Dealumination in soil of the Auckland, Bay of Plenty and Waikato Regions, New Zealand.

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Dealumination is a term we have used to describe an increase in the concentration of acid recoverable Al as a result of accelerated weathering or chemical attack of primary crystalline and short-range order aluminosilicates (Taylor and Kim 2009). Briefly, this process has been observed in farmed soils but not in soils under background or forestry land uses. Two specific mechanisms that could favour Al mobilisation from clay surfaces include partial dissolution by local areas of high acidity associated with fertiliser granules, and surface complexation and extraction by the fluoride and residual hydrofluoric acid present in phosphate fertilisers.

In keeping with this interpretation, acid recoverable concentrations of several trace elements that are normally retained inside aluminosilicates (in residual phases) were also significantly higher in farmed compared with background soils but were not selectively enriched at the soil surface.

This process of dealumination was initially identified in farmed soils in the Waikato region but there is no reason to suppose it is confined only to this region. Soil quality monitoring data, including acid extractable elements, from two neighbouring regions, Auckland and the Bay of Plenty were compared for farmed and not farmed land uses. Trends in data were also estimated as the sites are resampled on a 5-6 year rotation. Site selection, sampling and analysis follow the appropriate chapters of the Land and Soil Monitoring Manual (Frampton 2009, Hill and Sparling 2009, Kim and Taylor 2009).

Results from the Auckland and Bay of Plenty regions showed statistically significant higher concentrations of Al in farmed soils compared to not farmed ones (Table 1), consistent with the results from the Waikato region. The dealumination process appears more widespread than just the Waikato region.

Table 1. Strong acid recoverable Al in farmed and not farmed soils from 3 regions of New Zealand

	Mean Al in mg/kg and (number of samples)		
	Auckland	Bay of Plenty	Waikato
Farmed soils	21000 (54)	16900 (79)	36700 (170)
Not farmed soils	13200 (15)	14100 (17)	20600 (23)
Enrichment Factor	1.6	1.2	1.8
P (pooled t-test)	<0.015	<0.015	<0.0001

Across the 3 regions, 71 farmed and 8 not farmed sites had been sampled twice, approximately 5 years apart (Table 2). There was a significant increase in Al for farmed soils ($p < 0.0001$), a mean increase of about 6000 mg/kg, or about 1000-1200 mg/kg/y. There was no significant change ($p > 0.05$) for not farmed soils.

Table 2. Trends in strong acid recoverable Al in farmed and not farmed soils

	Mean Al in mg/kg		p (paired t-test)
	Year 1	Year 5	
Farmed (n=71)	25200	31500	<0.0001
Not Farmed (n=8)	21600	17100	>0.05

Further data from the 2009-2010 round of sampling is expected to be added to the dataset before the conference, allowing statistical analysis of soil order and dominant mineral type.

The impact and significance of this dealumination process on soil properties, soil quality and productivity is still to be established. Given this process has been identified in some of the major farming areas of New Zealand, there is some urgency in making certain the actual mechanism, and ascertaining its effects on soil properties and implications to soil management.

References

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