VISUAL EXPLORATION OF FLOAT GLASS DATA

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Abstract

Dr. Carriquiry commissioned a large & unique set of float glass data: concentration (in ppm) of 18 elements from 48 panes of float glass from 2 manufacturers (mfrs). Repeated measurements on the panes provide the data needed to understand the variability between *and* within mfrs, panes, and fragments. We first use graphical methods explore this float glass data (see Figs. 1-2). We also visualize statistical problems inherent to the data (see Fig. 3). Finally, we implement the ASTM standard method for glass source conclusions () and compare its performance on our data to that of the random forest (RF) method from Park and Carriquiry (2018) (see Figs. 4-6).

Figure 2: Comparing panes over time. Each box plot represents the ppm of each element in all measurements from one pane. Note the time trend in Hf, Zr in Mrf A panes, and the cyclical nature of Na in Mfr B panes.

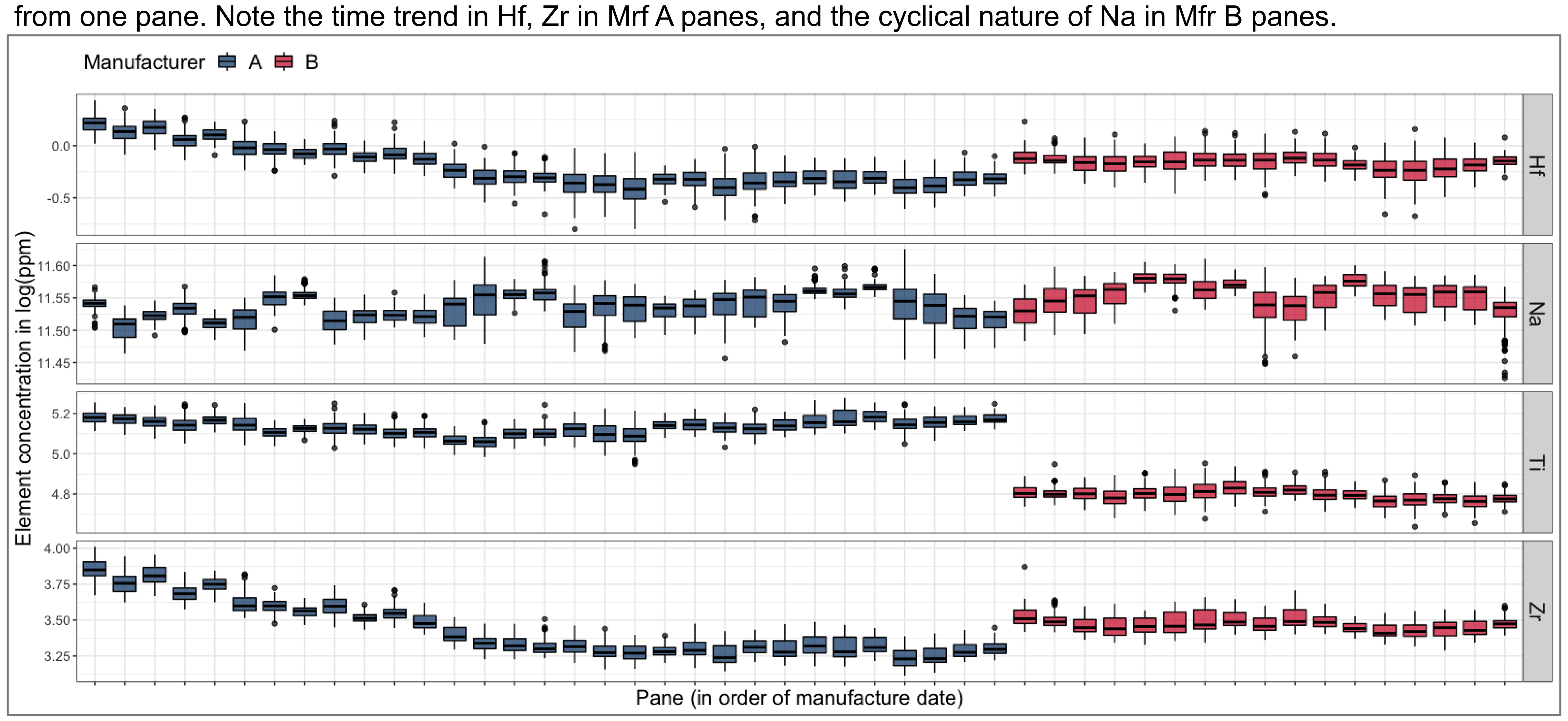
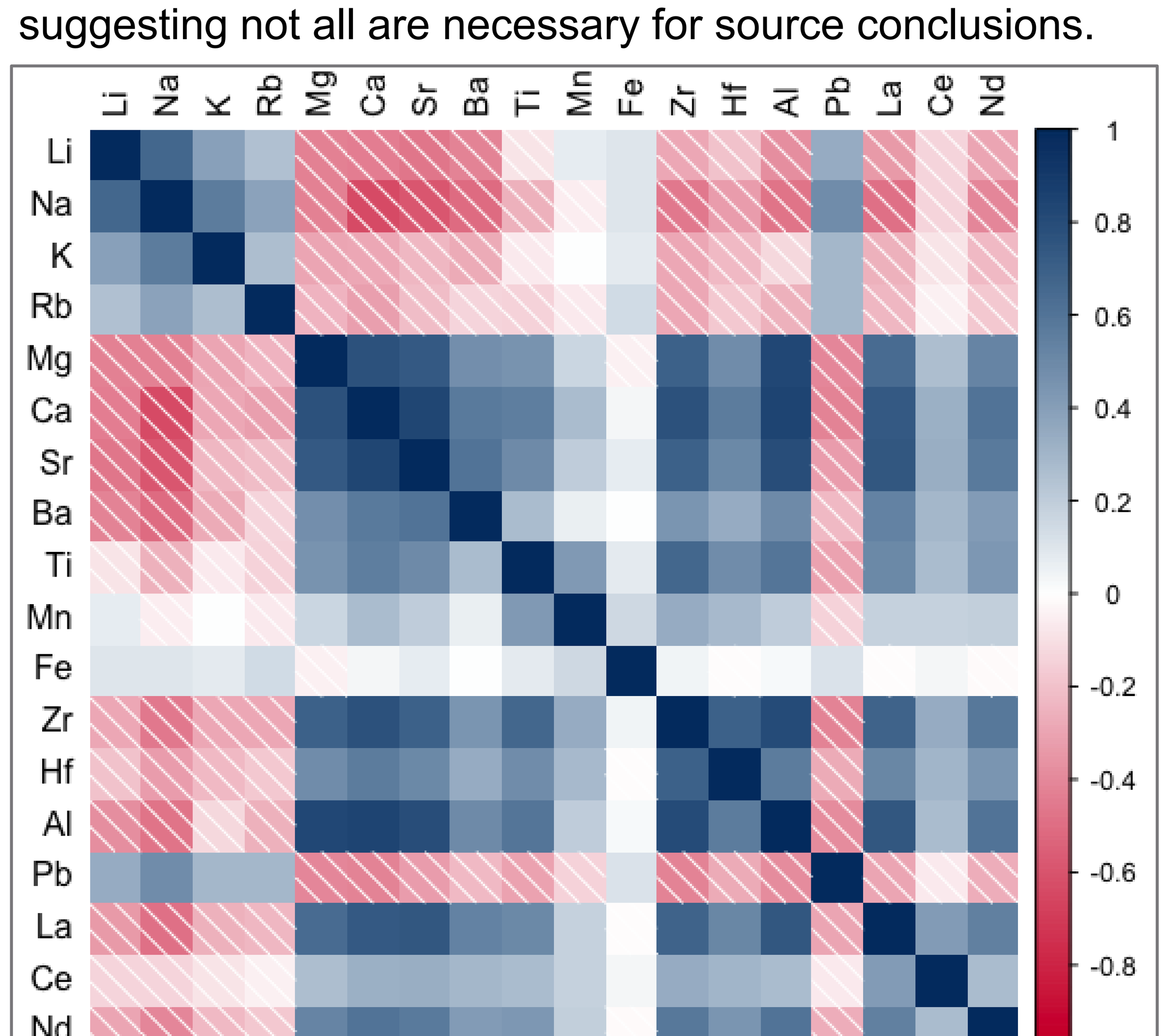


Figure 3: Correlations between elements in glass from Mfr B. Axes ordered according to metal type & mass. We see clear groupings of highly correlated elements, suggesting not all are necessary for source conclusions.



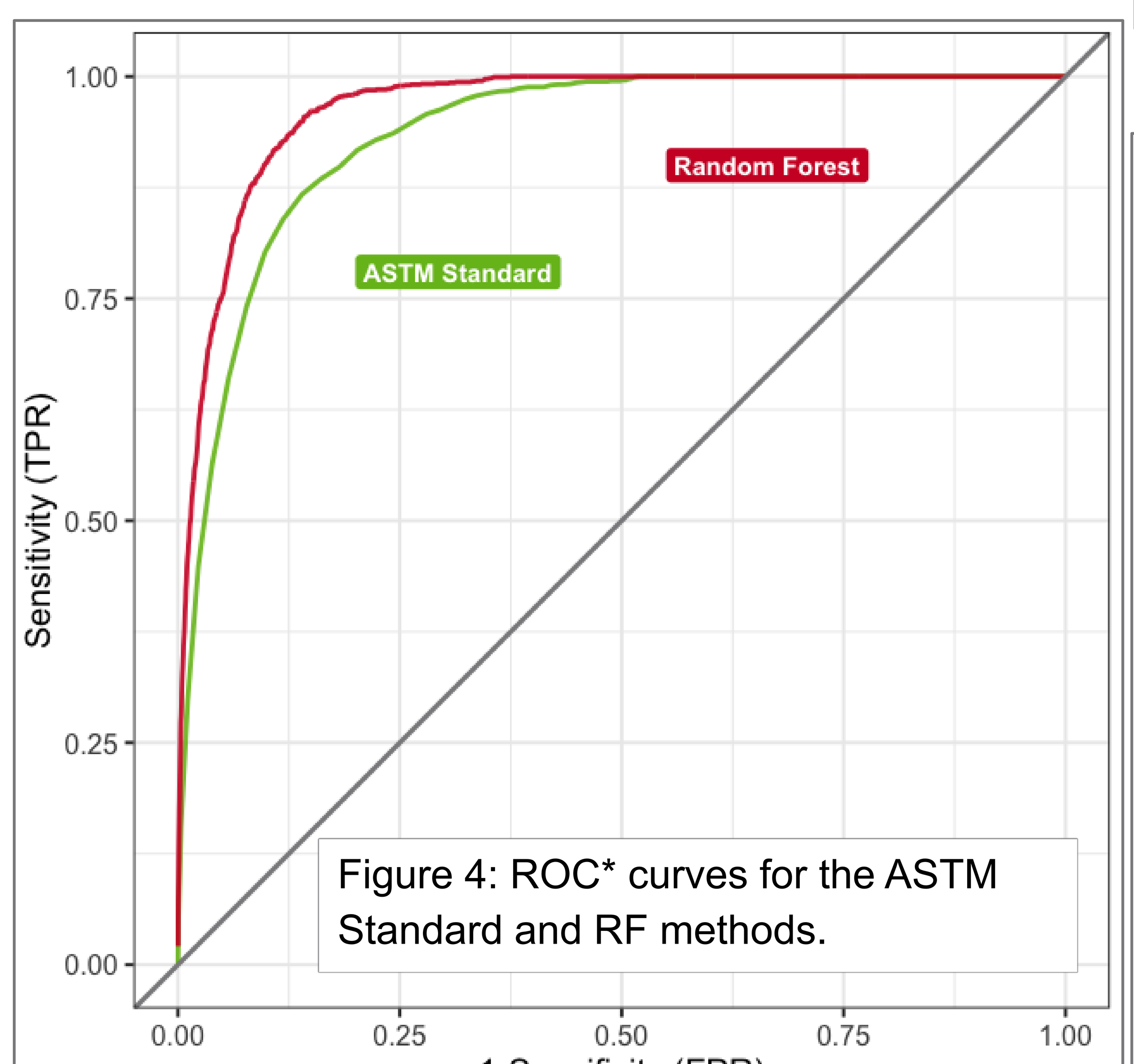
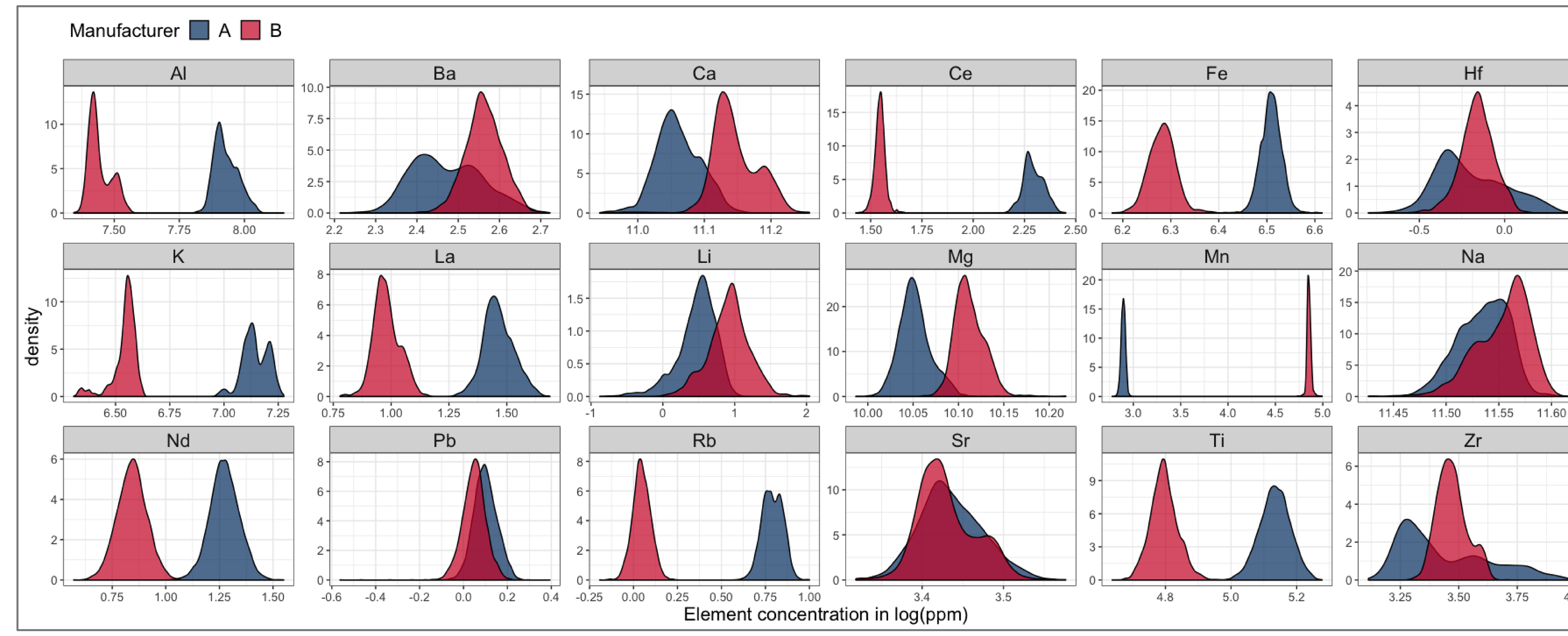


Figure 4: ROC* curves for the ASTM Standard and RF methods.

* - Receiver operating characteristic

Figure 1: Distribution of 18 elements in glass from two mfrs. The x-axis is the concentration in $\log_e$(ppm). We see a large difference in elements like Mn, Ce, & Rb, but large overlap in values in elements like Pb, Sr, & Na.



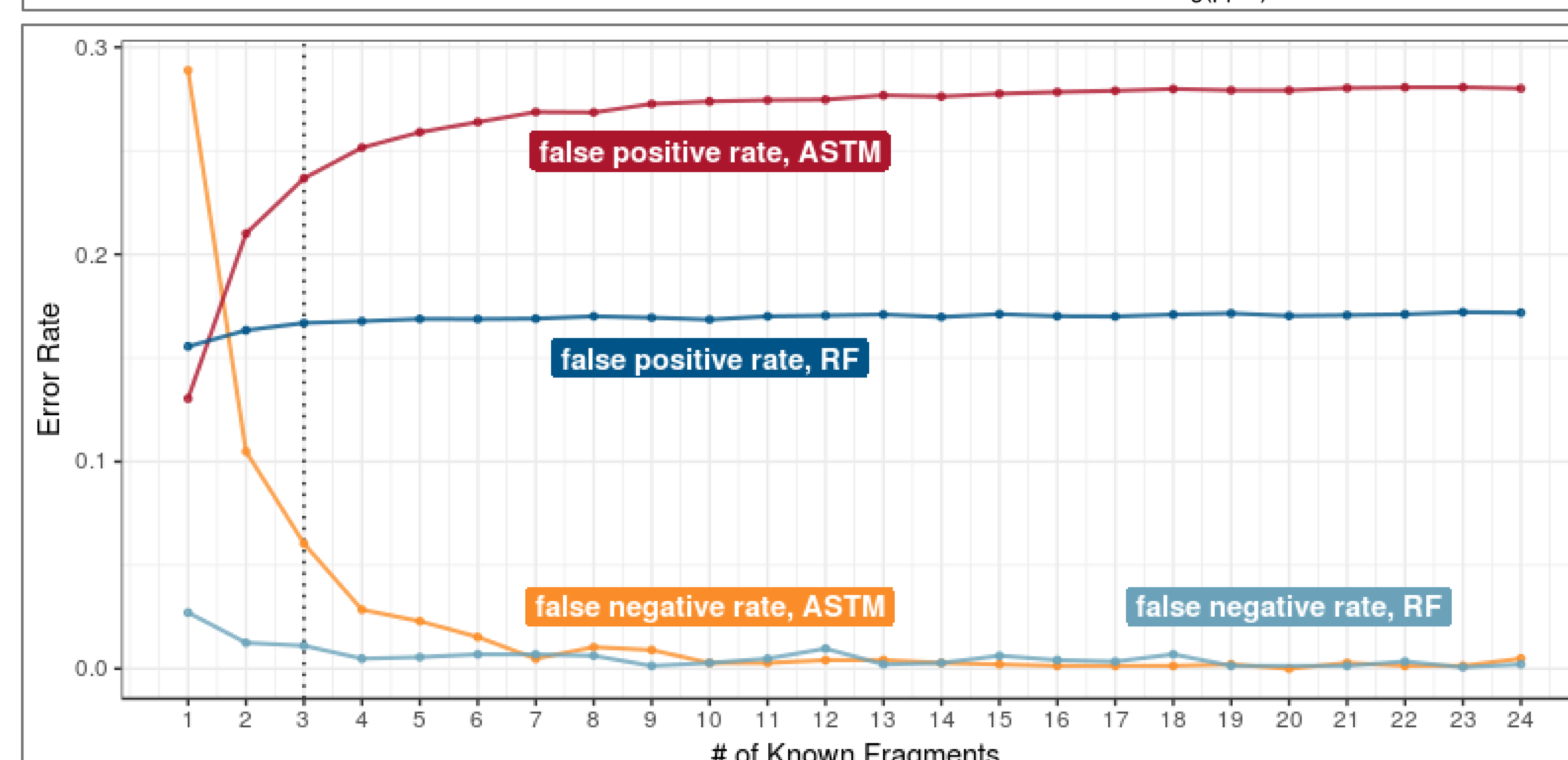
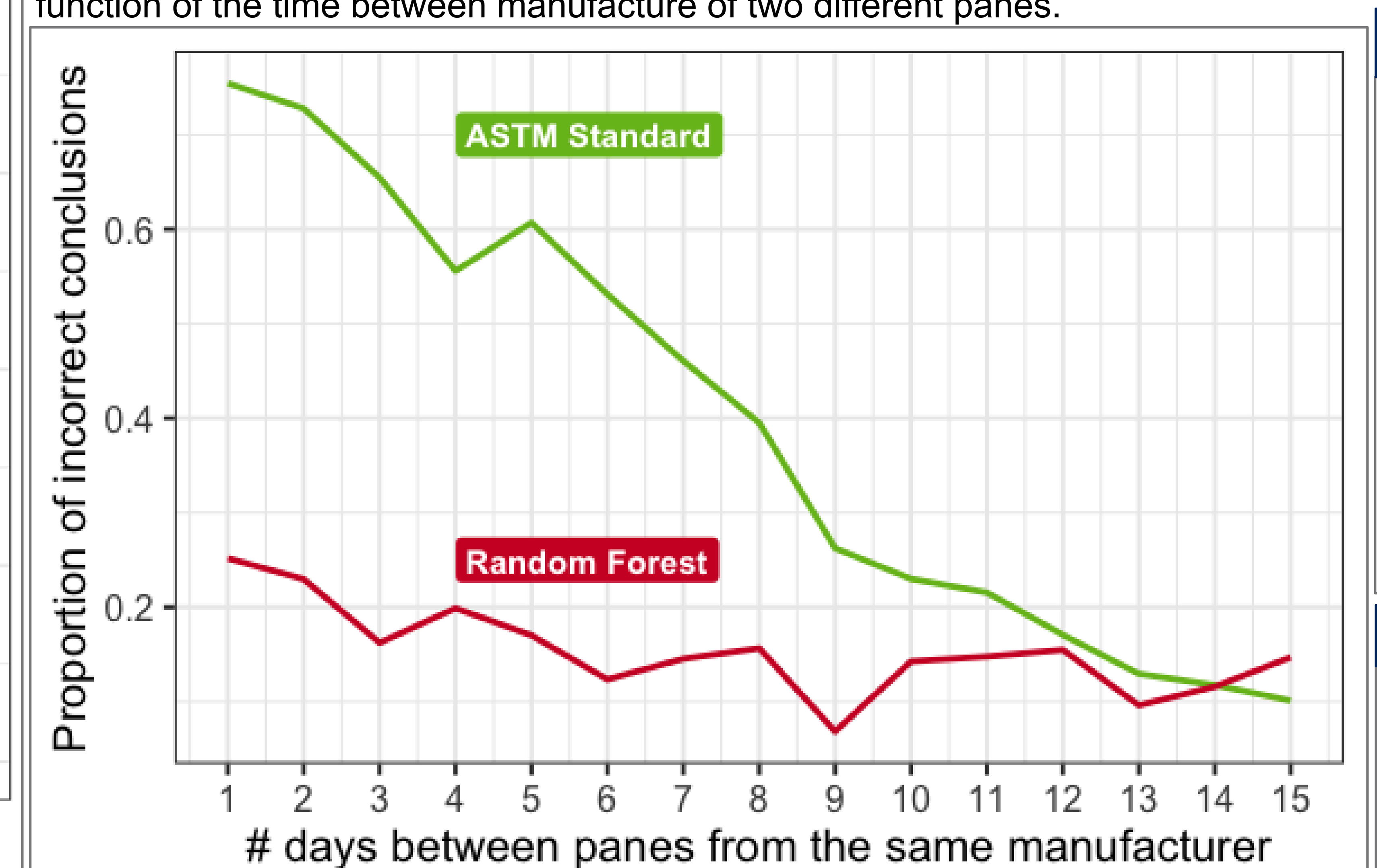


Figure 5: Error rates for each method by number of fragments measured to compute the known source value. To make a conclusion, one "questioned" fragment and 1+ "known" fragments are measured & means of element concentrations are compared. Error rates for the RF method are robust to changes in number of known fragments used to make a conclusion, while the ASTM method is more sensitive.

Figure 6: Ability of the standard and RF method to make the correct decision as a function of the time between manufacture of two different panes.



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