

Mineralogy and alteration of fly ash from secondary Pb metallurgy

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The mineralogy and solubility of fly ash and air-pollution-control (APC) residues from a secondary lead (Pb) smelter have been studied on samples from the Příbram smelter, Czech Republic, recycling car batteries, with the emphasis on their potential environmental effect. The X-ray diffraction analysis, scanning and transmission electron microscopy and electron microprobe were used for this investigation. The presence of dominant anglesite (PbSO₄) and laurionite (Pb(OH)Cl) was observed in a sintered residue from after-burning chambers (800-1000°C). Low temperature Pb-bearing phases, such as KCl·2PbCl₂ and caracolite (Na₃Pb₂(SO₄)₃Cl), were detected in the major APC residue from bag-type fabric filters. The formation of anglesite, cotunnite (PbCl₂), (Zn,Cd)₂SnO₄ and (Sb,As)₂O₃ was observed during the sintering of this APC residue at 500°C in rotary furnace (Ettler *et al.*, 2005a).

The 720-hour leaching test on filter residues indicated rapid release of Pb and other contaminants. Caracolite and KCl·2PbCl₂ are significantly dissolved and anglesite and cotunnite form the alteration products, as was confirmed by mineralogical analysis (XRD, TEM/EDS) and PHREEQC-2 modelling (Ettler *et al.*, 2005a,b). The observed Pb-bearing chlorides have significantly higher solubility than anglesite and, following emission from the smelter stack, can readily dissolve, transferring Pb into the environmental milieu (soils, water, inhabited areas). As a result, only anglesite as an alteration product was detected by X-ray diffraction analysis in soil horizons highly contaminated by Pb smelter emissions (Ettler *et al.*, 2005c).

References

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Synchrotron studies of RbBr-bearing solutions ± CO₂ in synthetic fluid inclusions

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Salt- and CO₂-bearing solutions are common in geological environments, yet the consequences of interactions between these components remain unclear. XAS studies of corundum-hosted synthetic fluid inclusions that contain RbBr -CO₂-H₂O solutions have shown that: 1) Br exhibits a strong pre-edge peak in CO₂-bearing solutions at temperatures between 25 and 150°C. The pre-edge feature is similar to that shown by covalently bonded Br, but observed and calculated concentrations of covalent Br-bearing compounds (HBr, Br₂, CH₃Br) are vanishingly small. An alternative possibility is that CO₂ contributes to a charge delocalisation on the solvated Br ion that confers some covalent character to bromine-solute interactions, and; 2) Rb EXAFS at temperatures to 650°C and pressures to 0.6 GPa are consistent with a decrease in the number of waters of hydration and Rb-nearest neighbour distances with increasing temperature and pressure. This result is consistent with those of previous workers. The presence of CO₂ in concentrations of up to X(CO₂) of 0.1 is not observed to have a significant effect on either the number of nearest neighbours or ion-solute differences. However, the possibility that CO₂ affects salt speciation by inducing an increase in ion association, cannot be eliminated. Simulations show that a significant increase in the number of Rb-anion nearest number pairs would be difficult to detect by this method.

Overall, the presence of CO₂ is shown to affect the local environment of salts in solution, at least at low temperatures. Complementary methods are required to determine the magnitude and consequences of CO₂-induced changes in fluids at higher temperatures and pressures.