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- Special Issues
- Library Search
- Title and Author Search

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Subscription

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[Volumes and Issues](#) [Contents of Issue 1](#)

Hydrol. Earth Syst. Sci., 5, 119-131, 2001
www.hydrol-earth-syst-sci.net/5/119/2001/

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The potential for phosphorus pollution remediation by calcite precipitation in UK freshwaters

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Abstract. This paper examines the potential for calcium carbonate to reduce phosphate pollution in freshwaters by co-precipitation, a process known as a "self cleansing mechanism". Calcium carbonate saturation levels and phosphate concentrations (SRP - soluble reactive phosphate) across the major eastern UK river basins are examined to test for solubility controls. The study shows that calcite saturation varies for each catchment as a function of flow and biological activity rather than by direct regulation by SRP. Indeed, there is no evidence, for any of the rivers studied, that calcite solubility controls hold. However, for groundwater and groundwater-fed springs in the Chalk of the Thames basin, calcite saturation is observed with associated low SRP levels. A self-cleansing mechanism may well be operative within the Chalk due to two factors. Firstly, there is a high potential for nucleation on the calcite micro-crystals in the aquifer. Secondly, there are within aquifer reactions that remove the calcite nucleating inhibitors (SRP and dissolved organic carbon, DOC) to levels lower than those occurring within the rivers do. These inhibitors enter the catchment at very high concentrations in association with agricultural pollution (fertilizer application and animal slurry) and household contamination (e.g. sewage sources from septic tanks). Under low flow conditions, when the saturation index for calcite is at its highest, so too is the concentration of the nucleation inhibitor SRP. Companion work shows that calcite precipitation can occur at the water-sediment interface of the river and this may involve SRP removal. The data, as a whole, define an apparent bound for calcite solubility control where in the presence of nucleating centres, SRP must be less than 4 mM-P I^{-1} and DOC must be less than 150 mM-C I^{-1} : a condition that does not seem to pertain within most UK rivers.

Keywords: calcite, calcium carbonate, phosphate, soluble reactive phosphate, dissolved organic carbon, LOIS, UK, rivers, self-cleansing mechanisms.

[Final Revised Paper](#) (PDF, 82 KB)

Citation: Neal, C.: The potential for phosphorus pollution remediation by calcite precipitation in UK freshwaters, Hydrol. Earth Syst. Sci., 5, 119-131, 2001. [Bibtex](#) [EndNote](#) [Reference Manager](#)

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