The exponential changes with time in mine water chemistry are not, strictly speaking, decay processes, but are a rate of change with a mathematical description. The term decay is used for convenience in this chapter in the context of describing rate of change in column leachate chemical concentration. For chemical processes that follow a decay function, it is possible to estimate concentration values at different times, and provide some insight into longer term leachate composition. The decay function implicitly assumes constant conditions, and does not account for variations such as change in pCO_2 or other test variables.

Decay constants were calculated by plotting the ratio $\ln(C_t/ C_o)$ versus time. The slope of that plot, determined by linear regression, gives an estimate of k, the decay constant. Estimated k values for concentration change are shown in table 8-5, for calcium, sulfate, alkalinity, specific conductance as a surrogate for dissolved solids, and selenium, along with their R^2 values. The R^2 indicates the percentage of variation explained by the regression, and is shown in parentheses in Table 8-5. R^2 values approaching 100% show a strong relationship for estimating decay constants, while lesser values indicate a weaker association.

Calcium concentration decay was statistically insignificant for two rocks; HCS-IN and MKSS-PA. Both rocks have calcium solubility constraints; gypsum for HCS-IN, and calcite for MKSS-PA. For these two rocks, mineral dissolution was rapid enough to prevent significant change in calcium concentration during the 14 weeks of leaching. The remaining 3 rocks differ by about a factor of 4, with the slowest rate of calcium change in BCS3-PA. This rock had the largest carbonate content.

Table 8-5
Estimated Decay Constants for Calcium, Sulfate,
Alkalinity and Selenium Concentration, and Specific Conductance

Sample	Calcium(1)	Sulfate(1)	Alkalinity(1)	Specific Conductance(1)	Selenium(1)
BCS3-PA	-4.2×10^{-3} (48.3%)(2)	-1.5×10^{-2} (73 %)	-3.4×10^{-3} (41.4%)	-6.2×10^{-3} (57%)	-4.1×10^{-2} (89.6%)
HCS-IN	N.S. (3)	$+6.4 \times 10^{-3}$ (52.4%)	-1.3×10^{-2} (82%)	$+ 1.0 \times 10^{-2}$ (91%)	-2.4×10^{-2} (94.5%)
KBF-WV	-1.7×10^{-2} (39%)	-3.7×10^{-2} (89.4%)	-4.8×10^{-3} (42.7%)	-5.5×10^{-3} (66.6%)	-5.0×10^{-2} (77.1%)
LKFC-PA	-1.0×10^{-2} (75%)	-1.2×10^{-2} (71.6%)	$+1.1 \times 10^{-2}$ (83%)	-9.7×10^{-3} (83.9%)	-1.6×10^{-2} (91.6%)
MKSS-PA	N.S.	-2.0×10^{-2} (78%)	-6.2×10^{-3} (55%)	N.S.	-

(1) Constant in $^{-day}$. Calcium, Sulfate in mg/L. Alkalinity as $CaCO_3$Eq. Specific Conductance data in µmhos/cm. Selenium in µg/L.
(2) Values in parentheses are R^2 values, or percentage of variation explained by the regression
(3) N.S. = not significant.

Sulfate decay, like calcium, is on the order of 10^{-2}/day for 4 rocks. The larger R^2 values indicate a stronger relationship to the decay function for sulfate than calcium. The sulfate values are closely spaced within a factor of about 2.5, indicating very similar sulfate leaching behavior.