14	<	<	17.9	<	7.72	<	5.57	<	6.62	2.34	71.9	<	2.79
poor	11-Oct-00	HCE 33-1	HCE 33-1	<	5.94	3.83	4.71	<	<	17.2	2.14	8.62	<	7.12	<	6.97	3.17	73.1	<	3.17
poor	11-Oct-00	HCE 33-2	HCE 33-2	<	5.93	<	6.65	<	5	15	2.1	6.31	<	6.11	<	6.31	2.81	77.4	<	2.36
poor	11-Oct-00	HCE 33-3	HCE 33-3	2.27	8.92	5.01	4.83	<	<	18.6	<	9.89	<	7.32	<	5.57	3.24	74.8	<	3.18
poor	11-Oct-00	HCE 33-4	HCE 33-4	<	5.95	3.89	7.06	<	<	19	2.06	10.4	<	6.67	2.03	6.98	3.07	78.5	<	2.9
good	25-May-99	LEACH NV-053-	Bottle Leach pos	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
good	25-May-99	LEACH NV-054-	Bottle Leach pos	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
good	25-May-99	LEACH NV-055-	Bottle Leach pos	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
good	25-May-99	LEACH NV-056-	Bottle Leach pos	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
good	25-May-99	LEACH NV-057-	Bottle Leach pos	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
good	25-May-99	LEACH NV-058-	Bottle Leach pos	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
good	25-May-99	LEACH OR-035-	Bottle Leach pos	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
good	25-May-99	LEACH OR-041-	Bottle Leach pos	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
good	25-May-99	LEACH OR-047-	Bottle Leach pos	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
good	26-Mar-01	Blank-01 12/8/9	Blank-01 12/8/98	3.68	7.62	0.635	2.87	0.812	0.137	0.697	0.12	0.941	0.133	0.467	0.0811	0.427	0.0741	5.19	0.989	0.497
good	26-Mar-01	Blank-02 12/8/9	Blank-02 12/8/98	2.97	5.52	0.442	2.11	0.568	0.108	1.47	0.0799	0.761	0.0876	0.312	0.0483	0.395	0.0553	2.97	0.624	0.288
good	26-Mar-01	Blank-03 12/8/9	Blank-03 12/8/98	4.2	8.72	0.775	3.35	0.92	0.168	0.84	0.138	0.993	0.158	0.414	0.0553	0.476	0.0652	4.63	0.961	0.697
good	26-Mar-01	Blank-04 12/8/9	Blank-04 12/8/98	3.2	6.19	0.653	2.31	0.781	0.288	0.76	0.303	1	0.283	0.577	0.219	0.631	0.203	4.61	0.719	0.427

n.a. Not Analyzed
< Less Than MDL

REE, Th, and U in Geothermal Fluids

Quality	Analysis Date d-m-y	Sample ID	Sample Description	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Y	Th	U
good	26-Mar-01	Blank-05 12/8/9	Blank-05 12/8/98	2.1	4.38	0.373	1.75	0.587	0.0917	0.448	0.0794	0.708	0.0858	0.219	0.0438	0.276	0.0506	2.95	0.555	0.284
good	26-Mar-01	Blank-06 12/8/9	Blank-06 12/8/98	1.87	3.3	0.29	1.28	0.383	0.0805	0.449	0.0635	0.549	0.0719	0.278	0.0395	0.284	0.0392	2.02	0.408	0.245
good	26-Mar-01	MDL-02 12/8/98	MDL-02 12/8/98	6.99	8.13	3.48	4.97	4.36	3.48	3.96	3.71	4.02	4.03	3.8	3.52	3.89	3.47	5.19	2.22	2.4
good	26-Mar-01	MDL-03 12/8/98	MDL-03 12/8/98	8.6	8.47	3.52	5.17	4.59	3.47	4.14	3.7	4.05	3.99	3.69	3.44	3.61	3.46	5.6	2.23	2.51
good	26-Mar-01	MDL-04 12/8/98	MDL-04 12/8/98	6.66	7.73	3.4	4.74	4.4	3.49	4.18	3.67	3.8	3.91	3.56	3.59	3.89	3.44	5.24	2.01	2.49
good	26-Mar-01	MDL-05 12/8/98	MDL-05 12/8/98	5.92	7.27	3.5	4.75	4.51	3.48	4.21	3.72	3.77	4	3.75	3.53	3.53	3.52	5.22	2.18	2.53
good	26-Mar-01	MDL-06 12/8/98	MDL-06 12/8/98	6.28	7.97	3.49	5.16	4.43	3.53	4.2	3.71	3.99	3.93	3.79	3.48	3.64	3.4	5.53	2.06	2.55
good	26-Mar-01	MDL-07 12/8/98	MDL-07 12/8/98	13.7	7.07	3.47	4.51	4.27	3.4	3.99	3.64	4.04	4.04	3.67	3.5	3.72	3.4	5.17	2	2.52
good	26-Mar-01	MDL-01 12/8/98	MDL-01 12/8/98	8.13	10	3.69	5.55	4.53	3.5	4.62	3.62	4.22	3.88	3.62	3.51	3.8	3.49	6.19	2.2	2.62
good	17-Dec-98	MDL-01	MDL-01	<	5.08	1.88	4.48	<	2.29	3	2.28	3.34	3.3	3.21	2.9	3.29	3.29	8.1	1.12	1.04
good	17-Dec-98	MDL-02	MDL-02	<	5.02	2.33	4.79	<	2.39	3.84	2.77	3.41	3.81	3.33	3.55	4.2	3.77	9.06	1.29	1.43
good	17-Dec-98	MDL-03	MDL-03	<	3.73	2.09	4.32	<	2.6	3.52	2.56	3.37	3.51	3.31	3.1	3.38	3.53	9.58	1.04	1.57
good	17-Dec-98	MDL-04	MDL-04	<	4.72	2.4	5.56	<	2.88	3.33	2.68	3.47	3.6	3.2	3.43	4.33	3.88	10	1.1	1.55
good	17-Dec-98	MDL-05	MDL-05	<	3.35	2.23	4.8	<	2.56	3.36	2.47	3.37	3.53	2.78	3.2	3.91	3.65	9.23	1.42	1.36
good	17-Dec-98	MDL-06	MDL-06	<	4.41	2.54	5.57	<	2.26	3.53	2.93	4.2	3.93	3.96	3.62	3.64	3.89	11.6	1.37	1.77
good	17-Dec-98	MDL-07	MDL-07	11.3	3.69	2.4	5.37	<	2.21	4.24	2.87	3.94	3.74	3.7	3.47	3.78	3.79	10.8	1.35	1.88
fair	17-Dec-98	BLK-01	BLK-01	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
fair	17-Dec-98	BLK-02	BLK-02	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
fair	17-Dec-98	BLK-03	BLK-03	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
fair	17-Dec-98	BLK-04	BLK-04	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
fair	17-Dec-98	BLK-05	BLK-05	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
fair	17-Dec-98	BLK-06	BLK-06	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<	<
good	20-Oct-98	IDL1 = 0.08 ppb	IDL1 = 0.08 ppb	71.2	77.8	66	68	<	66	138	87	103	110	128	80.8	117	88.3	75.9	29.3	31.7
good	20-Oct-98	IDL2 = 0.08 ppb	IDL2 = 0.08 ppb	78	76.2	65.2	75.1	<	73.3	131	91.2	102	104	119	76.7	116	90.2	71.2	28.7	30
good	20-Oct-98	IDL3 = 0.08 ppb	IDL3 = 0.08 ppb	76	71.6	68.3	77	<	65	135	93.2	100	100	139	81.2	121	95.3	76.9	33.4	28.3
good	20-Oct-98	IDL4 = 0.08 ppb	IDL4 = 0.08 ppb	85.9	83.1	69.3	80.7	<	70.6	147	89.2	97.8	105	124	84.8	125	91.9	69.9	30.7	30.8
good	20-Oct-98	IDL5 = 0.08 ppb	IDL5 = 0.08 ppb	73.1	81.9	65.7	67.1	<	57.9	143	89.6	109	107	129	80	121	89.4	88.9	32.8	26.3
good	20-Oct-98	IDL6 = 0.08 ppb	IDL6 = 0.08 ppb	73.7	73.8	71	75.6	<	61.9	153	87.8	113	104	123	79.1	114	88.8	75.4	33.4	30.9
good	20-Oct-98	IDL7 = 0.08 ppb	IDL7 = 0.08 ppb	68.8	77.1	62.5	75.9	<	70	164	88.1	103	103	130	78.9	114	92.9	90.2	28.7	28.2
good	26-Mar-01	IDL-1 = 0.008 pp	IDL-1 = 0.008 ppb	8.85	8.83	7.33	9.19	10.7	8.78	8.45	7.81	9.5	8.02	8.87	8.08	10	7.96	8.43	6.48	4.8
good	26-Mar-01	IDL-2 = 0.008 pp	IDL-2 = 0.008 ppb	9.3	9.59	7.12	9.91	11.6	9.77	8.89	8.29	10.2	7.92	9.34	8.18	8.71	8.09	8.07	5.99	4.44
good	26-Mar-01	IDL-3 = 0.008 pp	IDL-3 = 0.008 ppb	9.56	8.62	7.4	9.47	12.3	9.86	8.56	8.13	9.63	8.55	9.74	8.02	9.24	8.24	8.21	5.82	4.54
good	26-Mar-01	IDL-4 = 0.008 pp	IDL-4 = 0.008 ppb	9.08	9.1	7.4	10	11.8	9.6	10.5	8.15	8.47	8.4	10.2	7.83	8.79	8.11	8.06	5.89	4.22
good	26-Mar-01	IDL-5 = 0.008 pp	IDL-5 = 0.008 ppb	9.22	9.67	7.66	10.1	13.4	9.79	9.17	8.15	8.97	8.24	9.1	8.21	9.8	8.17	8.38	6.14	4.59
good	26-Mar-01	IDL-6 = 0.008 pp	IDL-6 = 0.008 ppb	9.72	9.44	7.83	8.98	11.8	9.8	10	8.43	9.24	8.12	9.14	8.29	8.74	8.19	8.4	5.68	4.54
good	26-Mar-01	IDL-7 = 0.008 pp	IDL-7 = 0.008 ppb	9.42	9.61	7.59	9.77	13.9	9.91	9.41	8.06	9.12	8.34	9.08	8.02	9.4	8	8.59	5.96	4.43
good	26-Jan-01	IDL = 0.005 ppb	IDL = 0.005 ppb	6.38	7	6.21	6.93	19.8	6	4.44	4.55	5.6	5.29	4.71	4.78	4.99	5.14	4.34	4.56	2.66
good	26-Jan-01	IDL = 0.005 ppb	IDL = 0.005 ppb	6.13	7.1	5.57	6.26	17.8	5.4	6.69	4.37	7.37	4.34	6.17	4.63	5.62	4.87	4.53	4.75	2.29
good	26-Jan-01	IDL = 0.005 ppb	IDL = 0.005 ppb	5.81	7.6	6.15	4.49	18	6.03	5.8	4.54	4.27	4.81	6.22	4.74	5.73	4.8	5.25	5.16	2.17
good	26-Jan-01	IDL = 0.005 ppb	IDL = 0.005 ppb	5.6	7.49	5.71	4.8	19.8	6.33	4.6	4.61	5.85	4.47	5.76	4.76	5.72	4.43	5.13	5.7	2.39
good	26-Jan-01	IDL = 0.005 ppb	IDL = 0.005 ppb	6.24	6.11	5.64	6.37	18.6	6.73	9.35	4.9	5.25	4.83	4.94	4.63	4.49	4.49	4.06	5.47	2.38
good	26-Jan-01	IDL = 0.005 ppb	IDL = 0.005 ppb	5.99	6.62	5.97	5.98	18.2	5.63	4.41	4.49	6.05	4.41	6.16	4.38	5.88	4.87	4.52	5.62	2.28
good	26-Jan-01	IDL = 0.005 ppb	IDL = 0.005 ppb	6.17	7.01	5.53	6.15	19	5.58	4.73	4.69	5.59	4.71	4.11	4.4	5.74	4.58	4.96	6.73	2.23
good	23-Feb-01	IDL-1	IDL-1	5.88	6.03	5.73	8.92	6.4	6.15	6.61	5.32	5.89	5.32	6.23	5.15	6.4	5.6	5.21	6.9	2.67
good	23-Feb-01	IDL-2	IDL-2	6.26	6.8	5.48	6.74	9.1	5.32	6.77	5.33	5.35	5.29	6.94	5.46	8.09	5.23	6.44	6.97	2.71
good	23-Feb-01	IDL-3	IDL-3	6.09	6.52	5.09	6.83	7.6	5.99	5.21	5.58	6.87	5.46	7.17	5.09	7.29	5.6	5.81	6.9	2.72
good	23-Feb-01	IDL-4	IDL-4	6.6	5.16	5.13	6.2	7.55	6.7	5.23	4.8	7.71	5.21	6.17	5.18	7.37	5.61	4.78	6.29	2.7

n.a. Not Analyzed
< Less Than MDL

REE, Th, and U in Geothermal Fluids

Quality	Analysis Date d-m-y	Sample ID	Sample Description	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Y	Th	U
good	23-Feb-01	IDL-5	IDL-5	6.64	6.81	5.82	5.33	10.7	5.52	4.55	5.18	4.12	5.48	8.29	5.34	7.23	5.2	5.04	6.3	2.97
good	23-Feb-01	IDL-7	IDL-7	6.14	7.11	5.28	7.27	9.16	5.72	7.14	5.02	5.85	5.43	7.93	4.78	6.32	5.05	5.21	5.93	2.45
good	07-May-01	Blank 1	MDL-1 200 pg/L	0.539	0.771	0.291	0.592	0.329	0.29	0.42	0.265	0.418	0.286	0.346	0.283	0.33	0.28	1.13	0.254	0.354
good	07-May-01	Blank 2	MDL-2 200 pg/L	0.407	0.57	0.246	0.532	0.267	0.27	0.316	0.218	0.32	0.253	0.264	0.231	0.508	0.22	0.695	0.248	0.287
good	07-May-01	Blank 3	MDL-3 200 pg/L	0.559	0.813	0.304	0.59	0.312	0.323	0.352	0.269	0.421	0.3	0.304	0.278	0.335	0.273	1.12	0.236	0.308
good	07-May-01	Blank 4	MDL-4 200 pg/L	0.523	0.709	0.293	0.674	0.366	0.305	0.435	0.269	0.42	0.291	0.323	0.29	0.346	0.275	0.822	0.263	0.332
good	07-May-01	Blank 5	MDL-5 200 pg/L	0.521	0.707	0.281	0.695	0.36	0.272	0.362	0.25	0.398	0.27	0.257	0.24	0.444	0.244	0.779	0.174	0.257
good	07-May-01	Blank 6	MDL-6 200 pg/L	0.438	0.662	0.256	0.443	0.37	0.291	0.387	0.252	0.378	0.247	0.341	0.259	0.314	0.263	0.784	0.2	0.242
good	07-May-01	Blank 7	MDL-7 200 pg/L	0.667	0.901	0.267	1.19	0.418	0.273	0.358	0.239	0.397	0.253	0.259	0.263	0.399	0.277	0.819	0.281	0.318
good	27-Aug-01	LMB-4	Method Blank-1	0.0007	0.0005	0.00052	0.0008	0.0006	0.0003	0.0002	0.0004	0.0003	0.0005	0.0002	0.0005	0.0004	0.0006	0.0002	0.0065	0.0052
good	27-Aug-01	LMB-5	Method Blank-3	0.0006	0.0005	0.00035	0.0046	0.0008	0.0003	0.0003	0.0003	0.0004	0.0004	0.0003	0.0005	0.0007	0.0006	0.0002	0.0032	0.0052
good	27-Aug-01	LMB-6	Method Blank-5	0.0007	0.0005	0.00034	0.002	0.0005	0.0003	0.0004	0.0003	0.0003	0.0004	0.0004	0.0006	0.001	0.0006	0.0002	0.0032	0.0053
good	27-Aug-01	LMB-7	Method Blank-7	0.0006	0.0005	0.00033	0.0012	0.0003	0.0004	0.0003	0.0003	0.0002	0.0003	0.0002	0.0003	0.0006	0.0004	0.0001	0.0021	0.0043
good	27-Aug-01	MDL-4	Method Blank-2	0.001	0.0007	0.00056	0.0037	0.001	0.0005	0.0007	0.0004	0.0003	0.0005	0.0004	0.0006	0.0012	0.0008	0.0003	0.0049	0.0085
good	27-Aug-01	MDL-5	Method Blank-4	0.0006	0.0005	0.00042	0.0009	0.0006	0.0005	0.0004	0.0002	0.0004	0.0003	0.0002	0.0006	0.0005	0.0005	0.0002	0.0028	0.0046
good	27-Aug-01	MDL-6	Method Blank-6	0.0006	0.0006	0.00039	0.0008	0.0006	0.0005	0.0004	0.0002	0.0003	0.0004	0.0002	0.0005	0.0005	0.0005	0.0002	0.0026	0.0048
good	27-Aug-01	MDL-7	Method Blank-8	0.0006	0.0005	0.00039	0.0007	0.0008	0.0004	0.0004	0.0002	0.0002	0.0002	0.0001	0.0005	0.0005	0.0004	0.0001	0.0018	0.0043

n.a. Not Analyzed
< Less Than MDL

Geothermal Fluid Cations Summary

Sample ID	Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	K	La	Li	Mg
MDL [mg/kg]	0.00115	0.00469	0.0206	0.0677	0.0057	0.00671	0.209	0.00614	0.00628	0.00464	0.0046	0.0437	0.034	0.00136	0.0325	0.0515
	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
OR-033-98	<	<	<	<	<	na	3.1	<	na	<	<	<	0.974	na	0.0644	0.0164
OR-034-98	<	<	0.0435	2.8	<	na	82.8	<	na	<	<	0.0248	43.9	na	2.21	0.933
OR-035-98	<	<	0.029	3.86	0.0528	na	160	<	na	<	<	0.132	23.4	na	1.14	1.06
OR-036-98	<	<	0.0475	5.24	0.0289	na	200	<	na	<	<	0.0206	27.5	na	1.28	0.347
OR-037-98	<	<	<	4.13	0.074	na	198	<	na	<	<	<	10.6	na	0.631	0.14
OR-038-98	<	<	<	5.2	0.0128	na	101	<	na	<	<	<	13.8	na	0.501	0.367
OR-039-98	<	<	<	17.6	0.0474	na	447	<	na	<	<	0.00513	42.7	na	2.21	1.15
OR-040-98	<	<	<	17.8	0.15	na	464	<	na	<	<	0.00987	42.7	na	2.21	1.1
OR-041-98	<	<	0.295	33.7	0.151	na	328	<	na	<	<	1.29	96	na	4.02	43.4
OR-042-98	<	<	<	8.47	<	na	4.77	<	na	<	<	<	5.07	na	0.116	<
OR-051-98	<	<	<	8.99	<	na	4.7	<	na	<	<	<	11.1	na	0.128	<
OR-043-98	<	0.102	0.0916	11.4	<	na	0.798	<	na	<	<	<	45	na	1.58	<
OR-044-98	<	<	0.484	34.1	0.127	na	16.4	<	na	<	<	<	90.7	na	3.52	2.07
OR-045-98	<	0.0376	0.12	15.8	0.0628	na	15.4	<	na	<	<	<	36.3	na	0.843	<
OR-046-98	<	0.567	0.113	16	0.0853	na	24.6	<	na	<	<	1.12	37.6	na	0.902	0.691
OR-047-98	<	0.176	<	1.75	<	na	7.36	<	na	<	<	<	8.9	na	0.662	<
OR-048-98	<	<	<	<	<	na	3.12	<	na	<	<	<	1.5	na	0.0488	<
OR-049-98	<	0.0602	<	<	<	na	4.78	<	na	<	<	<	4.24	na	0.0593	<
OR-052-98	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
ID-050-98	<	0.0609	<	<	<	na	13.6	<	na	<	<	<	4.75	na	0.0763	<
NV-053-98	<	1.09	0.944	12.3	0.071	na	10	<	na	<	<	<	72.6	na	2.58	<
NV-054-98	<	1.37	0.802	9.7	0.00799	na	7.82	<	na	<	<	<	66	na	2.39	<
NV-055-98	<	1.43	0.794	9.76	0.0094	na	8.2	<	na	<	<	<	65.9	na	2.37	<
NV-056-98	<	1.03	0.943	12.5	0.074	na	10.3	<	na	<	<	<	72.2	na	2.39	<
NV-057-98	<	1.02	0.822	12.1	0.0754	na	10.3	<	na	<	<	0.0207	69.3	na	2.2	<
NV-058-98	<	0.0107	<	2.97	0.0381	na	53.9	0.00438	na	<	<	0.128	24.9	na	0.968	45.6
NV-059-98	<	1.08	1.15	12.2	0.0689	na	9.47	<	na	<	<	<	70.1	na	2.56	<
NV-060-98	<	1.08	1.28	12	0.0709	na	9.68	0.00437	na	<	<	<	69.5	na	2.43	<
NV-061-98	<	1.03	1.32	11.9	0.0724	na	9.5	0.00393	na	<	<	<	68.5	na	2.4	<
NV-062-98	<	0.0181	0.514	5.86	0.144	na	16.4	0.00686	na	<	<	5.66	22	na	0.504	0.6
NV-063-98	0.000798	0.057	<	6.44	0.313	na	45	0.00519	na	<	<	5.77	89.1	na	5.4	0.329
NV-064-98	<	0.259	0.793	7.26	0.052	na	24.4	0.00368	na	<	<	0.128	44.2	na	1.12	0.0304
NV-065-98	<	1.38	0.951	13.1	0.0617	na	10.3	<	na	<	<	0.0174	75.1	na	2.9	<
NV-066-98	<	0.00499	<	0.384	0.0027	na	0.248	0.0049	na	<	<	0.166	0.256	na	0.0463	0.042
NV-067-98	<	<	<	0.7729	<	na	46.64	<	na	<	<	<	20.08	na	<	11.41
NV-068-98	<	<	<	<	<	na	41.75	<	na	<	<	5.488	19.4	na	<	10
NV-069-98	<	0.58	<	<	<	na	3.38	<	na	<	<	<	22.33	na	<	<
NV-070-98	<	0.424	<	<	<	na	3.4	<	na	<	<	<	21.62	na	<	<
NV-071-98	<	0.402	<	<	<	na	3.44	<	na	<	<	<	21.41	na	<	<
CA-087-99	<	0.04627	<	6.941	3.922	<	835	<	<	<	<	0.7067	359	<	5.23	2.273
CA-088-99	<	0.01855	<	7.821	4.34	<	762	<	<	<	<	1.302	348	<	5.607	3.03
CA-089-99	<	0.01128	<	7.692	4.073	<	729	<	<	<	<	0.09462	342	<	5.56	4.359
CA-090-99	<	0.04461	<	8.788	4.552	<	772	<	<	<	<	0.139	363	<	6.393	3.248
CA-091-99	<	0.03733	0.02101	8.634	4.303	<	742	<	<	<	<	0.5356	331	<	5.713	4.216

n.a. Not Analyzed
< Less Than MDL

Geothermal Fluid Cations Summary

Sample ID	Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	K	La	Li	Mg
MDL [mg/kg]	0.00115	0.00469	0.0206	0.0677	0.0057	0.00671	0.209	0.00614	0.00628	0.00464	0.0046	0.0437	0.034	0.00136	0.0325	0.0515
	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
CA-092-99	<	0.03343	<	7.883	3.896	<	815	<	<	<	<	0.1979	356	<	5.342	4.243
CA-093-99	<	0.02534	<	8.306	4.158	<	784	<	<	<	<	7.858	351	<	5.688	3.315
CA-094-99	<	0.0493	<	7.531	4.004	<	846	<	<	<	<	0.8967	363	<	4.99	2.366
CA-095-99	<	0.03991	<	7.002	3.568	<	836	<	<	<	<	0.3863	343	<	4.796	2.089
CA-096-99	<	0.06421	<	8.379	4.399	<	898	<	<	<	<	0.07999	379	<	5.843	3.29
NZ-000-98	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
CA-072-99	<	0.1396	<	1.22	0.08571	<	<	0.1098	0.139	0.1162	0.2232	1.041	1.953	0.1043	<	1.037
NZ-117-00	<	<	<	1.853	<	<	<	<	<	<	<	<	0.1224	<	<	<
NZ-163-00	<	<	<	0.3452	<	<	2.098	<	0.008048	<	<	<	0.2516	<	<	0.08738
NZ-300-01	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-110-00	0.006437	0.284	0.2149	821	0.8834	<	5.763	0.0296	<	<	<	<	78.77	<	8.995	0.1331
NZ-111-00	0.00596	0.2852	0.2212	810	0.7976	<	5.542	0.03055	<	<	<	0.07803	79.02	<	8.812	0.1568
NZ-112-00	<	<	<	42.89	1.44	<	304.8	<	<	<	<	8.774	32.02	<	2.12	70.76
NZ-007-98	<	<	<	4.87	<	na	2.71	0.00272	na	<	<	<	1.79	na	0.224	0.0257
NZ-113-00	<	0.01949	<	9.801	<	<	3.286	<	<	<	<	<	2.422	<	0.04323	0.08411
NZ-009-98	<	<	1.27	204	0.167	na	19.7	0.00456	na	<	<	3.24	49.1	na	2.41	6.35
NZ-115-00	<	<	0.8015	130.3	0.13	<	23.94	0.00719	<	<	<	0.2014	56.16	<	0.8759	7.972
NZ-010-98	<	<	1.23	230	0.175	na	7.09	0.00456	na	<	<	0.159	50.5	na	2.55	4.2
NZ-116-00	<	<	1.22	148.4	0.166	<	7.313	0.007408	<	<	<	0.1824	64.2	<	1.06	4.673
NZ-008-98	<	<	1.2	214	0.176	na	6.15	0.00344	na	<	<	0.0529	50	na	2.53	4.35
NZ-114-00	<	<	1.23	147.5	0.1398	<	4.06	0.007798	<	<	<	0.04921	65.66	<	1.031	4.62
NZ-021-98	<	0.237	2.7	54.8	<	na	2690	<	na	<	<	0.997	89.4	na	6.61	93.7
NZ-156-00	<	<	<	43.8	5.251	<	2670	<	0.008011	<	<	0.8952	59.57	<	2.413	72.4
NZ-157-00	<	<	<	42.1	5.401	<	2520	<	0.00798	<	<	1.296	54.97	<	2.361	72.7
NZ-022-98	<	0.156	2.33	54.7	<	na	2520	<	na	<	<	1.72	88.6	na	6.37	97.8
NZ-162-00	<	<	<	42.2	5.492	<	2510	<	0.008	<	<	0.09915	55.7	<	2.368	72.9
NZ-158-00	<	0.2122	<	56.2	3.009	<	536	<	0.008	<	<	0.1418	60.98	<	1.19	9.16
NZ-023-98	<	<	0.934	71.2	3.37	na	624	<	na	<	<	<	48.2	na	3.62	10.2
NZ-160-00	<	0.01292	<	64.8	1.47	<	615	<	0.008	<	<	<	66.78	<	1.408	8.34
NZ-024-98	<	<	1	84.7	2.12	na	651	<	na	<	<	<	51.3	na	4.14	9.28
NZ-161-00	<	<	<	60.8	3.063	<	581	<	0.008015	<	<	0.04884	63.34	<	1.333	9.332
NZ-129-00	<	0.0748	<	10.01	<	<	1.1	<	<	<	<	<	1.32	<	0.03611	<
NZ-128-00	<	0.0863	<	92.19	<	<	11.32	<	<	<	<	<	8.42	<	1.218	0.3481
NZ-130-00	<	<	<	42.8	0.0525	<	5.678	<	<	<	<	<	8.367	<	1.182	0.1096
NZ-131-00	<	0.0184	<	4.058	0.03717	<	7.859	<	0.008012	<	<	<	5.66	<	1.086	0.3424
NZ-132-00	<	0.03429	<	1.331	<	<	7.187	<	0.00802	<	<	<	4.318	<	0.5747	0.434
NZ-101-00	<	0.03373	0.3555	14.21	0.2349	<	8.969	<	<	<	0.02153	<	46.34	<	0.2876	0.9314
NZ-101-00	<	0.03373	0.3555	14.21	0.2349	<	8.969	<	<	<	0.02153	<	46.34	<	0.2876	0.9314
NZ-165-00	na	1.1	0.77	45.3	na	na	1.1	na	na	na	na	na	106	na	5.3	0.01
NZ-166-00	na	0.88	0.17	47.7	na	na	1.4	na	na	na	na	na	112	na	5.6	0.02
NZ-102-00	<	0.5336	1.239	39.58	<	<	0.8454	<	<	<	0.0206	<	77.7	<	3.944	<
NZ-102-00	<	0.5336	1.239	39.58	<	<	0.8454	<	<	<	0.0206	<	77.7	<	3.944	<
NZ-098-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-098-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na

n.a. Not Analyzed
< Less Than MDL

Geothermal Fluid Cations Summary

Sample ID	Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	K	La	Li	Mg
MDL [mg/kg]	0.00115	0.00469	0.0206	0.0677	0.0057	0.00671	0.209	0.00614	0.00628	0.00464	0.0046	0.0437	0.034	0.00136	0.0325	0.0515
	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
NZ-167-00	na	0.75	0.13	38.7	na	na	0.54	na	na	na	na	na	74	na	5	0.01
NZ-103-00	<	0.02347	<	0.6824	<	<	<	<	<	<	<	<	0.7748	<	<	<
NZ-103-00	<	0.02347	<	0.6824	<	<	<	<	<	<	<	<	0.7748	<	<	<
NZ-159-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-159-00	<	0.6014	0.2656	32.1	<	<	1.309	<	0.008022	<	<	0.1427	70.9	<	3.324	<
NZ-099-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-099-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-168-00	na	0.77	0.25	35	na	na	1.5	na	na	na	na	na	77	na	4.2	0.01
NZ-169-00	na	0.9	<0.1	50.6	na	na	0.76	na	na	na	na	na	121	na	6.3	0.002
NZ-164-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-100-00	<	<	<	0.9863	0.278	<	26.11	<	<	<	0.01568	5.561	12.79	<	<	9.581
NZ-100-00	<	<	<	0.9863	0.278	<	26.11	<	<	<	0.01568	5.561	12.79	<	<	9.581
NZ-138-00	<	0.07367	0.3571	5.207	0.04416	<	6.216	<	0.00803	<	<	<	67.4	<	1.838	0.06591
NZ-012-98	<	<	0.517	5.18	0.043	na	6.08	0.00358	na	<	<	0.0145	39.4	na	3.04	0.0514
NZ-136-00	<	0.07432	0.4787	5.537	0.06715	<	5.742	<	0.007999	<	<	0.2279	50.1	<	2.32	2.634
NZ-137-00	<	0.0966	0.4943	5.988	0.06236	<	5.551	<	0.008028	<	0.1529	0.1067	53.12	<	2.493	1.917
NZ-011-98	<	<	0.69	5.98	0.066	na	5.44	0.003	na	<	<	0.398	31.9	na	3.76	1.81
NZ-139-00	<	0.117	0.7566	6.502	0.01032	<	2.73	<	0.008018	<	<	<	59.92	<	2.842	<
NZ-140-00	<	0.1107	0.7327	6.456	0.01014	<	2.707	<	0.008011	<	<	<	60.14	<	2.772	<
NZ-014-98	<	<	1.29	6.96	0.0123	na	3.34	<	na	<	<	<	44.3	na	<	0.0269
NZ-013-98	<	<	1.14	7.09	0.0139	na	2.72	0.00348	na	<	<	<	37.5	na	<	0.0237
NZ-306-01																
NZ-003-98	<	<	5.37	25.5	0.00949	na	32.1	0.0028	na	<	<	<	63.9	na	8.48	0.0608
NZ-121-00	<	0.1723	6.297	31.02	<	<	33.89	<	<	<	<	<	149.9	<	6.48	0.06918
NZ-122-00	<	0.1676	6.487	31.69	<	<	35.31	<	<	<	<	<	156.8	<	6.415	0.06769
NZ-119-00	<	17.52	<	12.22	0.05679	<	23.63	<	<	<	<	5.581	65.98	0.002112	2.79	1.64
NZ-120-00	<	1.59	1.58	10.57	0.08749	<	17.8	<	<	<	<	2.675	57.42	<	2.31	1.654
NZ-001-98	<	4.1	1.51	11	0.0651	na	20.2	0.00289	na	<	<	1.83	42.2	na	4.38	2.24
NZ-002-98	<	42.8	1.74	6.12	0.04	na	21.9	0.00443	na	<	<	11.1	28.6	na	2.89	2.74
NZ-118-00	<	50.92	1.52	8.548	0.0166	<	24.93	<	<	<	<	11.19	51.21	0.01524	2.011	3.749
NZ-307-01	parking lot															
NZ-018-98	<	<	0.194	<	<	na	7	0.0124	na	0.00736	<	<	7.4	na	2.2	0.212
NZ-133-00	<	0.01122	0.2156	1.195	0.009464	<	7.492	<	0.008028	<	<	<	8.59	<	1.841	0.215
NZ-232-00	<	0.2544	<	0.9661	<	<	<	<	<	<	<	<	4.166	<	0.4633	<
NZ-004-98	<	1.97	<	<	0.0773	na	2.6	0.00451	na	<	<	8.2	5.51	na	0.038	0.712
NZ-005-98	<	7.55	<	<	0.119	na	4.51	0.00428	na	<	<	8.75	13.1	na	0.417	0.836
NZ-134-00	<	6.94	0.06396	0.298	0.1122	<	6.25	<	0.008046	<	<	13.11	27.3	0.001729	0.4543	1.162
NZ-006-98	<	31.9	<	<	0.107	na	0.214	0.00555	na	<	<	11.4	6.17	na	<	0.293
NZ-135-00	0.001232	66.41	<	<	0.101	<	0.401	<	0.007991	<	<	6.937	9.343	0.008039	<	0.4636
NZ-017-98	<	<	0.556	<	<	na	1.42	0.0131	na	<	<	<	41.6	na	4.21	0.0456
NZ-127-00	<	0.1092	0.5472	4.558	<	<	1.683	<	<	<	<	<	51.48	<	3.698	<
NZ-015-98	<	<	0.265	<	0.00703	na	1.58	0.0128	na	<	<	<	35.6	na	3.79	0.123
NZ-123-00	<	0.06619	0.7569	4.614	<	<	1.739	<	<	<	<	<	49.96	<	3.289	0.1082
NZ-016-98	<	<	0.376	<	0.00613	na	1.88	0.013	na	0.00739	<	0.0595	36	na	3.4	0.243

n.a. Not Analyzed
< Less Than MDL

Geothermal Fluid Cations Summary

Sample ID	Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	K	La	Li	Mg
MDL [mg/kg]	0.00115	0.00469	0.0206	0.0677	0.0057	0.00671	0.209	0.00614	0.00628	0.00464	0.0046	0.0437	0.034	0.00136	0.0325	0.0515
	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
NZ-125-00	<	0.05272	0.5411	4.228	<	<	1.827	<	<	<	<	0.1182	50.74	<	3.18	0.1517
NZ-126-00	<	0.04716	0.573	4.283	<	<	1.869	<	<	<	<	0.1159	51.51	<	3.214	0.1532
NZ-124-00	<	15.88	0.0673	2.139	0.03649	<	2.912	<	<	<	0.05853	3.44	40.01	<	2.387	1.197
NZ-225-00	<	0.9634	<	20.2	<	<	<	<	<	<	<	<	114	<	7.02	<
NZ-226-00	<	1.156	<	23.1	<	<	<	<	<	<	<	<	122	<	7.472	<
NZ-227-00	<	0.7883	<	5.593	0.7132	<	<	<	<	<	<	8.544	31.11	<	1.702	<
NZ-228-00	<	2.002	0.5361	21.68	<	<	<	<	<	<	<	1.368	121.3	<	7.368	<
NZ-229-00	<	0.3878	<	18.44	<	<	<	<	<	<	<	<	111.2	<	6.397	<
NZ-230-00	<	1.044	<	19.32	<	<	<	<	<	<	<	<	114.7	<	6.626	<
NZ-231-00	<	1.593	<	16.84	<	<	<	<	<	<	<	<	98.37	<	5.568	<
NZ-020-98	<	6.37	0.922	43.9	0.0391	na	36.4	0.0125	na	<	<	0.98	77.7	na	7.1	4.24
NZ-108-00	<	25.31	0.2814	16.81	<	<	33.55	<	<	<	<	3.75	54.14	0.0034	2.308	8.93
NZ-109-00	<	5.477	0.09067	15.5	<	<	31	<	<	<	<	1.531	38.89	<	1.975	7.513
NZ-107-00	<	16.41	0.9235	18.61	<	<	42.49	<	<	<	<	12.2	58	0.007647	2.637	9.069
NZ-019-98	<	18.3	0.889	16.8	<	na	39	0.0149	na	<	<	12.9	39.8	na	3.45	8.18
NZ-105-00	<	0.6546	0.2262	19.54	<	<	0.5154	<	<	<	<	0.06598	94.8	<	4.729	0.09357
NZ-106-00	<	0.6261	1.804	21.53	<	<	0.5061	<	<	<	<	<	107.2	<	5.1	<
NZ-151-00	<	0.5054	4.477	31.55	<	<	7.537	<	0.00801	<	<	0.09507	340	<	15.74	0.0533
NZ-150-00	<	0.6061	4.693	32.83	<	<	8.986	<	0.008018	<	<	<	331	<	14.75	<
NZ-152-00	<	0.5104	4.289	31.68	<	<	5.757	<	0.007995	<	<	0.08324	387	<	16	<
NZ-154-00	<	7.44	<	<	0.06157	<	8.356	<	0.00805	<	<	1.551	12.67	0.001813	<	2.026
NZ-153-00	<	0.006383	<	0.4375	0.204	<	11.82	<	0.008039	<	<	0.86	12.71	<	<	2.682
NZ-155-00	<	0.0104	0.497	4.357	<	<	8.621	<	0.00805	<	<	0.05063	16.52	<	2.192	1.214
NZ-171-00	na	0.22	0.28	33	na	na	1.2	na	na	na	na	na	78	na	6.6	0.041
NZ-172-00	na	0.36	0.95	35	na	na	5.9	na	na	na	na	na	89	na	6.6	0.011
NZ-173-00	na	na	2.9	30.1	na	na	0.9	na	na	na	na	na	157	na	8.4	<0.05
NZ-148-00	<	0.515	10.24	32.67	<	<	1.06	<	0.008008	<	<	<	130	<	6.56	<
NZ-029-98	<	0.521	13.1	32.5	<	na	1.41	0.0142	na	<	<	0.113	128	na	<	0.0433
NZ-174-00	na	0.31	0.19	27	na	na	3.3	na	na	na	na	na	160	na	6.9	<0.05
NZ-175-00	na	na	2.2	31.3	na	na	0.53	na	na	na	na	na	123	na	9.7	<0.01
NZ-147-00	<	0.4892	1.237	28.83	<	<	0.3837	<	0.007999	<	<	<	94.1	<	6.76	<
NZ-030-98	<	0.511	1.01	30.3	<	na	0.479	0.0144	na	<	<	<	103	na	<	0.0412
NZ-176-00	na	na	3.4	46.8	na	na	0.5	na	na	na	na	na	194	na	11.4	<0.05
NZ-177-00	na	na	3.6	41.6	na	na	5.7	na	na	na	na	na	140	na	7.9	0.01
NZ-178-00	na	na	1.8	25.8	na	na	0.29	na	na	na	na	na	107	na	8.4	<0.05
NZ-179-00	na	na	2.8	33.4	na	na	1.3	na	na	na	na	na	130	na	8.8	<0.01
NZ-180-00	na	na	3	46.8	na	na	0.48	na	na	na	na	na	128	na	9.4	<0.01
NZ-182-00	na	na	2.7	48.9	na	na	1.2	na	na	na	na	na	104	na	9.1	0.01
NZ-181-00	na	na	2.6	33	na	na	0.59	na	na	na	na	na	136	na	9.2	<0.05
NZ-183-00	na	na	3.5	43.8	na	na	2.7	na	na	na	na	na	122	na	8.5	<0.01
NZ-184-00	na	na	na	44.6	na	na	5	na	na	na	na	na	210	na	11.4	0.5
NZ-185-00	na	na	3.6	36.9	na	na	3.5	na	na	na	na	na	177	na	9.8	0.1
NZ-186-00	na	na	na	42.7	na	na	3.1	na	na	na	na	na	210	na	11.3	<0.05
NZ-187-00	na	na	na	35.7	na	na	2.4	na	na	na	na	na	180	na	9.8	<0.05

n.a. Not Analyzed
< Less Than MDL

Geothermal Fluid Cations Summary

Sample ID	Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	K	La	Li	Mg
MDL [mg/kg]	0.00115	0.00469	0.0206	0.0677	0.0057	0.00671	0.209	0.00614	0.00628	0.00464	0.0046	0.0437	0.034	0.00136	0.0325	0.0515
	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
NZ-149-00	<	0.3377	3.05	39.2	<	<	2.737	<	0.008012	<	0.09253	<	149.6	<	6.831	<
NZ-028-98	<	0.181	4.02	45.7	0.0662	na	5.2	0.0138	na	0.00989	<	0.0887	164	na	<	0.0452
NZ-170-00	na	na	1.3	17.7	na	na	9.6	na	na	na	na	na	76	na	8.1	5
NZ-188-00	na	0.14	0.84	26	na	na	78	na	na	na	na	na	72	na	3.5	25
NZ-146-00	<	0.184	3.84	26.27	<	<	13.89	<	0.00801	<	<	<	174.9	<	8.523	<
NZ-027-98	<	0.233	4.61	29.2	<	na	23.4	0.0123	na	<	<	0.0453	170	na	<	0.0445
NZ-026-98	<	0.155	4.09	25.9	<	na	21.4	0.012	na	<	<	0.0601	151	na	<	0.0533
NZ-025-98	<	0.247	4.7	29.9	<	na	24.3	0.0126	na	<	<	<	172	na	<	0.0476
NZ-302-01																
NZ-303-01																
NZ-304-01																
NZ-305-01																
NZ-031-98	<	<	<	6.21	0.111	na	15.3	0.0131	na	<	<	<	22.8	na	2.92	5.09
NZ-145-00	<	<	0.06414	6.938	0.1261	<	16.79	<	0.008028	<	<	<	33.02	<	2.236	5.87
NZ-141-00	<	0.02649	9.249	74.9	0.0129	<	33.28	<	0.00802	<	<	<	113	<	17.42	0.106
NZ-142-00	<	0.03071	10.18	87.1	0.01329	<	38.49	<	0.008029	<	<	<	142	<	18.8	0.3487
NZ-143-00	<	0.006401	10	89.2	0.03156	<	43.02	<	0.008023	<	<	<	136	<	18.57	0.256
NZ-144-00	<	0.02149	9.609	83.3	0.0181	<	37.04	<	0.00803	<	<	<	130	<	18.42	0.1204
NZ-233-00	<	751.4	<	17.51	0.2527	<	721.6	<	<	1.689	<	360.4	183.5	0.1297	0.4347	277.9
NZ-234-00	<	723.2	<	16.97	0.3379	<	738	<	<	1.561	<	338.7	176.3	0.1178	0.4	254.8
NZ-235-00	<	758.4	<	16.52	0.3031	<	696.7	<	<	1.871	<	424	196.2	0.1288	0.408	282
NZ-236-00	<	498	<	16.84	1.17	<	1119	<	<	0.5284	<	612.8	80.87	0.03882	1.35	705.4
NZ-237-00	<	307.7	<	21.24	0.19	<	1417	<	<	0.2373	<	592	91.6	<	2.168	1552
NZ-238-00	<	563.9	3.711	32.93	<	<	2048	<	<	0.6915	<	1207	83.13	<	2.82	2001
NZ-239-00	<	575.1	0.5409	30.26	0.4871	<	1309	<	<	1.061	<	606.4	194.9	<	1.795	1381
NZ-032-98	<	1160	2.83	43.6	0.22	na	2240	0.318	na	1.13	<	1560	76.7	na	3.25	2580
NZ-240-00	<	32.51	<	1.211	<	<	257.7	<	<	<	<	22.36	37.8	<	0.4667	203.7
NZ-241-00	<	36.02	<	1.02	<	<	209.4	<	<	<	<	34.2	47.16	<	0.2803	187.5
NZ-242-00	<	15.84	<	0.842	0.1569	<	215.1	<	<	<	<	18.26	43.6	<	0.2409	177.1
NZ-243-00	<	14.11	<	0.735	<	<	180.8	<	<	<	<	17.35	41.47	<	0.2399	165.1
NZ-244-00	<	6.73	<	0.6299	<	<	172.4	<	<	<	<	4.971	37.82	<	0.2409	158.8
NZ-245-00	<	24.75	<	0.7604	0.463	<	219	<	<	<	<	37.4	47.35	<	0.2383	167.5
NZ-246-00	<	1.958	<	0.6174	<	<	178.8	<	<	<	<	1.981	37.89	<	0.2061	165
NZ-247-00	<	27.49	<	0.8278	0.2414	<	182.9	<	<	<	<	25.43	45.88	<	0.2619	174.3
NZ-248-00	<	10.99	<	0.6727	<	<	183.9	<	<	<	<	15.68	39.83	<	0.2143	156.2
NZ-249-00	<	10.29	<	0.5453	<	<	159.8	<	<	<	<	8.616	35.32	<	0.226	151.3
NZ-250-00	<	4.852	<	0.5438	<	<	155.8	<	<	<	<	6.364	37.43	<	0.2141	149.8
NZ-251-00	<	8.22	<	0.5209	<	<	149.6	<	<	<	<	15.99	35.8	<	0.2069	141.4
NZ-252-00	<	25.52	<	0.6402	0.1633	<	213.3	<	<	<	<	37.18	41.84	<	0.2903	184.2
NZ-104-00	<	0.9926	<	0.862	0.02915	<	162	<	<	<	<	0.1833	52.57	<	0.07021	169.4
NZ-259-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-255-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-254-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-261-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na

n.a. Not Analyzed
< Less Than MDL

Geothermal Fluid Cations Summary

Sample ID	Ag	Al	As	B	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	K	La	Li	Mg
MDL [mg/kg]	0.00115	0.00469	0.0206	0.0677	0.0057	0.00671	0.209	0.00614	0.00628	0.00464	0.0046	0.0437	0.034	0.00136	0.0325	0.0515
	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
NZ-253-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-262-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-256-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-260-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-258-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-257-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-263-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
PP-264-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
PP-265-00	na	na	na	<	na	na	442.8	na	na	na	na	24.58	508.4	na	na	3.276
PP-266-00	na	na	na	79.8	na	na	447.5	na	na	na	na	79.03	511.2	na	na	4.953
PP-267-00	na	na	na	97.11	na	na	263.4	na	na	na	na	27.54	916	na	na	<
PP-268-00	na	na	na	125.1	na	na	277.6	na	na	na	na	3.907	916.7	na	na	<
PP-269-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
DJ-270-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
DJ-271-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
DJ-272-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
DJ-273-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
DJ-274-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
DJ-275-00	na	na	na	111.9	na	na	525.5	na	na	na	na	<	3003	na	na	<
DJ-276-00	na	na	na	386.7	na	na	510	na	na	na	na	<	2946	na	na	<
DJ-277-00	na	na	na	376.7	na	na	537.5	na	na	na	na	<	3108	na	na	<
DJ-278-00	na	na	na	390.4	na	na	532.1	na	na	na	na	1.067	3096	na	na	<

n.a. Not Analyzed
< Less Than MDL

Geothermal Fluid Cations Summary

Sample ID	Mn	Mo	Na	Ni	P	Pb	Sb	Se	Si	Sr	Ti	V	Y	Zn
MDL [mg/kg]	0.0051	0.00494	0.0432	0.00613	0.0675	0.0243	0.0247	0.0198	0.098	0.0132	0.0042	0.00416	0.00355	0.00683
	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
OR-033-98	<	0.0223	51.5	<	<	<	<	<	32	0.0258	0.00132	<	na	<
OR-034-98	0.165	<	620	<	<	<	<	<	65.1	0.56	<	<	na	<
OR-035-98	0.0453	<	560	<	<	<	<	<	29.8	0.914	<	<	na	<
OR-036-98	0.00505	<	638	<	<	<	<	<	38.8	1.13	<	<	na	<
OR-037-98	<	<	358	<	<	<	<	<	19.1	1.1	<	<	na	<
OR-038-98	0.0374	<	304	<	<	<	<	<	26.3	0.98	<	<	na	<
OR-039-98	0.0923	<	1030	<	<	<	<	<	32.1	4.18	<	<	na	<
OR-040-98	0.09	<	1010	<	<	<	<	<	31.8	4.06	<	<	na	<
OR-041-98	0.239	<	2570	<	<	<	<	<	37.5	8.1	<	<	na	<
OR-042-98	<	0.0807	161	<	<	<	<	<	40.6	0.0471	<	<	na	<
OR-051-98	<	0.0926	113	<	<	<	<	<	46	<	<	<	na	<
OR-043-98	<	0.0717	560	<	<	<	0.044	<	115	0.181	<	<	na	<
OR-044-98	<	0.04	969	<	<	<	0.082	0.0444	68.3	0.912	<	<	na	<
OR-045-98	0.047	<	428	<	<	<	<	<	78.9	0.362	<	<	na	<
OR-046-98	0.204	<	414	<	<	<	<	<	80.6	0.577	<	<	na	<
OR-047-98	<	<	238	<	<	<	<	<	37.8	0.115	<	<	na	<
OR-048-98	<	0.0388	105	<	<	<	<	<	46.2	<	<	<	na	<
OR-049-98	<	0.0388	114	<	<	<	<	<	72.7	<	<	<	na	<
OR-052-98	na	na	na	na	na	na	na	na	na	na	na	na	na	na
ID-050-98	<	<	172	<	<	<	<	<	33.3	0.118	<	<	na	<
NV-053-98	0.00335	0.0728	475.3	<	<	0.0287	0.0953	<	300	0.415	<	0.0113	na	<
NV-054-98	0.00209	0.0775	407.3	<	<	0.0289	0.0851	<	305	0.295	<	0.00964	na	<
NV-055-98	0.00209	0.0824	409.1	<	<	0.0267	0.0824	<	316	0.314	<	0.00937	na	<
NV-056-98	0.00216	0.0813	487.2	<	<	0.0283	0.0916	<	318	0.445	<	0.0109	na	<
NV-057-98	0.00296	0.0772	482.2	<	<	<	0.0893	<	280	0.441	<	0.0103	na	<
NV-058-98	0.245	0.013	235.6	<	<	0.0273	<	<	30.2	1.22	<	0.0212	na	<
NV-059-98	0.0024	0.0781	494.3	<	<	<	0.0921	<	339	0.457	<	0.0115	na	<
NV-060-98	0.00322	0.09	487.7	0.0302	<	0.0332	0.098	<	333	0.445	<	0.0129	na	<
NV-061-98	0.00309	0.092	484.1	0.0259	<	0.0534	0.102	<	322	0.444	<	0.0138	na	0.02
NV-062-98	0.0557	<	505.1	0.0237	<	0.058	<	<	87.1	0.641	<	<	na	<
NV-063-98	0.108	<	874	0.0313	<	0.066	<	<	144	2.36	0.00239	<	na	<
NV-064-98	0.0191	<	396.4	0.028	<	0.0628	0.0317	<	138	1.07	0.00307	<	na	<
NV-065-98	0.00267	0.0941	506.7	0.0385	<	0.0734	0.111	<	362	0.489	0.00303	0.0144	na	<
NV-066-98	0.00451	0.0134	0.5431	0.0244	<	<	0.0156	<	0.776	0.0064	0.00284	<	na	<
NV-067-98	<	<	335.5	<	<	<	<	<	31.76	1.37	<	<	na	<
NV-068-98	<	<	328.3	<	<	<	<	<	29.07	1.28	<	<	na	<
NV-069-98	<	<	207	<	<	<	<	<	141.2	0.0824	<	<	na	<
NV-070-98	<	<	203.7	<	<	<	<	<	138.4	0.0823	<	<	na	<
NV-071-98	<	<	202.4	<	<	<	<	<	145.6	0.0836	<	<	na	<
CA-087-99	0.1556	<	4000	0.006791	<	<	<	<	209.4	29.75	<	<	<	<
CA-088-99	0.3814	<	4040	0.006251	<	<	<	<	209.4	30.34	<	<	<	<
CA-089-99	0.1668	<	4220	0.008459	<	<	<	<	209.4	30.26	<	<	<	<
CA-090-99	0.1606	<	4390	0.01297	<	<	<	<	209.4	33	<	<	<	<
CA-091-99	0.1794	<	4130	0.0147	0.07032	<	<	0.04017	186.9	31.33	<	<	<	<

n.a. Not Analyzed
< Less Than MDL

Geothermal Fluid Cations Summary

Sample ID	Mn	Mo	Na	Ni	P	Pb	Sb	Se	Si	Sr	Tl	V	Y	Zn
MDL [mg/kg]	0.0051	0.00494	0.0432	0.00613	0.0675	0.0243	0.0247	0.0198	0.098	0.0132	0.0042	0.00416	0.00355	0.00683
	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
CA-092-99	0.1763	<	4110	0.01056	<	<	<	<	160	30.61	<	<	<	<
CA-093-99	0.5304	<	4200	0.02076	<	<	<	0.02107	209.4	31.74	<	<	<	<
CA-094-99	0.1479	<	4080	0.01411	<	<	<	0.05041	209.4	29.8	<	<	<	<
CA-095-99	0.1277	<	4020	0.01502	<	<	<	0.04012	193	29.04	<	<	<	<
CA-096-99	0.165	<	4480	0.01352	<	<	<	0.0452	209.4	na	<	<	<	<
NZ-000-98	na	na	na	na	na	na	na	na	na	na	na	na	na	na
CA-072-99	0.08781	0.1302	1.68	0.1226	1.12	<	<	<	1.892	<	<	<	<	0.1
NZ-117-00	<	<	1.62	0.008663	<	<	0.04943	0.0252	<	0.01495	<	0.005257	<	<
NZ-163-00	<	<	6.644	0.007577	0.1159	<	<	0.03708	0.3099	0.1811	<	<	<	<
NZ-300-01	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-110-00	0.01819	0.009071	808.2	0.008557	<	<	1.198	<	176.3	1.23	<	<	<	<
NZ-111-00	0.02486	0.009474	800.6	0.01292	0.3727	<	1.255	<	176.9	1.212	<	<	<	<
NZ-112-00	0.3593	0.006364	297.6	0.00974	0.3036	<	<	<	50.24	3.817	<	<	<	<
NZ-007-98	<	<	122	<	<	<	<	<	26.2	0.0845	<	<	na	<
NZ-113-00	<	<	122.2	0.00884	<	<	0.03575	0.02682	31.32	0.116	<	0.004667	<	<
NZ-009-98	0.138	<	3270	<	<	<	<	<	48.2	1.98	<	<	na	0.0173
NZ-115-00	0.03463	0.01076	2499	0.009415	0.168	<	<	<	57.35	2.37	<	0.006779	<	0.08277
NZ-010-98	<	<	3470	<	<	<	<	<	49.7	1.96	<	<	na	0.013
NZ-116-00	<	0.01093	2854	0.007093	0.2209	<	<	<	65.21	2.495	<	0.004279	<	<
NZ-008-98	<	<	3530	<	<	<	<	<	51.8	1.21	<	<	na	<
NZ-114-00	<	0.008593	2851	0.01002	0.2052	<	0.02514	<	72.39	1.061	<	0.004402	<	<
NZ-021-98	0.116	0.188	6800	<	<	<	<	<	13.6	<	<	<	na	<
NZ-156-00	0.1157	<	6040	0.01211	0.1313	<	<	<	16.09	na	<	<	<	<
NZ-157-00	0.1076	<	5730	0.01331	0.126	<	<	<	15.06	na	<	<	<	<
NZ-022-98	0.101	0.187	6420	<	<	0.0205	<	<	12.8	<	<	<	na	<
NZ-162-00	0.1011	<	5740	0.01177	0.1304	<	<	<	15.16	na	<	<	<	<
NZ-158-00	0.06027	<	3330	0.009716	0.116	<	<	<	23.76	39.82	<	<	<	<
NZ-023-98	0.0237	0.0893	4670	<	<	<	<	<	19.5	<	<	<	na	<
NZ-160-00	0.1296	<	3710	0.00813	0.1096	<	<	<	27.74	na	<	<	<	<
NZ-024-98	0.128	0.0997	4320	<	<	<	<	<	23.9	<	<	<	na	<
NZ-161-00	0.06594	<	3530	0.009122	0.12	<	<	<	25.01	41.26	<	<	<	0.06266
NZ-129-00	<	<	80	0.01006	<	<	0.03353	0.03172	30.32	0.03394	<	0.005308	<	<
NZ-128-00	0.007088	<	367.8	0.00948	<	<	<	<	20.76	0.4711	<	0.005047	<	<
NZ-130-00	<	<	260	0.008984	<	<	<	<	24.47	0.4951	<	0.004939	<	<
NZ-131-00	0.005786	0.0107	97.3	<	0.09652	<	<	<	32.84	0.5137	<	<	<	<
NZ-132-00	0.0324	<	63.8	<	<	<	<	<	20.91	0.4006	<	<	<	<
NZ-101-00	0.02509	0.04335	200	<	<	<	0.0453	<	100	0.3134	<	<	<	<
NZ-101-00	0.02509	0.04335	206.8	<	<	<	0.0453	<	105.7	0.3134	<	<	<	<
NZ-165-00	na	na	742	na	na	na	na	na	na	na	na	na	na	na
NZ-166-00	na	na	708	na	na	na	na	na	na	na	na	na	na	na
NZ-102-00	0.03501	0.01501	444	<	<	<	<	<	217	0.03281	<	<	<	<
NZ-102-00	0.03501	0.01501	445.5	<	<	<	<	<	217.4	0.03281	<	<	<	<
NZ-098-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-098-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na

n.a. Not Analyzed
< Less Than MDL

Geothermal Fluid Cations Summary

Sample ID	Mn	Mo	Na	Ni	P	Pb	Sb	Se	Si	Sr	Ti	V	Y	Zn
MDL [mg/kg]	0.0051	0.00494	0.0432	0.00613	0.0675	0.0243	0.0247	0.0198	0.098	0.0132	0.0042	0.00416	0.00355	0.00683
	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
NZ-167-00	na	na	640	na	na	na	na	na	na	na	na	na	na	na
NZ-103-00	0.02513	<	3.137	<	<	<	<	<	3.691	<	<	<	<	0.01111
NZ-103-00	0.02513	<	3.137	<	<	<	<	<	3.691	<	<	<	<	0.01111
NZ-159-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-159-00	0.0155	0.01269	440	0.008471	0.1113	<	<	<	203.6	0.1361	<	<	<	<
NZ-099-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-099-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-168-00	na	na	578	na	na	na	na	na	na	na	na	na	na	na
NZ-169-00	na	na	760	na	na	na	na	na	na	na	na	na	na	na
NZ-164-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-100-00	2.472	0.0063	59.9	<	0.2402	<	<	<	59.7	0.1954	<	<	<	<
NZ-100-00	2.472	0.0063	60.01	<	0.2402	<	<	<	59.75	0.1954	<	<	<	<
NZ-138-00	0.01136	0.01221	402	<	0.134	<	0.03414	<	153	0.04491	<	0.008157	<	<
NZ-012-98	0.0148	<	425	<	<	<	<	<	176	0.0318	<	0.0088	na	<
NZ-136-00	0.4028	0.01764	418	<	0.1003	<	<	<	142	0.04234	<	0.004741	<	<
NZ-137-00	0.2831	0.01782	438	<	<	<	0.02748	<	144	0.04301	<	<	<	<
NZ-011-98	0.291	0.0156	480	<	<	<	<	<	173	0.0328	<	<	na	<
NZ-139-00	<	0.01396	448	0.006282	0.132	<	0.0846	<	178	0.0324	<	0.01374	<	<
NZ-140-00	<	0.01424	452	0.007163	0.1392	<	0.1035	<	179	0.03367	<	0.01415	<	<
NZ-014-98	<	0.0131	531	<	<	<	0.0886	<	222	0.0182	<	<	na	<
NZ-013-98	<	0.012	486	<	<	<	0.0798	<	213	0.0207	<	0.00773	na	<
NZ-306-01														
NZ-003-98	0.0969	<	1240	<	<	<	0.122	<	201	0.29	<	<	na	<
NZ-121-00	0.08098	<	1092	0.01068	<	<	0.06813	0.02149	171.9	0.3789	<	0.005238	<	<
NZ-122-00	0.08222	<	1139	0.01119	<	<	0.0494	<	180.1	0.3769	<	0.005176	<	<
NZ-119-00	0.263	<	511.6	0.009246	<	<	0.03811	<	136.6	0.208	0.03113	0.009059	0.007471	0.0306
NZ-120-00	0.209	<	447.5	0.009377	0.1571	<	0.0254	<	140.7	0.1635	<	0.008927	<	0.007912
NZ-001-98	0.288	<	508	<	<	<	<	<	136	0.171	<	<	na	0.0114
NZ-002-98	0.551	<	429	<	<	<	<	<	146	0.121	<	0.0101	na	0.165
NZ-118-00	0.5829	<	345.3	0.0186	<	<	0.03136	<	152.7	0.122	<	0.01269	0.02863	0.2008
NZ-307-01														
NZ-018-98	0.0407	0.0205	260	<	<	<	<	<	80.4	0.0335	<	<	na	<
NZ-133-00	0.06188	0.01913	140	<	<	<	<	<	53.4	0.0578	<	<	<	<
NZ-232-00	<	na	64.3	na	<	<	<	<	59.88	<	<	<	<	<
NZ-004-98	0.237	<	8.9	<	<	<	<	<	65.8	0.0252	<	<	na	0.0113
NZ-005-98	0.255	0.0119	25.7	<	<	<	<	<	116	0.038	0.0613	<	na	0.0214
NZ-134-00	0.3174	0.01723	39.5	<	<	<	<	<	194	0.05041	<	<	0.0127	0.03233
NZ-006-98	0.0848	<	2.61	<	<	<	<	<	66	0.0146	0.164	<	na	<
NZ-135-00	0.106	0.00725	1.599	<	<	<	<	<	76.24	<	0.007017	<	0.008632	0.01164
NZ-017-98	<	0.0425	315	<	<	<	<	<	180	<	<	<	na	<
NZ-127-00	0.005515	0.03424	283.3	0.01129	<	<	0.06888	0.0395	136	0.038	<	0.00759	<	<
NZ-015-98	<	0.0148	241	<	<	<	<	<	76	<	<	<	na	<
NZ-123-00	0.01426	0.01328	240.2	0.01088	<	<	0.09682	0.0441	119.5	0.03779	<	0.005944	<	<
NZ-016-98	<	0.0246	248	<	<	<	<	<	78	<	<	<	na	<

n.a.	Not Analyzed
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Geothermal Fluid Cations Summary

Sample ID	Mn	Mo	Na	Ni	P	Pb	Sb	Se	Si	Sr	Ti	V	Y	Zn
MDL [mg/kg]	0.0051	0.00494	0.0432	0.00613	0.0675	0.0243	0.0247	0.0198	0.098	0.0132	0.0042	0.00416	0.00355	0.00683
	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
NZ-125-00	0.01604	0.02737	219	0.01112	<	<	0.05868	0.02543	115.1	0.03519	<	0.005814	<	<
NZ-126-00	0.01621	0.02817	219.5	0.01087	<	<	0.0521	0.02496	117	0.03372	<	0.00522	<	<
NZ-124-00	0.09858	<	110.3	0.03339	<	<	0.0416	0.0352	106.4	0.04575	<	0.007438	0.0091	<
NZ-225-00	<	na	326	na	<	<	<	<	206	<	<	<	<	<
NZ-226-00	<	na	350.1	na	<	<	<	<	119.4	<	<	<	<	<
NZ-227-00	0.1879	na	87.84	na	<	<	<	<	113	0.02907	<	<	<	0.1937
NZ-228-00	<	na	345.7	na	<	<	<	<	139.1	<	<	<	<	0.1783
NZ-229-00	<	na	326	na	<	<	<	1.168	65.33	<	<	<	<	<
NZ-230-00	<	na	337.3	na	<	<	<	<	335.5	<	<	<	<	0.1708
NZ-231-00	<	na	287.6	na	<	<	<	<	244	<	<	<	<	0.1886
NZ-020-98	0.607	0.0108	691	<	<	<	<	<	130	0.203	<	<	na	<
NZ-108-00	1.23	<	316.3	<	<	<	<	<	110	0.0838	<	0.007842	0.02957	0.05203
NZ-109-00	1.138	<	274.6	<	<	<	<	<	83.16	0.04283	<	<	0.02343	0.01413
NZ-107-00	1.25	<	300.3	0.00992	<	<	0.03038	0.01988	132.3	0.1179	<	<	0.04554	0.1211
NZ-019-98	1.28	<	414	<	<	<	<	<	133	0.0846	<	<	na	0.0989
NZ-105-00	<	0.02093	320	<	<	<	0.07595	<	346.9	<	<	0.006656	<	<
NZ-106-00	<	0.03859	347	<	<	<	0.2803	<	366.2	0.0138	<	0.00508	<	<
NZ-151-00	0.03198	0.03618	1220	0.00896	0.124	<	0.0251	<	329	0.04763	<	0.004283	<	<
NZ-150-00	0.02397	0.02541	1200	0.008714	0.1208	<	0.08058	<	309	0.07009	<	0.0044	<	<
NZ-152-00	0.03916	0.03708	1200	0.009187	0.1274	<	0.1452	<	371	0.03916	<	0.004209	<	<
NZ-154-00	0.1779	0.005269	25.27	0.01021	0.1388	<	0.02546	0.03718	76.5	0.069	<	0.004657	0.0128	0.02528
NZ-153-00	0.3078	0.0147	152	0.007882	0.3641	<	<	0.04537	68.57	0.1538	<	<	<	<
NZ-155-00	0.02932	0.006004	214	0.008178	0.2309	<	0.03675	0.03544	74.32	0.06596	<	<	<	<
NZ-171-00	na	na	672	na	na	na	na	na	na	na	na	na	na	na
NZ-172-00	na	na	736	na	na	na	na	na	na	na	na	na	na	na
NZ-173-00	na	na	726	na	na	na	na	na	na	na	na	na	na	na
NZ-148-00	<	0.03342	621	<	0.1058	<	8.919	<	255	0.0402	<	0.00826	<	<
NZ-029-98	<	0.0104	704	<	<	0.0208	9.8	<	272	<	<	<	na	<
NZ-174-00	na	na	849	na	na	na	na	na	na	na	na	na	na	na
NZ-175-00	na	na	772	na	na	na	na	na	na	na	na	na	na	na
NZ-147-00	<	0.0404	693	0.007769	0.168	<	0.1644	<	214	0.03369	<	0.00821	<	<
NZ-030-98	<	<	740	<	<	0.0271	0.1	<	228	<	<	<	na	<
NZ-176-00	na	na	994	na	na	na	na	na	na	na	na	na	na	na
NZ-177-00	na	na	799	na	na	na	na	na	na	na	na	na	na	na
NZ-178-00	na	na	728	na	na	na	na	na	na	na	na	na	na	na
NZ-179-00	na	na	800	na	na	na	na	na	na	na	na	na	na	na
NZ-180-00	na	na	788	na	na	na	na	na	na	na	na	na	na	na
NZ-182-00	na	na	801	na	na	na	na	na	na	na	na	na	na	na
NZ-181-00	na	na	745	na	na	na	na	na	na	na	na	na	na	na
NZ-183-00	na	na	776	na	na	na	na	na	na	na	na	na	na	na
NZ-184-00	na	na	1004	na	na	na	na	na	na	na	na	na	na	na
NZ-185-00	na	na	847	na	na	na	na	na	na	na	na	na	na	na
NZ-186-00	na	na	994	na	na	na	na	na	na	na	na	na	na	na
NZ-187-00	na	na	847	na	na	na	na	na	na	na	na	na	na	na

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Geothermal Fluid Cations Summary

Sample ID	Mn	Mo	Na	Ni	P	Pb	Sb	Se	Si	Sr	Ti	V	Y	Zn
MDL [mg/kg]	0.0051	0.00494	0.0432	0.00613	0.0675	0.0243	0.0247	0.0198	0.098	0.0132	0.0042	0.00416	0.00355	0.00683
	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
NZ-149-00	<	0.0172	694.9	0.007721	<	<	0.422	<	253	0.06476	<	0.0074	<	<
NZ-028-98	<	<	1010	<	<	<	0.451	<	330	0.347	<	<	na	<
NZ-170-00	na	na	682	na	na	na	na	na	na	na	na	na	na	na
NZ-188-00	na	na	543	na	na	na	na	na	na	na	na	na	na	na
NZ-146-00	<	0.05179	1099	0.008034	0.1087	<	0.1356	<	195.4	0.1047	<	<	<	<
NZ-027-98	<	0.0552	1200	<	<	0.0214	0.112	<	194	0.101	<	<	na	<
NZ-026-98	<	0.0556	1120	<	<	0.0274	0.131	<	177	0.084	<	<	na	<
NZ-025-98	<	0.0507	1230	<	<	<	0.116	<	222	0.0913	<	<	na	<
NZ-302-01														
NZ-303-01														
NZ-304-01														
NZ-305-01														
NZ-031-98	0.297	<	240	<	<	<	<	<	75.4	0.0847	<	<	na	<
NZ-145-00	0.3053	0.01179	240	0.006264	0.2121	<	0.05331	<	98	0.1304	<	0.005282	<	<
NZ-141-00	0.005274	0.005966	1390	0.00668	0.1277	<	0.6056	<	69.1	1.604	<	0.00512	<	<
NZ-142-00	0.01961	0.007603	1640	0.006481	0.1024	<	0.7162	<	111	1.803	<	0.008252	<	<
NZ-143-00	0.02927	0.006136	1690	0.006417	0.09672	<	0.6772	<	112	1.856	<	0.007861	<	<
NZ-144-00	0.01087	0.006261	1610	0.007184	0.09842	<	0.6337	<	91.4	1.749	<	0.007419	<	<
NZ-233-00	7.17	na	300.4	na	10.2	<	0.4106	<	87.72	4.317	0.2393	3.454	0.2264	0.6516
NZ-234-00	6.58	na	282.3	na	8.648	0.6568	0.3822	<	88.24	4.162	0.2279	3.204	0.2138	0.558
NZ-235-00	7.034	na	285.6	na	9.588	0.6864	0.4304	<	77.13	4.531	0.6413	3.539	0.2294	0.772
NZ-236-00	25.44	na	569.1	na	4.792	<	0.831	<	479.1	2.592	5.44	1.741	0.2331	2.04
NZ-237-00	57.96	na	960	na	1.853	<	0.8162	<	188	0.9493	0.1976	1.532	0.2751	3.481
NZ-238-00	68.09	na	1122	na	<	<	1.796	<	163.4	1.09	0.1311	3.852	0.2551	4.912
NZ-239-00	50.6	na	969.4	na	3.331	<	0.662	<	231.6	2.98	1.721	2.543	0.2259	1.489
NZ-032-98	94.4	0.0151	1730	0.461	0.0757	0.135	0.397	<	131	1.35	0.26	5.47	na	8.2
NZ-240-00	5.852	na	266.6	na	<	<	<	<	142	0.243	<	<	<	<
NZ-241-00	5.14	na	213.2	na	<	<	<	<	118	0.2015	0.2309	<	<	<
NZ-242-00	4.852	na	192	na	<	<	<	<	145.9	0.174	0.1389	<	<	<
NZ-243-00	4.56	na	181.9	na	<	<	<	<	122.1	0.1196	<	<	<	<
NZ-244-00	4.536	na	180	na	<	<	<	<	146.8	0.08996	<	<	<	<
NZ-245-00	4.607	na	194.3	na	<	<	<	<	186.2	0.21	0.6929	0.1132	<	<
NZ-246-00	4.512	na	180.1	na	<	<	<	<	142.9	0.06888	<	<	<	<
NZ-247-00	4.877	na	195.9	na	<	<	<	<	143.4	0.1807	0.2568	<	<	<
NZ-248-00	4.327	na	176.7	na	1.829	<	<	<	140.4	0.1236	0.1108	<	<	<
NZ-249-00	4.227	na	167	na	<	<	<	<	129.5	0.09289	<	<	<	<
NZ-250-00	4.153	na	163.6	na	<	<	<	<	141.3	0.07711	<	<	<	<
NZ-251-00	3.93	na	154.8	na	<	<	<	<	140.9	0.08274	<	<	<	<
NZ-252-00	5.251	na	197.8	na	<	<	<	<	159.9	0.1309	0.1487	<	<	<
NZ-104-00	5.892	<	230.3	<	<	<	<	<	110.1	0.1102	<	0.01618	0.01212	<
NZ-259-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-255-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-254-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-261-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na

n.a. Not Analyzed
< Less Than MDL

Geothermal Fluid Cations Summary

Sample ID	Mn	Mo	Na	Ni	P	Pb	Sb	Se	Si	Sr	Ti	V	Y	Zn
MDL [mg/kg]	0.0051	0.00494	0.0432	0.00613	0.0675	0.0243	0.0247	0.0198	0.098	0.0132	0.0042	0.00416	0.00355	0.00683
	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]	[mg/kg]
NZ-253-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-262-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-256-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-260-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-258-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-257-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
NZ-263-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
PP-264-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
PP-265-00	na	na	3569	na	na	na	na	na	184.7	na	na	na	na	na
PP-266-00	na	na	3634	na	na	na	na	na	286.7	na	na	na	na	na
PP-267-00	na	na	4529	na	na	na	na	na	391	na	na	na	na	na
PP-268-00	na	na	4524	na	na	na	na	na	432.9	na	na	na	na	na
PP-269-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
DJ-270-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
DJ-271-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
DJ-272-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
DJ-273-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
DJ-274-00	na	na	na	na	na	na	na	na	na	na	na	na	na	na
DJ-275-00	na	na	8580	na	na	na	na	na	512.9	na	na	na	na	na
DJ-276-00	na	na	8350	na	na	na	na	na	503.5	na	na	na	na	na
DJ-277-00	na	na	8483	na	na	na	na	na	513.3	na	na	na	na	na
DJ-278-00	na	na	8718	na	na	na	na	na	560	na	na	na	na	na

n.a. Not Analyzed
< Less Than MDL

Geothermal Waters Field Measurements and Anions Summary

Sample ID	Collect Date d/m/y	Sample Description	Cond [uMOHS/cm]	Salinity [per mil]	T [C]	Sampling Pressure [bars gage]	Enthalpy	pH	Total Alk as HCO3 [mg/kg]	F - [mg/kg]	C l - [mg/kg]	Br - [mg/kg]	PO4 -3 [mg/kg]	NO3 - [mg/kg]	SO4 -2 [mg/kg]
OR-033-98	06/13/98	Bagby	448		44.8			9.46	72.5	0.543	14.2	0.024	<	<	44.7
OR-034-98	06/13/98	Breitenbush	6200	4	48.8			7.03	143	1.91	1030	4.55	<	<	123
OR-035-98	06/14/98	Bigelow (Deer Lick)	4450	2.7	30.8			7.03	36.5	0.317	1120	4.35	<	<	132
OR-036-98	06/14/98	Bellknap	9900		67.6			7.59	26.6	0.0751	1480	4.14	<	<	173
OR-037-98	06/14/98	Terwilliger / Cougar	3700		38.4			8.66	48.2	0.334	807	3.54	<	<	254
OR-038-98	06/14/98	Wall Creek	2480	0.8	31.8			7.38	49.7	3.42	609	1.95	<	<	138
OR-039-98	06/15/98	McCredie	13800	5.8	60.1			7.34	38.0	2.01	2550	5.12	<	<	269
OR-040-98	06/15/98	McCredie	12000		62.5			7.44	45.4	2.02	2550	5.36	<	<	271
OR-041-98	06/15/98	Umpqua	15900	7.5	39.9			6.44	1507	1.24	3840	9.4	<	<	210
OR-042-98	10/04/98	Crystal Crane Hot Spring	1550	0.5	61.5			8.20	753	9.07	70.1	0.266	<	0.573	73
OR-051-98	10/04/98	Crystal Crane Hot springs	1550		49.3			8.20	924	9.56	69.7	0.432	<	0.211	71.9
OR-043-98	10/04/98	Micky Hot Springs	6300		95.0			8.73	1639	15.1	0.0154	0.743	<	0.09	18.1
OR-044-98	10/05/98	Alvord Hot Springs	9600		72.5			6.76	1227	10	430	2.6	<	0.341	201
OR-045-98	10/05/98	North Borax Lake Hot Sp	5200		92.3			7.30	1605	6.07	237	1.6	<	0.042	280
OR-046-98	10/05/98	Middle Borax Lake Hot S	4800		72.0			7.00	1507	6.16	243	1.6	<	0.213	282
OR-047-98	10/05/98	Whitehorse Ranch Hot S	1370		35.0			7.68	1468	19	46	0.236	<	2.29	80.3
OR-048-98	10/06/98	Sniveley Hot Springs Far	8300		42.4			9.36	371	15.2	16	0.0675	<	0.032	77.7
OR-049-98	10/06/98	Sniveley North of main H	1330		71.9			8.89	371	14	21.3	0.0939	<	0.1	81.2
OR-052-98	10/06/98	Sniveley Hot Springs sma	8700		39.0			9.35							
ID-050-98	10/06/98	Zims Hot Springs	1690		52.4			9.00	198	1.74	32.4	0.237	<	0.0938	293
NV-053-98	12/03/98	Dixie Valley Well# 76-A7	1780	1.2		6.4		9.11	262	11.5	561	0.472	<	0.103	227
NV-054-98	12/03/98	Dixie Valley Well# 37-33	1480	1.2		6.8		9.20	252	13.6	469	0.354	<	<	208
NV-055-98	12/03/98	Dixie Valley Well# 28-33	1810	1.1		6.9		8.92	257	13.6	473	0.362	<	<	211
NV-056-98	12/03/98	Dixie Valley Well# 73-B7	1990	1.3		6.4		9.12	212	12.9	580	0.492	<	<	242
NV-057-98	12/03/98	Dixie Valley Well# 82A-7	4230			6.2		8.78	222	12.9	575	0.524	<	<	244
NV-058-98	12/03/98	Goeringer Well	1670	0.8	23.7	3.9		7.44	414	0.67	294	0.198	<	0.874	201
NV-059-98	12/03/98	Dixie Valley Well# 74-7	1820	1.2		6.0		9.07	234	12.2	572	0.54	<	<	233
NV-060-98	12/03/98	Dixie Valley Well# 63-7	2220	1.1		6.1		9.01	217	12.8	578	0.584	<	<	241
NV-061-98	12/03/98	Dixie Valley Well# 73-7	2080	1.2		6.0		9.08	208	13	581	0.598	<	<	239
NV-062-98	12/03/98	Dixie Valley Well# 62-21	1580	1		3.8		6.70	1107	4.94	80.8	0.0765	<	<	231
NV-063-98	12/03/98	Dixie Valley Well# 66-21	6800	2.9	37.0			6.04	216	12.3	1410	<	12.7	<	86.7
NV-064-98	12/03/98	Dixie Valley Well# 45-14	3820					6.73	148	5.52	499	0.36	<	<	217
NV-065-98	12/03/98	Dixie Valley Injection Brin	4020		110.0			9.62	234	14.3	564	0.424	<	0.406	252
NV-066-98	12/03/98	Dixie Valley steam conde	178					6.90	34.4	<	0.536	<	0.103	26.7	18.7
NV-067-98	12/04/98	Carbonate Mound SW ed	3180		66.5			6.66	957	5.7	43.1	<	<	0.29	128
NV-068-98	12/04/98	Carbonate Mound Top sc	3250		71.2			6.99	925	5.92	42	0.1	<	<	121
NV-069-98	12/04/98	Beowawe Well# 77-13	1560		142.8	3.1		9.71	382	13.1	54.8	0.0593	<	<	111
NV-070-98	12/04/98	Beowawe Well# Ginn 1-1	1700		144.4	3.1		9.82	376	13.2	55.4	0.0778	<	<	110
NV-071-98	12/04/98	Beowawe Well# Ginn 2-1	1160		145.6	3.4		9.78	365	12.8	54.2	0.0565	<	<	109
CA-087-99	06/10/99	Heber HGU#7, Zone 2	26500	13.4	146.1	3.4		7.70		2.67	8360	10	<	<	96.1
CA-088-99	06/10/99	Heber HGU#9, Zone 2	28300		138.9	3.2		6.74		2.44	7770	10.6	<	<	91.4
CA-089-99	06/10/99	Heber HGU#11, Zone 2	23900	12.9	131.1	2.6		8.08		2.08	8250	11.1	<	<	85.2

Geothermal Waters Field Measurements and Anions Summary

Sample ID	Collect Date d/m/y	Sample Description	Cond [uMOHS/cm]	Salinity [per mil]	T [C]	Sampling Pressure [bars gage]	Enthalpy	pH	Total Alk as HCO3 [mg/kg]	F - [mg/kg]	C l - [mg/kg]	Br - [mg/kg]	PO4 -3 [mg/kg]	NO3 - [mg/kg]	SO4 -2 [mg/kg]
CA-090-99	06/10/99	Heber HGU#13, Zone 4	27000	14.9	127.2	2.3		7.82		2.47	8760	11.2	<	<	85.8
CA-091-99	06/10/99	Heber HGU#16, Zone 3	25200	13.8	136.7	2.6		7.75		2.31	8180	10	<	<	84.4
CA-092-99	06/10/99	Heber HGU#14, Zone 1	26600	13.8	123.3	1.3		8.05		2.24	8370	11	<	<	85.4
CA-093-99	06/10/99	Heber HGU#12, Zone 1	29600	13.9	134.4	3.1		7.42		2.4	8700	11.2	<	<	87.1
CA-094-99	06/10/99	Heber HGU#10, Zone 1	32200		138.9	3.2		7.44		2.63	8580	11.2	<	<	94.9
CA-095-99	06/10/99	Heber HGU#8, Zone 1	37000	16	140.0	3.4		7.05		2.46	8600	2.79	<	<	114
CA-096-99	06/10/99	Heber Injection Brine Lin	33000	14.4	75.0			8.13		2.37	9200	12.3	<	<	97.4
NZ-000-98	03/22/98	Trip Blank													
CA-072-99	06/09/99	Heber/Salton Sea DI Water Blank						7.01		<	<	<	<	<	<
NZ-117-00	03/30/00	Trip Blank								<	<	<	<	<	<
NZ-163-00	04/10/00	Trip Blank								<	0.282	0.00978	<	<	<
NZ-300-01	01/01/01	Trip Blank													
NZ-110-00	03/20/00	Ngawha NG-12 well cooli	5700	2.9		11.8		8.58	741	1.14	1070	6.44	<	<	30.2
NZ-111-00	03/20/00	Ngawha NG-9 well coolin	5800	3		18.15		6.59	749	1.85	1030	6.1	0.86	<	8.86
NZ-112-00	03/20/00	Kamo Soda Spring	3100	1.6	24.7			6.14	1804	0.229	253	0.504	<	0.108	0.371
NZ-007-98	03/23/98	Miranda hot springs	780		56.0			9.08	71.8	<	100	<	<	11.2	3.36
NZ-113-00	03/21/00	Miranda hot springs	980		51.3			9.15	98.7	0.791	136	0.388	<	<	11.5
NZ-009-98	03/23/98	Te Aroha cold spring	8800	4.9	25.1			6.88	6849	0.32	432	<	<	18.2	282
NZ-115-00	03/21/00	Te Aroha cold spring	7000	4.1	23.6			6.94	6257	0.986	529	1.2	0.357	5.26	302
NZ-010-98	03/23/98	Te Aroha hand pump #15	16600	6.8	46.1			7.20	6856	1.28	508	<	<	32.4	177
NZ-116-00	03/21/00	Te Aroha hand pump #17	14300	6.3	43.8			7.13	6971	1.04	477	1.3	0.415	0.162	333
NZ-008-98	03/23/98	Te Aroha Mokena Geyse	23300		77.7			7.82	6678	0.349	444	<	<	19.6	288
NZ-114-00	03/21/00	Te Aroha Mokena Geyse	11100		70.0			8.12	7121	1.04	481	1.31	0.46	0.518	339
NZ-021-98	03/26/98	Morere hot spring #1 upp	50000	28.2	46.6			6.91	36.5	<	16300	43.3	<	<	<
NZ-156-00	04/08/00	Morere hot spring #1 upp	50000	26.0	47.2			6.94	38.5	<	22000	48.9	<	0.425	<
NZ-157-00	04/08/00	Morere hot spring #2 dow	50000	26.2	44.6			7.10	41.6	<	21400	47.9	<	0.627	0.58
NZ-022-98	03/26/98	Morere hot spring #2 sma	50000	26.8	41.9			6.93	40.2	<	15800	40.8	<	<	<
NZ-162-00	04/09/00	Morere hot spring #2 sma	50000	26.2	44.6			7.26	41.6	<	21100	48.3	<	0.5	0.0187
NZ-158-00	04/09/00	Te Puia Springs #1 uphill	35000	15.2	55.0			6.70	143	<	8270	31.1	<	<	47.6
NZ-023-98	03/26/98	Te Puia Springs #1, smal	33300		51.1			6.66	137	<	7330	17	<	<	64
NZ-160-00	04/09/00	Te Puia Springs #2 Up tr	43800	19.3	60.0			6.94	102	0.0312	9000	28	<	0.947	200
NZ-024-98	03/26/98	Te Puia Springs #2, up tr	44200		59.0			6.82	77.9	0.754	8840	20.4	<	<	43
NZ-161-00	04/09/00	Te Puia Springs #3 End c	41400	17.3	65.1			6.64	160	0.00604	8700	27.1	<	<	155
NZ-129-00	03/24/00	Puketitiri (Mangatatu)	1020	0.2	43.5			9.32	170	18.7	20.2	0.0711	<	0.0652	10
NZ-128-00	03/24/00	Tarawera	3320	1.3	47.3			8.30	181	13.5	671	1.83	<	0.0336	15.7
NZ-130-00	03/26/00	Hamner Springs	2220	1.1	48.4			8.61	191	5.21	432	1.48	<	<	28.3
NZ-131-00	03/26/00	Lewis River Hot Spring	760		48.7			7.96	349	3.84	13.1	<	0.155	0.051	4.2
NZ-132-00	03/26/00	Maruia Thermal Resort	630	0.2	43.0			8.34	81.9	2.9	76	0.167	<	0.0398	20
NZ-101-00	03/09/00	Kawerau district swimmin	1.417			5.5		6.41	229	0.705	301	1.09	<	<	10.4
NZ-101-00	03/09/00	Kawerau district swimming pool well 5.5 bars gage web				5.5		6.20		0.78	314	1.1	<	<	10.8
NZ-165-00	08/20/98	Kawerau KA-19 well				0	1123	9.25		3.4	1010	3.7			10.6
NZ-166-00	08/18/98	Kawerau KA-21 well				10.7	1278	7.44		2.5	994	3.7			4.7

Geothermal Waters Field Measurements and Anions Summary

Sample ID	Collect Date d/m/y	Sample Description	Cond [uMOHS/cm]	Salinity [per mil]	T [C]	Sampling Pressure [bars gage]	Enthalpy	pH	Total Alk as HCO3 [mg/kg]	F - [mg/kg]	C l - [mg/kg]	Br - [mg/kg]	PO4 -3 [mg/kg]	NO3 - [mg/kg]	SO4 -2 [mg/kg]
NZ-102-00	03/10/00	Kawerau KA-23 well 5 ba	2940			5		6.10	241	1.69	816	2.91	<	<	7
NZ-102-00	03/10/00	Kawerau KA-23 well 5 bars gage weber sampler but 11				5		5.92		1.7	798	2.8	<	<	3.9
NZ-098-00	04/06/00	Kawerau KA-24 unfiltered raw sample							270	2.24	600	2.14	<	<	10
NZ-098-00	04/06/00	Kawerau KA-24 unfiltered raw sample				0				<	<	<	<	<	<
NZ-167-00	08/18/98	Kawerau KA-27 well				10.7	1025	7.6		2.4	767	2.8			10.3
NZ-103-00	03/15/00	Kawerau KA-30 well 2 ba	620			2		6.24	313	0.00774	7.58	<	<	<	18.7
NZ-103-00	03/15/00	Kawerau KA-30 well 2 bars gage weber sampler, closed				2		6.20		<	5.1	<	<	<	1.8
NZ-159-00	04/06/00	Kawerau KA-32 well							315	2.15	741	2.67	<	<	8.14
NZ-159-00	04/06/00	Kawerau KA-32 well				5.6									
NZ-099-00	03/28/00	Kawerau KA-34 well						5.67	284	0.404	1110	29.2	<	<	8.02
NZ-099-00	03/28/00	Kawerau KA-34 well				0				<	<	<	<	<	<
NZ-168-00	08/20/98	Kawerau KA-35 well				10.7	1138	7.96		2.4	760	2.9			12.6
NZ-169-00	08/21/98	Kawerau KA-36 well				9.9	1385	7.85		2.6	1000	3.8			3.8
NZ-164-00	04/05/00	Kawerau KA-37 well				10.6									
NZ-100-00	03/09/00	Kawerau Thermal Motel v	548		39.6			5.82	282	0.153	23.3	0.1	<	<	<
NZ-100-00	03/09/00	Kawerau Thermal Motel well				0		6.42		0.19	29	0.08	<	<	0.76
NZ-138-00	04/01/00	Waimangu Clamshell Spi	5800	2.4	83.8			7.85	171	0.778	468	1.7	0.0823	0.262	159
NZ-012-98	03/24/98	Waimangu Clamshell Spi	5700		75.7			8.04	154	<	431	1.82	<	8.43	132
NZ-136-00	04/01/00	Waimangu Frying Pan La	3750	1.6	51.5			6.15	64.9	3.23	603	1.86	<	<	230
NZ-137-00	04/01/00	Waimangu Frying Pan La	4080	1.8	50.5			6.14	38.7	3.52	521	2.02	<	<	234
NZ-011-98	03/24/98	Waimangu Frying Pan La	3950		50.5			5.70	36.7	1.59	521	<	<	15	177
NZ-139-00	04/01/00	Waimangu Iodine Pool	5800	2.4	73.5			8.50	183	3.82	538	2.08	<	<	98.2
NZ-140-00	04/01/00	Waimangu Iodine Pool	5800	2.4	74.5			8.50	181	3.83	530	2.08	<	0.204	96.6
NZ-014-98	03/24/98	Waimangu Iodine pool; other end near outlet			68.0			8.34	152	2.9	556	1.51	<	9.73	74.7
NZ-013-98	03/24/98	Waimangu Iodine pool; s	5500		64.3			8.33	152	3.74	562	1.52	<	17.6	77.4
NZ-306-01	01/01/01	306-01 Champagne Pool													
NZ-003-98	03/22/98	Waiotapu Champagne P	50000		74.4			5.28	25.4	2.28	1700	4.04	<	35.4	77.3
NZ-121-00	03/23/00	Waiotapu Champagne P	6800		76.2			5.57	52.4	4.95	1540	5.88	<	0.639	89.4
NZ-122-00	03/23/00	Waiotapu Champagne P	6000		76.2			5.46	48.9	4.92	1510	5.92	<	0.364	152
NZ-119-00	03/23/00	Waiotapu Frying Pan Fla	7200	3.5	42.0			2.53		0.0512	573	2.32	<	0.0514	708
NZ-120-00	03/23/00	Waiotapu Frying Pan Fla	7000	2.9	86.5			3.40		1	537	2.14	0.244	0.464	321
NZ-001-98	03/22/98	Waiotapu Oyster Pool ou	4520	280	28.4			2.47		2.5	662	2.58	<	2.54	331
NZ-002-98	03/22/98	Waiotapu Oyster Pool sto	7800		91.3			2.01		<	370	<	<	6.6	863
NZ-118-00	03/23/00	Waiotapu Oyster pool sto	10900	4.9	73.5			1.94		0.0099	510	1.59	<	0.273	1190
NZ-307-01	01/01/01	307-01 Waikite													
NZ-018-98	03/25/98	Waikite #1; first pool on r	2420		92.0			7.46	304	0.478	100	<	<	1.19	27.6
NZ-133-00	03/31/00	Waikite #1; first pool on r	2580	1.1	97.8			7.53	322	2.77	129	0.38	<	<	32
NZ-232-00	03/05/92	IGNS-08 TeKopia 5-3-92													
NZ-004-98	03/22/98	Te Kopia Reserve #1 U s	820	0.2	39.6			2.61		8.33	24	<	<	10.2	134
NZ-005-98	03/22/98	Te Kopia Reserve #2 edg	1760	0.7	47.0			2.40		<	20.4	<	<	1.16	225
NZ-134-00	03/31/00	Te Kopia Reserve #2 edg	2420	1.1	53.6			2.37		0.995	29.3	0.0496	0.179	<	376
NZ-006-98	03/22/98	Te Kopia Reserve #3 fiss	7500		87.4			1.74		<	4.67	<	<	14.5	926

Geothermal Waters Field Measurements and Anions Summary

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NZ-135-00	03/31/00	Te Kopia Reserve #3 fiss	7000		79.4			1.90		0.853	0.275	<	0.575	0.859	1230
NZ-017-98	03/25/98	Orakei Korako Diamond	4280		93.4			8.46	257	20	256	<	<	20.8	65.4
NZ-127-00	03/23/00	Orakei Korako Diamond	3300		79.0			8.55	320	11.6	268	0.952	<	1.6	80.9
NZ-015-98	03/25/98	Orakei Korako Fred and	3750		93.0			6.93	181	6.24	211	<	<	6.7	89.8
NZ-123-00	03/23/00	Orakei Korako Fred and	3900		92.2			6.92	157	12.1	243	0.794	0.049	<	106
NZ-016-98	03/25/98	Orakei Korako Map of Af	2430		62.6			6.90	158	11.3	205	<	<	11	83.7
NZ-125-00	03/23/00	Orakei Korako Map of Af	2900		61.2			7.74	172	11.1	242	0.79	<	1.9	108
NZ-126-00	03/23/00	Orakei Korako Map of Af	2900		61.2			7.74	168	11.1	248	0.74	<	0.23	111
NZ-124-00	03/23/00	Orekei Korako Ruatapu	2620	1.2	39.2			2.48		5.62	128	0.38	<	0.309	428
NZ-225-00	12/22/97	IGNS-01 RK9 22-12-97													
NZ-226-00	10/05/98	IGNS-02 RK9 5-10-98													
NZ-227-00	07/08/97	IGNS-03 RK9 8-7-97													
NZ-228-00	02/09/99	IGNS-04 RK9 9-2-99													
NZ-229-00	10/08/98	IGNS-05 RK5 8-10-98													
NZ-230-00	02/09/99	IGNS-06 RK5 9-2-99													
NZ-231-00	12/22/97	IGNS-07 RK5 22-12-97													
NZ-020-98	03/25/98	Rotokawa #4?	10200		79.3			2.79		2.75	1080	2.3	<	41.1	455
NZ-108-00	04/05/00	Rotokawa #4?	7000	2.9	83.5			2.56		0.558	395	1.3	<	<	773
NZ-109-00	04/05/00	Rotokawa NW Western	5700	2.3	83.5			2.76		1.57	351	1.22	<	0.619	482
NZ-107-00	04/05/00	Rotokawa Parariki	8600	3.6	87.0			1.96		0.455	384	1.31	0.67	0.044	1030
NZ-019-98	03/25/98	Rotokawa Parariki sulfur	8200		83.3			1.51		<	341	<	<	16.1	895
NZ-105-00	04/05/00	Rotokawa RK-5 well 26 b	2200	1.2		26		6.51	81.1	3.13	702	1.89	<	0.0543	17.3
NZ-106-00	04/05/00	Rotokawa RK-9 well 26 b	2570	1.4		26		6.38	92.5	3.08	546	2	<	0.0338	6.98
NZ-151-00	04/07/00	Mokai MK-3 well 20.0 bar	10000	5.3		20		5.67	9.4	4.32	2570	5.22	0.15	0.0328	6
NZ-150-00	04/07/00	Mokai MK-5 well 18.8 bar	9100	4.9		18.8		6.16	12.5	5.68	2540	6.31	<	0.0322	8.01
NZ-152-00	04/07/00	Mokai MK-6 well 18.8 bar	8600	4.9		19.2		5.54	7.3	4.44	2670	4.97	0.116	0.32	3.68
NZ-154-00	04/07/00	Mokai Pool	1020	0.2	35.6			2.91		0.134	7.95	<	0.0679	2.22	198
NZ-153-00	04/07/00	Mokai Spring	1200	0.3	49.7			6.07	464	0.404	24.5	0.0967	0.244	0.0297	0.734
NZ-155-00	04/07/00	Mokai Stream	2260	0.8	56.9			7.03	80.6	1.22	274	0.995	0.242	16.3	4.24
NZ-171-00	05/01/99	Broadlands BR-10 well				10-12		5.87		3.3	894	2.9			13.8
NZ-172-00	05/05/99	Broadlands BR-14 well				7.5		6.85		8.6	1120	3.7			6.3
NZ-173-00	04/07/97	Broadlands BR-15 well				23	1317	6.3		5.4	1170	3.9			8.8
NZ-148-00	04/04/00	Broadlands BR-15 well 1	3670	2.3		14.2		7.05	276	5.8	1140	3.49	<	0.46	10
NZ-029-98	03/28/98	Broadlands BR-15 well; h	8100			4.0		6.88	177	4.24	1020	2.56	<	<	2.78
NZ-174-00	13/7/99	Broadlands BR-18 well				3.8		7.13		3.3	1230	4.9			15.6
NZ-175-00	02/25/98	Broadlands BR-20 well				8.3	1095	8.44		5.1	1030	3.7			66
NZ-147-00	04/04/00	Broadlands BR-20 well 7	4510	2.3		7.2		8.81	655	3.32	680	1.86	0.133	0.0509	96.9
NZ-030-98	03/28/98	Broadlands BR-20 well; h	7200			4.5		8.48	484	3.82	830	2.13	<	<	59.3
NZ-176-00	04/07/97	Broadlands BR-22 well				9.8	1242	7.2		6.4	1610	5.1			21
NZ-177-00	03/17/98	Broadlands BR-24 well				6.9	1592	6.92		4.4	1400	4.7			7.5
NZ-178-00	04/10/97	Broadlands BR-25 well				10.9	1059	8.64		7.8	837	2.8			23
NZ-179-00	03/17/98	Broadlands BR-31 well				3.4	1157	7.9		5.5	1120	4.1			43

Geothermal Waters Field Measurements and Anions Summary

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NZ-180-00	02/26/98	Broadlands BR-36 well				8.7	1749	7.78		8.1	1120	3.7			13
NZ-182-00	04/11/97	Broadlands BR-42 well				14.1	2155	6.84		8.4	1140	3.7			12
NZ-181-00	04/11/97	Broadlands BR-43 well				10.5	991	7.24		9.1	1040	3.6			10
NZ-183-00	02/26/98	Broadlands BR-44 well				8.7	1970	7.4		8.8	1200	4			15
NZ-184-00	07/03/97	Broadlands BR-48 well				0		8.2		7.2	1600	5.6			2.3
NZ-185-00	07/03/97	Broadlands BR-48 well				5.7	1575	7.05		6.1	1410	4.9			5.5
NZ-186-00	03/19/97	Broadlands BR-48 well				5	1422	8.19		6.6	1640	5.7			3.5
NZ-187-00	03/19/97	Broadlands BR-48 well				5	1422	6.88		5.8	1410	5.3			5.4
NZ-149-00	04/04/00	Broadlands BR-48 well 1	4150	2.7		10.2		6.81	178	6.6	1400	4.62	<	0.174	11.5
NZ-028-98	03/28/98	Broadlands BR-48 well;	12300		88.3			7.90	183	5.56	1460	4.1	<	<	1.65
NZ-170-00	04/10/97	Broadlands BR-8 well				3.6	958	7.45		3.8	634	2.2			88
NZ-188-00	04/23/99	Broadlands BRM-09 monitor well						6.44		0.66	844	2.9			17.7
NZ-146-00	04/04/00	Wairakei W-207 well 7.1	7600	3.1		7.1		8.32	41.1	7.78	1610	5.48	<	4.89	29.4
NZ-027-98	03/27/98	Wairakei W-215 well atm	16300		80.1			7.85	48.8	6.49	2110	4.16	<	<	23.6
NZ-026-98	03/27/98	Wairakei W-229 well high	7000			5.1		8.20	46.1	5.18	1800	3.95	<	<	23.6
NZ-025-98	03/27/98	Wairakei W-229 well weir	14800		91.0			7.96	47.7	5.69	2040	3.93	<	31.9	25.2
NZ-302-01	01/01/01	Northern Lake Taupo Margin pH 5.5													
NZ-303-01	01/01/01	Northern Lake Taupo Margin pH 6.5													
NZ-304-01	01/01/01	De Bretts Stream													
NZ-305-01	01/01/01	De Bretts Bore													
NZ-031-98	03/28/98	De Bretts in Taupo; flowir	2670		63.4			6.34	295	<	202	<	<	<	45.7
NZ-145-00	04/03/00	De Bretts in Taupo; flowir	2640	1.1	61.6			6.26	293	0.412	221	0.772	0.214	2.5	62.1
NZ-141-00	04/03/00	Tokaanu (Taumaata Puhi	24200	10.2	94.9			7.48	76.6	1.24	2310	9.62	<	0.786	61.5
NZ-142-00	04/03/00	Tokaanu Hoani Pool	17300	7.1	56.6			7.32	75.4	1.25	2670	10.6	<	0.0751	68.1
NZ-143-00	04/03/00	Tokaanu Takarea Pool	18200	7.7	63.0			6.19	41.6	1.28	2510	10	<	1.48	78
NZ-144-00	04/03/00	Tokaanu Takarea Pool #	21900	9.8	82.9			6.91	65.3	1.19	2380	10.1	<	1.32	65.4
NZ-233-00	11/04/93	IGNS-09 RCL 4-11-93													
NZ-234-00	02/18/94	IGNS-10 RCL 18-2-94													
NZ-235-00	05/04/95	IGNS-11 RCL 4-5-95													
NZ-236-00	05/10/96	IGNS-12 RCL 10-5-96													
NZ-237-00	02/28/97	IGNS-13 RCL 28-2-97													
NZ-238-00	03/17/98	IGNS-14 RCL 17-3-98													
NZ-239-00	01/10/99	IGNS-15 RCL 10-1-99													
NZ-032-98	03/28/98	Mt Ruapehu Crater Lake;	50000	38	22.3			1.14		158	11500	13	<	<	1980
NZ-240-00	10/22/93	IGNS-16 WI 22-10-93													
NZ-241-00	01/15/94	IGNS-17 WI 15-1-94													
NZ-242-00	02/23/94	IGNS-18 WI 23-2-94													
NZ-243-00	05/05/94	IGNS-19 WI 5-5-94													
NZ-244-00	11/15/95	IGNS-20 WI 15-11-95													
NZ-245-00	07/06/95	IGNS-21 WI 6-7-95													
NZ-246-00	02/28/95	IGNS-22 WI 28-2-95													
NZ-247-00	02/14/96	IGNS-23 WI 14-2-96													

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NZ-248-00	05/02/96	IGNS-24 WI 2-5-96													
NZ-249-00	11/04/96	IGNS-25 WI 4-11-96													
NZ-250-00	01/31/97	IGNS-26 WI 31-1-97													
NZ-251-00	05/06/97	IGNS-27 WI 6-5-97													
NZ-252-00	07/29/98	IGNS-28 WI 29-7-98													
NZ-104-00	03/18/00	White Island Black Pot, a	3950		96.0			5.57	113	4.96	596	2.38	<	0.04	1280
NZ-260-00		DDI Field Bank							acidified						
NZ-256-00		G1, AqRe rinse							acidified						
NZ-255-00		G10, Br20							acidified						
NZ-262-00		G10, Br20							acidified						
NZ-254-00		G6, Br9							acidified						
NZ-263-00		G6, Br9							acidified						
NZ-257-00		G8, Br9							acidified						
NZ-261-00		G8, Br9							acidified						
NZ-259-00		G9, Br20							acidified						
NZ-258-00		G9, Br9							acidified						
PP-264-00	12/10/1997	U.Tas. DDI Blank							acidified						
PP-265-00	12/10/1997	Palinpinon DDI Blank							acidified						
PP-266-00	12/06/1997	N1-2 Well Palinpinon			199, 206	3.3	886	7.60	acidified	4.98	7544	21.8			336
PP-267-00	12/06/1997	N1-3 Well Palinpinon			199, 206	3.3	886	7.60	acidified	6.26	7806	22.3			411
PP-268-00	12/07/1997	PN14-1 Well Palinpinon			312, 261	7	1039	7.14	acidified	7.44	9549	27.4			122
PP-269-00	12/07/1997	PN14-2 Well Palinpinon			312, 261	7	1039	7.14	acidified	6.49	9393	29.4			132
NZ-270-00	1970's	HCE 30A-1													
NZ-271-00	1970's	HCE 30A-2													
NZ-272-00	1970's	HCE 30A-3													
NZ-273-00	1970's	HCE 30A-4													
NZ-274-00	1970's	HCE 30A-5													
NZ-275-00	1970's	HCE 30A-6													
NZ-276-00	1970's	HCE 33-1													
NZ-277-00	1970's	HCE 33-2													
NZ-278-00	1970's	HCE 33-3													
NZ-279-00	1970's	HCE 33-4													

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