From:	Ron Yehia
To:	"Sarah Kimball"
Subject:	FW: SGP Silver Peak year 2009 TG hole sample chemistry (RE: [Fwd: Preliminary Report for 18-11 TGH and 53-15 TGH])
Date:	Tuesday, March 23, 2010 12:21:42 PM
Attachments:	Fig 5 - LivsCl etc.pdf Fig 6 - Mg and B vs. Cl - detail.pdf Fig 7 - Na and K vs. Cl.pdf Fig 8 - SiO2 vs Cl.pdf Legend.pdf Fig 4 - TdegFvsCl etc.pdf

Ron Yehia
Project Geologist

SGP

Renewable *for Life*

375 - 555 Burrard Street, Box 244
Vancouver, BC, Canada V7X 1M7
Mobile: (775) 722-4385
P: (604) 683 0332 Ext. 105
F: (604) 683 0342 | Toll Free: 800 563 5631
E: ryehia@sierrageopower.com
W: www.sierrageopower.com

From: Jeff Witter [mailto:jwitter@sierrageopower.com]
Sent: December 9, 2009 16:00
To: ryehia@sierrageopower.com
Subject: FW: SGP Silver Peak year 2009 TG hole sample chemistry (RE: [Fwd: Preliminary Report for 18-11 TGH and 53-15 TGH])

Jeff Witter, Ph.D.
Project Geologist

SGP

Renewable *for Life*

Sierra Geothermal Power Corp
500 - 666 Burrard Street, Vancouver, BC, Canada V6C 3P6
Direct: (778) 370 1391
Mobile: (206) 550 2545

P: (604) 683 0332 | F: (604) 683 0342 | Toll: 800 563 5631
E: jwitter@sierrageopower.com
W: www.sierrageopower.com

From: Chris Klein [mailto:cwk@geothermex.com]
Sent: December 9, 2009 2:32 PM
To: jronne@sierrageopower.com
Cc: 'Jeff Witter'; 'GeothermEx, Inc.'; 'Roger Henneberger'
Subject: SGP Silver Peak year 2009 TG hole sample chemistry (RE: [Fwd: Preliminary Report for 18-11 TGH and 53-15 TGH])

Hello, Joel

Attached are revisions of Figures 4 - 8, plus a legend, from our 19 August 2006 Memorandum ("Fluids chemistry of the thermal waters and playa brines at the Silver Peak (Clayton Valley) geothermal prospect, Nevada", To Randy Henkle and yourself, Cayley Geothermal) made by adding the new samples from this year's temperature gradient drilling. The TG hole data (green circles) are labeled with the hole number plus (W) for Western Environmental Testing analysis (WET) or (T) for Thermochem (TCI) analysis. Figure 1 of the 2006 memo was a location map, and Figures 2 and 3 were graphs of isotope data not analyzed in the new samples.

In short, the new data have not added a whole lot of new information. Most of the samples look like the playa brines sampled in 2006 and before and don't change the conclusions of that report, that the brines produced from Li mining wells and other exploration holes drilled in the playa have evolved from the hydrothermal water that issues on the west side (Silver Pk) and on the NE side at Pearl H.S. Geothermometer estimates also remain unchanged.

Perhaps the most interesting new data are from 18-11 and 53-15.

The chemistry of 18-11 tends to resemble Bath House Hot Spring and the NHS well but with lower SiO_2 that implies that 18-11 taps shallow outflow, not upflow.

The water from 53-15 has SiO_2 similar to 18-11, but otherwise much lower TDS plus notably low K/Na and notably high Mg (both signs of lower temperature). The deepest, hottest thermal water that upwells at Silver Peak (and at Pearl) may have Cl at about 5,000 mg/l. This is far from certain, but one working hypothesis. By comparison, Cl at 53-15 is only about 7,000 and Cl at Bath House and NHS is about 14,000~18,000. It follows that 53-15 is close to the upwelling type (not diluted), but rather substantially cooled and re-equilibrated, lowering K/Na and SiO_2 and raising Mg. In contrast, the hotter waters of Bath House and NHS would be mixtures between the upwelling thermal water (not much yet cooled) and, from the basin, cooled thermal water that has been concentrated by evaporation. A problem with this hypothesis lies in assuming that K/Na at 53-15 has decreased due to cooling, because this ratio tends to respond more slowly than Mg and SiO_2.

An alternate hypothesis is that the upwelling type has 14,000~18,000 mg/l Cl and 53-15 is this water with a lot of dilution and cooling (lowering SiO_2, raising Mg, lowering K/Na). The only dilution candidate available is the Ca-Mg-HCO_3 Waterworks spring at Silver Peak (town), which is generally acceptable but lacks the needed Mg and Na relative to K to make mixing the only process responsible for elevated Mg and lowered K/Na. (So, again, K/Na has to be a cooling response.)

In either case, 53-15 is not particularly close to upwelling in terms of high permeability and rapid flow.

Some specific observations are as follows:

Figure 4 - T°F vs Cl: the formation temperatures sampled at some of the TG holes are rather uncertain and in such cases I've plotted the minimum temperature plus a line that leads to the maximum temperature. The temperature used for 53-15 is particularly uncertain. The new data tend to confirm the previous conclusion that upwelling thermal water has TDS towards (probably at) the low end of TDS seen in the playa.

Figure 4 - SiO2 vs T°F: the graph supports a previous observation that WET lab has been producing suspiciously low SiO2 numbers, at least in some samples and perhaps in all. None of the samples from either lab, however, reaches SiO2 at the NHS well. Levels of SiO2 at 53-15(T), 18-11(T) and Bath House Springs are all similar and lower than SiO2 at NHS well. This can be taken to mean that the waters at these three sites have cooled more slowly and lost SiO2 (some loss has probably occurred also at NHS). (At 53-15 mixing may also be involved.) I would not make too much of the slightly lower SiO2 at 18-11 compared to 53-15; small differences in cooling rates and temperatures of equilibration are probably involved.

Figure 4 - K vs Na, detail: the Visual Reference Line is new, to help discern different levels of K relative to Na. I've drawn this as a visual estimate to represent the average of samples from Bath House Springs and NHS well (the scatter of the NHS points is probably analysis errors), because spring waters are less likely to re-equilibrate than shallow well waters that have longer residence. The new data in general conform to this reference line, with average K/Na a hair lower perhaps due to cooling. Again, one can get out the magnifying glass. For example, the highest Na/K (lowest K/Na) is at 53-15 (both labs) with 73-10 close behind. Does this indicate more cooling? Perhaps. The low K/Na ratio at 73-10 certainly correlates with a particularly low temperature for the data set. The slightly high K/Na at 26-14 may be an analysis error, as that sample is also relatively cool for the dataset.

Figure 5 - Li vs Cl: nothing notable

Figure 5 - Mg vs Cl: see comments at Figure 6 below.

Figure 5 - SO4 vs Cl: nothing notable except the similarity of 18-11 to NHS and Bath House.

Figure 5 - HCO3 vs Cl: the new data all conform to the range previously observed. The entire data set shows a rather large range of HCO3 at similar Cl, which may be in part a consequence of analysis errors and shifts of pH during sample storage before analysis. Note for example the different HCO3 at 18-11 reported by WET and by TCI. 26-14 shows relatively high HCO3 and SO4 compared to Cl, which correlates with the slightly odd Na/K and Mg/Cl at that well. The lower HCO3 at 18-11(T) and at 53-15(both labs) compared to NHS and Bath House appear to be a result

of some mixing with the cold Ca-Mg-HCO3 water of Waterworks, but other graphs (e.g. Mg vs Cl detail) imply that re-equilibration as well as mixing is involved.

Figure 6 - Mg vs Cl Detail: You may recall that Mg is suppressed at high temperatures and increases during cooling. 18-11 is most similar to NHS and Bath House and has the lowest Mg/Cl observed (except the more dilute 26-14), along what appears to be a mixing line. Other samples all show higher Mg/Cl, very probably due to cooling. The highest Mg/Cl is at 53-15, which corresponds to the low K/Na at the same site. Note that the 53-15 Mg (as well as 73-10 and 43-14) is much higher than Mg in the cool Waterworks water. Does the high Mg at 53-15 imply an effect in particular of the Reed Dolomite (even though the well was drilled in Wyman Fm), since Mg is similar at 73-10 which entered the Reed? Hard to say and perhaps doubtful, since 43-14 (Qal to TD) has similar Mg.

Figure 6 - SO4 vs Cl Detail: nothing notable except the similarity of 18-11 to NHS and Bath House.

Figure 6 - B vs Cl: nothing notable. Small irregularities of the B/Cl ratio may be due to absorption of B into clay minerals.

Figure 6 - SO4 vs Ca: on average (not all samples) the Bath House points (pink diamonds) show slightly higher SO4 and lower Ca than the NHS samples (red triangles), and 18-11 resembles the Bath House average more closely than NHS well average. This may not mean much.

Figure 7 - all graphs: nothing notable.

Christopher W. Klein
Senior Geochemist - Geologist
GeothermEx, Inc.
3260 Blume Dr., Suite 220
Richmond, CA 94806
U.S.A.
Tele: 510-527-9876
Fax: 510-527-8164
email: cwk@geothermex.com

From: Joel Ronne [mailto:mr.ronne@gmail.com]
Sent: Friday, December 04, 2009 11:54 PM
To: Chris Klein
Cc: Jeff Witter
Subject: [Fwd: Preliminary Report for 18-11 TGH and 53-15 TGH]

Hi Chris,
Here are the Thermochem analysis of the last two water samples. I was hoping to see a higher silica number on 53-15 as it was taken after the LCZ (presumed fault) in the Wyman. Are you getting any story from the geochem results so far at Silver Peak?
Joel

Hello Kelly,

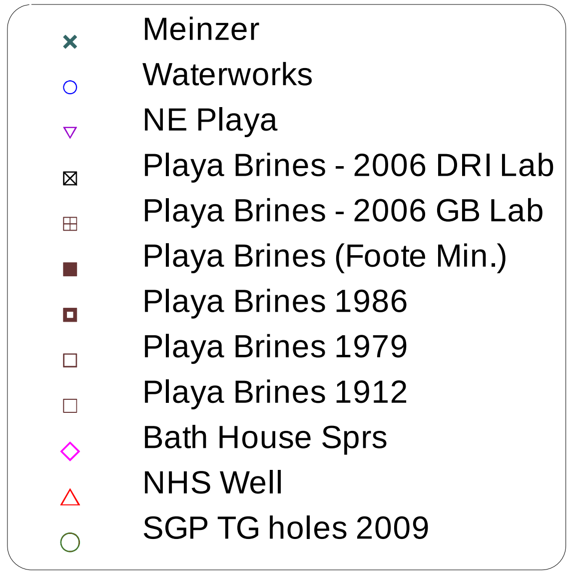
Please allow me to introduce myself. I am the new Quality Control manager at Thermochem. Russ has asked me to send you a preliminary report for the water samples you submitted for analysis. This report is only preliminary; the data review should be completed next week and a final report will be issued then.

I have attached the report in PDF format.

Please let me know if you have any other questions.

Best Regards,

Paula Bosserman
QC Manager
Thermochem, Inc.
3414 Regional Parkway, Suite A
Santa Rosa, CA 95403
(707) 575-1310, ext. 118


Meinzer
Waterworks
NE Playa
Playa Brines - 2006 DRI Lab
Playa Brines - 2006 GB Lab
Playa Brines (Foote Min.)
Playa Brines 1986
Playa Brines 1979
Playa Brines 1912
Bath House Sprs
NHS Well
SGP TG holes 2009

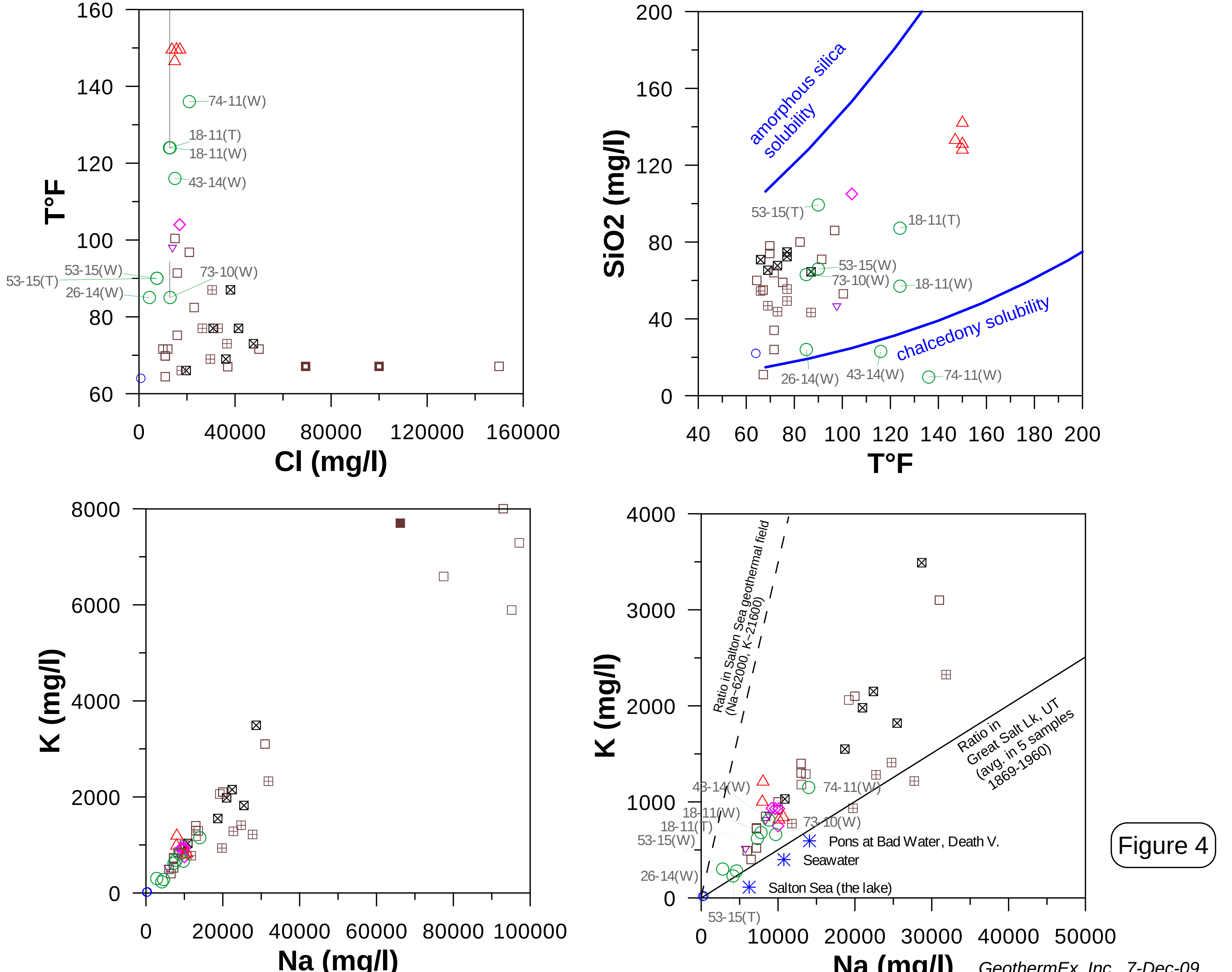


Figure 4

GeothermEx, Inc. 7-Dec-09

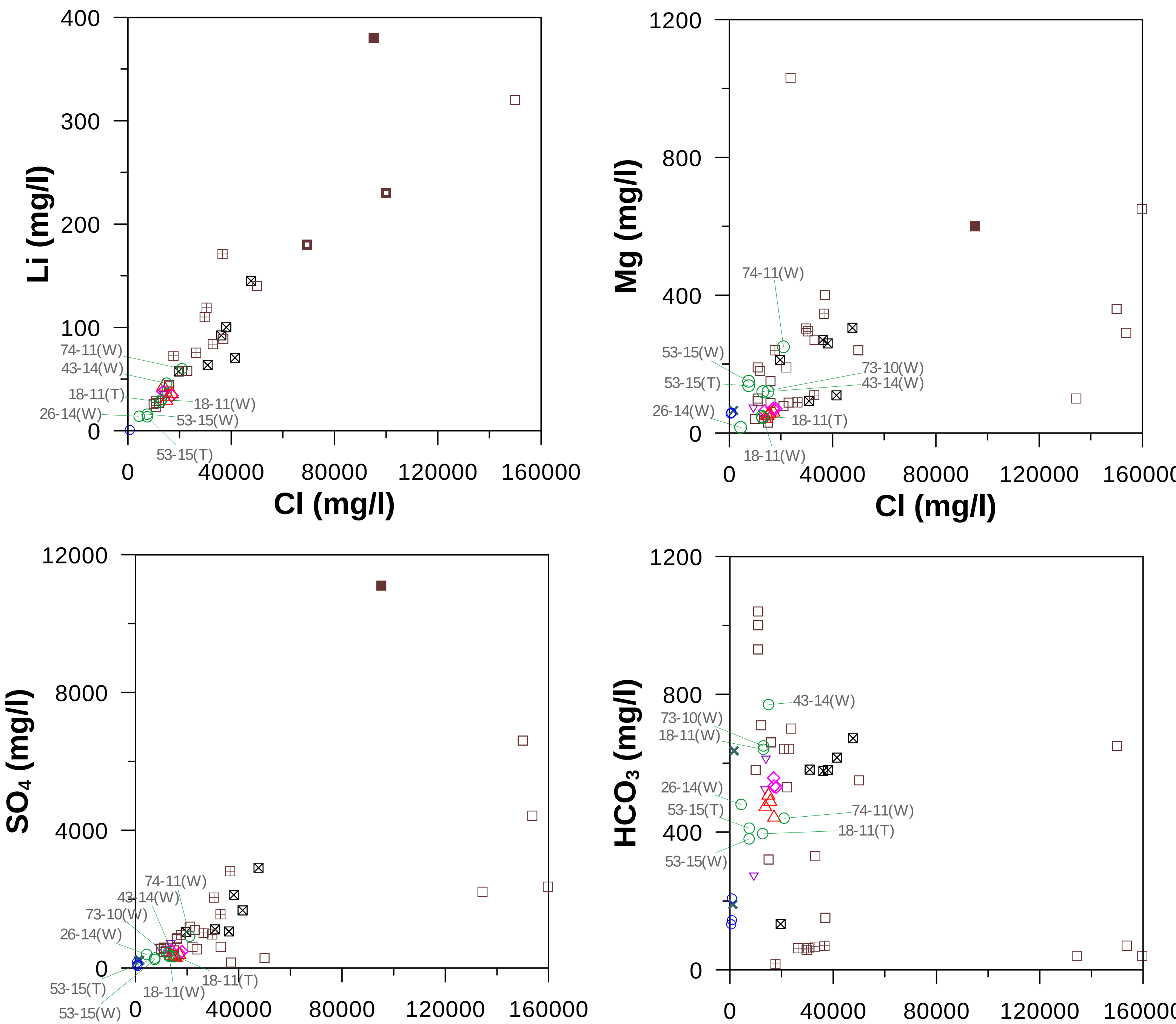


Figure 5

GeothermEx, Inc. 7-Dec-09

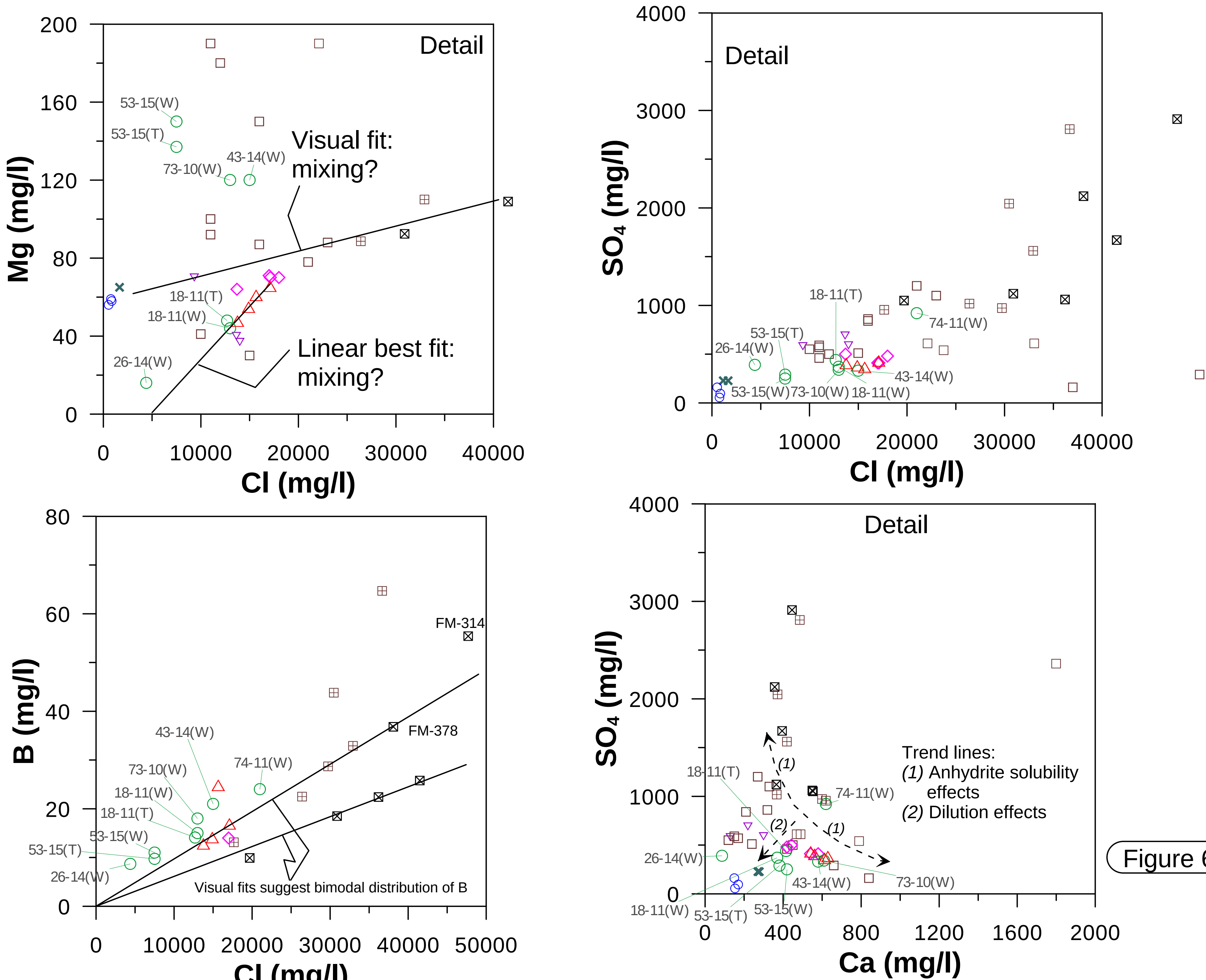


Figure 6

GeothermEx, Inc. 8-Dec-09

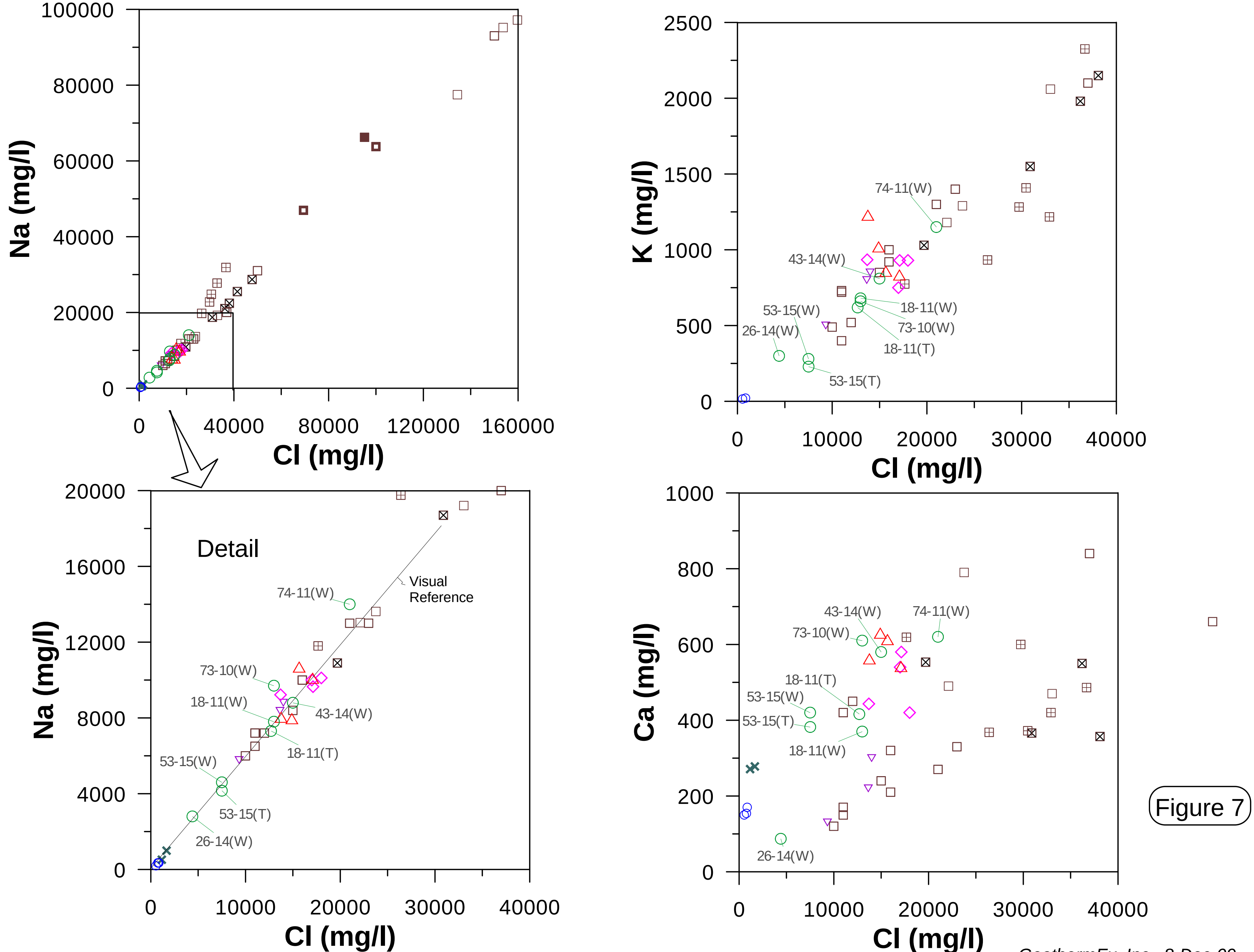
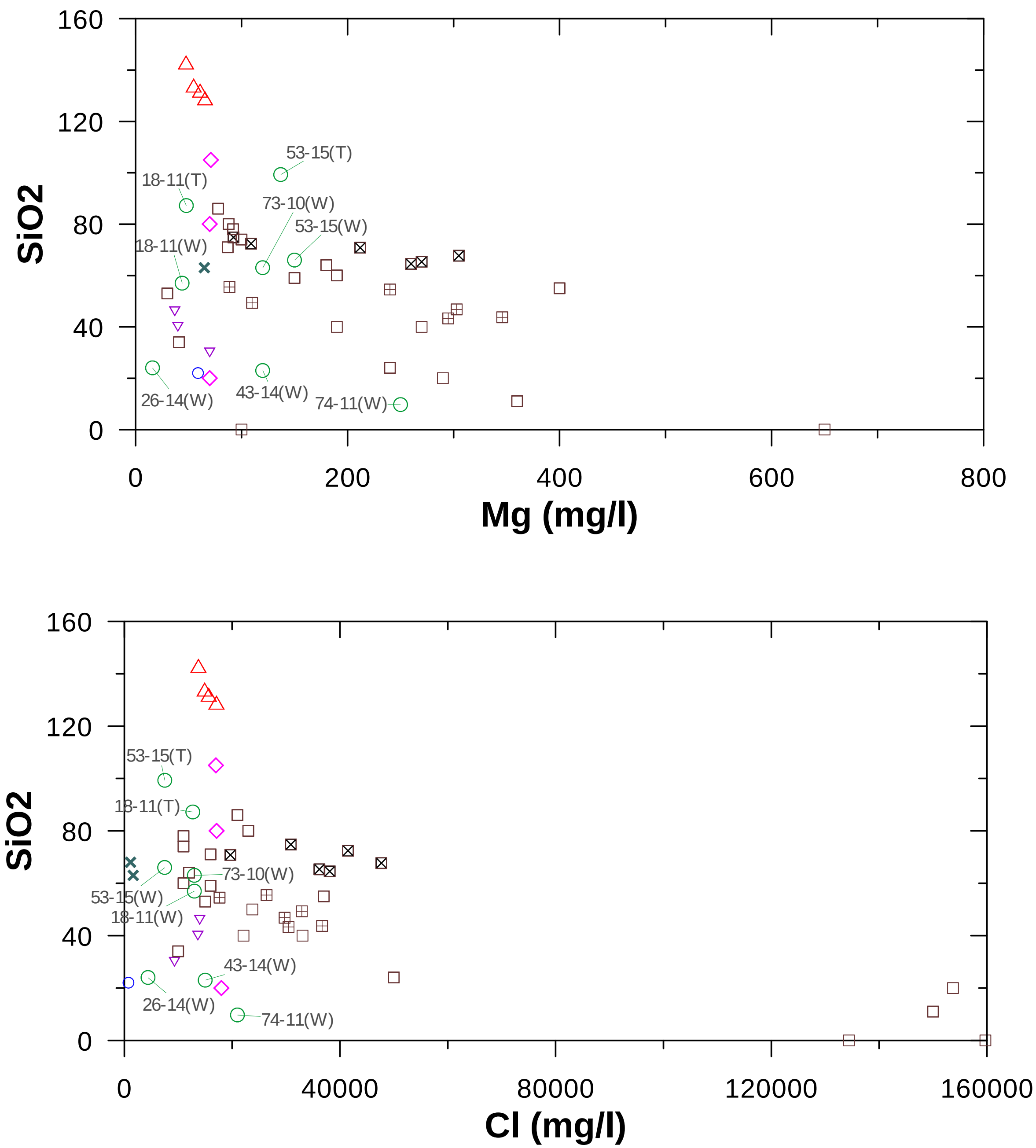


Figure 7

GeothermEx, Inc. 8-Dec-09



SiO2
Mg (mg/l)
53-15(T)
18-11(T)
73-10(W)
53-15(W)
18-11(W)
26-14(W)
43-14(W)
74-11(W)
SiO2
Cl (mg/l)
53-15(T)
18-11(T)
73-10(W)
53-15(W)
18-11(W)
43-14(W)
26-14(W)
74-11(W)

Figure 8