THE MACAULAY LAND USE RESEARCH INSTITUTE

SELENIUM CONTENT OF AGRICULTURAL SOILS FROM SCOTLAND

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INTRODUCTION

Selenium (Se) is an essential element for human health. A decline in selenium intake by the UK population has occurred because of the replacement of American wheat by UK grain with a lower Se content (*Fig. 1, Table 1*). Because of the decline and demands for more locally produced food, there is increasing interest in gaining spatial knowledge about the selenium status of soils.

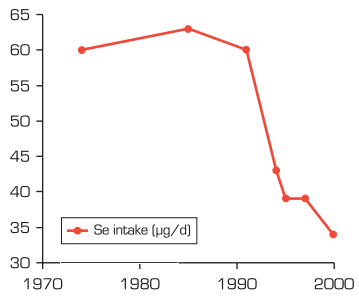


Fig. 1. Selenium intakes in the UK (SACN, 2007)

Low	
• England	39 (µg/d)
• Finland (pre 1984)	25
• France	29-43
• Germany	35
• Areas of China	7-11
• New Zealand (variable)	10-100
Moderate - high	
• Finland (post 1984)	110-120
• Canada	98-224
• US	60-220
• Areas of China	750-4990

Table 1. Selenium intakes (SACN, 2007)

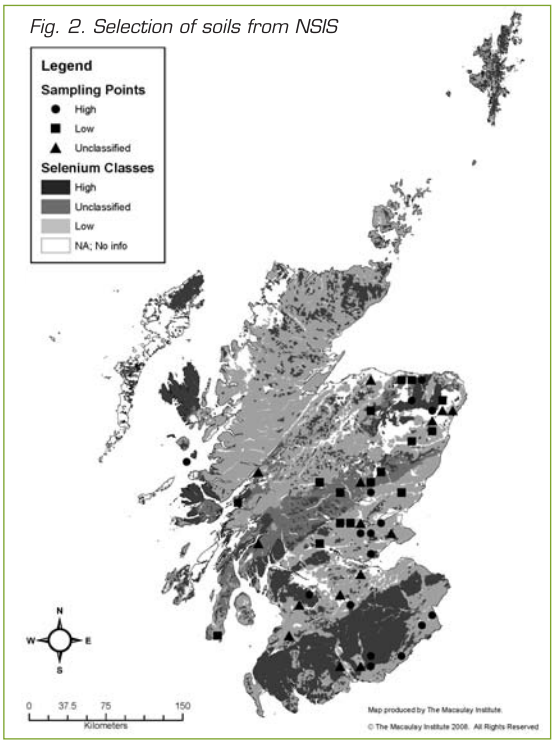
HYPOTHESIS

The Se content of Scottish soils is related to the parent rock type.

Selection of soils for analysis

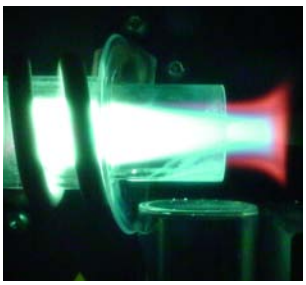
We selected agricultural soils from the 10-km grid positions of the National Soil Inventory of Scotland. The soils analysed were chosen on the basis that those derived from andesitic, basaltic or argillaceous rock are expected to contain more Se than soils derived from granites, sandstone, rhyolites, mica schist or non-volcanic greywackes (Ure and Berrow, 1982). We converted parent rock types to soil associations and selected soils expected to have relatively high, low and unclassified Se status (total 47 samples, *Fig. 2*).

Fig. 2. Selection of soils from NSIS



ANALYTICAL METHODOLOGY

The soils were extracted with *aqua regia*. The Se contents of extracts were measured by ICP-MS using $^{78}Se^{+}$ and a collision cell containing hydrogen to remove polyatomic interferences.



RESULTS

No significant difference between the *aqua-regia* soluble Se contents of the soils and their mapped parent material *(Fig. 3a)* or soil group *(Fig. 3b)* was apparent but there was a positive linear correlation with loss on ignition *(Fig. 4)* or organic matter content. To refine the mineralogical understanding the soils were quantitatively analysed by XRD. Partial least squares analysis of the mineralogical data revealed that the Se content of the soil was best explained by a three–component model (R^2 = 71%) and was positively related to organic matter (β = 0.68), negatively related to K-feldspar (β = -0.26) with other minerals being less important. It is difficult to explain the negative relationship with feldspar but this may be because feldspars are a major component of granite and other highly evolved rocks.

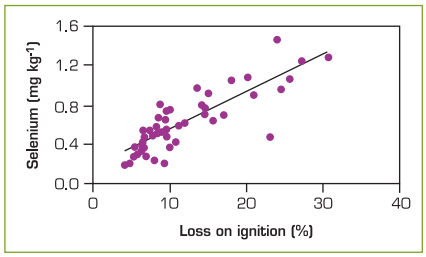


Fig. 4. Relationship between selenium content of soils and loss on ignition

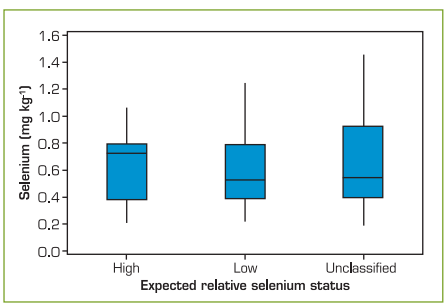


Fig. 3a. Boxplot comparison of selenium in soils predicted to have relatively high, low and unclassified selenium contents

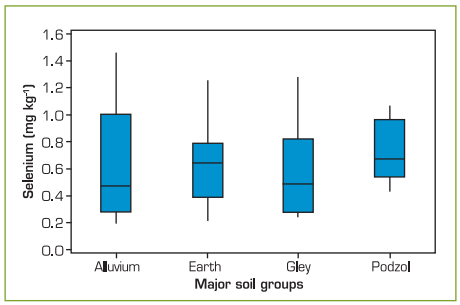


Fig.3b. Boxplot comparison of selenium in major soil groups

CONCLUSION

- The selenium content of agricultural soils from Scotland is positively related to soil organic matter and negatively related to K-feldspar contents.
- The range of selenium concentration values we found for Scottish soils, 0.19 to 1.46 mg kg^{-1} (mean 0.63 mg kg^{-1}), is consistent with previously published values.

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