INDICATIVE ASSESSMENT OF Ni PHYTOMINING VIABILITY IN SERPENTINITE OUTCROP AT GINIGALPELESSA

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Degree of Master of Philosophy

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DECLARATION OF THE CANDIDATE

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The above candidate has carried out research for the MPhil thesis under my supervision.

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ACKNOWLEDGMENT

Foremost, I would like to convey my sincere gratitude to my M.Phil. supervisors Prof. A.M.K.B. Abeysinghe, Prof. H.M.R. Premasiri, and Prof. N.P Ratnayake of the Department of Earth Resources Engineering, University of Moratuwa and Prof. W.T.P.S.K Senarath of the Department of Botany, University of Sri Jayewardenepura, for their immense guidance, support, and supervision for my research work. Also, I wish to acknowledge the financial support provided by the Senate Research Committee (SRC), University of Moratuwa under the grant number SRC/LT/2021/15. Moreover, I would like to convey my heartfelt gratitude to the other members of the research team, Prof. A. S. Ratnayake, Eng. N.P Dushyantha and Eng. N.M. Batapola for their enormous support and guidance throughout the research.

Furthermore, I am sincerely thankful to Dr. S.P. Chaminda, Head of the Department of Earth Resources Engineering, University of Moratuwa, Dr. G. V. I. Samaradivakara, the Former Head, Dr. C. L. Jayawardena, the Research Coordinator, and all the academic staff members for their support and guidance. Also, I wish to thank the non-academic staff members, especially Mrs. W.A.S.M. Wickramarachchi, Mrs. A.R. Amarasinghe, Mr. S.S.U. Silva, Mr. W.R.M.D.M.B. Wickramasinghe, Mr. W.W.S. Perera, and Mr. S.D. Sumith of the Department of Earth Resources Engineering, University of Moratuwa for their continuous assistance during sample collection, processing, and analysis.

I am deeply grateful for my family, friends, and all the individuals, who encouraged, supported, and guided me throughout this research work to complete my M.Phil research.

Abstract

With the recent recognition of Ni as a critical metal, it is challenging to find alternative Ni resources and new extraction techniques to secure a stable supply of Ni. In this context, Ni phytomining has attracted widespread attention as an eco-friendly mining approach, which was especially developed to extract metal from low-grade metal resources. In phytomining, hyperaccumulator plants are used to recover Ni from Ni-rich low-grade soils such as serpentine. Ginigalpelessa is one of the largest serpentinite deposits in Sri Lanka, where the geology and serpentine toxicity are well-documented. However, limited approaches have been taken to study the potential of Ni phytomining in soil. Therefore, 31 locations were sampled and collected soil and rock to assess the Ni enrichment in the serpentine soil. The native plants were analyzed to identify hyperaccumulators for phytomining experiments. Though the total Ni grade in soil varied from 0.4-1.7 wt%, the low bioavailable fraction (1-4 wt%) makes it challenging to implement phytomining in the deposit. Hyperaccumulation assessment of native plants recognized *Apluda mutica* (*A. mutica*) as the best plant species for phytomining. During phytomining trials, the selected Ni accumulator species showed a strong negative correlation between hyperaccumulation and increasing soil treatments. *Crotalaria verrucosa* and *A. mutica* produced the highest Ni-rich bio-ores. The leaching assays were carried out with open burnt and incinerated bio-ores of *A. mutica* under different pulp densities (100 g/L and 200 g/L) and H_2SO_4 concentrations (1 mol/L and 5 mol/L). The highest leaching efficiency was observed as 59% in open burnt samples (under 100 g/L; 5 mol/L H_2SO_4). The high Ni-enriched locations (>1.5 wt%) in the deposit need to be assessed further for direct Ni mining while the remaining area can be developed for in-situ phytomining. The hyperaccumulators identified in the study can be used for soil remediation from Ni and Co-contaminated soils.

Keywords: Ni enrichment, Ni hyperaccumulators, bioconcentration factor, leaching efficiency

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LIST OF ABBREVIATIONS

Abbreviations	**Description**
EDTA	Ethylenediaminetetraacetic Acid
ICP-MS	Inductively Coupled Plasma Mass Spectrometer
REE	Rare Earth Elements
USGS	United State Geological Society
XRD	X-Ray Difraction

LIST OF APPENDICES