Reservoir Chemistry for Management HW

The first step is to tabulate the data given, extracting the enthalpies (measured @ surface, quartz, and Na-K-Ca geothermometers) and surface chloride concentrations from the well and surface samples. The result is:

Well ID	H_{well}	H_{quartz}	H_{NKC}	$\mathrm{Cl}_{surface}$
1	-	1000	1000	835
3	770	775	900	673
4	1279	935	1015	1600
5	-	-	680	949
6	1000	890	1035	1063
7	877	865	1015	1260
pool	-	1000	-	1898

Now, add steam fractions using the Na-K-Ca geothermometer (it has the most data and is OK in this temperature regime) and the enthalpies of 100 C water and steam (419 and 2676 kJ/kg respectively). From the conservation of energy, we know that the steam fraction has to be:

$$y = \frac{H_{mix} - H_{liq}}{H_{vap} - H_{liq}}$$

where y the steam fraction, H_{mix} is the mixed enthalpy (from Na-K-Ca system), H_{liq} is the liquid enthalpy @ 100 C, H_{vap} is the vapor enthalpy @ 100 C.

This is easily computed in Octave (or Matlab) in a single step:

```
Hmix=[1000 775 935 680 890 865 1000]
steam = (Hmix - 419)/(2676-419)
```

Compute total discharge chloride concentrations using the just-calculated steam fractions:

$$\mathrm{Cl}_{td} = \mathrm{Cl}_{surface} \cdot (1 - y)$$

where Cl_{td} is the total discharge chloride concentration, $\mathrm{Cl}_{surface}$ is the surface concentration measured after steam fractionation.

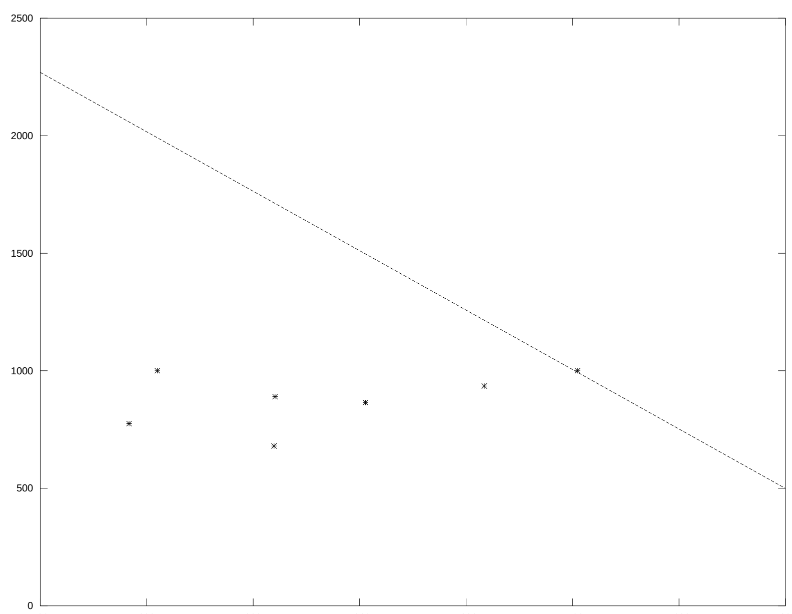
This can again be easily calculated in Octave (Matlab) in a single line:

```
Cl=[835 673 1600 949 1063 1260 1848]
Cl_td = Cl.*(1-y)
```

The resulting new table with steam fraction and chloride concentrations looks like:

Well ID	H_{well}	H_{quartz}	H_{NKC}	Steam	$Cl_{surface}$	Cl_{td}
1	-	1000	1000	0.257	835	620
3	770	775	900	0.158	673	567
4	1279	935	1015	0.230	1600	1234
5	-	-	680	0.116	949	839
6	1000	890	1035	0.209	1063	841
7	877	865	1015	0.198	1260	1011
pool	-	1000	-	0.257	1898	1409

Plot & Discussion



The plot of chloride vs. enthalpy shows the dilution and steam fractionation of the water in various wells.