TRACE ELEMENTS

IN

NEW ZEALAND PLANTS

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ABSTRACT

In biogeochemical studies initiated for the first time in New Zealand, some trace elements in indigenous plants and in the soils supporting these plants, were determined by emission spectrography and atomic absorption spectrophotometry.

A test of the biogeochemical method of prospecting was made by studying elemental concentrations in leaves of three tree species and in the corresponding soils from mineralised and non-mineralised ground at Copper-stain Creek, North-West Nelson. All samples were analysed for copper and molybdenum. Olearia rani was also analysed for zinc.

Elemental contents in plants and soils were compared by correlation calculations on a computer. The molybdenum content of the ash of O. rani leaves showed a highly-significant correlation with the content of the same element in corresponding soil samples. This indicated that O. rani could be used as a biogeochemical indicator for molybdenum mineralisation. No other significant plant-soil correlations were found for molybdenum, copper or zinc.

For a further set of O. rani samples, leaves, twigs, wood and flowers were all analysed for zinc, copper and molybdenum. This data showed that the leaves of O. rani were better than the other parts of the plant, and that analyses based on ash weight were better than dry weight values for indicating molybdenum mineralisation in the soil.

Cumulative frequency diagrams gave values for threshhold concentrations used to delineate the anomalous areas at Copperstain Creek.

Molybdenum contents in the ash of plants showed wide variations, ranging from one to 1600 parts per million. Copper and zinc contents showed less variation but there were significant differences in the mean values for each species.

A New Zealand serpentine flora and the associated soils from near Dun Mountain on the Nelson Mineral Belt was studied. In an initial orientation survey, it was found that seventy-one samples of twenty-six species showed that wide variations existed in the concentrations of the elements chromium, nickel, cobalt and copper. Six of these species were sampled further and analysed for chromium, nickel, copper, cobalt, calcium and magnesium.

The species Cassinia vauvilliersii, Hebe odora and Leptospermum scoparium were sampled both randomly and from a localised area of serpentine where soils were more uniform. Plant elemental contents were found to vary up to several orders of magnitude in both sets of samples. Specimens of the same species sampled from near the boundary of serpentine with sedimentary rocks and from an andesitic area at Mt. Egmont, contained much lower amounts of chromium, nickel, cobalt and magnesium and higher amounts of calcium than samples from serpentine.

Correlation coefficients were calculated for the relationships between pairs of elements and showed that for C. vauvilliersii, there were highly-significant correlations between plant ash and soil contents for chromium, nickel and cobalt. H. odora and L. scoparium showed similar but less pronounced correlations for the same three elements. It was concluded that these species, especially C. vauvilliersii would be useful for biogeochemical prospecting.

Twenty samples of each of the serpentine-endemic species, Myosotis monroi, Notothlaspi australe and Pimelea suteri were also

collected for comparison with the other, more common species. P. suteri, in particular, is a strong accumulator of chromium, nickel and cobalt although L. scoparium also accumulates chromium to a greater degree than the other species.

The highest concentrations found included 2.6% chromium in the ash of a P. suteri and 9% chromium in a soil in which L. scoparium grew. These values are higher than any previously observed in other parts of the world. Good correlations were found for some pairs of elements showing that chromium, nickel and cobalt are strongly related in soils and in most plant species.

The range of calcium and magnesium contents in plant ash was from one to 30%. Although the exchangeable-calcium content of soils was about one twentieth of that for magnesium, the Ca/Mg ratio in plants ranged from 0.1 to 5.0.

In view of the unusual concentrations of chromium in serpentine plants, the metabolism and uptake of the radioisotope chromium-51 was studied in selected species. Translocation of ^{51}Cr when applied as chromate to cuts in the stem or the tips of branches of seedlings was observed to be greater in P. suteri and L. scoparium than in C. vauvilliersii or H. odora, as indicated by radioautography. In young L. scoparium (manuka) plants, ^{51}Cr supplied as chromate was translocated as chromate in the xylem sap as shown by high-voltage electrophoresis.

Trifolium pratense seedlings (red clover) which were more readily available and grown in nutrient solution for ease of manipulation, were able to absorb and translocate ^{51}Cr to the leaves when the ^{51}Cr was supplied as either sodium chromate or chromic chloride.

In both species (T. pratense and L. scoparium), generally much less than 5% of the ^{51}Cr appeared to be bound to protein or nucleic acids. In the roots of L. scoparium seedlings, 32% of the radioactivity was soluble in boiling 80% ethanol and a further portion was soluble in boiling water. These fractions were examined by high-voltage electrophoresis and a total of 18% of the ^{51}Cr in roots of L. scoparium cultured in nutrient solution existed as the trioxalatochromate(III) ion with lesser amounts as two other soluble anionic compounds. T. pratense did not show the presence of the trioxalatochromate(III) ion.

It was concluded that the feasibility of carrying out biogeochemical prospecting in New Zealand has been demonstrated for the first time. Further, the plant chemistry studies have contributed not only to general plant nutrition research, but also have provided basic information for the understanding of the trace element metabolism involved in biogeochemical prospecting.

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