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#this code is written in R (version 4.4.1) for the manuscript
"The evolution of the marine carbonate factory"

d88_shallow = 0.36; #observed average d88Sr in shallow marine
carbonates
d88_max   = 0.48; #observed maximum d88Sr in the pre-Cryogenian
d88_input = 0.27; #input, bulk silicate earth d88Sr
ff_modern = -0.21; #modern Sr isotope fractionation betweeen
shallow water carbonate and seawater
ff_hypothetical = -0.3; #hypothetical Sr isotope fractionation
betweeen shallow water carbonate and seawater

#Calculate Seawater d88Sr
d88_sw1 = d88_max;
d88_sw2 = d88_shallow - ff_modern;
d88_sw3 = d88_shallow - ff_hypothetical;

lamda = seq(0, 0.9, 0.01); #proportion of shallow marine sink in
total carbonate sink

#Calculate the fractionation between inferred carbonate sink and
seawater
D_inferred_sw1 = (d88_shallow-d88_sw1)- (d88_shallow -
                  d88_input)/(1-lamda);
D_inferred_sw2 = (d88_shallow-d88_sw2)- (d88_shallow -
                  d88_input)/(1-lamda);
D_inferred_sw3 = (d88_shallow-d88_sw3)- (d88_shallow -
                  d88_input)/(1-lamda);

#plot the figure
plot(lamda, D_inferred_sw1, type = "line", lty = 6,
     xlim = c(0,0.9), ylim = c(-0.8, 0), col = "blue",
     ylab = "Δcarb_sw", xlab = "Fshallow/Ftotal")
abline(h = d88_input-d88_sw1, col = "blue")
abline(h = d88_shallow-d88_sw1, lty=3, col = "blue")
lines(lamda, D_inferred_sw2, lty = 6, col = "red")
abline(h = d88_input-d88_sw2, col = "red")
abline(h = d88_shallow-d88_sw2, lty=3, col = "red")
lines(lamda, D_inferred_sw3, lty = 6, col = "orange")
abline(h = d88_input-d88_sw3, col = "orange")
abline(h = d88_shallow-d88_sw3, lty=3, col = "orange")
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