

Table 7. Fraction of release of trace elements during the 28 d experiment calculated as the ratio of the mass of the major element released to the mass of the major element composition of the slag fraction.

slag fraction	As (%)	Ba (%)	Cd (%)	Co (%)	Cr (%)	Cu (%)	Ni (%)	Pb (%)	Sb (%)	Sr (%)	Zn (%)
SCB12Archive-1.3-3.5	0.18	0.15	0.013	0.0023	0.024	0.0046	0.054	0.012	0.20	0.35	0.0024
SCB12A-1.5-3.1											
BSB5A-1.5-2.3	0.091	0.11	0.0076	0.0017	0.023	0.0042	0.030	0.0068	0.089	0.35	0.0012
DE8C-2.25-3.25	0.16	0.21	0.0044	0.0029	0.023	0.033	0.061	0.0099	2.3	0.31	0.0015
DE8C-3.25-4.25											

The concentrations of the remaining trace elements – four of which are oxyanions (arsenic, antimony, chromium, and selenium) and two of which behave as transition metals (silver and thallium) – are shown as a function of time for the 28 d experiments in Figure 12. For antimony, arsenic, chromium, and selenium, the concentrations in the release experiments are above the concentrations in the Columbia River water. For silver and thallium, concentrations just above or mostly below the detection limits of ICP-MS were measured both in the release experiments and in the Columbia River water. Arsenic displayed a more consistent pattern of release during the 28 d experiment than most other trace elements – the order of release for the slag fractions is SCB12A > DE8C > BSB5A. The BSB5A slag fraction released the lowest fraction of the total arsenic in the slag (Table 7). Antimony and selenium were released at much higher concentrations by the DE8C slag fraction, but for antimony, not because there was more antimony in the DE8C slag, but because a higher fraction of the antimony was released. The fraction of selenium released could not be determined because the selenium concentration in the slag fractions was below the detection limit. The three slag fractions released chromium at similar concentrations and at similar fractions of the total chromium in the slags.

The major anions released by the slag fractions were measured by ion chromatography at the conclusion of the 28 d experiments (Table 8); these anions were not measured over time. The alkalinity was not measured for these samples. For fluoride, chloride, and sulfate, the concentrations released from the slag fractions into Columbia River water exceeded the concentrations present in the Columbia River water; for nitrate, the concentration released was less than that of Columbia River water for two slag fractions. The BSB5A slag fraction released more chloride and sulfate than the other slag fractions, and the DE8C slag fraction released less sulfate than the other slag fractions. The pH of the slag release solutions increased by about 0.4-0.6 pH units during the 28 d release experiments (Table 8). The initial pH was similar to that of the Columbia River water. Nitrogen purging was probably responsible for some of the pH increase because the purging would remove carbon dioxide. The duplicate experiments for each slag fraction displayed similar initial and final pH values.

Table 8. Concentrations of major anions released from the slag fractions into Columbia River water at the end of the 28 d experiments compared to the composition of the upper Columbia River water (also presented in Table 4) and the initial and final pH for the 28 d release experiments.

28 d release / river water	F ⁻ (ppm)	Cl ⁻ (ppm)	NO ₃ ⁻ (ppm)	SO ₄ ²⁻ (ppm)	pH initial/final ^a
SCB12Archive-1.3-3.5/SCB12A-1.5-3.1	0.21	1.09	0.22	23.6	6.71 / 7.25 6.65 / 7.12
BSB5A-1.5-2.3	0.18	1.78	0.60	19.2	6.92 / 7.31 6.89 / 7.39
DE8C-2.25-3.25/DE8C-3.25-4.25	0.15	1.12	0.22	12.8	6.83 / 7.42 7.10 / 7.56
total, Columbia River water	0.068	0.89	0.45	8.58	6.9±0.3

^a initial and final pH values for duplicate experiments

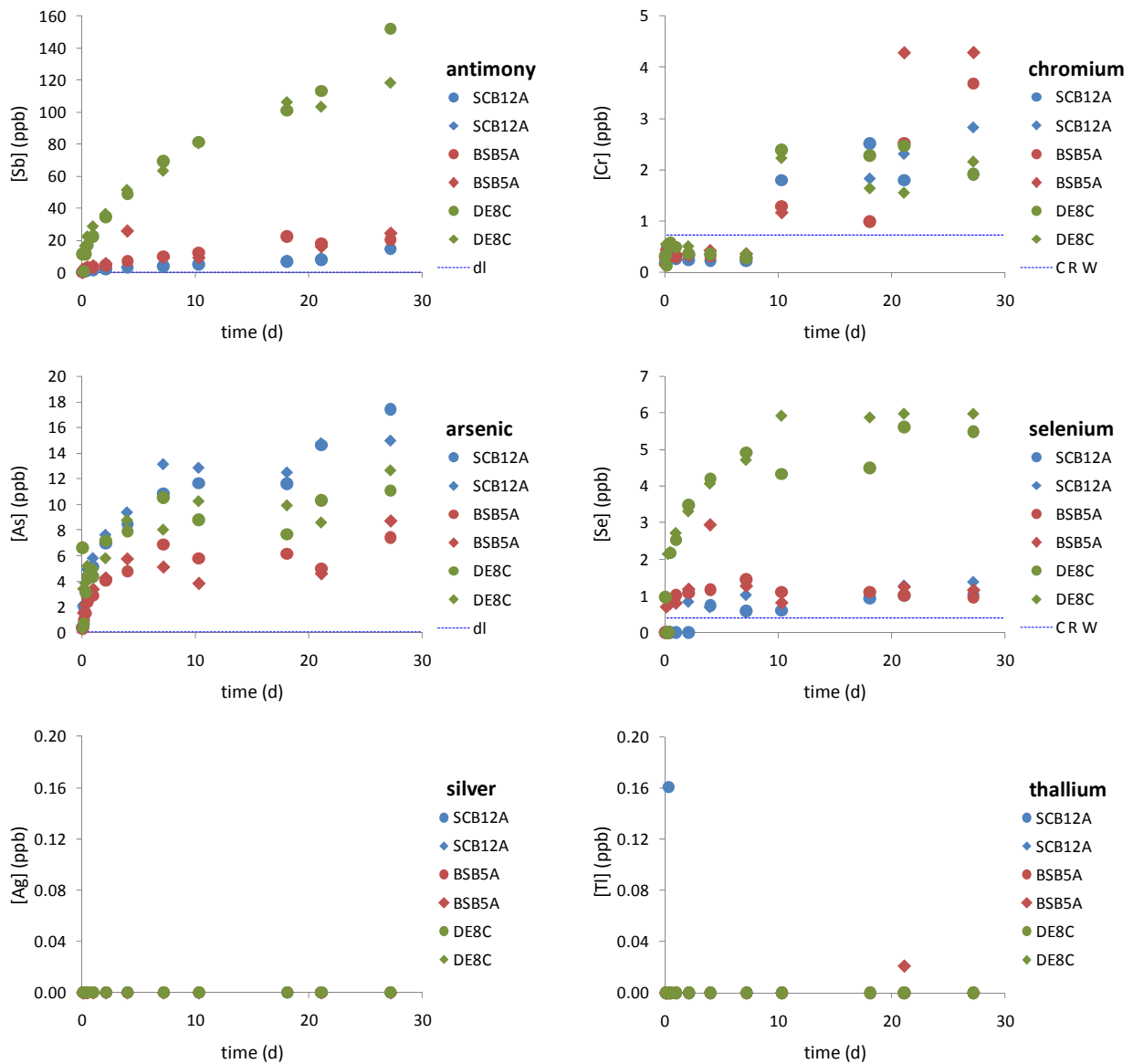


Figure 12. The release of antimony, chromium, arsenic, selenium, silver, and thallium from the slag separated from upper Columbia River sediment samples to Columbia River water under nitrogen-purged conditions during 28 d experiments. Duplicate results shown for each of the three slag fractions: SCB12A (composite of SCB12Archive and SCB12A), BSB5A, and DE8C. Measurements below the detection limits are shown as concentrations of zero. Horizontal dashed line shows concentration of elements in Columbia River water (C R W) or detection limit (dl). No horizontal line shown for silver and thallium because nearly all samples were measured below the detection limit.

References

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