DMTA analysis 2020-01-15

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Dental Microwear Textural Analysis

Latest analyses for dental microwear textural analysis

```
library(tidyverse)
teeth <- read.csv("teeth8.csv")
summary(teeth)
```

```
##               Number    Fossil_Modern      Provenance      Member
##  NMS.Z.2002.217.2:  2   Fossil:220    Koobi Fora: 63   Modern :180
##  OMO-350-10005   :  2   Modern:180    Modern    :180   KBS    : 40
##  1169            :  1                 Nachukui  : 29   F0     : 32
##  12225           :  1                 Shungura  :128   Lomekwi: 19
##  12226           :  1                                  Burgi  : 18
##  1253            :  1                                  C8     : 10
##  (Other)         :392                                  (Other):101
##    Mean_date          Tooth         Facet        Facet.2          Genus_FM
##  Min.   :1.000   UM2    :123          :107          :131   Aepyceros  :160
##  1st Qu.:1.000   LM2    : 92   ptcd   : 93   db     :123   M_Aepyceros: 84
##  Median :1.740   UM12   : 48   PTCD   : 74   dl     : 44   Alcelaphus : 27
##  Mean   :1.743   LM3    : 28   par    : 40   ml     : 42   Cephalophus: 27
##  3rd Qu.:2.295   lm12   : 27   PRO    : 33   dv     : 38   Antidorcas : 26
##  Max.   :3.175   lm3    : 22   ptc    : 16   m      : 14   M_Giraffa  : 23
##                  (Other): 60   (Other): 37   (Other):  8   (Other)    : 53
##              Species_FM          Genus                  Species
##  Aep. shungurae   :142   Aepyceros  :244   Aep. shungurae   :142
##  M_Aep. melampus  : 84   Alcelaphus : 27   Aep. melampus    :102
##  A. buselaphus    : 27   Antidorcas : 36   A. buselaphus    : 27
##  C. silvicultor   : 27   Cephalophus: 27   C. silvicultor   : 27
##  Ant. recki       : 26   Equus      : 24   Ant. recki       : 26
##  G. camelopardalis: 23   Giraffa    : 42   G. camelopardalis: 23
##  (Other)          : 71                     (Other)          : 53
##       Asfc          Linestart           epLsar             HAsfc9
##  Min.   : 0.300   Min.   :0.07488   Min.   :0.000119   Min.   :0.0635
##  1st Qu.: 1.270   1st Qu.:0.13313   1st Qu.:0.001768   1st Qu.:0.1900
##  Median : 1.938   Median :0.21081   Median :0.003210   Median :0.2815
##  Mean   : 2.378   Mean   :0.46770   Mean   :0.003580   Mean   :0.3159
##  3rd Qu.: 2.819   3rd Qu.:0.40800   3rd Qu.:0.005152   3rd Qu.:0.3862
##  Max.   :12.516   Max.   :9.70000   Max.   :0.009620   Max.   :1.3460
##
##     HAsfc81            Tfv        Data
##  Min.   :0.2293   Min.   :-3976   GM:198
##  1st Qu.:0.4139   1st Qu.:38622   LC:194
```

```
##  Median :0.5254   Median :45359   LS:  8
##  Mean   :0.5885   Mean   :45483
##  3rd Qu.:0.6843   3rd Qu.:54187
##  Max.   :2.4017   Max.   :95040
##
```

Prepare the data

Sort out categories and variables

```
## Add Wear Textural Index to dataset ##
teeth<- mutate(teeth, WTI=((0.4161546*Asfc)+(0.5302947*epLsar)+(0.7386494*Tfv)))

##mutate() : dataframe, new column name, transformation
teeth <- mutate(teeth, rAsfc = rank(Asfc), rSmc = rank(Linestart), repLsar = rank(epLsar),
                rHAsfc9 = rank(HAsfc9), rHAsfc81 = rank(HAsfc81), rTfv = rank(Tfv), rWTI=rank(WTI))
teeth$Member<-as.factor(teeth$Member)
teeth$Genus<-as.factor(teeth$Genus)

#Order Fossil Modern
teeth$Fossil_Modern<- factor(teeth$Fossil_Modern, ordered = TRUE, levels= c("Fossil", "Modern"))

#Order Provenance (Koobi Fora first, then Nachukui and Modern)
teeth$Provenance<- factor(teeth$Provenance, ordered = TRUE, levels= c("Koobi Fora", "Nachukui", "Shungu

#Order Member chronologically (Koobi Fora first, then Nachukui)
teeth$Member<- factor(teeth$Member, ordered = TRUE, levels= c("Tulu Bor", "Burgi", "KBS", "Lomekwi", "L
                                                              "B", "C", "D", "E", "F", "G","Modern"))
```

Aepyceros data for Asfc and epLsar

Prepare summary data and plot for anisotropy

```
sum<- teeth %>%
  group_by(Mean_date, Genus, Provenance)%>%
  filter(Genus== "Aepyceros" & Provenance != "Modern")%>%
  summarise(meanepLsar=mean(epLsar), seepLsar=sd(epLsar)/sqrt(n()))
sum
```

```
## # A tibble: 12 x 5
## # Groups:   Mean_date, Genus [12]
##    Mean_date Genus     Provenance meanepLsar  seepLsar
##        <dbl> <fct>     <ord>           <dbl>     <dbl>
##  1      1.74 Aepyceros Koobi Fora    0.00438  0.000509
##  2      1.78 Aepyceros Nachukui      0.00327  0.00127
##  3      2.08 Aepyceros Shungura      0.00252  0.000336
##  4      2.12 Aepyceros Nachukui      0.00440  0.00161
##  5      2.22 Aepyceros Koobi Fora    0.00559  0.00245
##  6      2.30 Aepyceros Shungura      0.00317  0.000273
##  7      2.36 Aepyceros Shungura      0.00356  0.000484
##  8      2.46 Aepyceros Shungura      0.00275  0.000563
##  9      2.72 Aepyceros Shungura      0.00186  0.000216
## 10      2.98 Aepyceros Nachukui      0.00372  0.000633
## 11      3.04 Aepyceros Koobi Fora    0.00426 NA
## 12      3.18 Aepyceros Shungura      0.00345  0.000595
```

```
epLsarplot<- ggplot(sum, aes(x= Mean_date, y=meanepLsar, group=interaction(Provenance, Genus), colour=Pr
  scale_color_brewer(palette="Set1")+
  geom_point(size=2)+
  geom_line()+
  geom_errorbar(aes(ymin=meanepLsar-seepLsar, ymax=meanepLsar+seepLsar), width=0, height=0)+
  theme_grey() +
  theme(legend.position="right", axis.title.x = element_text(size=12, face="bold"),
        axis.title.y = element_text(size=12, face="bold"))+
  scale_x_reverse()+ xlim(3.5, 1.5)+
  scale_y_continuous(position = "right", limits=c(0,0.010))+
  xlab("Mean date (Ma)")+ ylab("Anisotropy (epLsar)")
```

```
## Scale for 'x' is already present. Adding another scale for 'x', which will
## replace the existing scale.
```

Prepare summary data and plot for complexity

```
sum<- teeth %>%
  group_by(Mean_date, Genus, Provenance)%>%
  filter(Genus== "Aepyceros" & Provenance != "Modern")%>%
  summarise(meanAsfc=mean(Asfc), seasfc=sd(Asfc)/sqrt(n()))
sum
```

```
## # A tibble: 12 x 5
## # Groups:   Mean_date, Genus [12]
##    Mean_date Genus     Provenance meanAsfc seasfc
##        <dbl> <fct>     <ord>         <dbl>  <dbl>
##  1      1.74 Aepyceros Koobi Fora     2.69  0.433
##  2      1.78 Aepyceros Nachukui       5.31  1.96
##  3      2.08 Aepyceros Shungura       1.85  0.215
##  4      2.12 Aepyceros Nachukui       1.89  0.449
##  5      2.22 Aepyceros Koobi Fora     3.67  0.757
##  6      2.30 Aepyceros Shungura       2.12  0.140
##  7      2.36 Aepyceros Shungura       2.12  0.264
##  8      2.46 Aepyceros Shungura       2.09  0.480
##  9      2.72 Aepyceros Shungura       2.50  0.283
## 10      2.98 Aepyceros Nachukui       3.02  0.498
## 11      3.04 Aepyceros Koobi Fora     9.67 NA
## 12      3.18 Aepyceros Shungura       2.21  0.352
```

```
Asfcplot<- ggplot(sum, aes(x= Mean_date, y=meanAsfc, group=interaction(Provenance, Genus), colour=Prover
  scale_color_brewer(palette="Set1")+
  geom_point(size=2)+
  geom_line()+
  geom_errorbar(aes(ymin=meanAsfc-seasfc, ymax=meanAsfc+seasfc), width=0, height=0)+
  theme_grey() +
  theme(legend.position="right", axis.title.x = element_text(size=12, face="bold"),
        axis.title.y = element_text(size=12, face="bold"))+
  scale_x_reverse()+ xlim(3.5, 1.5)+
  scale_y_reverse()+ ylim(6, 0)+
  xlab("Mean date (Ma)")+ ylab("Complexity (Asfc)")
```

Combine the two plots using the grid package

```
library(grid)
grid.newpage()
grid.draw(rbind(ggplotGrob(epLsarplot), ggplotGrob(Asfcplot), size = "last"))
```