# Tracing sources of cadmium in agricultural soils using cadmium stable isotopes

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The application of phosphate fertilizers has, on a global basis, resulted in long-term accumulation of cadmium (Cd) in agricultural soils [1]. While this accumulation has led to concern over potential environmental consequences, we currently lack a viable tool to track fertilizer-derived Cd in terrestrial environments. In 1997, the main source of phosphate fertilizers in New Zealand (NZ) was changed from Nauru to a mixed product sourced from other phosphorites with lower concentrations of Cd. Around the same time, Cd accumulation in a 66-year-long field trial (Winchmore Farm, South Island, NZ) showed an apparent plateau [2]. In this study, Cd isotope ratios ($\varepsilon^{114/110}$Cd) were used to trace Cd sources in Winchmore soil and determine the cause of this plateau. The $\varepsilon^{114/110}$Cd was measured in archived phosphate fertilizer, phosphorite and topsoil (0-7.5 cm) samples from Winchmore. The $\varepsilon^{114/110}$Cd of fertilized topsoils and fertilizers was distinct from control (unfertilized) subsoils by around +0.6‰. Bayesian isotope modelling using pre- and post-2000 fertilizers and control soil as the end-members, confirmed the dominant contribution of Cd is from pre-2000 fertilizers ($\varepsilon^{114/110}$Cd=2.48±0.37) with signature comparable to source rocks ($\varepsilon^{114/110}$Cd=2.19± 0.39) but distinct from control subsoil ($\varepsilon^{114/110}$Cd=-3.33 ±0.41). The decline in Cd concentration after 2000 followed the reduction in fertilizer Cd concentration. The $\varepsilon^{114/110}$Cd of soil remained quite constant following the source change, confirming that soil Cd represents the historical burden of Cd (originating from Nauru phosphorites) and concurrent applications of fertilizer are not resulting in further accumulation of Cd.

[1] De Boo (1990) *Toxicol. Environ. Chem.* **27**, 55-63.
[2] McDowell (2012) *N. Z. J. Ag. Res.***55**, 133-146.