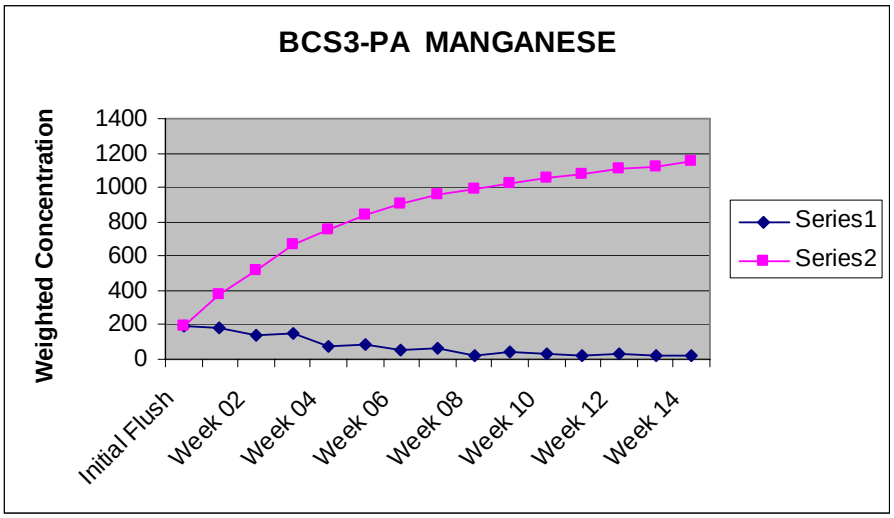
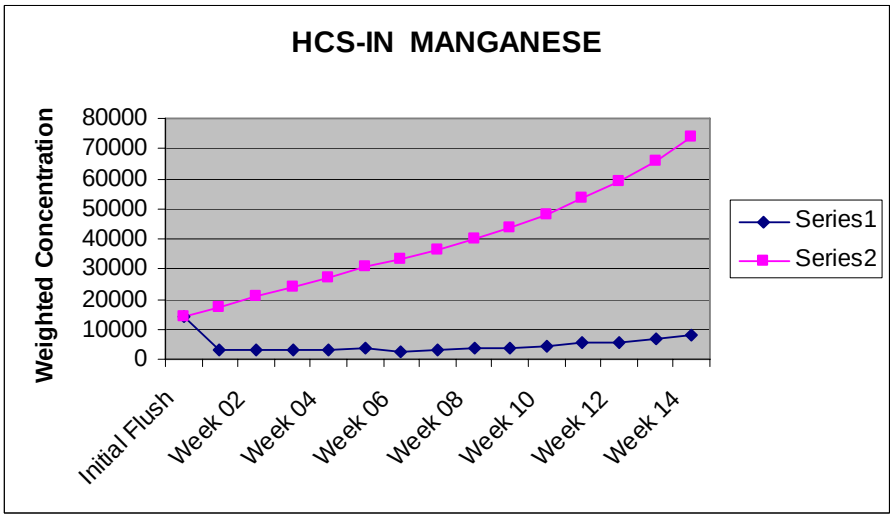
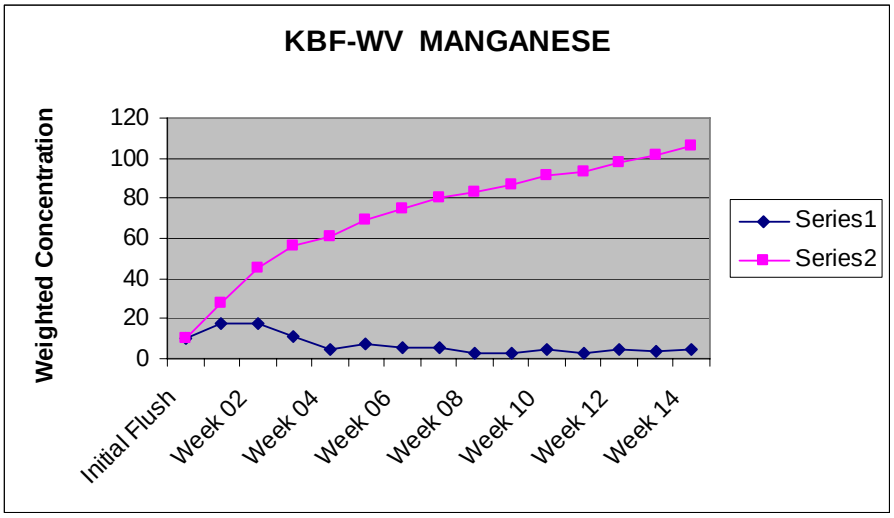
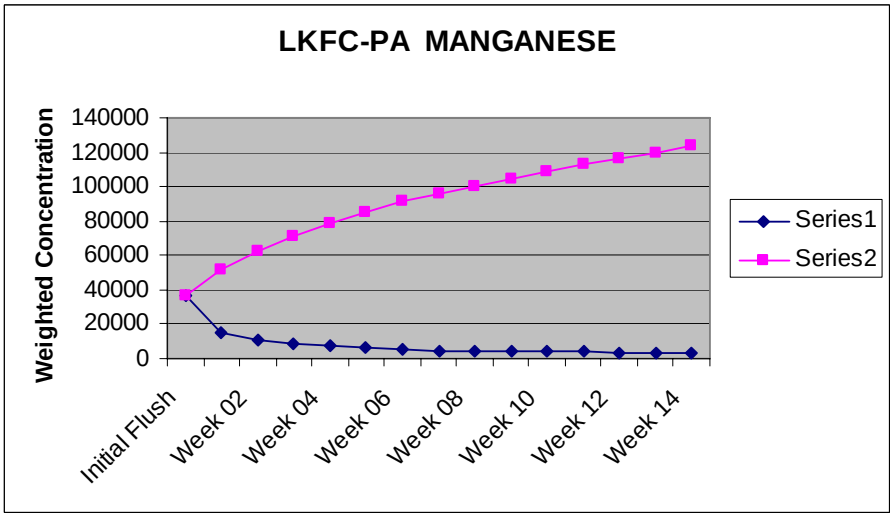
Manganese, Iron and Aluminum

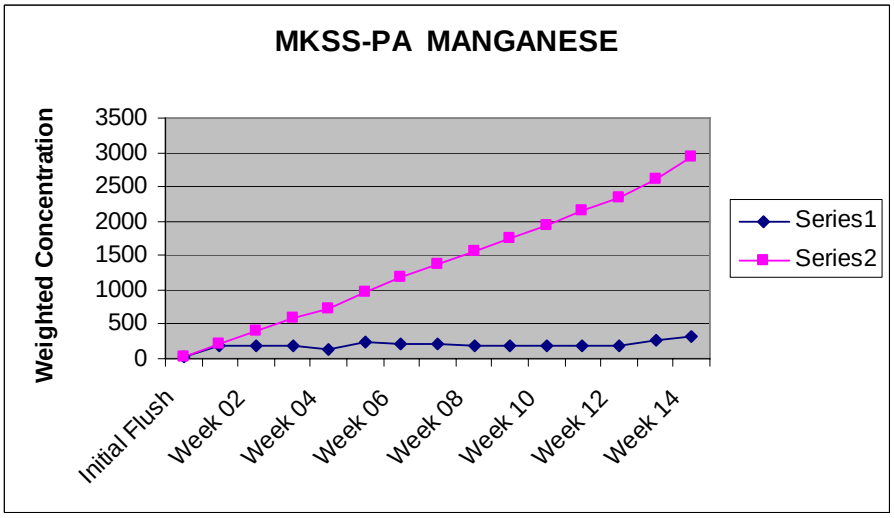
Manganese, iron, and aluminum are common constituents of most rocks. Manganese and iron are highly insoluble in neutral to alkaline environments but can be leached by low pH waters and, as such, are of concern when there is production of acid. Manganese was extracted from the columns in sufficient quantity to produce smooth leach curves. Iron concentrations were lower and so the plots are more erratic. Aluminum was mostly below the detection limit in the analyses, and is not further discussed in this section. The leach curves for manganese and iron are shown in Figure 7.41.

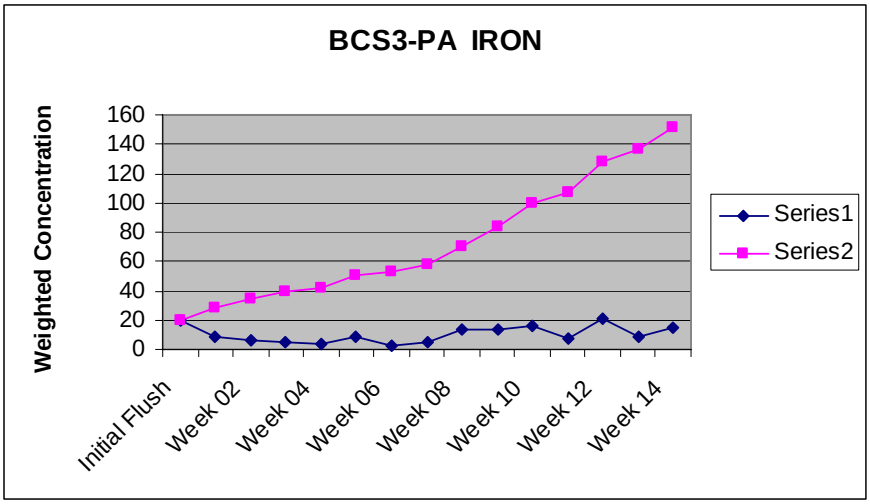


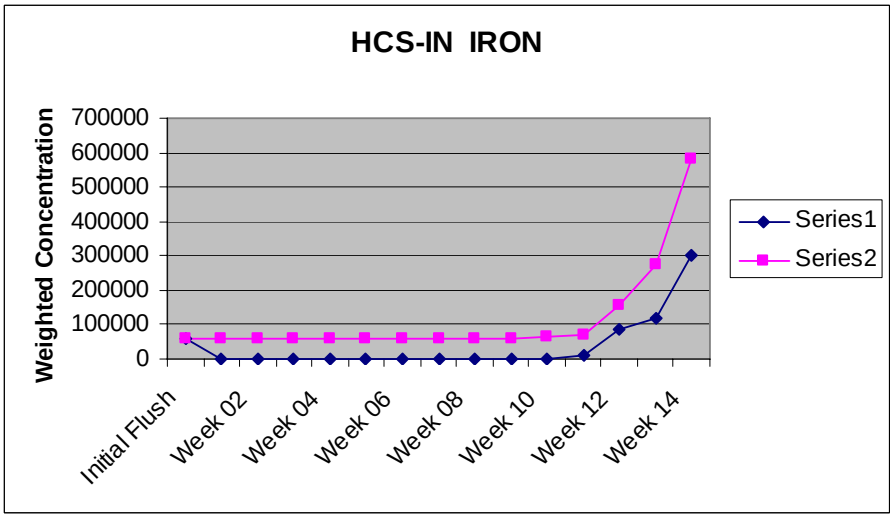


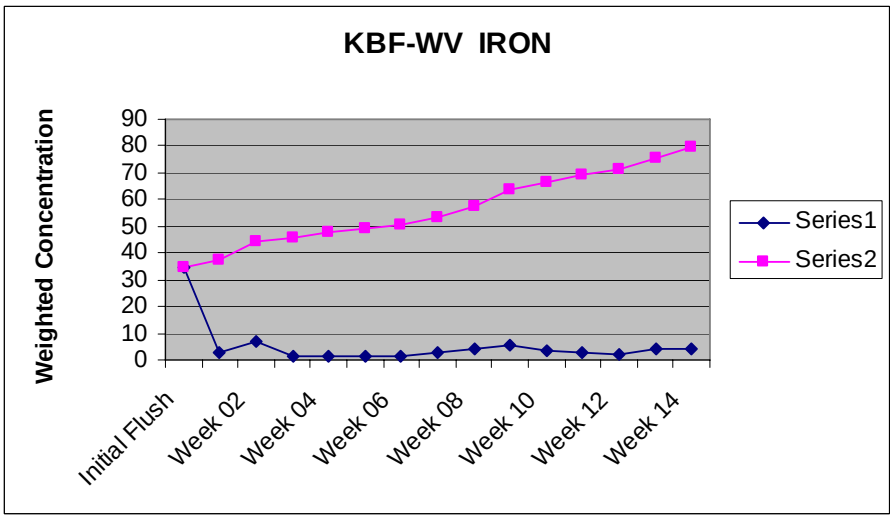

KBF-WV MANGANESE
Weighted Concentration
120
100
80
60
40
20
0
Initial Flush
Week 02
Week 04
Week 06
Week 08
Week 10
Week 12
Week 14
Series1
Series2

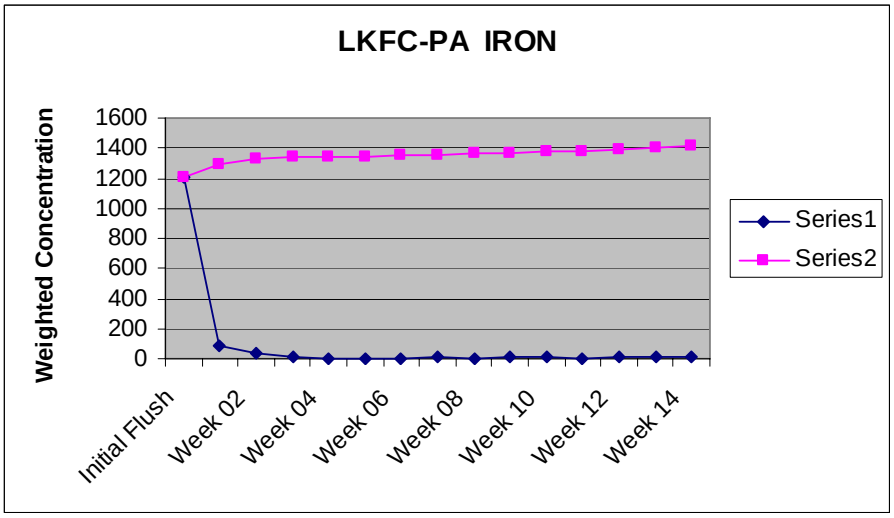

LKFC-PA MANGANESE
Weighted Concentration
140000
120000
100000
80000
60000
40000
20000
0
Initial Flush
Week 02
Week 04
Week 06
Week 08
Week 10
Week 12
Week 14
Series1
Series2


MKSS-PA MANGANESE
Weighted Concentration
3500
3000
2500
2000
1500
1000
500
0
Initial Flush
Week 02
Week 04
Week 06
Week 08
Week 10
Week 12
Week 14
Series1
Series2


BCS3-PA IRON
Weighted Concentration
160
140
120
100
80
60
40
20
0
Initial Flush
Week 02
Week 04
Week 06
Week 08
Week 10
Week 12
Week 14
Series1
Series2


HCS-IN IRON
Weighted Concentration
700000
600000
500000
400000
300000
200000
100000
0
Initial Flush
Week 02
Week 04
Week 06
Week 08
Week 10
Week 12
Week 14
Series1
Series2


KBF-WV IRON
Weighted Concentration
90
80
70
60
50
40
30
20
10
0
Initial Flush
Week 02
Week 04
Week 06
Week 08
Week 10
Week 12
Week 14
Series1
Series2



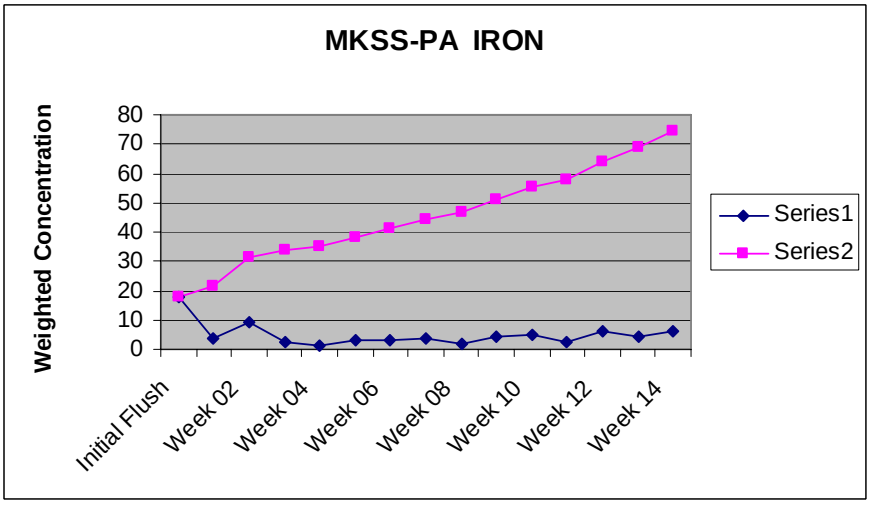


Figure 7.41. Leach curves for manganese and iron.

Discussion and Conclusions Concerning Minor Elements

Considering the inter-laboratory variations, the averaged data give remarkably smooth rate curves for the cumulative release of various minor elements. Regressions based on a power law fit (equation 7.2) were calculated for each of the cumulative release curves (Table 9).

The data for the major cations, calcium, magnesium and potassium plot on very smooth curves that give excellent power function fits with values of the statistical goodness of fit parameter, R^2, in the range of 0.94 to 0.99. If the leaching process were purely diffusion controlled, the exponent, n, should be 0.500. The fitted values scatter around the ideal value with the rather wide range of 0.3 to 0.7. It is probably reasonable to conclude that the release of these elements from the columns is a diffusion-controlled process.