

MERGE DESJARDINS AND ASHTON TREES

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Setup

```
library(RRphylo)
library(manipulate)
library(ape)
library(phytools)
library(ggtree)
library(tidyverse)
library(RColorBrewer)
library(ggnewscale)
setwd("/FastData/czirion/Crypto_Diversity_Pipeline/analyses/tree_duplications/scripts")
```

Metadata

Use the metadata table that has all the samples included in the final Crypto_Desjardins_Ashton dataset (n = 1055).
Make separate dataframes for each metadata field.

```
metadata <- read.delim( "../..data/derived/metadata.csv", header=TRUE, sep=",")
summary <- metadata %>%
  group_by(dataset, lineage) %>%
  summarize(count = n())
summary
```

dataset	lineage	count
Ashton	VNI	668
Desjardins	VNBI	122
Desjardins	VNBII	64
Desjardins	VNI	185
Desjardins	VNII	16
Reference	VNI	1

```
metadata$vni_subdivision[metadata$vni_subdivision == ""] <- NA
metadata$vni_subdivision <- factor(metadata$vni_subdivision,
  levels = c("VNIa-4", "VNIa-5", "VNIa-32",
    "VNIa-93", "VNIa-X", "VNIa-Y", "VNIb",
    "VNIIc", "VNIa-outlier"))

sublineage <- metadata %>%
  filter(lineage == "VNI")%>%
  select(strain, vni_subdivision)%>%
  column_to_rownames("strain")%>%
  droplevels()

lineage <- metadata %>%
  select(strain, lineage)%>%
```

```

      column_to_rownames("strain")
dataset <- metadata %>%
      select(strain, dataset)%>%
      column_to_rownames("strain")
source <- metadata %>%
      select(strain, source)%>%
      column_to_rownames("strain")

```

Make color vectors for all plots

```

lineage_colors <- brewer.pal(8, "Dark2")[c(1, 2, 3, 4)]
names(lineage_colors) <- levels(as.factor(metadata$lineage))

sublineage_colors <- c(brewer.pal(12, "Set3")[c(1:10)], "white")
names(sublineage_colors) <- levels(sublineage$vni_subdivision)

```

Desjardins tree

Import the raw Desjardins tree

```

desj_tree_path <- "../..data/raw/CryptoDiversity_Desjardins_Tree.tre"
desj_tree <- read.tree(desj_tree_path)

```

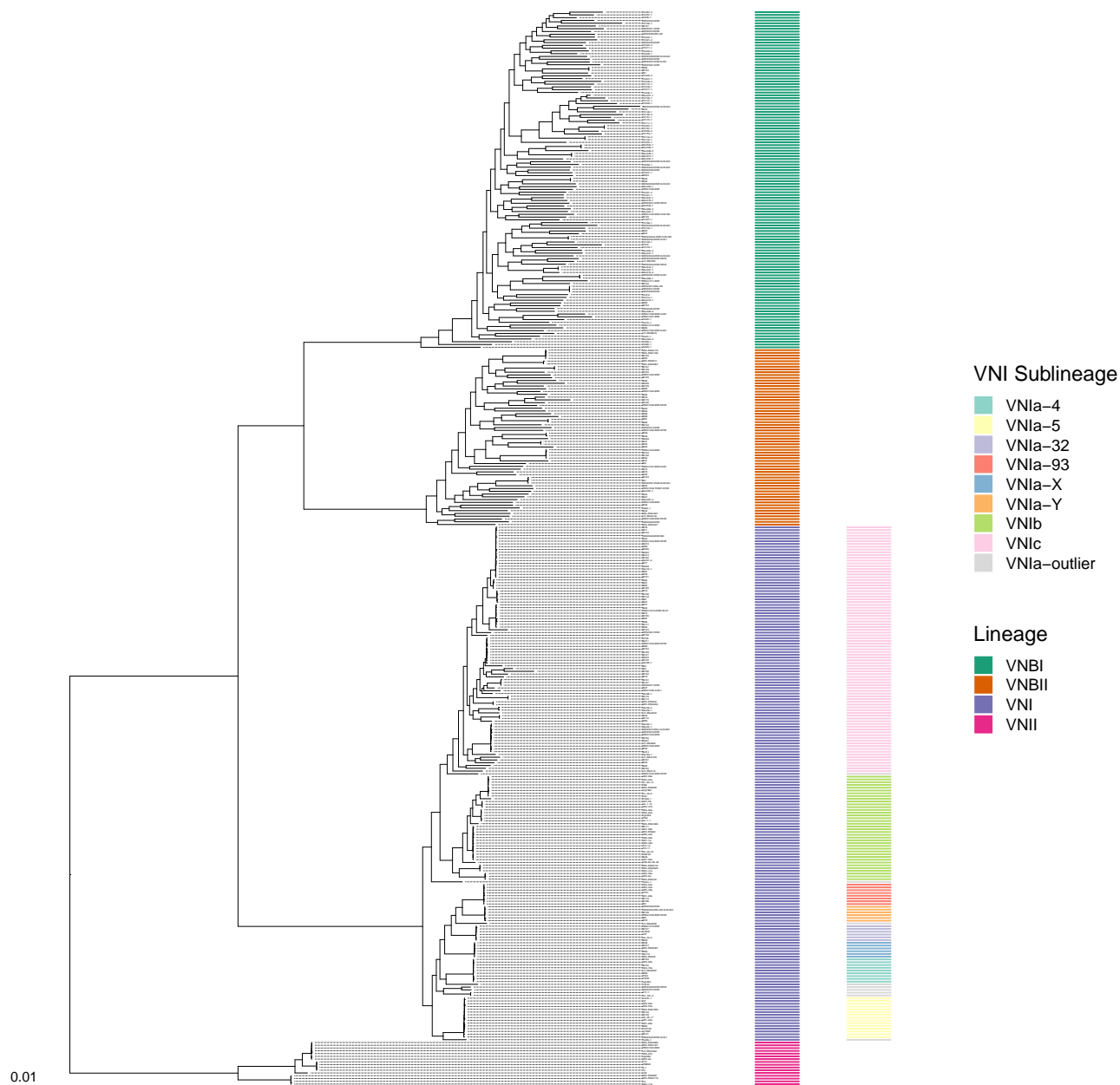
Reroot the tree at the middle of the branch leading to VNII

```

VNII_root <- getMRCA(desj_tree, c("C2", "C12"))
edge_length <- subset(desj_tree$edge.length, desj_tree$edge[,2] == VNII_root)
desj_tree <- reroot(desj_tree, VNII_root, edge_length/2)
write.tree(desj_tree, file = "../..data/processed/desj_tree.newick")

```

Plot of Desjardins tree



Ashton tree

Import the raw Ashton tree

```
ashton_tree_path <- "../../../data/raw/2017.06.09.all_ours_and_desj.snp_sites.mod.fa.cln.tree"
ashton_tree_unrooted <- read.tree(ashton_tree_path)
```

Rename tips to use strain names

```
ashton_tree_unrooted$tip.label <- sapply(ashton_tree_unrooted$tip.label, function(x) {
  if (x %in% metadata$run) {
    metadata$strain[metadata$run == x]
  } else {
    x
  }
})
```

```
}  
})
```

```
tips <- ashton_tree_unrooted$tip.label  
length(tips)
```

[1] 865

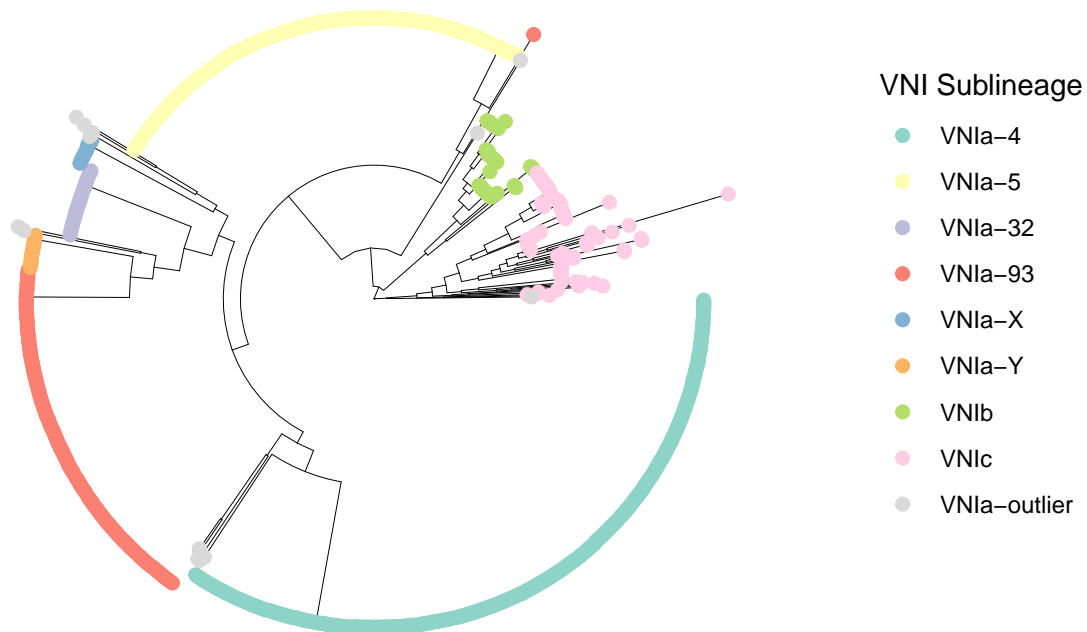
```
tips_missing_from_final_dataset <- setdiff(tips, metadata$strain)
```

Compare list of strains missing from metadata with the original Ashton metadata

```
ashton_metadata <- read.delim( "/FastData/czirion/Crypto_Diversity_Pipeline/Crypto_Ashton/config/metadata_missing_from_dataset.csv")  
metadata_missing_from_dataset <- ashton_metadata %>%  
  filter(strain %in% tips_missing_from_final_dataset) %>%  
  select(sample, strain, lineage, VNI_subdivision)  
metadata_missing_from_dataset
```

sample	strain	lineage	VNI_subdivision
ERS542414	15277_3#7	VNI	VNIa-4
ERS542415	15277_3#8	VNI	VNIa-4
ERS542595	15277_3#45	VNI	VNIa-4
ERS542403	15277_3#1	VNI	VNIa-4
ERS542456	15277_3#18	VNI	VNIa-4
ERS542410	15277_3#5	VNI	VNIa-5
ERS542411	15277_3#6	VNI	VNIa-5
	CNS_1465	VNI	VNIa-93
ERS542584	15277_3#42	VNI	VNIa-93
ERS542502	14893_1#16	VNI	VNIa-93

Plot unrooted Ashton tree

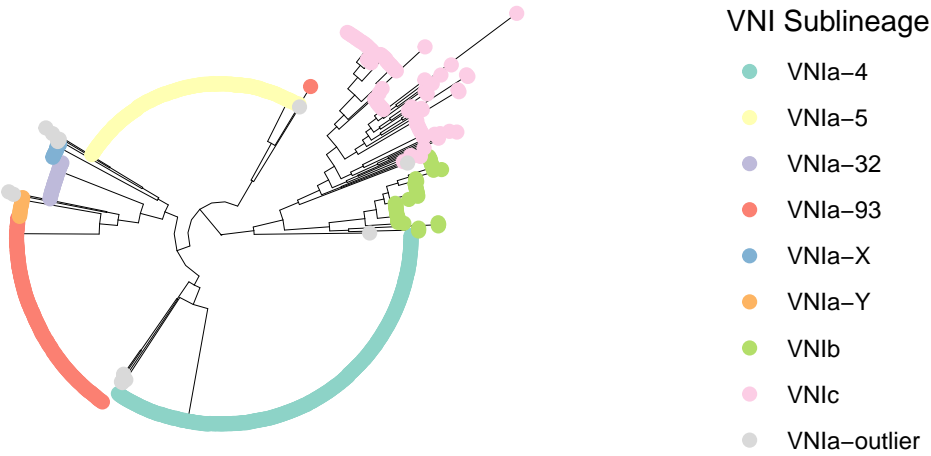


Warning: Removed 11 rows containing missing values or values outside the scale range (``geom_point_g_gtree()``).

Root Ashton tree at the middle of the branch leading to VNla

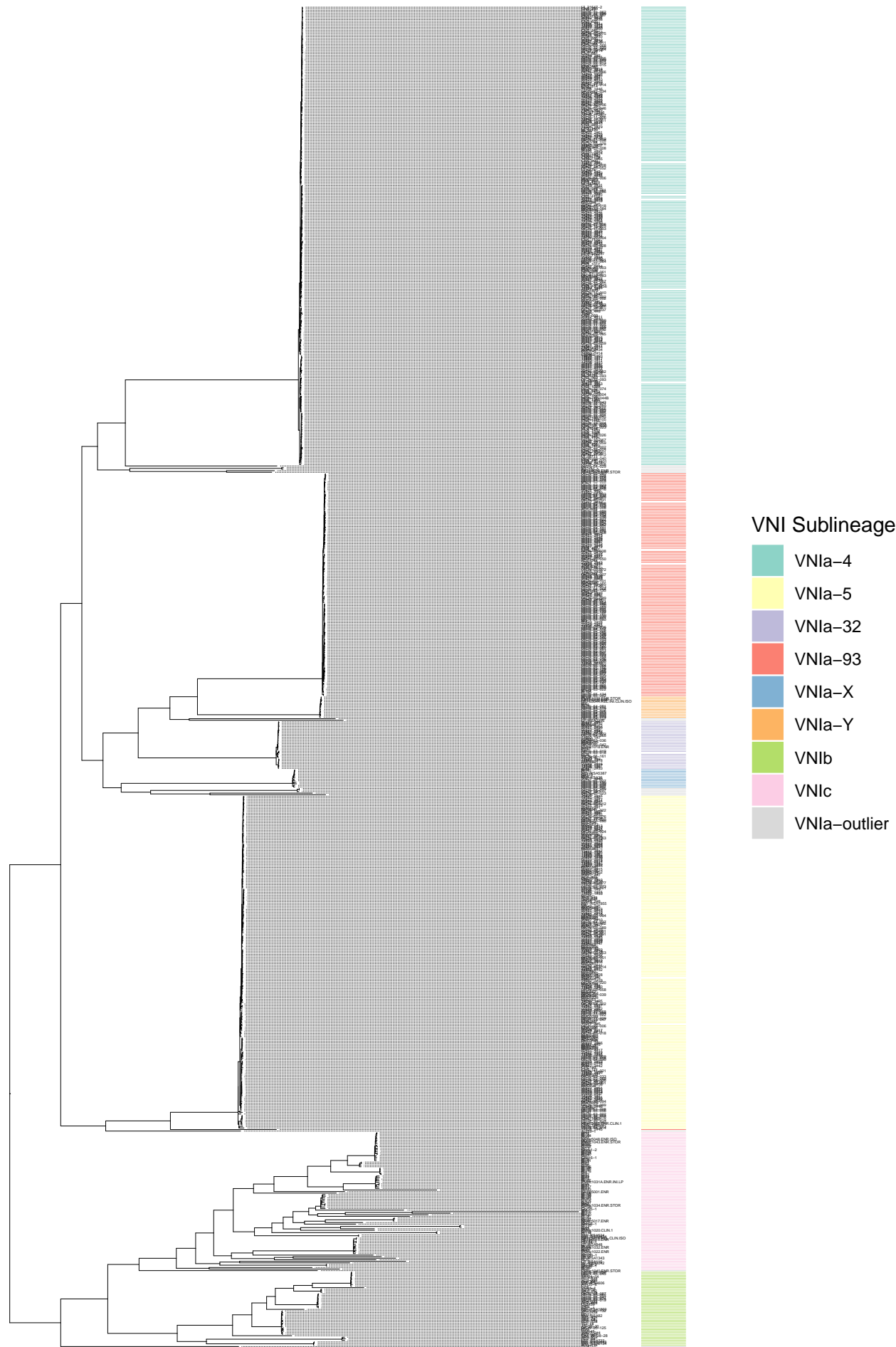
```
VNIa_root <- getMRCA(ashton_tree_unrooted, c("AD3-95a", "Tu259-1"))
edge_length <- subset(ashton_tree_unrooted$edge.length,
  ashton_tree_unrooted$edge[,2] == VNIa_root)
ashton_tree <- reroot(ashton_tree_unrooted, VNIa_root, edge_length/2)
write.tree(ashton_tree, file = "../data/processed/ashton_tree.newick")
```

Plot the rooted Ashton tree



Warning: Removed 11 rows containing missing values or values outside the scale range
(`geom_point_g_gtree()`).

Plot a rectangular version of the Ashton tree



Merge Desjardins and Ashton trees

Specify clades in Desjardins tree

```
VNI <- c("Bt92", "Bt79")
VNI_node <- getMRCA(desj_tree, VNI)
VNII <- c("C2", "C12")
VNII_node <- getMRCA(desj_tree, VNII)
VNB <- c("Bt7", "Bt34")
VNB_node <- getMRCA(desj_tree, VNB)
```

Get the ages of the nodes from the original Desjardins tree

```
edge_lengths <- node.depth.edglength(desj_tree)
node_labels <- c(desj_tree$tip.label, desj_tree$node.label)
edge_length_mapping <- data.frame(
  node = node_labels,
  edge_length = edge_lengths,
  max_length = max(edge_lengths))
edge_length_mapping <- edge_length_mapping %>%
  mutate(age = max_length - edge_length) %>%
  rownames_to_column("node_id")
clade_ages <- edge_length_mapping %>%
  filter(node_id %in% c(VNI_node, VNII_node, VNB_node))
nodeages <- c("Bt92-Bt79" = clade_ages$age[clade_ages$node_id == VNI_node],
  "C2-C12" = clade_ages$age[clade_ages$node_id == VNII_node],
  "Bt7-Bt34" = clade_ages$age[clade_ages$node_id == VNB_node])
tip_ages <- edge_length_mapping %>%
  filter(node %in% metadata$strain)
tipages <- tip_ages$age
names(tipages) <- tip_ages$node
```

Remove VNI clade from Desjardins tree to use it as backtree

```
VNI_tips <- tips(desj_tree, VNI_node)
backtree <- drop.tip(desj_tree, VNI_tips)
```

Create the reference tables

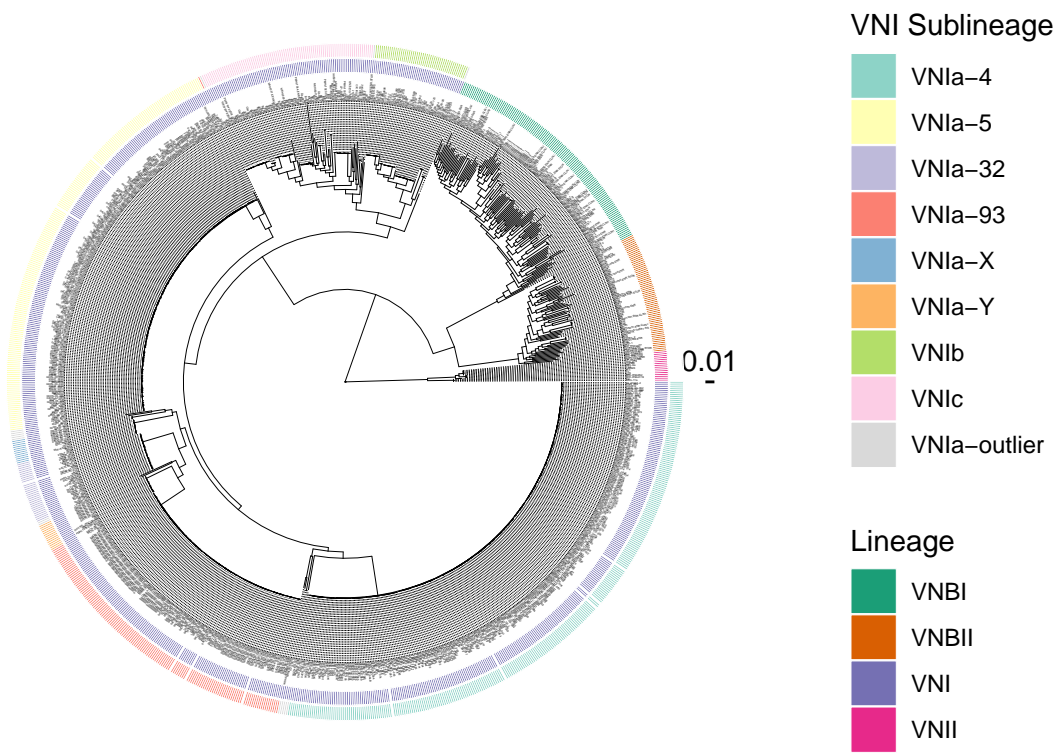
```
reference <- data.frame(bind=c("CNS_289-20427_2#4"),
  reference=c("Bt7-Bt34"),
  poly=c(FALSE))
```

Merge

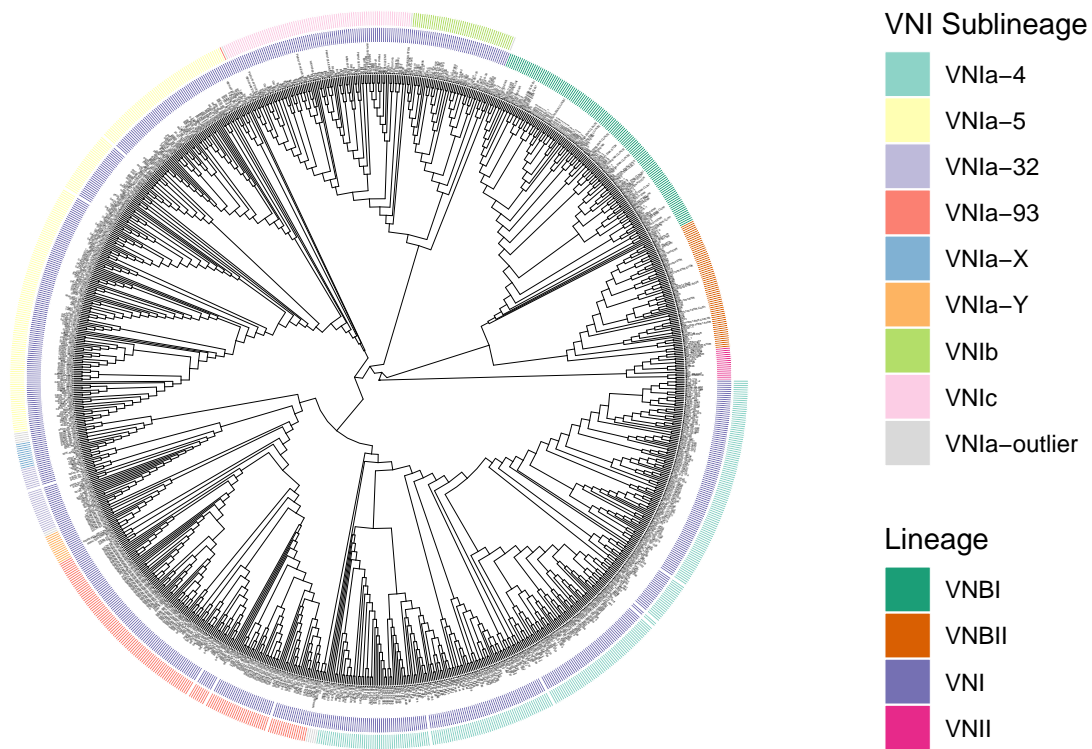
```
merged <- tree.merger(backbone = backtree,
  data=reference,
  source.tree = ashton_tree,
  plot=FALSE,
  node.ages = nodeages,
  tip.ages = tipages)
```

```
write.tree(merged, file = ".././data/processed/merged_tree.newick")
```


Plot merged tree with branchlengths (not real)



Plot cladogram of merged tree



Plot minimal version of the tree

Get one sample of each non-VNI lineage, VNI sublineage, and all VNIa-outlier

```
VNI <- metadata %>%
  filter(lineage == "VNI", vni_subdivision != "VNIa-outlier") %>%
  group_by(vni_subdivision) %>%
  slice(1) %>%
  ungroup()
VNIa_outlier <- metadata %>%
  filter(vni_subdivision == "VNIa-outlier")
VNII <- metadata %>%
  filter(lineage == "VNII") %>%
  slice(1) %>%
  ungroup()
VNBI <- metadata %>%
  filter(lineage == "VNBI") %>%
  slice(1) %>%
  ungroup()
VNBII <- metadata %>%
  filter(lineage == "VNBII") %>%
  slice(1) %>%
  ungroup()
tips <- rbind(VNI, VNIa_outlier, VNII, VNBI, VNBII)%>%
  select(strain)
```

Make a small version of the merged tree only with the tips in tips

```
small_tree <- drop.tip(merged, setdiff(merged$tip.label, tips$strain))
```

Plot the small tree

