KBH_94_23_DE_5_all_pyx_lines

Both CPX and OPX are included

Line 1 OPX Line 3 CPX Line 4 OPX Line OPX Line 5 OPX/CPX/OPX

Line 5

is a tiny CPX inside of a larger OPX

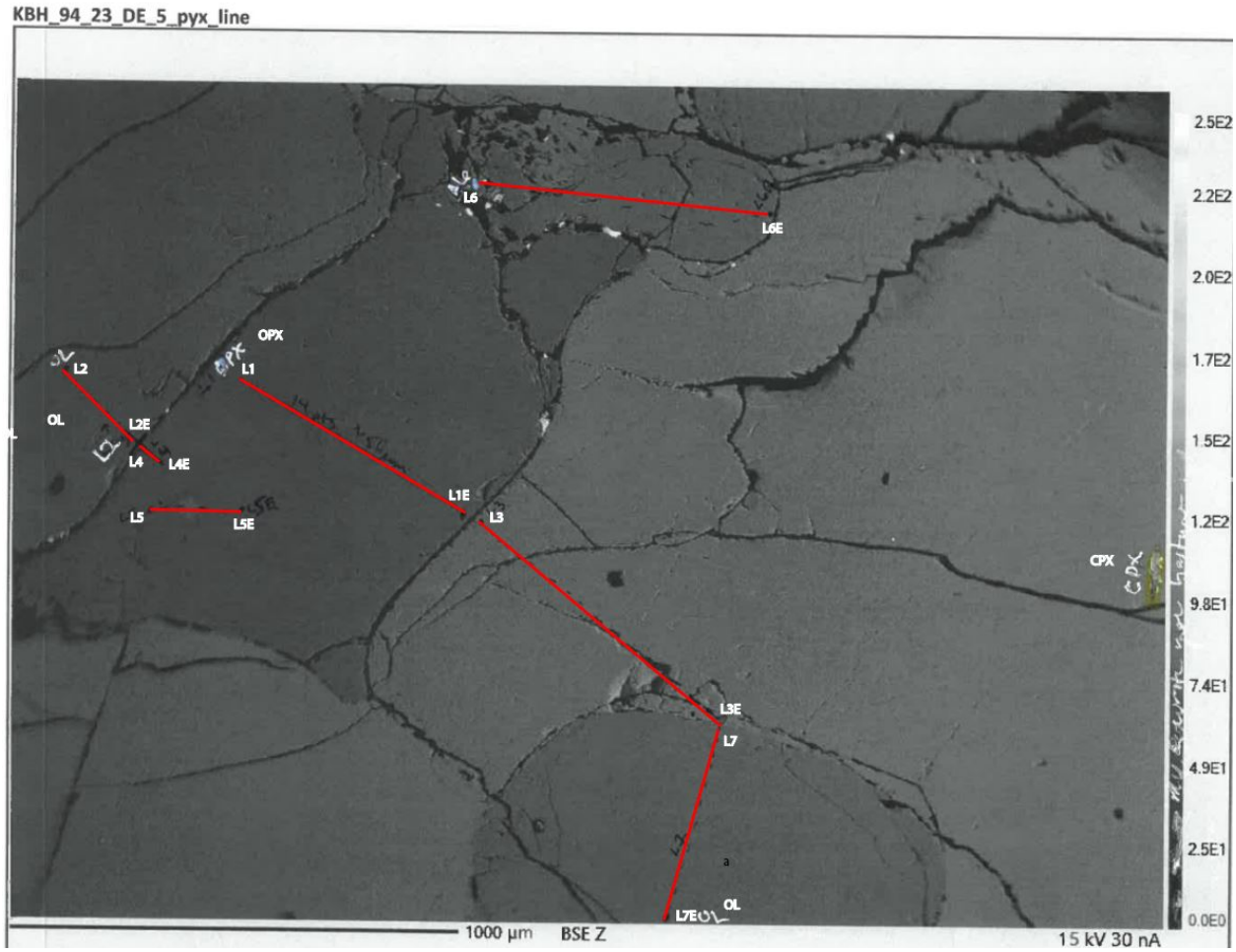


Figure 1: alt text

#Bring in the CSV

Not working %>% filter(!is.na(phos_ox))

Ternary of both OPX and CPX:

```
MgO_num <- mutate(M5_DE_all_pyx_KBH_94_23, mg_dat = MgO/40.304,
                  fe_dat = FeO/71.844,
                  ca_dat = CaO/56.077,
                  Mg = (mg_dat/(mg_dat+fe_dat+ca_dat))*100,
                  Fe = (fe_dat/(mg_dat+fe_dat+ca_dat))*100,
                  Ca = (ca_dat/(mg_dat+fe_dat+ca_dat))*100
                  )
show_tbl_1 <- knitr::kable(MgO_num)#%>%
   #kable_material(c("striped", "hover"))
  #kable_styling()
  #kable_styling(font_size = 7)
  #kable_styling(latex_options="scale_down")
show_tbl_1
```

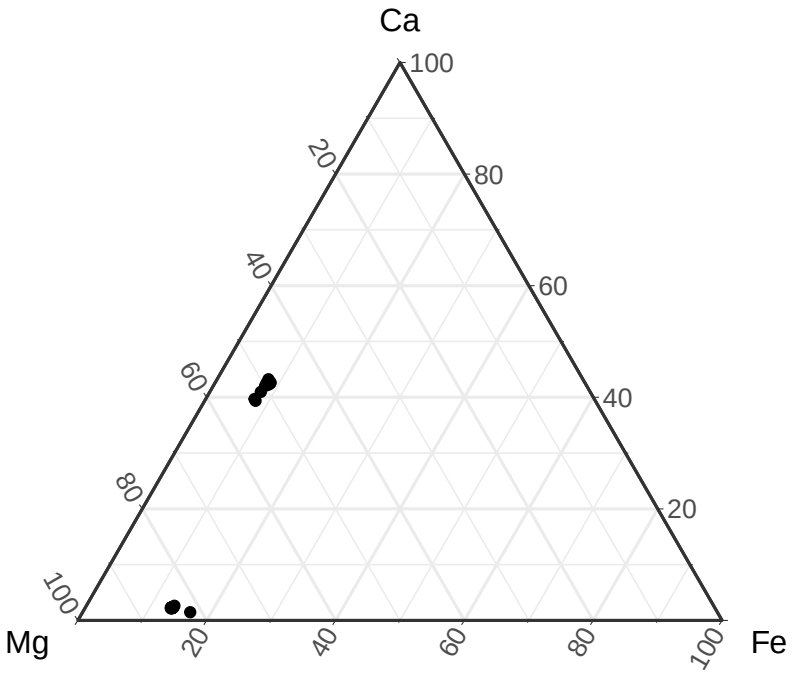
OPX	P2O5	SiO2	TiO2	Al2O3	Cr2O3	MgO	CaO	MnO	FeO	NiO	Na2O	K2O	mg_dat	fe_dat	ca_dat	Mg	Fe	Ca
1.1	0	52.856	0.241	5.803	0.359	30.472	1.166	0.138	8.740	0	0.134	0.009	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.2	0	53.478	0.222	5.786	0.401	30.686	1.172	0.184	8.753	0	0.122	0.003	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.3	0	53.457	0.226	5.678	0.403	30.807	1.133	0.182	8.847	0	0.142	0.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.4	0	53.029	0.223	5.569	0.409	30.364	1.132	0.178	8.758	0	0.123	0.001	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.5	0	53.688	0.190	5.548	0.410	30.993	1.133	0.188	8.806	0	0.140	0.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.6	0	53.717	0.188	5.466	0.403	30.922	1.131	0.158	8.783	0	0.114	0.006	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.7	0	53.728	0.218	5.446	0.437	30.982	1.094	0.166	8.770	0	0.127	0.006	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.8	0	53.836	0.203	5.507	0.407	30.894	1.144	0.193	8.755	0	0.120	0.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.9	0	53.026	0.216	5.347	0.426	30.581	1.133	0.160	8.813	0	0.120	0.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.1_0	0	53.834	0.205	5.523	0.414	30.857	1.136	0.188	8.671	0	0.125	0.003	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.11	0	53.688	0.185	5.563	0.438	30.974	1.197	0.183	8.762	0	0.150	0.010	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.12	0	53.498	0.235	5.547	0.438	30.689	1.150	0.181	8.800	0	0.122	0.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.13	0	53.582	0.224	5.635	0.409	30.970	1.177	0.183	8.824	0	0.154	0.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.14	0	53.930	0.258	5.867	0.444	31.142	1.197	0.189	8.780	0	0.147	0.002	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.1	0	50.280	0.768	7.590	0.792	15.494	18.796	0.132	4.841	0	1.414	0.005	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.2	0	50.846	0.691	7.449	0.828	15.651	18.924	0.133	4.720	0	1.417	0.013	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.3	0	50.933	0.661	7.485	0.844	15.916	18.842	0.122	4.710	0	1.417	0.009	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.4	0	50.851	0.622	7.432	0.842	15.792	18.879	0.137	4.602	0	1.428	0.013	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.5	0	50.672	0.606	7.489	0.861	15.741	18.878	0.112	4.690	0	1.411	0.012	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.6	0	51.316	0.579	7.524	0.856	15.952	18.725	0.105	4.583	0	1.421	0.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.7	0	50.778	0.562	7.525	0.856	15.826	18.827	0.122	4.583	0	1.421	0.009	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.8	0	50.301	0.556	7.407	0.886	15.573	18.786	0.115	4.631	0	1.343	0.004	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.9	0	50.890	0.611	7.434	0.867	15.790	18.995	0.140	4.601	0	1.429	0.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.1_0	0	50.838	0.581	7.503	0.843	15.678	18.837	0.113	4.586	0	1.418	0.006	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.11	0	52.314	0.551	7.880	0.745	16.686	17.331	0.115	4.454	0	1.492	0.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.12	0	52.908	0.633	7.932	0.828	16.984	18.942	0.127	4.693	0	1.565	0.001	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.13	0	55.104	0.647	8.541	0.807	18.081	18.938	0.119	4.636	0	1.832	0.009	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.14	0	50.560	0.669	7.394	0.798	15.571	18.832	0.133	4.839	0	1.396	0.009	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.15	0	50.575	0.765	6.659	0.785	16.227	19.999	0.115	4.725	0	0.876	0.002	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

OPX	P2O5	SiO2	TiO2	Al2O3	Cr2O3	MgO	CaO	MnO	FeO	NiO	Na2O	K2O	mg_dat	fe_dat	ca_dat	Mg	Fe	Ca
4.1	0	48.348	0.402	5.592	0.068	36.200	0.911	0.208	13.173	0	0.027	0.024	0.8981739	8335501	6248	1581767	16.70247	1.679859
4.2	0	53.648	0.242	5.827	0.350	30.748	1.204	0.163	8.860	0	0.134	0.003	0.7629019	2332282	14789	504825	13.58632	3.265384
4.3	0	52.614	0.255	5.898	0.339	29.886	1.307	0.177	8.700	0	0.158	0.021	0.7415145	2109507	23308	2700118	13.66892	2.630859
4.4	0	53.524	0.236	5.799	0.363	30.898	1.214	0.218	8.914	0	0.135	0.000	0.7666237	2407040	21648	8027615	13.59942	2.572870
4.5	0	53.463	0.247	5.798	0.367	30.512	1.162	0.170	8.837	0	0.137	0.000	0.7570464	2300262	20728	1504431	13.65526	2.600420
4.6	0	53.693	0.283	5.824	0.381	30.791	1.186	0.190	8.819	0	0.142	0.000	0.7639681	2275120	21149	9514955	13.52088	2.329572
4.7	0	53.631	0.246	5.775	0.364	30.590	1.158	0.191	8.788	0	0.129	0.000	0.7589817	2232060	20658	0214875	13.56175	2.489497
5.1	0	53.723	0.250	5.652	0.353	30.973	1.185	0.190	8.775	0	0.136	0.005	0.7684845	2213960	21134	1728622	13.39609	3.317688
5.2	0	53.723	0.211	5.596	0.362	30.777	1.150	0.164	8.694	0	0.125	0.000	0.7636215	2101020	20508	7536490	13.36942	2.765671
5.3	0	53.755	0.230	5.625	0.343	30.922	1.213	0.188	8.816	0	0.125	0.007	0.7672191	2271003	21638	4016547	13.46156	3.372961
5.4	0	50.937	0.723	7.448	0.650	15.728	19.047	0.137	4.941	0	1.425	0.004	0.3902340	0687703	396548	08607	84611108	42.528151
5.5	0	50.914	0.718	7.430	0.655	15.680	19.086	0.127	4.905	0	1.425	0.003	0.3890433	0682729	40353	4847724	8559048	42.668472
5.6	0	50.852	0.697	7.387	0.632	15.765	18.881	0.130	4.873	0	1.396	0.007	0.3911502	0678275	366907	815968	5524498	42.315857
5.7	0	53.694	0.224	5.557	0.378	30.720	1.190	0.169	8.709	0	0.131	0.011	0.7622072	2122102	1228	98254417	13.39978	3.045752
5.8	0	53.766	0.200	5.535	0.372	30.860	1.151	0.182	8.755	0	0.137	0.009	0.7656808	2186013	20525	6331982	13.41982	2.760333
5.9	0	53.709	0.189	5.539	0.373	30.972	1.166	0.205	8.707	0	0.140	0.014	0.7684597	2119830	20792	8840478	13.31140	2.883809
5.1_0	0	53.852	0.194	5.563	0.376	30.915	1.180	0.194	8.766	0	0.128	0.011	0.7670451	2201040	21048	8528123	13.40663	2.512102

```r
tern <- ggtern(data = MgO_num, aes(x = Mg,
                        y = Ca,
                        z = Fe)) +
geom_point()+
  labs(title = "CPX and OPX")+
  theme_bw()

tern
```

CPX and OPX



#OPX

#Average Composition:

```
mol_numbers <- mutate(M5_DE_all_OPX_KBH_94_23, P2O5/141.943,#Change file here
                      SiO2/53.083,
                      TiO2/79.865,
                      Al2O3/101.961,
                      Cr2O3/99.993,
                      MgO/40.304,
                      CaO/56.077,
                      MnO/70.937,
                      FeO/71.844,
                      NiO/74.692,
                      Na2O/61.979,
                      K2O/94.195)

oxygen_number <- mutate(mol_numbers, p = P2O5/141.943*5,
                        si = SiO2/53.083 * 2,
                        ti = TiO2/79.865 * 2,
                        al = Al2O3/101.961 * 3,
                        cr = Cr2O3/99.993 * 3,
                        mg = MgO/40.304 * 1,
                        ca = CaO/56.077 * 1,
                        mn = MnO/70.937 * 1,
                        fe = FeO/71.844 * 1,
                        ni = NiO/74.692 * 1,
```

```
                        na = Na2O/61.979 * 1,
                        k = K2O/94.195 * 1
                        )

sum_ox <- select(oxygen_number, p,
                    si,
                    ti,
                    al,
                    cr,
                    mg,
                    ca,
                    mn,
                    fe,
                    ni,
                    na,
                    k
                    )

sum_row <- sum_ox %>%
  mutate(sum = rowSums(.))

#CHANGE BASED ON PYX=6 OL/SPI=4

six_div_sum <- mutate(sum_row,norm_constant = 6/sum) %>%
  select(norm_constant)

six_div_sum_oxygen_number <- bind_cols(oxygen_number,six_div_sum)

oxy_num_mult_norm_const <- mutate(six_div_sum_oxygen_number, a = p*norm_constant,
                                  b = si*norm_constant,
                                  c = ti*norm_constant,
                                  d = al*norm_constant,
                                  e = cr*norm_constant,
                                  f = mg*norm_constant,
                                  g = ca*norm_constant,
                                  h = mn*norm_constant,
                                  i = fe*norm_constant,
                                  j = ni*norm_constant,
                                  k = na*norm_constant,
                                  l = k*norm_constant
                                  )

mult_cations <- mutate(oxy_num_mult_norm_const, a1 = a * 2/5,
                        a2 = b * 1/2,
                        a3 = c * 1/2,
                        a4 = d * 2/3,
                        a5 = e * 2/3,
                        a6 = f * 1/1,
                        a7 = g * 1/1,
                        a8 = h * 1/1,
                        a9 = i * 1/1,
                        a10 = j * 1/1,
                        a11 = k * 2/1,
```

```
                      a12 = 1 * 2/1)

end <- mult_cations %>%
  summarise(ave_P = mean(a1),
            ave_Si = mean(a2),
            ave_Ti = mean(a3),
            ave_Al = mean(a4),
            ave_Cr = mean(a5),
            ave_Mg = mean(a6),
            ave_Ca = mean(a7),
            ave_Mn = mean(a8),
            ave_Fe = mean(a9),
            ave_Ni = mean(a10),
            ave_Na = mean(a11),
            ave_K = mean(a12)
            )
show_tbl_2 <- knitr::kable(end)
show_tbl_2
```

ave_P	ave_Si	ave_Ti	ave_Al	ave_Cr	ave_Mg	ave_Ca	ave_Mn	ave_Fe	ave_Ni	ave_Na	ave_K
0	1.938535	0.0055559	0.213224	0.0145782	1.481388	0.0398728	0.0049301	0.2397925	0	0.0080514	0.0155217

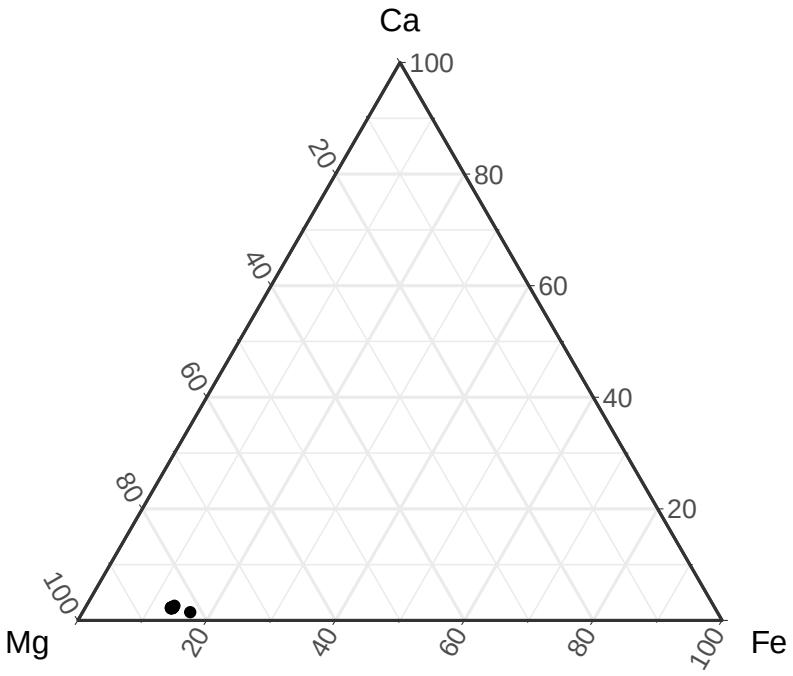
Ternary for OPX only

```
MgO_num <- mutate(M5_DE_all_OPX_KBH_94_23, mg_dat = MgO/40.304,# Change file here too
                  fe_dat = FeO/71.844,
                  ca_dat = CaO/56.077,
                  Mg = (mg_dat/(mg_dat+fe_dat+ca_dat))*100,
                  Fe = (fe_dat/(mg_dat+fe_dat+ca_dat))*100,
                  Ca = (ca_dat/(mg_dat+fe_dat+ca_dat))*100
                  )

  tern <- ggtern(data = MgO_num, aes(x = Mg,
                           y = Ca,
                           z = Fe)) +
  geom_point()+
    labs(title = "OPX")+
    theme_bw()

  tern
```

OPX



#CPX

#Ave composition of CPX

```
mol_numbers <- mutate(M5_DE_all_CPX_KBH_94_23, P2O5/141.943,#Change file here
                      SiO2/53.083,
                      TiO2/79.865,
                      Al2O3/101.961,
                      Cr2O3/99.993,
                      MgO/40.304,
                      CaO/56.077,
                      MnO/70.937,
                      FeO/71.844,
                      NiO/74.692,
                      Na2O/61.979,
                      K2O/94.195)

oxygen_number <- mutate(mol_numbers, p = P2O5/141.943*5,
                        si = SiO2/53.083 * 2,
                        ti = TiO2/79.865 * 2,
                        al = Al2O3/101.961 * 3,
                        cr = Cr2O3/99.993 * 3,
                        mg = MgO/40.304 * 1,
                        ca = CaO/56.077 * 1,
                        mn = MnO/70.937 * 1,
                        fe = FeO/71.844 * 1,
                        ni = NiO/74.692 * 1,
```

```
                        na = Na2O/61.979 * 1,
                        k = K2O/94.195 * 1
                        )

sum_ox <- select(oxygen_number, p,
                    si,
                    ti,
                    al,
                    cr,
                    mg,
                    ca,
                    mn,
                    fe,
                    ni,
                    na,
                    k
                    )

sum_row <- sum_ox %>%
  mutate(sum = rowSums(.))

#CHANGE BASED ON PYX=6 OL/SPI=4

six_div_sum <- mutate(sum_row,norm_constant = 6/sum) %>%
  select(norm_constant)

six_div_sum_oxygen_number <- bind_cols(oxygen_number,six_div_sum)

oxy_num_mult_norm_const <- mutate(six_div_sum_oxygen_number, a = p*norm_constant,
                                  b = si*norm_constant,
                                  c = ti*norm_constant,
                                  d = al*norm_constant,
                                  e = cr*norm_constant,
                                  f = mg*norm_constant,
                                  g = ca*norm_constant,
                                  h = mn*norm_constant,
                                  i = fe*norm_constant,
                                  j = ni*norm_constant,
                                  k = na*norm_constant,
                                  l = k*norm_constant
                                  )

mult_cations <- mutate(oxy_num_mult_norm_const, a1 = a * 2/5,
                        a2 = b * 1/2,
                        a3 = c * 1/2,
                        a4 = d * 2/3,
                        a5 = e * 2/3,
                        a6 = f * 1/1,
                        a7 = g * 1/1,
                        a8 = h * 1/1,
                        a9 = i * 1/1,
                        a10 = j * 1/1,
                        a11 = k * 2/1,
```

```
                      a12 = l * 2/1)

end <- mult_cations %>%
  summarise(ave_P = mean(a1),
            ave_Si = mean(a2),
            ave_Ti = mean(a3),
            ave_Al = mean(a4),
            ave_Cr = mean(a5),
            ave_Mg = mean(a6),
            ave_Ca = mean(a7),
            ave_Mn = mean(a8),
            ave_Fe = mean(a9),
            ave_Ni = mean(a10),
            ave_Na = mean(a11),
            ave_K = mean(a12)
            )

show_tbl_3 <- knitr::kable(end)
show_tbl_3
```

ave_P	ave_Si	ave_Ti	ave_Al	ave_Cr	ave_Mg	ave_Ca	ave_Mn	ave_Fe	ave_Ni	ave_Na	ave_K
0	1.920044	0.0161248	0.2937758	0.0318024	0.7901361	0.6697853	0.0034842	0.1302866	0	0.0909568	0.1808839

Ternary of CPX only

```
MgO_num <- mutate(M5_DE_all_CPX_KBH_94_23, mg_dat = MgO/40.304,# Change file here too
                  fe_dat = FeO/71.844,
                  ca_dat = CaO/56.077,
                  Mg = (mg_dat/(mg_dat+fe_dat+ca_dat))*100,
                  Fe = (fe_dat/(mg_dat+fe_dat+ca_dat))*100,
                  Ca = (ca_dat/(mg_dat+fe_dat+ca_dat))*100
                  )

  tern <- ggtern(data = MgO_num, aes(x = Mg,
                           y = Ca,
                           z = Fe)) +
  geom_point()+
    labs(title = "CPX")+
    theme_bw()

  tern
```

CPX