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title: "Costa Rican Glass Compositions"

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output:

html\_document:

df\_print: paged

word\_document: default

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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.

```{r setup, include=FALSE}

knitr::opts\_chunk$set(echo = TRUE, warning = FALSE)

cr\_data <- read.csv("data/wt%\_probe\_data.csv")

library(dbplyr)

library(tidyverse)

library(tinytex)

library(huxtable)

library(flextable)

library(kableExtra)

```

```{r selection, include=FALSE}

rock\_cr1a <- cr\_data %>%

filter(grepl("CR1A", cr\_data$Comment)) %>%

mutate("RockName" = "CR1A")

rock\_cr1b <- cr\_data %>%

filter(grepl("CR1B", cr\_data$Comment)) %>%

mutate("RockName" = "CR1B")

rock\_cr2a <- cr\_data %>%

filter(grepl("CR2A", cr\_data$Comment)) %>%

mutate("RockName" = "CR2A")

rock\_cr2b <- cr\_data %>%

filter(grepl("CR2B", cr\_data$Comment)) %>%

mutate("RockName" = "CR2B")

rock\_cr3 <- cr\_data %>%

filter(grepl("CR3", cr\_data$Comment)) %>%

mutate("RockName" = "CR3")

rock\_cr4 <- cr\_data %>%

filter(grepl("CR4", cr\_data$Comment)) %>%

mutate("RockName" = "CR4")

rock\_cr5 <- cr\_data %>%

filter(grepl("CR5", cr\_data$Comment)) %>%

mutate("RockName" = "CR5")

rock\_cr7 <- cr\_data %>%

filter(grepl("CR7", cr\_data$Comment)) %>%

mutate("RockName" = "CR7")

rock\_data <- rbind(rock\_cr1a, rock\_cr1b, rock\_cr2a, rock\_cr2b, rock\_cr3, rock\_cr4, rock\_cr5, rock\_cr7)

rock\_data <- rock\_data[,c(30, 24, 2:16)]

rock\_data <- rock\_data %>%

mutate("MgN" = ((MgO / (40.31)) / ((MgO / (40.31)) + (FeO / (71.85)))) \* (100))

rock\_data$RockName <- as.factor(rock\_data$RockName)

```

Data points were constrained as follows:

Wt% Totals > 95.0 and < 101.0

SiO2 < 90.0

Al2O3 > 10.0 and < 22.0

K2O > 1.0

```{r data constraints, include = FALSE}

rock\_data[rock\_data == ""] <- NA

rock\_data\_wt <- rock\_data %>%

select("RockName":"Total", "MgN") %>% #choose relevant columns

filter(Total > 95.0 & Total < 101.0) %>% #select rows based on Total

filter(is.na(V2O3) & SiO2 < 90.0 & Al2O3 < 22.0 & Al2O3 > 10 & K2O > 1.0) #select rows based on elements

```

Create plot for SiO2 vs Na2O + K2O by each rock

```{r silica vs alkali, echo = FALSE, fig.dim = c(10,7)}

alkali\_plot <- ggplot(rock\_data\_wt, aes(x = SiO2, y = Na2O + K2O)) +

facet\_wrap(vars(RockName)) +

geom\_point(aes(shape = RockName, color = RockName)) +

scale\_shape\_manual(values = c(7, 8, 21:25, 10)) +

scale\_color\_manual(values = c("coral1", "chartreuse3", "turquoise3", "blue2", "deeppink2", "orchid1", "seagreen3", "firebrick3")) +

guides(color = guide\_legend(override.aes = list(size = 5))) +

theme(text = element\_text(size = 15),

legend.key.size = unit(1.0, "cm"),

legend.title = element\_text(size = 14))

alkali\_plot

```

Create plot for SiO2 vs Mg# by each rock

```{r si vs mg all, echo = FALSE, fig.dim = c(10,7)}

mg\_plot\_all <- ggplot(rock\_data\_wt, aes(x = SiO2, y = MgN)) +

facet\_wrap(vars(RockName)) +

geom\_point(aes(shape = RockName, color = RockName)) +

scale\_shape\_manual(values = c(7, 8, 21:25, 10)) +

scale\_color\_manual(values = c("coral1", "chartreuse3", "turquoise3", "blue2", "deeppink2", "orchid1", "seagreen3", "firebrick3")) +

guides(color = guide\_legend(override.aes = list(size = 5))) +

theme(text = element\_text(size = 15),

legend.key.size = unit(1.0, "cm"),

legend.title = element\_text(size = 14))

mg\_plot\_all

```

Create plot for SiO2 vs FeO by each rock

```{r si vs fe all, echo = FALSE, fig.dim = c(10,7)}

fe\_plot\_all <- ggplot(rock\_data\_wt, aes(x = SiO2, y = FeO)) +

facet\_wrap(vars(RockName)) +

geom\_point(aes(shape = RockName, color = RockName)) +

scale\_shape\_manual(values = c(7, 8, 21:25, 10)) +

scale\_color\_manual(values = c("coral1", "chartreuse3", "turquoise3", "blue2", "deeppink2", "orchid1", "seagreen3", "firebrick3")) +

guides(color = guide\_legend(override.aes = list(size = 5))) +

theme(text = element\_text(size = 15),

legend.key.size = unit(1.0, "cm"),

legend.title = element\_text(size = 14))

fe\_plot\_all

```

Create plot for Al2O3 vs TiO by each rock

```{r al vs ti all, echo = FALSE, fig.dim = c(10,7)}

alti\_plot\_all <- ggplot(rock\_data\_wt, aes(x = Al2O3, y = TiO2)) +

facet\_wrap(vars(RockName)) +

geom\_point(aes(shape = RockName, color = RockName)) +

scale\_shape\_manual(values = c(7, 8, 21:25, 10)) +

scale\_color\_manual(values = c("coral1", "chartreuse3", "turquoise3", "blue2", "deeppink2", "orchid1", "seagreen3", "firebrick3")) +

guides(color = guide\_legend(override.aes = list(size = 5))) +

theme(text = element\_text(size = 15),

legend.key.size = unit(1.0, "cm"),

legend.title = element\_text(size = 14))

alti\_plot\_all

```

##Create TAS template

```{r tas template, include = FALSE, fig.dim = c(10,5)}

d = data.frame(x = c(40, 80), y = c(0,15))

theme\_set(theme\_bw(base\_size=28))

#makes the TAS template

p <- ggplot(data=d, mapping=aes(x=x, y=y)) +

geom\_blank() +

theme(panel.grid.major = element\_blank(),

panel.grid.minor = element\_blank()) +

scale\_y\_continuous(limits=c(0,15), expand = c(0, 0)) +

scale\_x\_continuous(limits=c(40,80), expand = c(0, 0)) +

labs(y=expression(Na[2]\*O + K[2]\*O\*~ wt~'%'), x=expression(SiO[2]\*~ wt~'%'))+

annotate("segment", x=45, xend=45, y=1, yend=5)+

annotate("segment", x=45, xend=52, y=5, yend=5)+

annotate("segment", x=52, xend=69, y=5, yend=8)+

annotate("segment", x=76.5, xend=69, y=1, yend=8)+

annotate("segment", x=69, xend=69, y=8, yend=13)+

annotate("segment", x=45, xend=61.32, y=5, yend=13.7)+

annotate("segment", x=52, xend=52, y=1, yend=5)+

annotate("segment", x=57, xend=57, y=1, yend=5.9)+

annotate("segment", x=63, xend=63, y=1, yend=6.9)+

annotate("segment", x=52, xend=49.4, y=5, yend=7.3)+

annotate("segment", x=57, xend=53.05, y=5.9, yend=9.25)+

annotate("segment", x=63, xend=57.6, y=6.9, yend=11.7)+

annotate("segment", x=41, xend=45, y=3, yend=3)+

annotate("segment", x=41, xend=41, y=1, yend=3)+

annotate("segment", x=41, xend=41, y=3, yend=7, linetype="dashed")+

annotate("segment", x=41, xend=45, y=7, yend=9.4, linetype="dashed")+

annotate("segment", x=45, xend=52.5, y=9.4, yend=14)+

annotate("segment", x=49.4, xend=45, y=7.3, yend=9.4)+

annotate("segment", x=53, xend=48.4, y=9.3, yend=11.5)+

annotate("segment", x=57.6, xend=50.3, y=11.7, yend=15)

```

```{r template with labels, echo = FALSE, fig.dim = c(10,5)}

tas <- p + annotate("text", label = "Basalt", x = 48.5, y = 2, size=4)+

annotate("text", label = "Basaltic\n andesite", x = 54.3, y = 3.0, size=4)+

annotate("text", label = "Andesite", x = 60, y = 3.5, size=4)+

annotate("text", label = "Dacite", x = 67.5, y = 4.2, size=4)+

annotate("text", label = "Rhyolite", x = 75, y = 7, size=4)+

annotate("text", label = "Trachy- \n basalt", x = 48.8, y = 5.7, size=4)+

annotate("text", label = "Basaltic \n trachy- \n andesite", x = 53, y = 7, size=4)+

annotate("text", label = "Trachy- \n andesite", x = 57.8, y = 8.2, size=4)+

annotate("text", label = "Trachydacite", x = 65, y = 9, size=4)+

annotate("text", label = "Trachyte", x = 62.5, y = 11.5, size=4)+

annotate("text", label = "Picro- \n basalt", x = 43, y = 1.5, size=4)+

annotate("text", label = "Basanite \n (Ol > 10%)", x = 43.7, y = 6, size=4)+

annotate("text", label = "Tephrite \n (Ol < 10%)", x = 45, y = 7.8, size=4)+

annotate("text", label = "Phono- \n tephrite", x = 48.5, y = 9.5, size=4)+

annotate("text", label = "Tephri- \n phonolite", x = 52.5, y = 11.5, size=4)+

annotate("text", label = "Phonolite", x = 57, y = 14, size=4)+

annotate("text", label = "Foidite", x = 45, y = 12, size=4)

```

Plot Alkali by Rock Name

```{r alkali by rockname, echo = FALSE, fig.dim = c(10,7)}

final\_alkplot <- rock\_data\_wt %>%

group\_by(RockName) %>%

ggplot(mapping = aes(x = SiO2, y = Na2O + K2O, colour = RockName, legend(cex = 0.75))) +

geom\_point(aes(shape = RockName, color = RockName)) +

scale\_shape\_manual(values = c(7, 8, 21:25, 10)) +

scale\_color\_manual(values = c("coral1", "chartreuse3", "turquoise3", "blue2", "deeppink2", "orchid1", "seagreen3", "firebrick3")) +

guides(color = guide\_legend(override.aes = list(size = 5))) +

theme(text = element\_text(size = 15),

legend.key.size = unit(1.0, "cm"),

legend.title = element\_text(size = 14))

final\_alkplot

```

Overlay Alkali Plot on TAS Diagram

```{r overlay, echo = FALSE, fig.dim = c(10,7)}

tas +

geom\_point(data = rock\_data\_wt, aes(x = SiO2, y = Na2O + K2O, shape = RockName, color = RockName)) +

scale\_shape\_manual(values = c(7, 8, 21:25, 10)) +

scale\_color\_manual(values = c("coral1", "chartreuse3", "turquoise3", "blue2", "deeppink2", "orchid1", "seagreen3", "firebrick3")) +

guides(color = guide\_legend(override.aes = list(size = 5))) +

theme(text = element\_text(size = 15),

legend.key.size = unit(1.0, "cm"),

legend.title = element\_text(size = 14))

```

Now to look at plots of all rocks together

Plot Silica vs Mg# by rock

```{r si vs mg, echo = FALSE, fig.dim = c(10,7)}

mg\_plot <- rock\_data\_wt %>%

group\_by(RockName) %>%

ggplot(mapping = aes(SiO2, MgN, colour = RockName)) +

geom\_point(aes(shape = RockName, color = RockName)) +

scale\_shape\_manual(values = c(7, 8, 21:25, 10)) +

scale\_color\_manual(values = c("coral1", "chartreuse3", "turquoise3", "blue2", "deeppink2", "orchid1", "seagreen3", "firebrick3"))

mg\_plot <- mg\_plot +

guides(color = guide\_legend(override.aes = list(size = 5))) +

theme(text = element\_text(size = 15),

legend.key.size = unit(1.0, "cm"),

legend.title = element\_text(size = 14))

mg\_plot + scale\_x\_continuous(name = "SiO2", limits = c(50, 80))

```

Plot Silica vs Iron by rock

```{r si vs fe, echo = FALSE, fig.dim = c(10,7)}

fe\_plot <- rock\_data\_wt %>%

group\_by(RockName) %>%

ggplot(mapping = aes(SiO2, FeO, colour = RockName)) +

geom\_point(aes(shape = RockName, color = RockName)) +

scale\_shape\_manual(values = c(7, 8, 21:25, 10)) +

scale\_color\_manual(values = c("coral1", "chartreuse3", "turquoise3", "blue2", "deeppink2", "orchid1", "seagreen3", "firebrick3"))

fe\_plot <- fe\_plot +

guides(color = guide\_legend(override.aes = list(size = 5))) +

theme(text = element\_text(size = 15),

legend.key.size = unit(1.0, "cm"),

legend.title = element\_text(size = 14))

fe\_plot + scale\_x\_continuous(name = "SiO2", limits = c(50, 80))

```

Plot Aluminum vs Titanium by rock

(the mean and standard deviation of each is in table below)

```{r al vs ti, echo = FALSE, fig.dim = c(10,7)}

alti\_plot <- rock\_data\_wt %>%

group\_by(RockName) %>%

ggplot(mapping = aes(Al2O3, TiO2, colour = RockName)) +

geom\_point(aes(shape = RockName, color = RockName)) +

scale\_shape\_manual(values = c(7, 8, 21:25, 10)) +

scale\_color\_manual(values = c("coral1", "chartreuse3", "turquoise3", "blue2", "deeppink2", "orchid1", "seagreen3", "firebrick3"))

alti\_plot <- alti\_plot +

guides(color = guide\_legend(override.aes = list(size = 5))) +

theme(text = element\_text(size = 15),

legend.key.size = unit(1.0, "cm"),

legend.title = element\_text(size = 14))

alti\_plot

```

```{r table for mean and sd, include=FALSE}

al\_ti\_tb <- rock\_data\_wt %>%

group\_by(RockName) %>%

summarize(Al2O3mn = mean(Al2O3), Al2O3sd = sd(Al2O3),

TiO2mn = mean(TiO2), TiO2sd = sd(TiO2))

```

```{r print alti table, echo=FALSE}

alti\_hux <- hux(al\_ti\_tb) %>%

add\_colnames() %>%

set\_bold(row = 1, col = everywhere, value = TRUE) %>%

set\_number\_format(2:9, 2:5, 3) %>%

set\_col\_width(1) %>%

set\_all\_borders(TRUE)

alti\_hux

```

```{r another table, echo=FALSE}

kable(al\_ti\_tb) %>%

kable\_styling(bootstrap\_options = "striped", "hover", full\_width = F)

```

Taking a look at comparing CR1A to CR1B

```{r 1a to 1b glass - si/alk, echo=FALSE, fig.dim = c(10,7)}

cr1a\_cr1b\_alk <- rock\_data\_wt %>%

filter(grepl("CR1", rock\_data\_wt$RockName)) %>%

ggplot(aes(SiO2, Na2O + K2O, colour = RockName)) +

geom\_point(aes(shape = RockName, color = RockName)) +

scale\_shape\_manual(values = c(7, 8)) +

scale\_color\_manual(values = c("coral1", "chartreuse3")) +

geom\_point()

cr1a\_cr1b\_alk <- cr1a\_cr1b\_alk +

guides(color = guide\_legend(override.aes = list(size = 5))) +

theme(text = element\_text(size = 15),

legend.key.size = unit(1.0, "cm"),

legend.title = element\_text(size = 14))

cr1a\_cr1b\_alk

```

```{r 1a to 1b glass - si/mg, echo=FALSE, fig.dim = c(10,7)}

cr1a\_cr1b\_mg <- rock\_data\_wt %>%

filter(grepl("CR1", rock\_data\_wt$RockName)) %>%

ggplot(aes(SiO2, MgN, colour = RockName)) +

geom\_point(aes(shape = RockName, color = RockName)) +

scale\_shape\_manual(values = c(7, 8)) +

scale\_color\_manual(values = c("coral1", "chartreuse3")) +

guides(color = guide\_legend(override.aes = list(size = 5))) +

theme(text = element\_text(size = 15),

legend.key.size = unit(1.0, "cm"),

legend.title = element\_text(size = 14))

cr1a\_cr1b\_mg

```

```{r 1a to 1b glass - si/fe, echo=FALSE, fig.dim = c(10,7)}

cr1a\_cr1b\_fe <- rock\_data\_wt %>%

filter(grepl("CR1", rock\_data\_wt$RockName)) %>%

ggplot(aes(SiO2, FeO, colour = RockName)) +

geom\_point(aes(shape = RockName, color = RockName)) +

scale\_shape\_manual(values = c(7, 8)) +

scale\_color\_manual(values = c("coral1", "chartreuse3")) +

guides(color = guide\_legend(override.aes = list(size = 5))) +

theme(text = element\_text(size = 15),

legend.key.size = unit(1.0, "cm"),

legend.title = element\_text(size = 14))

cr1a\_cr1b\_fe

```

```{r 1a to 1b glass - Al/Ti, echo=FALSE, fig.dim = c(10,7)}

cr1a\_cr1b\_alti <- rock\_data\_wt %>%

filter(grepl("CR1", rock\_data\_wt$RockName)) %>%

ggplot(aes(Al2O3, TiO2, colour = RockName)) +

geom\_point(aes(shape = RockName, color = RockName)) +

scale\_shape\_manual(values = c(7, 8)) +

scale\_color\_manual(values = c("coral1", "chartreuse3")) +

guides(color = guide\_legend(override.aes = list(size = 5))) +

theme(text = element\_text(size = 15),

legend.key.size = unit(1.0, "cm"),

legend.title = element\_text(size = 14))

cr1a\_cr1b\_alti

```