

---

# Contents

---

<b>INTRODUCTION</b> . . . . .	vii
<b>CHAPTER 1. A NEW APPROACH TO MULTI-SITE AND MULTI-SCALE REHABILITATION BY PHYTOEXTRACTION</b> . . . . .	1
1.1. Remedial phytoextraction on a highly contaminated former mining site: pilot site at “Les Avinières” . . . . .	3
1.1.1. What are the characteristics of the site at “Les Avinières”? . . . . .	3
1.1.2. What are that objectives? . . . . .	5
1.1.3. What are the boundaries of the study site? . . . . .	6
1.1.4. Why choose phytoextraction? . . . . .	7
1.1.5. Does phytoextraction cause the transfer of TEs via pollinating insects? . . . . .	9
1.1.6. What is the bacterial composition of the soil in “Les Avinières”? . . . . .	12
1.1.7. What are the adaptation strategies of this species of bacteria? . . . . .	14
1.1.8. KDG, a key sugar for the development of Rhizobium metallidurans? . . . . .	17
1.1.9. How do we design an optimized method to synthesize KDG? . . . . .	18
1.1.10. Is KDG capable of introducing competitive bacterial growth? . . . . .	20
1.1.11. From KDG to bi-specific phytoextraction. . . . .	23
1.1.12. How do we optimize the agronomic conditions of Zn phytoextraction?. . . . .	28
1.2. Phytoextraction on Caledonian mining sites currently in use: toward productive rehabilitation . . . . .	30

1.2.1. An economy toward the exploitation of nickel. . . . .	30
1.2.2. What are the environmental consequences? . . . . .	31
1.2.3. What are the objectives of this study? . . . . .	33
1.2.4. Two studies and two objectives . . . . .	35
1.2.5. Where were studies 1 and 2 carried out? . . . . .	37
1.2.6. What are the constraints imposed by the nature of the Caledonian soil? . . . . .	39
1.2.7. How do we monitor the growth of transplanted species? . . . . .	40
1.2.8. Non-destructive assessments of biomass . . . . .	41
1.2.9. Have we managed to reduce the typical mortality rate? . . . . .	42
1.2.10. Is the plant growth satisfactory? . . . . .	44
1.2.11. What are the accumulation capacities of nickel and manganese? . . . . .	45
1.2.12. Conclusion . . . . .	46
<b>CHAPTER 2. FROM PHYTOEXTRACTION TO GREEN CHEMISTRY AND VICE VERSA VIA ECOCATALYSIS . . . . .</b>	<b>51</b>
2.1. Ecocatalysis, starting point for a new green chemistry? . . . . .	53
2.1.1. A project that is part of a new sustainable chemistry . . . . .	53
2.1.2. What is ecocatalysis? . . . . .	54
2.2. Some concrete examples of ecocatalysis. . . . .	58
2.2.1. A new approach to pharmaceutical chemistry: from <i>Psychotria douarrei</i> to monastrol . . . . .	58
2.2.2. An unprecedented recovery of cellulose waste . . . . .	61
2.2.3. Oxidizing solutions for substitution according to REACH. . . . .	61
2.2.4. Bio-based palladium, a strategic solution at the crossroads of innovation and performance. . . . .	64
2.2.5. The need to return to naturalness: biocosmetics or natural cosmetics? . . . . .	68
<b>CONCLUSION . . . . .</b>	<b>69</b>
<b>BIBLIOGRAPHY . . . . .</b>	<b>73</b>
<b>INDEX . . . . .</b>	<b>83</b>