Phosphate stabilization of metalliferous mine wastes: The key to solving a major environmental menace?

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Phosphate stabilization of mine wastes aims to immobilize metals and encapsulate sulfide surfaces with stable, impermeable coatings of solid phosphate phases [e.g. 1, 2, 3, 4]. This study was undertaken to determine whether it is possible to use phosphate amendment (ie. phosphorite, phosphate fertilizer) to induce the formation of stable, impermeable phosphate coatings in polyminerallic sulfidic mine wastes using laboratory experiments and field trials.

Mine waste materials were obtained from the Broken Hill, Cannington and Century base metal mines (Australia). Waste materials were metal (PbZn) rich and consisted of major aluminosilicates as well as trace amounts of sulfide minerals (e.g. galena, sphalerite, pyrite). Column leach experiments were conducted on phosphate amended fine-grained waste rocks and tailings, whereas coarse-grained waste rock was investigated using heap leach piles at the Century mine site. Results of the laboratory experiments show that the fine-grained waste, treated with phosphorite, produced leachates with near-neutral pH values and did not allow the leaching of apatite and the formation of secondary phosphate phases. Consequently, metal mobility in these columns was restricted by the neutral pH conditions. Also, the field trials reveal that the coarse-grained waste rock was not coated by phosphate phases and that phosphate amendment of waste materials did not improve leachate quality compared to unamended waste. By contrast, the application of water-soluble phosphate fertilizer to fine-grained polyminerallic sulfidic waste suppressed sulfide oxidation and was most effective in inhibiting Pb release. The study demonstrates that phosphate stabilization represents a potential remediation tool for fine-grained Pb-rich mine wastes, particularly tailings.

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More constraints on the causes of the CO_2 deglacial rise based on its stable carbon isotopic ratio : Results and applications for last and penultimate deglaciations

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The reasons for the glacial (G) – interglacial (IG) CO_2 rise remain highly debated. This study provides an additional constraint on the causes of the ~90 ppmv CO_2 rise observed for the last two deglaciations, by using the stable carbon isotopic ratio, $\delta^{13}CO_2$. $\delta^{13}CO_2$ is analyzed in parallel with CO_2, using ice samples originating from the EPICA Dome C core (EDC) of East Antarctica and applying the dry extraction method (ice crushing).

A direct comparison of the CO_2 results for the last two deglaciations reveal a similar overall pattern (of a CO_2 rise) but many differences in the magnitude and the millenial-scale structure : higher amplitudes are observed for TII showing a total of ~110 ppmv G-IG difference instead of ~80 ppmv for TI, while the Bølling/Allerød warm equivalent of TI seems missing at TII. This is not that surprising when comparing with the δD evolution for the same time periods, where TII is more amplified than TI, or even with the CH_4 pattern, showing a continuous increase throughout TII.

Both deglaciations are accompanied by an initial atmospheric ^{13}C-depletion, providing evidence on the ocean deglacial dominance. The comparison of the $\delta^{13}CO_2$ evolution during TI and TII demonstrates significant discrepancies: first, the whole trend is more ^{13}C-depleted by 0.2‰ during TII, with higher magnitudes (up to 0.8‰, compared with a max of 0.6‰ for TI) and without that many oscillations on a millenial scale as observed for TI. This potentially implies same C-cycle forcings but of different strength.