Costa Rican Glass Compositions

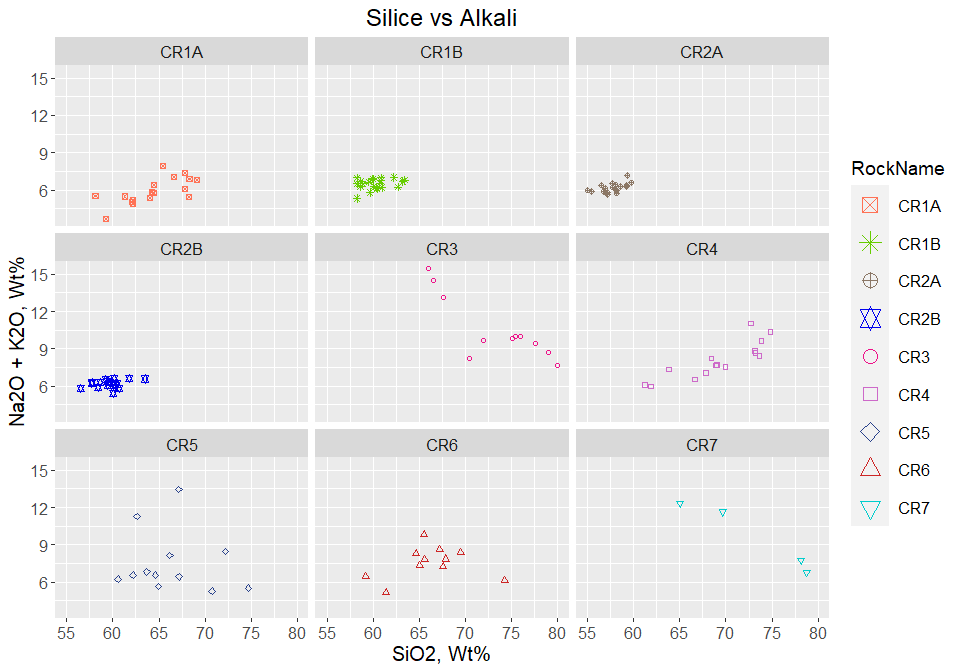
Julie M. Coulombe

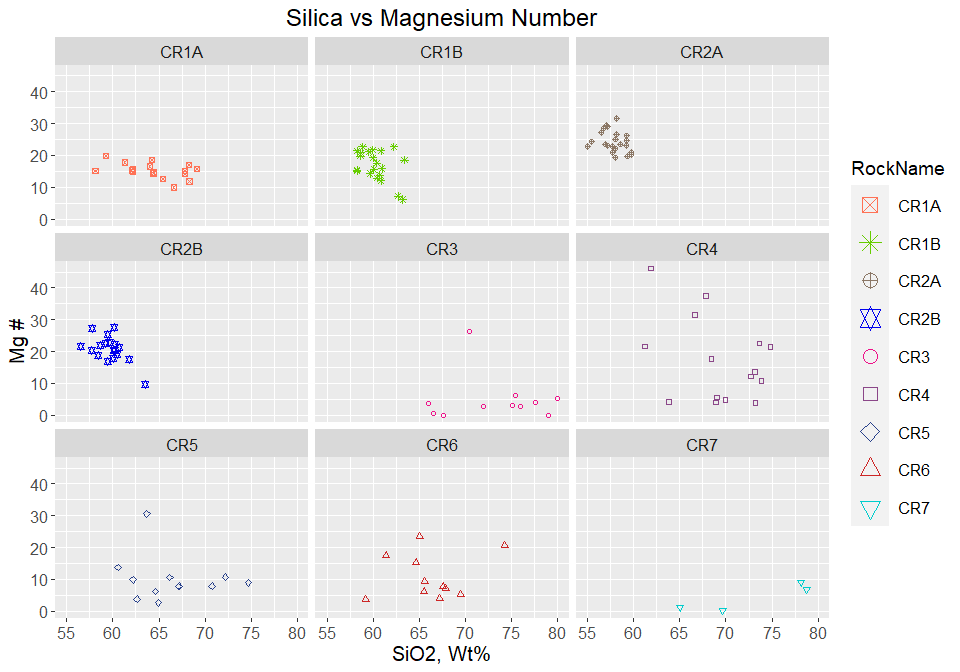
August 31, 2020

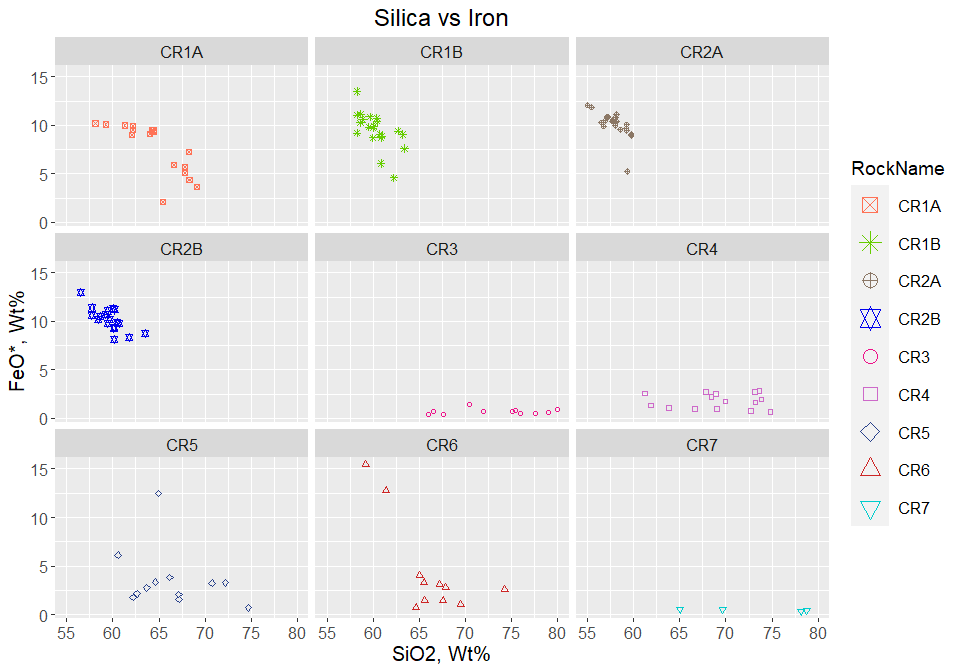
An analysis of volcanic glass sampled from the Tajo La Florida quarry at Barva Volcano in Costa Rica. Samples collected are from potentially different lava flows. Data was acquired by using an electron microprobe.

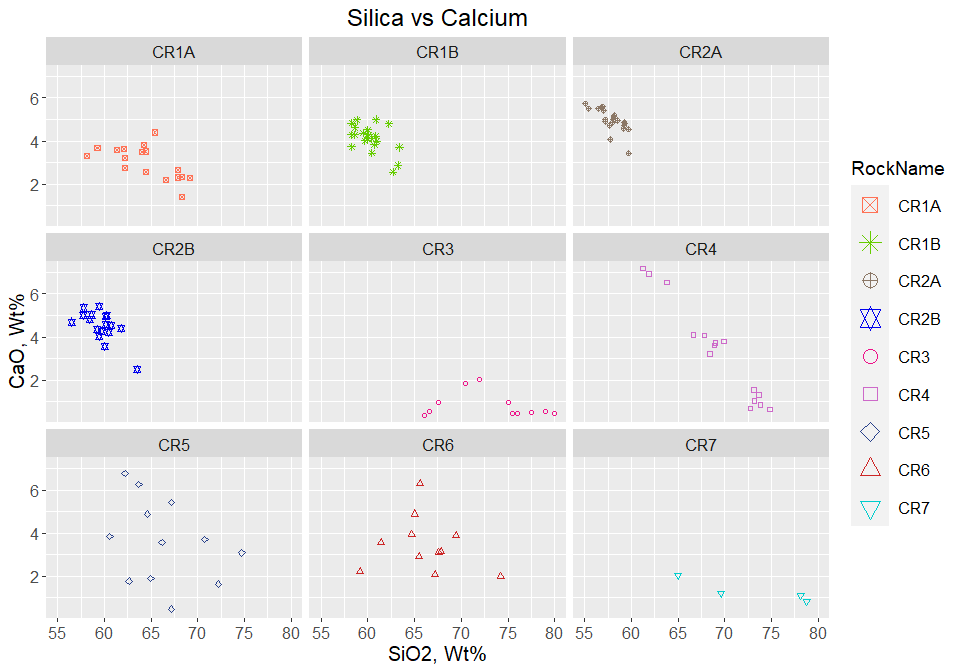
Data points were constrained as follows:

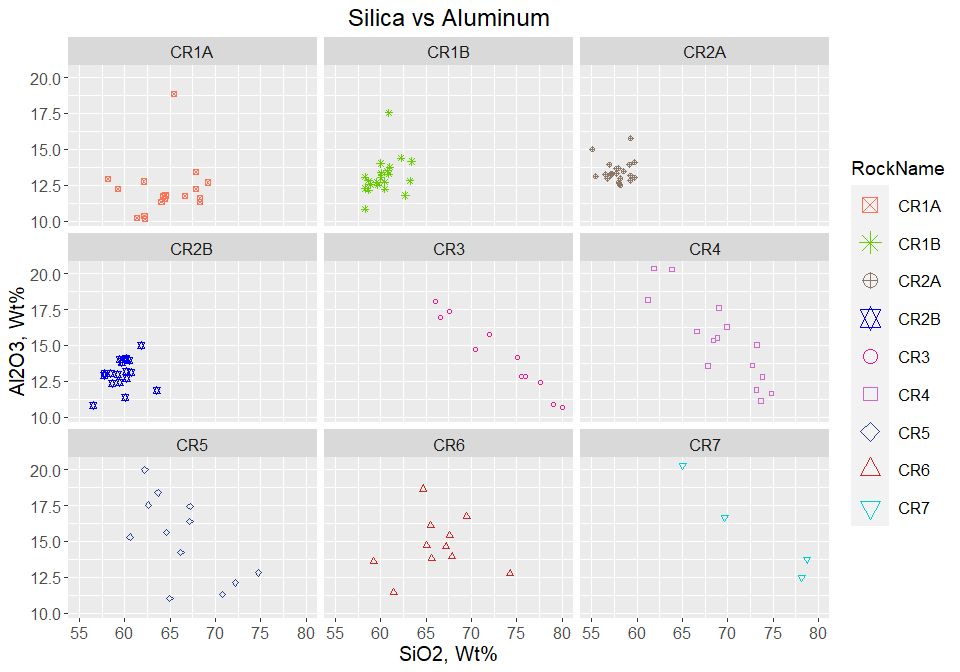
Wt% Totals > 95.0 and < 101.0  
SiO2 < 90.0 and > 40.0 Al2O3 > 9.0 and < 22.0  
K2O > 1.0

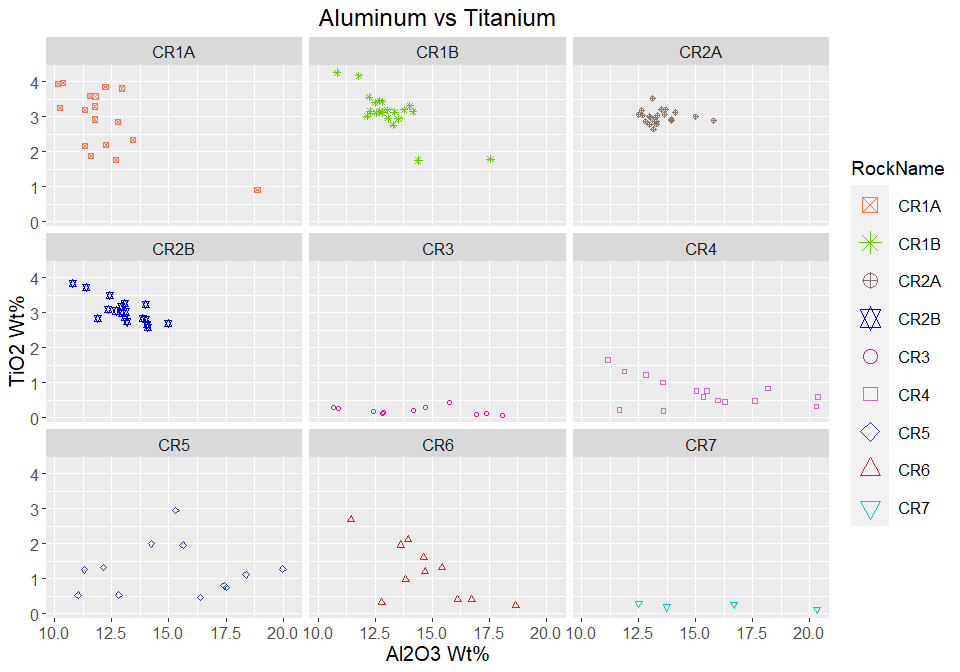




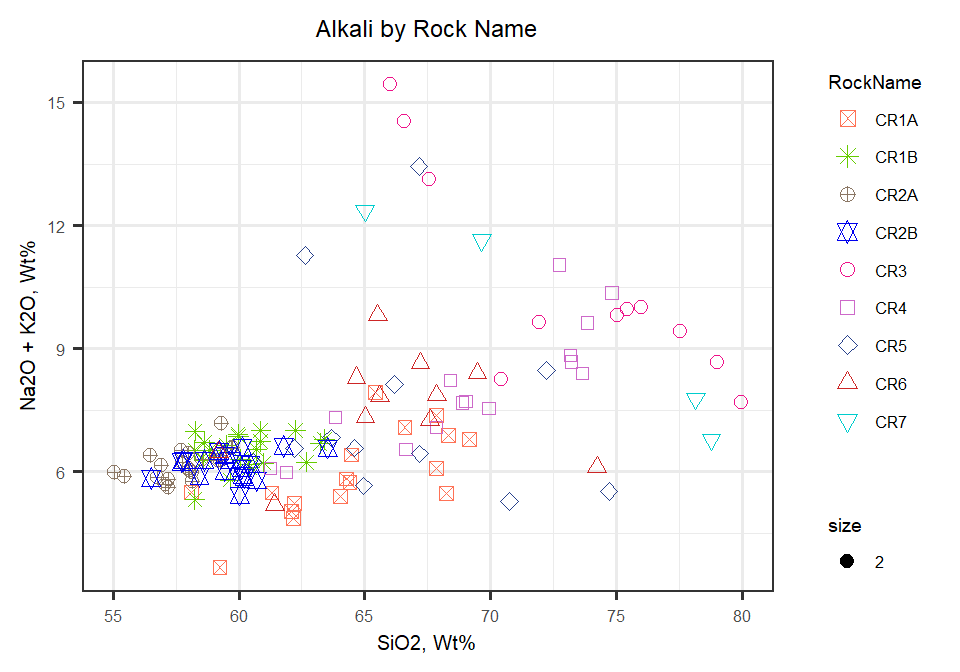


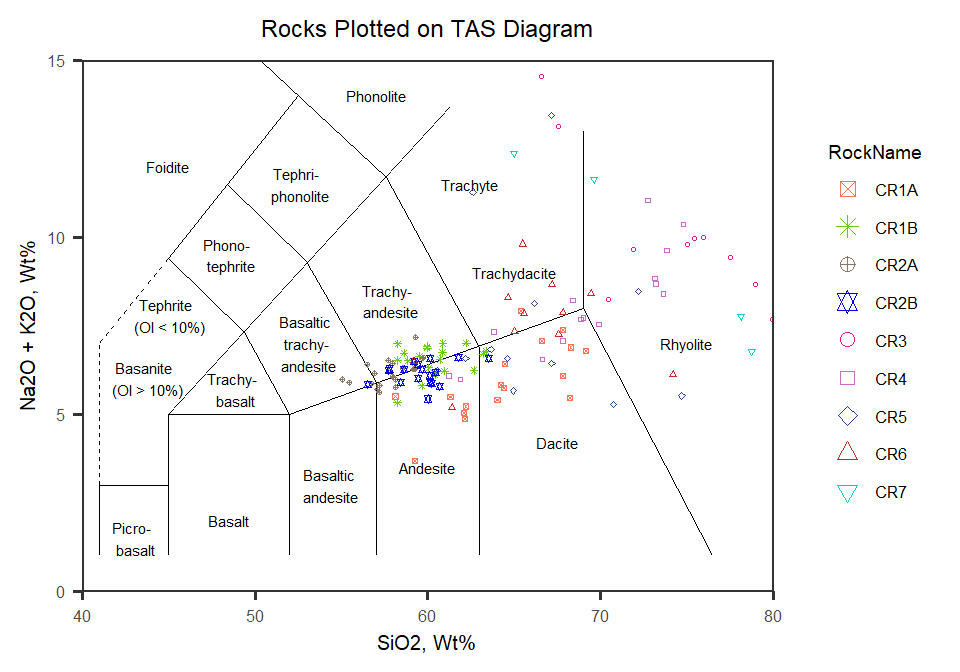




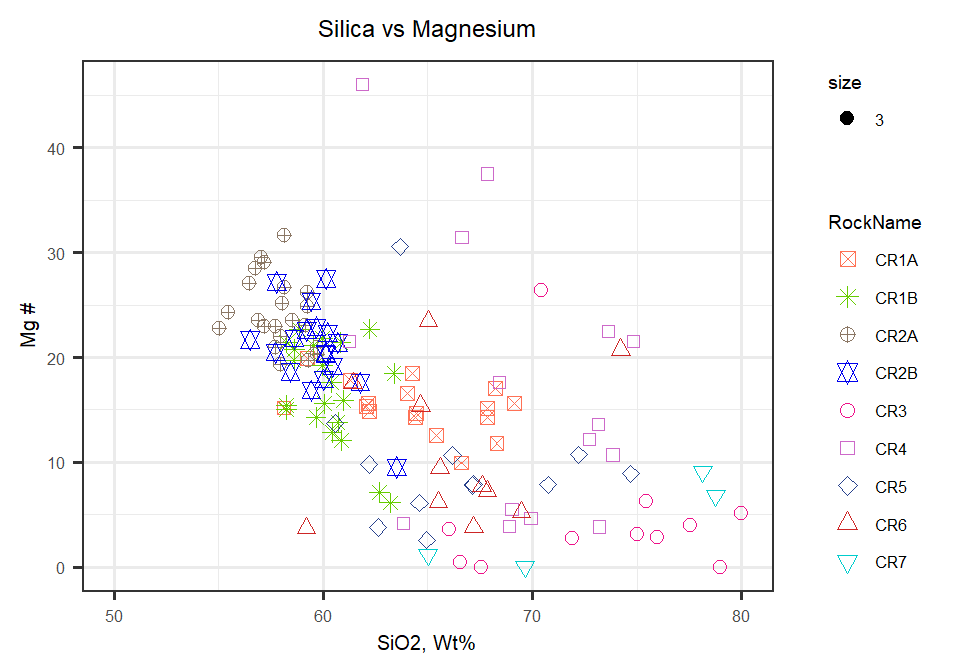


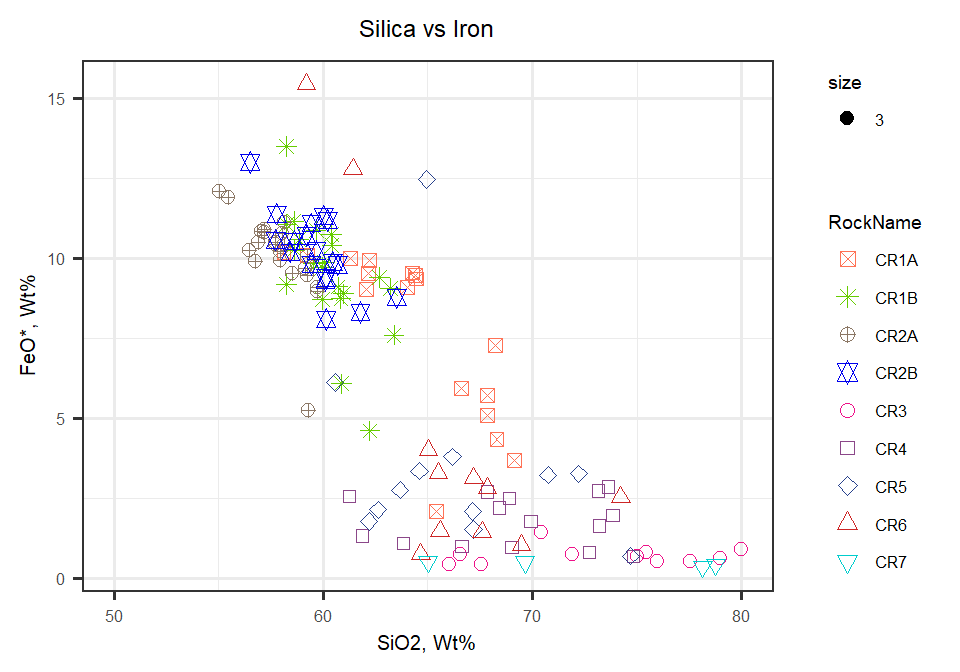
Plot Alkali by Rock Name

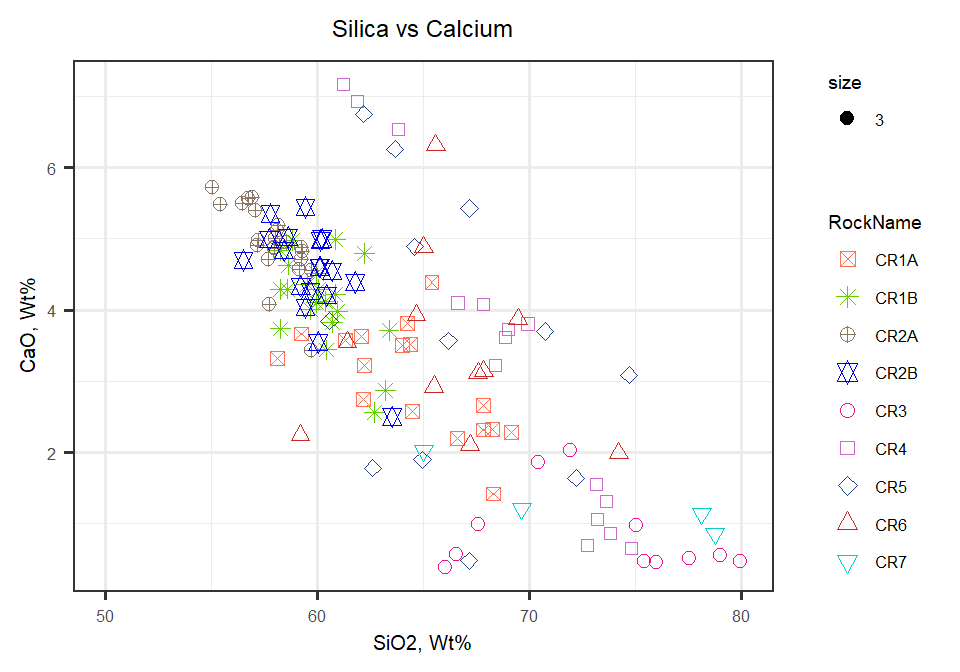


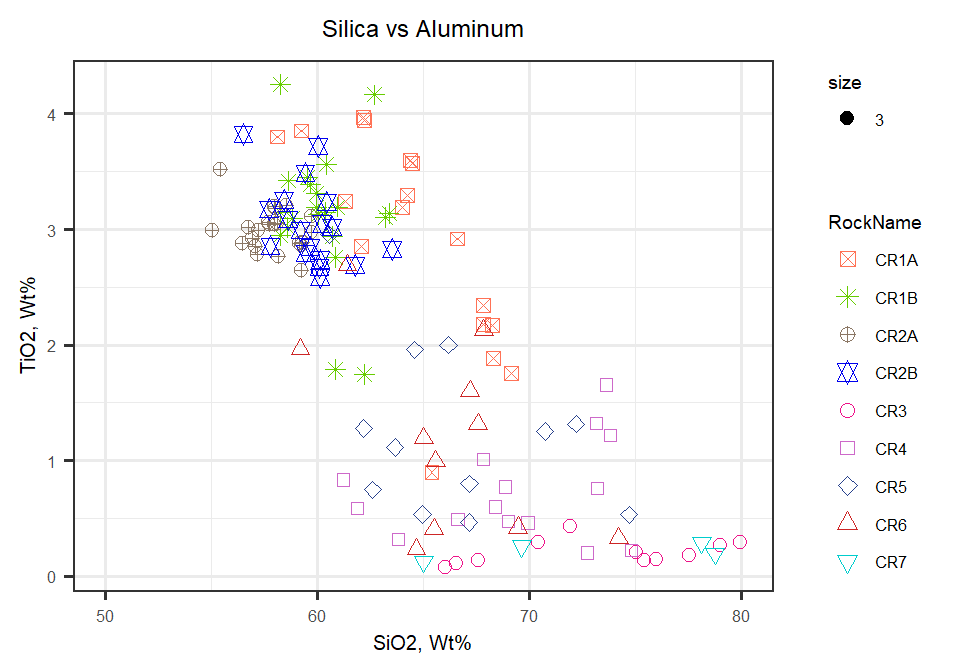


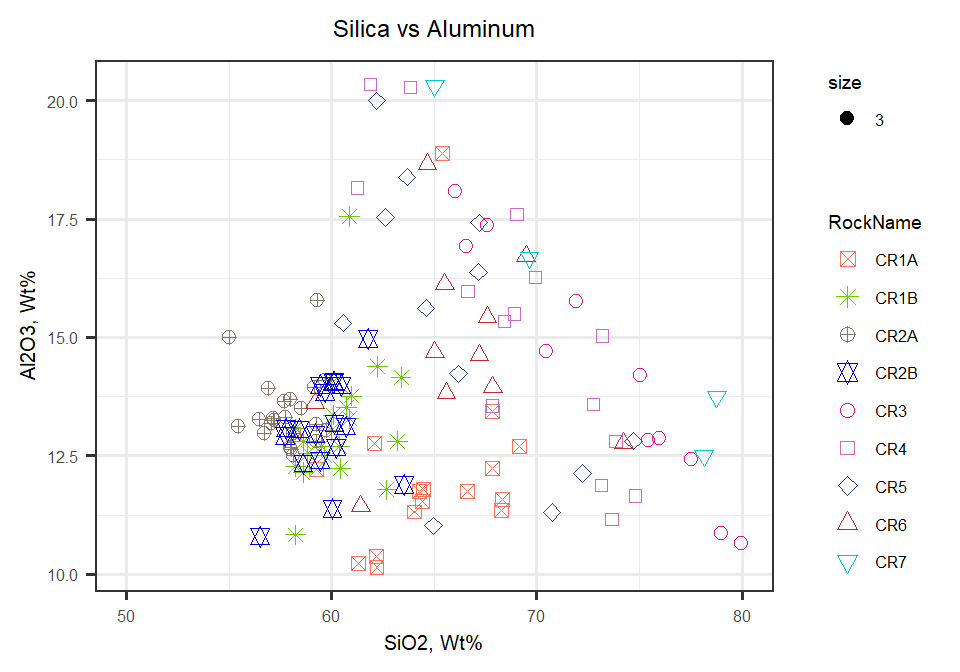
Now to look at plots of all rocks together

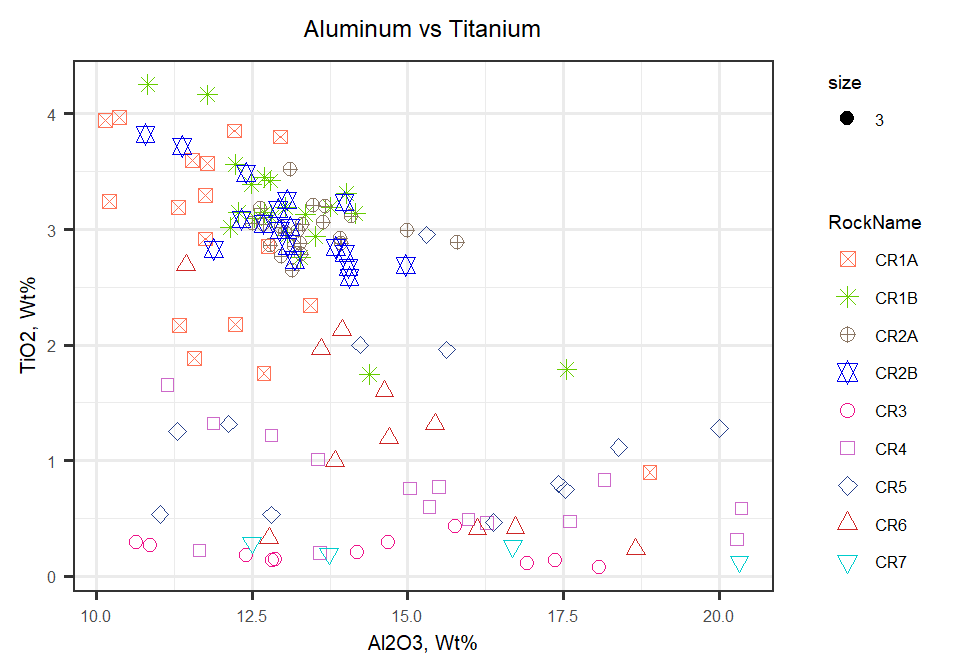


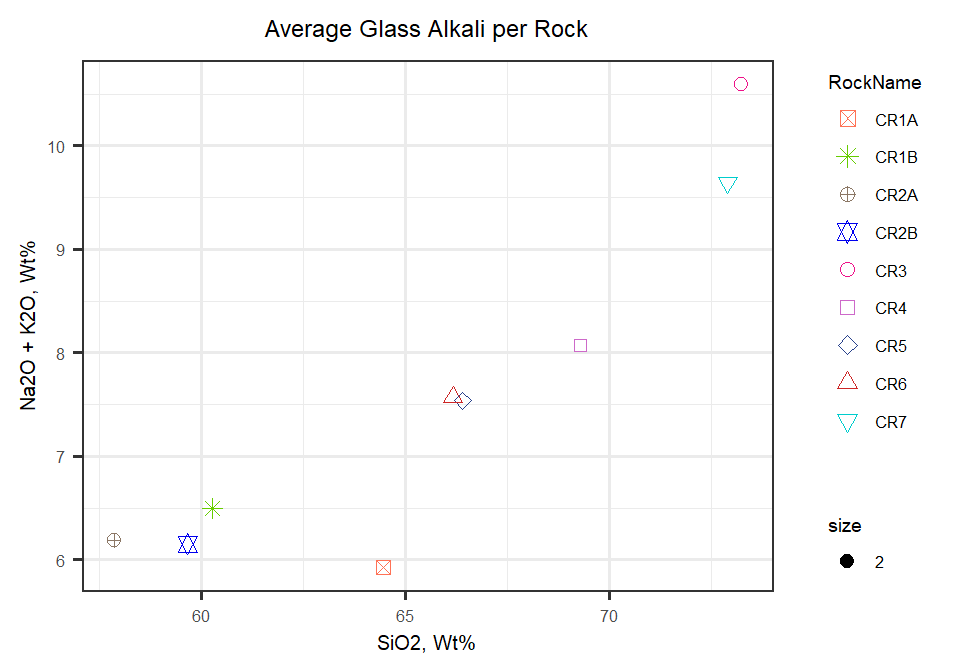


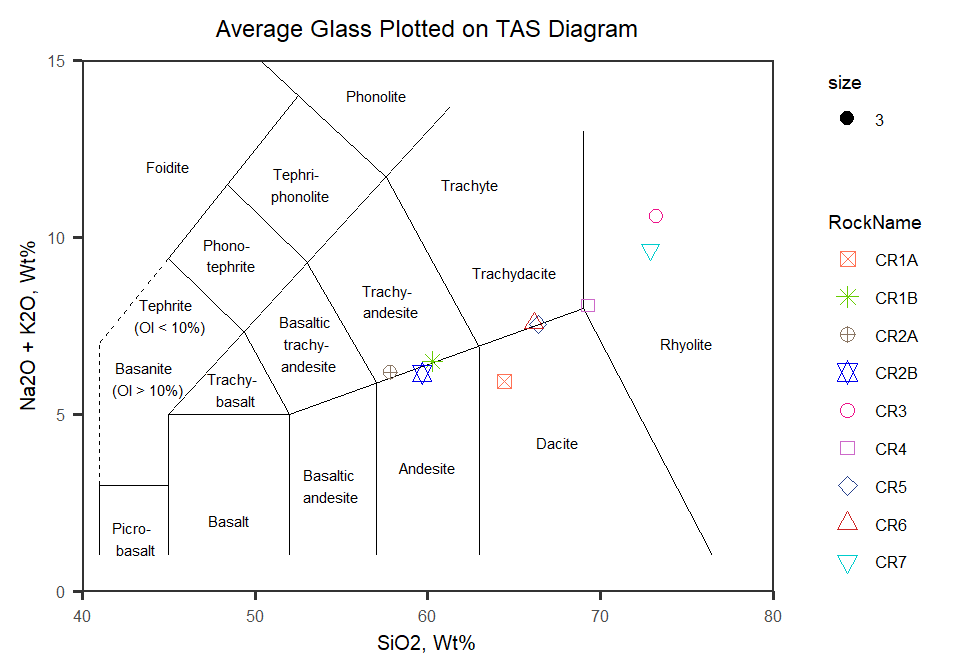


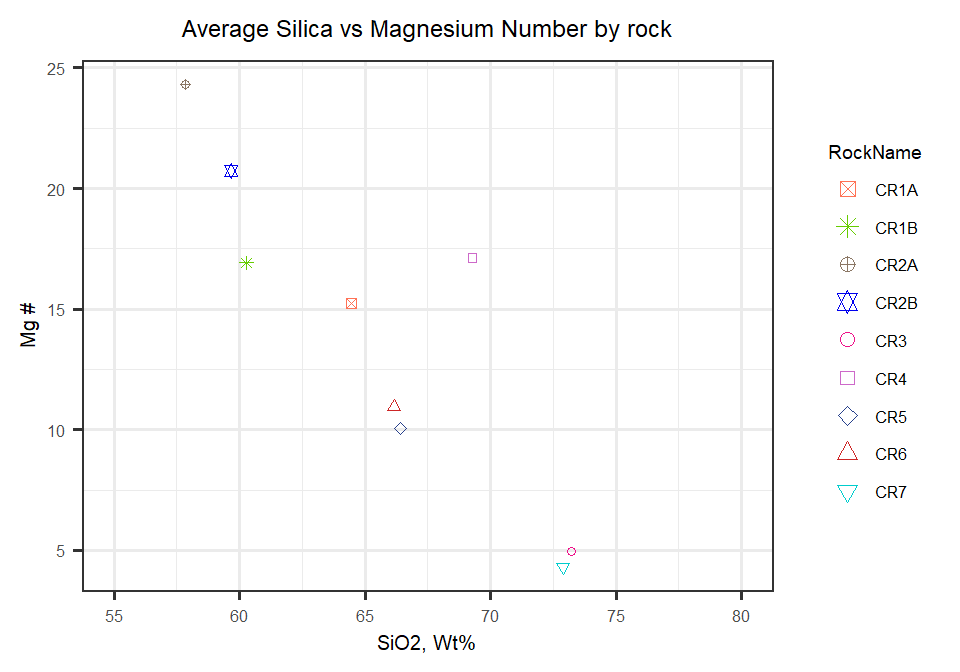


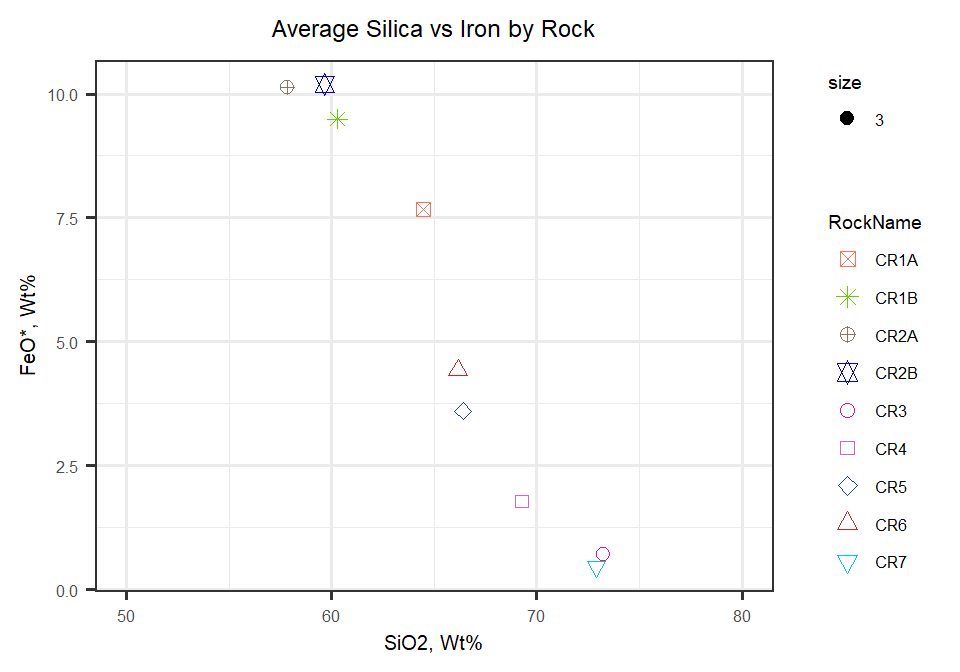


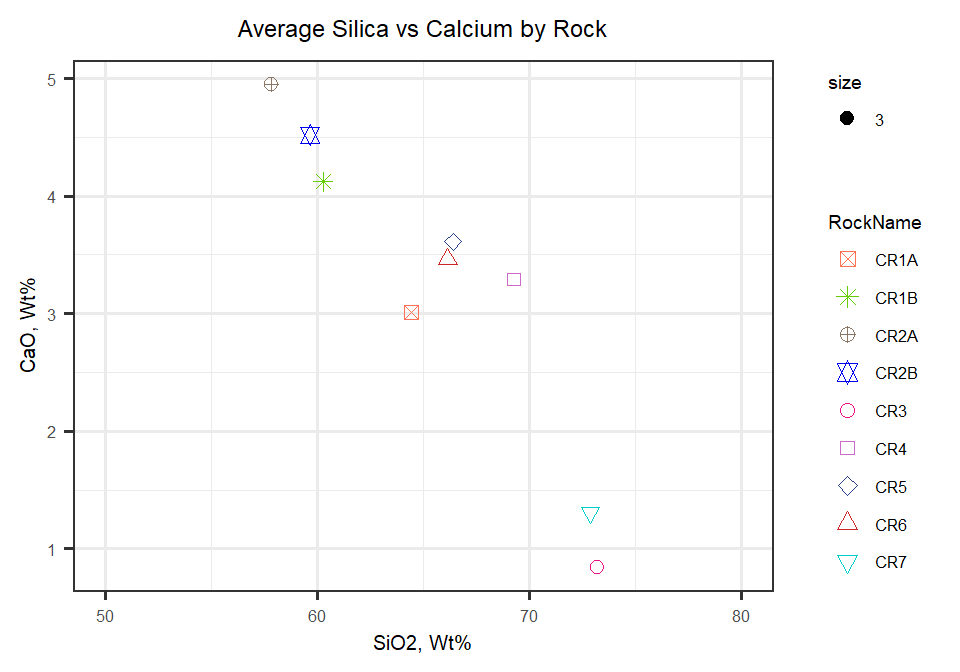


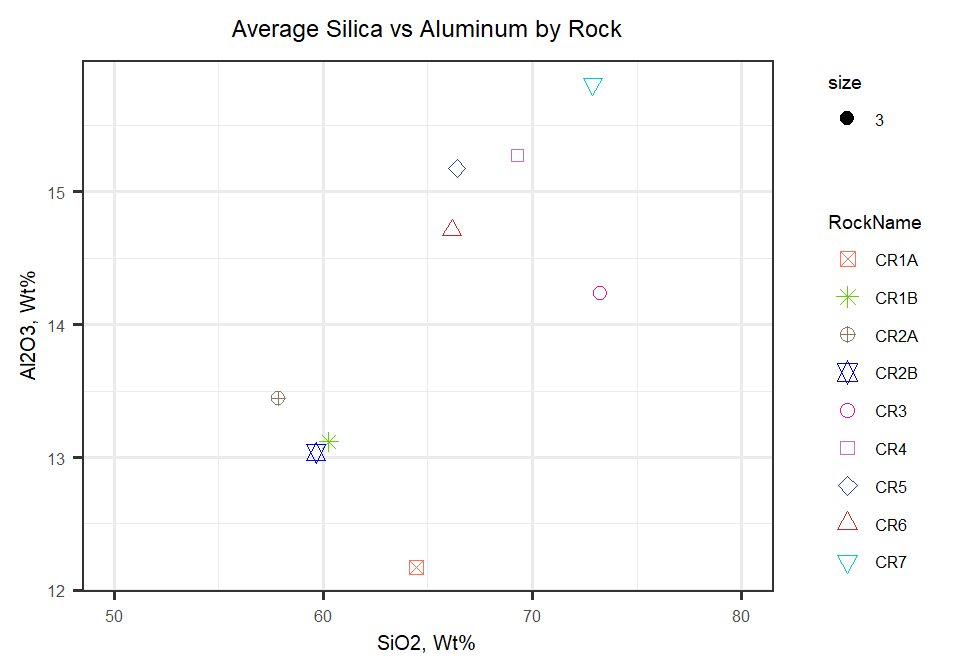












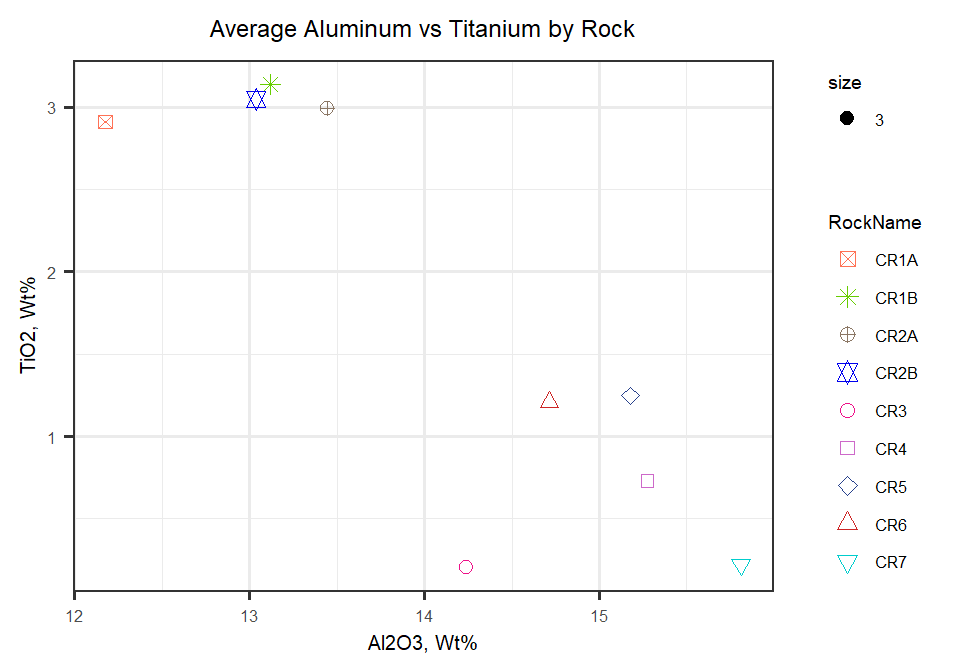


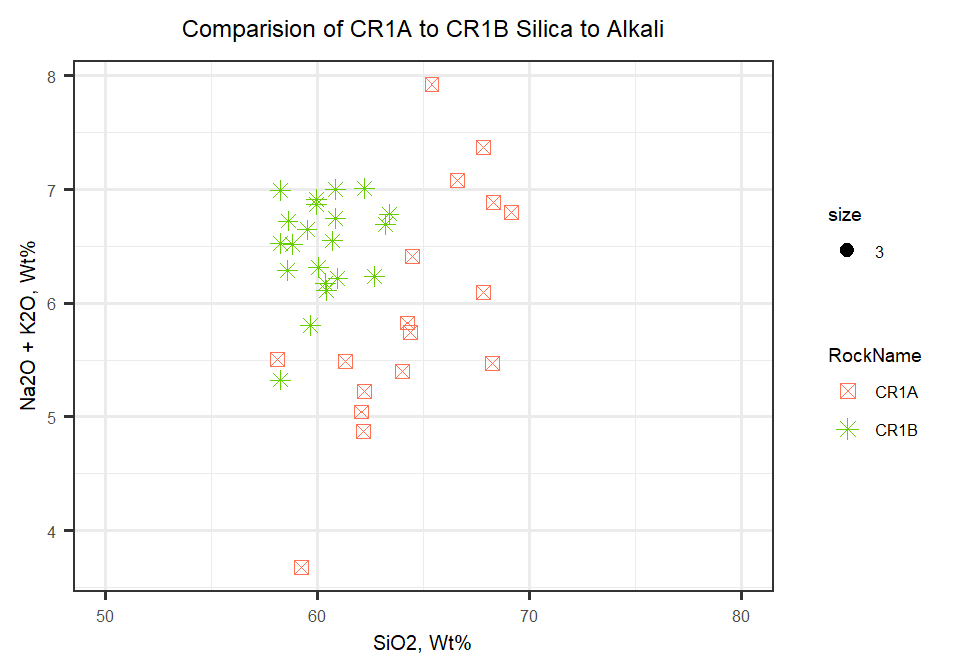
Table laying out representative glass samples

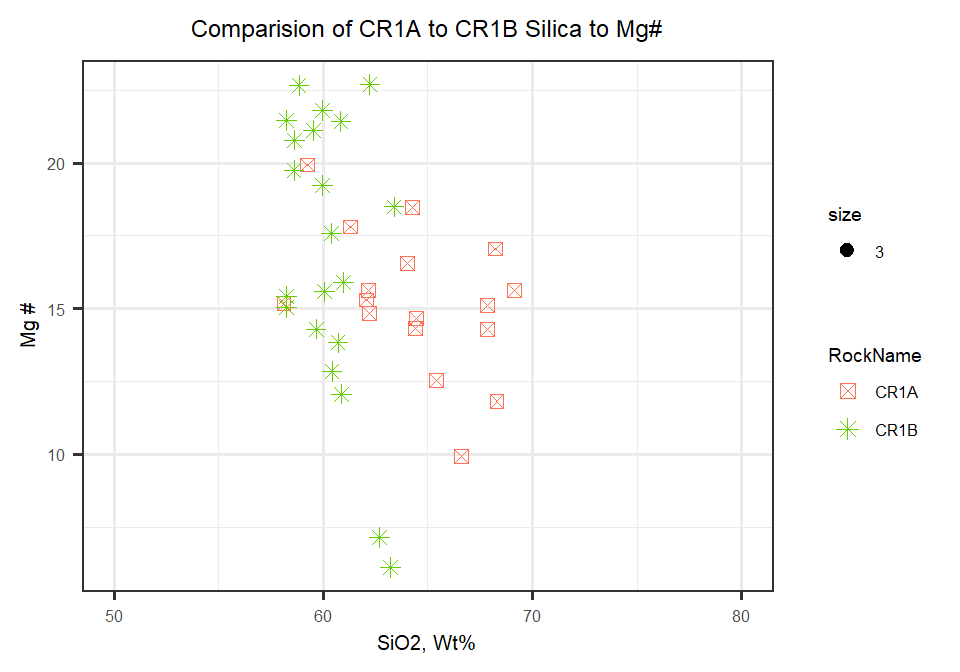
|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **wt %** | **CR1A2\_2 Pt1** | **CR1B\_1 Pt15** | **CR2A2\_3 PT1** | **CR2B2\_1 PT2** | **CR31\_3 PT7** | **CR42\_1 PT6** | **CR51\_2 PT5** | **CR72\_3 Pt1** |
| SiO2 | 64.5 | 60.4 | 59.2 | 59.7 | 71.9 | 69 | 66.2 | 69.6 |
| TiO2 | 3.57 | 3.15 | 2.87 | 2.84 | 0.43 | 0.473 | 2 | 0.26 |
| Al2O3 | 11.8 | 12.7 | 12.8 | 13.8 | 15.8 | 17.6 | 14.2 | 16.7 |
| Cr2O3 | 0.0336 | 0.0312 | 0 | 0 | 0 | 0.0078 | 0.0106 | 0.037 |
| MgO | 0.901 | 1.29 | 1.86 | 1.7 | 0.0119 | 0.0313 | 0.254 | 0.0002 |
| CaO | 2.57 | 4.12 | 4.71 | 4.26 | 2.03 | 3.73 | 3.57 | 1.21 |
| MnO | 0.154 | 0.125 | 0.117 | 0.151 | 0 | 0.0008 | 0.0356 | 0.003 |
| FeO | 9.36 | 10.8 | 10 | 10.2 | 0.741 | 0.954 | 3.8 | 0.503 |
| Na2O | 2.22 | 3.02 | 3.23 | 3.86 | 4.66 | 3.35 | 2.42 | 4.7 |
| K2O | 4.19 | 3.15 | 3.17 | 2.41 | 4.99 | 4.38 | 5.71 | 6.94 |
| S | 0 | 0.0067 | 0.0116 | 0.0021 | 0.0109 | 0.0207 | 0.0068 | 0.0163 |
| P2O5 | 1.13 | 0.889 | 0.663 | 0.735 | 0.118 | 0.0725 | 1.77 | 0.0859 |
| Total | 100 | 99.6 | 98.7 | 99.7 | 101 | 99.6 | 100 | 100 |

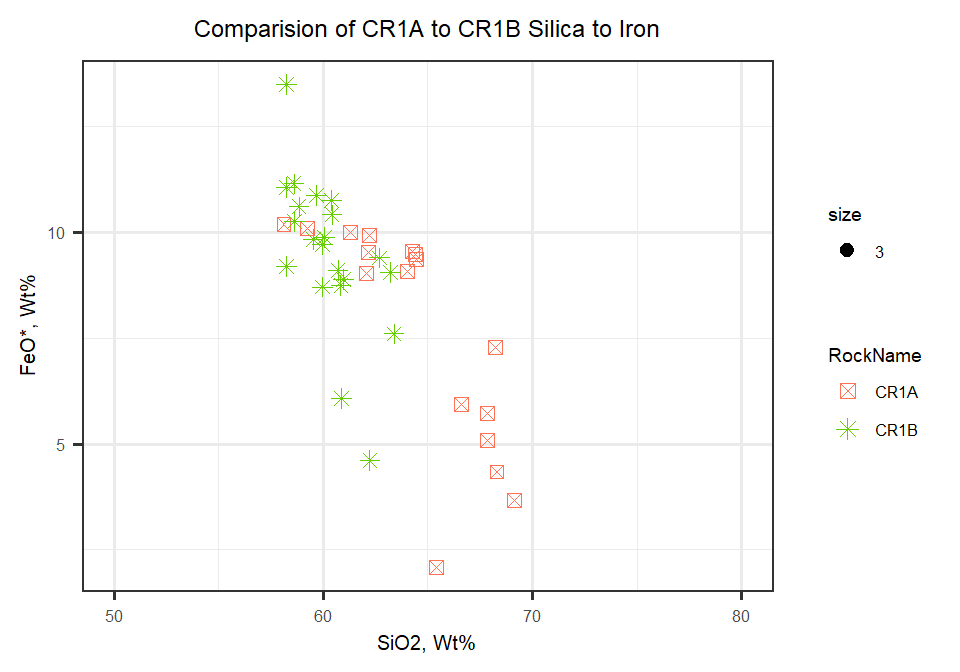
Table showing glass averages

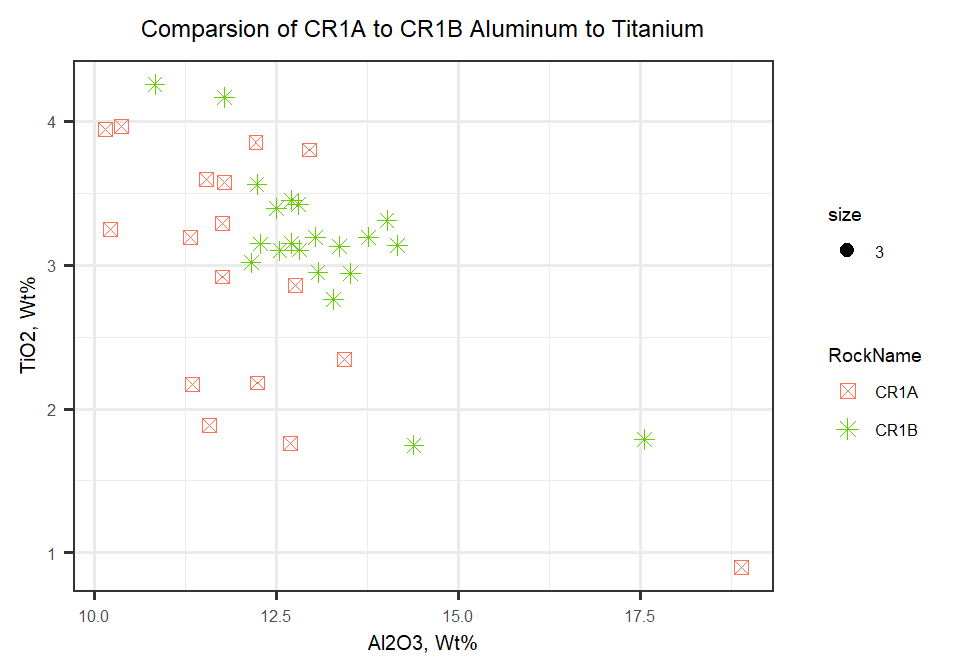
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## [1] 64.45433  
##   
## [[1]]$`SiO2 sd`  
## [1] 3.290488  
##   
## [[1]]$`TiO2 m`  
## [1] 2.910218  
##   
## [[1]]$`TiO2 sd`  
## [1] 0.8986779  
##   
## [[1]]$`Al2O3 m`  
## [1] 12.17435  
##   
## [[1]]$`Al2O3 sd`  
## [1] 1.963957  
##   
## [[1]]$`Cr m`  
## [1] 0.007735294  
##   
## [[1]]$`CR sd`  
## [1] 0.01160635  
##   
## [[1]]$`MgO m`  
## [1] 0.8038529  
##   
## [[1]]$`MgO sd`  
## [1] 0.3578373  
##   
## [[1]]$`CaO m`  
## [1] 3.008994  
##   
## [[1]]$`CaO sd`  
## [1] 0.7657281  
##   
## [[1]]$`MnO m`  
## [1] 0.1272353  
##   
## [[1]]$`MnO sd`  
## [1] 0.04315827  
##   
## [[1]]$`FeO m`  
## [1] 7.666929  
##   
## [[1]]$`FeO sd`  
## [1] 2.638125  
##   
## [[1]]$`Na2O m`  
## [1] 2.627912  
##   
## [[1]]$`Na2O sd`  
## [1] 1.155817  
##   
## [[1]]$`K2O m`  
## [1] 3.301482  
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## [[1]]$`K2O sd`  
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## [[1]]$`S m`  
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## [[1]]$`S sd`  
## [1] 0.006174467  
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## [[2]]$`MnO sd`  
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## [[2]]$`FeO m`  
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## [[2]]$`P2O5 sd`  
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## [[2]]$`MgN m`  
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## [[2]]$`MgN sd`  
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##   
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## [[2]]$`Total sd`  
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##   
##   
## [[3]]  
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## [[3]]$`SiO2 sd`  
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## [[3]]$`TiO2 m`  
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##   
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## [[3]]$`Cr m`  
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##   
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##   
## [[3]]$`MnO sd`  
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## [[3]]$`K2O sd`  
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## [[3]]$`S sd`  
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## [[3]]$`P2O5 sd`  
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## [[3]]$`MgN sd`  
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## [[3]]$`Total sd`  
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## [[4]]  
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## [[4]]$`CaO sd`  
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## [[4]]$`MnO sd`  
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## [[4]]$`Total sd`  
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##   
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## [[5]]$`Al2O3 sd`  
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##   
## [[5]]$`Cr m`  
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##   
## [[5]]$`CR sd`  
## [1] 0.01228933  
##   
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## [1] 0.03642727  
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##   
## [[5]]$`CaO m`  
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## [[5]]$`CaO sd`  
## [1] 0.581086  
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## [[5]]$`MnO sd`  
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## [[5]]$`FeO m`  
## [1] 0.7147636  
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## [[5]]$`FeO sd`  
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## [[5]]$`K2O sd`  
## [1] 2.962089  
##   
## [[5]]$`S m`  
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## [[5]]$`MgN sd`  
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##   
## [[6]]  
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## [[6]]$`TiO2 sd`  
## [1] 0.4206567  
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## [[6]]$`Al2O3 sd`  
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##   
## [[6]]$`Cr m`  
## [1] 0.00804  
##   
## [[6]]$`CR sd`  
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## [[6]]$`MgO m`  
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##   
## [[6]]$`MgO sd`  
## [1] 0.2592515  
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## [[6]]$`CaO m`  
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##   
## [[6]]$`CaO sd`  
## [1] 2.271397  
##   
## [[6]]$`MnO m`  
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##   
## [[6]]$`MnO sd`  
## [1] 0.0255495  
##   
## [[6]]$`FeO m`  
## [1] 1.784167  
##   
## [[6]]$`FeO sd`  
## [1] 0.7747708  
##   
## [[6]]$`Na2O m`  
## [1] 3.083993  
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## [[6]]$`Na2O sd`  
## [1] 1.173769  
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## [[6]]$`K2O m`  
## [1] 4.989747  
##   
## [[6]]$`K2O sd`  
## [1] 2.495419  
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## [[6]]$`S m`  
## [1] 0.01023333  
##   
## [[6]]$`S sd`  
## [1] 0.01008568  
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## [1] 17.11348  
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## [[6]]$`MgN sd`  
## [1] 13.12573  
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## [1] 99.15493  
##   
## [[6]]$`Total sd`  
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##   
##   
## [[7]]  
## [[7]]$n  
## [1] 12  
##   
## [[7]]$`SiO2 m`  
## [1] 66.40144  
##   
## [[7]]$`SiO2 sd`  
## [1] 4.282366  
##   
## [[7]]$`TiO2 m`  
## [1] 1.247217  
##   
## [[7]]$`TiO2 sd`  
## [1] 0.7438442  
##   
## [[7]]$`Al2O3 m`  
## [1] 15.17747  
##   
## [[7]]$`Al2O3 sd`  
## [1] 2.919962  
##   
## [[7]]$`Cr m`  
## [1] 0.006675  
##   
## [[7]]$`CR sd`  
## [1] 0.01259821  
##   
## [[7]]$`MgO m`  
## [1] 0.2106583  
##   
## [[7]]$`MgO sd`  
## [1] 0.2008231  
##   
## [[7]]$`CaO m`  
## [1] 3.611117  
##   
## [[7]]$`CaO sd`  
## [1] 1.957575  
##   
## [[7]]$`MnO m`  
## [1] 0.02691667  
##   
## [[7]]$`MnO sd`  
## [1] 0.01982436  
##   
## [[7]]$`FeO m`  
## [1] 3.599592  
##   
## [[7]]$`FeO sd`  
## [1] 3.11314  
##   
## [[7]]$`Na2O m`  
## [1] 3.495275  
##   
## [[7]]$`Na2O sd`  
## [1] 1.029641  
##   
## [[7]]$`K2O m`  
## [1] 4.041175  
##   
## [[7]]$`K2O sd`  
## [1] 3.021635  
##   
## [[7]]$`S m`  
## [1] 0.00725  
##   
## [[7]]$`S sd`  
## [1] 0.006086274  
##   
## [[7]]$`P2O5 m`  
## [1] 0.8809583  
##   
## [[7]]$`P2O5 sd`  
## [1] 0.4592443  
##   
## [[7]]$`MgN m`  
## [1] 10.0337  
##   
## [[7]]$`MgN sd`  
## [1] 7.145318  
##   
## [[7]]$`Total m`  
## [1] 98.70577  
##   
## [[7]]$`Total sd`  
## [1] 1.525565  
##   
##   
## [[8]]  
## [[8]]$n  
## [1] 11  
##   
## [[8]]$`SiO2 m`  
## [1] 66.16332  
##   
## [[8]]$`SiO2 sd`  
## [1] 3.965378  
##   
## [[8]]$`TiO2 m`  
## [1] 1.2088  
##   
## [[8]]$`TiO2 sd`  
## [1] 0.8253154  
##   
## [[8]]$`Al2O3 m`  
## [1] 14.7146  
##   
## [[8]]$`Al2O3 sd`  
## [1] 1.978333  
##   
## [[8]]$`Cr m`  
## [1] 0.01233636  
##   
## [[8]]$`CR sd`  
## [1] 0.01273501  
##   
## [[8]]$`MgO m`  
## [1] 0.3176364  
##   
## [[8]]$`MgO sd`  
## [1] 0.4455244  
##   
## [[8]]$`CaO m`  
## [1] 3.462109  
##   
## [[8]]$`CaO sd`  
## [1] 1.288545  
##   
## [[8]]$`MnO m`  
## [1] 0.04826364  
##   
## [[8]]$`MnO sd`  
## [1] 0.05612009  
##   
## [[8]]$`FeO m`  
## [1] 4.426818  
##   
## [[8]]$`FeO sd`  
## [1] 4.929057  
##   
## [[8]]$`Na2O m`  
## [1] 3.208118  
##   
## [[8]]$`Na2O sd`  
## [1] 0.7205093  
##   
## [[8]]$`K2O m`  
## [1] 4.362755  
##   
## [[8]]$`K2O sd`  
## [1] 1.432639  
##   
## [[8]]$`S m`  
## [1] 0.007136364  
##   
## [[8]]$`S sd`  
## [1] 0.009010913  
##   
## [[8]]$`P2O5 m`  
## [1] 0.7787091  
##   
## [[8]]$`P2O5 sd`  
## [1] 0.5911652  
##   
## [[8]]$`MgN m`  
## [1] 10.95463  
##   
## [[8]]$`MgN sd`  
## [1] 7.078747  
##   
## [[8]]$`Total m`  
## [1] 98.71055  
##   
## [[8]]$`Total sd`  
## [1] 1.246528  
##   
##   
## [[9]]  
## [[9]]$n  
## [1] 4  
##   
## [[9]]$`SiO2 m`  
## [1] 72.89522  
##   
## [[9]]$`SiO2 sd`  
## [1] 6.70111  
##   
## [[9]]$`TiO2 m`  
## [1] 0.219025  
##   
## [[9]]$`TiO2 sd`  
## [1] 0.07151608  
##   
## [[9]]$`Al2O3 m`  
## [1] 15.8101  
##   
## [[9]]$`Al2O3 sd`  
## [1] 3.48115  
##   
## [[9]]$`Cr m`  
## [1] 0.017375  
##   
## [[9]]$`CR sd`  
## [1] 0.01571165  
##   
## [[9]]$`MgO m`  
## [1] 0.010275  
##   
## [[9]]$`MgO sd`  
## [1] 0.009800468  
##   
## [[9]]$`CaO m`  
## [1] 1.30625  
##   
## [[9]]$`CaO sd`  
## [1] 0.5035083  
##   
## [[9]]$`MnO m`  
## [1] 0.0144  
##   
## [[9]]$`MnO sd`  
## [1] 0.0229312  
##   
## [[9]]$`FeO m`  
## [1] 0.451425  
##   
## [[9]]$`FeO sd`  
## [1] 0.0788229  
##   
## [[9]]$`Na2O m`  
## [1] 4.434725  
##   
## [[9]]$`Na2O sd`  
## [1] 1.386593  
##   
## [[9]]$`K2O m`  
## [1] 5.2074  
##   
## [[9]]$`K2O sd`  
## [1] 1.567286  
##   
## [[9]]$`S m`  
## [1] 0.01005  
##   
## [[9]]$`S sd`  
## [1] 0.01060519  
##   
## [[9]]$`P2O5 m`  
## [1] 0.0341  
##   
## [[9]]$`P2O5 sd`  
## [1] 0.03524817  
##   
## [[9]]$`MgN m`  
## [1] 4.300101  
##   
## [[9]]$`MgN sd`  
## [1] 4.35584  
##   
## [[9]]$`Total m`  
## [1] 100.4104  
##   
## [[9]]$`Total sd`  
## [1] 0.3165144

Taking a look at comparing CR1A to CR1B (two samples from the same flow)









Taking a look at comparing CR2A to CR2B

