This thesis is presented in partial fulfillment of the requirements for the degree of Master in Science

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Errata

Contents pages: Numbering out by one unit after page 14 which should be page 13. All subsequent pages should be one less. Hence also Table 4 is on page 30 not 31.

Page 2 line 6: "its" not "it's".

Page 12: last sentence should read "The permissible values may be different for various countries or states depending on individual regulation and land use."

Page 20 line 6: the part of the equation that shows "π^2/mc" should read as "$\pi^2 e^2$/mc".

References:

Page 19: "Patel and Agarwal 1991" should read as "Patel and Agarwal 1992".
"Cleven and Fokkert 1994" should read as "Cleven and Fokkert 1993".

Page 36 line 14: "Stockey" should read as "Stockley".

Page 61: Nicks and Chambers reference: "phytominig" should read as "phytomining".

Page 63 at top: The Stockley (1980) ref. is missing and should read as follows:
Stockley,E. 1980. Biogeochemical Studies on the Nickel Complex Contained in the Nickel-accumulating Legume *Pearsonia metallifera* from the Great Dyke Area, Zimbabwe. BSc (Hons.) Thesis, Massey University, Palmerston North, New Zealand.

Page 63 line 3: The date of the Tremel et al. ref. is 1997 not 1996.

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Thallium Phytoextraction and its Economic Significance

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Abstract

Thallium is a volatile toxic metal which has many industrial uses. The sources of thallium include natural geochemical sources and by-products of industrial processes. One of the problems in assessing thallium pollution potential is the lack of an accurate method of quantification of this element. Flame atomic absorption spectrometry (FAAS) is a good method of analysis but only down to the 1.0 mg/kg (ppm) level. For lower concentrations, analytical techniques have been difficult and inaccurate. A newly described method using graphite furnace atomic absorption spectrometry (GFAAS) has been found useful for low Tl concentrations. A method was designed to detect low concentrations of thallium in plant and soil samples. The graphite furnace technique worked well for the data presented in this paper. However, samples of different origin could have more severe matrix effects such as high iron contents.

Thallium has been found to be readily available for plant uptake. The extractability of thallium was significantly higher then other metals such as cadmium and zinc. This property is ideal when considering a possible phytoextraction operation. Two plant species were found to accumulate thallium to levels up to 411mg/kg in *Iberis intermedia* and 504mg/kg in *Biscutella laevigata*. These high values indicate potential for phytoremediation and phytomining in areas of sufficient contamination. The properties of which make thallium an ideal candidate for phytoremediation also make the metal a high risk for biota.

Experiments were also conducted to determine the partitioning and sequestration of thallium within plant organelles. This work was limited to the two hyperaccumulating species but future work could compare non-tolerant species. Evidence from this research might give a better understanding to the mechanism involved in plant uptake and storage of thallium. Agricultural crops used for human consumption or animal grazing may cause deleterious health effects. Thallium is extremely toxic, effecting the nervous system and impairing heart function at low levels. Higher concentrations will cause death. It is possible that some of the illness symptoms observed in humans may be derived from low levels of

thallium in foodstuffs. Aside from a few economic mineral deposits, there is no information of a world-wide distribution of thallium, so health effects can not be accurately assessed.

This thesis describes experiments carried out on common vegetable and their uptake of thallium to determine safe levels of this element within the soil. This information will also be useful to farmers growing crops on contaminated soil will advise them on which plants would uptake less thallium. Thallium has not been studied as extensively as many other heavy metals that are more common in the environment. Although the crustal abundance of thallium is low (0.49-0.7 mg/kg average range), the toxicity of this element is very high, and it is readily available for plant uptake. The toxic effects on animals and plants should be monitored closely.