

Scientific Lecture

Hyperaccumulator Plants

University of New Caledonia

Monday 30 July 2018 | 09:00-16:45

Salle du Pôle Numérique et Technologique

www.nouvelle-caledonie.ird.fr

sandrine.isnard@ird.fr

www.univ.nc

valerie.sarramegna@unc.nc



INTRODUCTION

More than 40 years since the discovery of the spectacular New Caledonian hyperaccumulator tree *Pycnandra acuminata*, knowledge on these unusual plants has advanced considerably. Hundreds of other hyperaccumulators of metal and metalloid elements have since been reported, and new discoveries continue to be made at an accelerated pace. The field has matured and is the current subject of detailed investigations into the molecular biology and physiological aspects of the hyperaccumulation phenomenon, as well as research on ecological interactions. Hyperaccumulator plants have also found useful applications in phytoextraction technologies, especially in nickel phytomining.

Much effort in the late 1970s focused on finding more nickel hyperaccumulators in the Mediterranean region and Turkey, in New Caledonia and elsewhere. To date, 65 hyperaccumulator plants have been found from New Caledonia, 13 from Cuba, and 59 from Turkey, with smaller numbers from Brazil, Malaysia, Indonesia, the Philippines and several other countries. The search is not over: more hyperaccumulators have recently been found among herbarium collections using a handheld X-ray fluorescence instrument. The extreme behaviour implied by hyperaccumulation results from specific metal or metalloid transport and sequestering mechanisms. Inquiries into these processes span all biological sciences, from genetics and molecular biology to physiology and biochemistry.

PROGRAMME

- 08:30** **Coffee-break / Welcome**
- 09:00–09:15** Opening by Sandrine Isnard, IRD and Valérie Burtet-Sarramegna, UNC
- 09:15–10:00** **The discovery and global distribution of hyperaccumulator plants**
Roger Reeves
- 10:00–10:45** **Biogeochemistry of nickel in ultramafic ecosystems**
Guillaume Echevarria, Université de Lorraine-INRA
- 10:45–11:15** **Agromining: progress in farming for metals, especially nickel**
Alan Baker, UQ, Brisbane
- 11:15–11.45** **Incorporating hyperaccumulator plants into mine closure**
Stéphane McCoy, Vale Inco
- Lunch**
- 13:00** **Coffee-break**
- 13:30–14:00** **Synchrotron techniques applied to New Caledonian hyperaccumulators**
Antony van der Ent, UQ, Brisbane
- 14:00–14:30** **Seed ecology of the nickel hyperaccumulator *Psychotria gabriellae***
Bruno Fogliani, IAC
- 14:30–15:00** **Diversity and distribution of hyperaccumulation in the flora of New Caledonia**
Sandrine Isnard, IRD
- 15:00–15:30** **Ecophysiological and field experiments on New Caledonian hyperaccumulator plants**
Adrian Paul, UQ, Brisbane
- 15:30** **Coffee-break**
- 15:45–16:15** **Understanding the biomolecular mechanisms of hyperaccumulation**
Valerie Burtet, UNC
- 16:15–16:45** **Phytomining trials in New Caledonia**
Cyril Poulain, CNRS

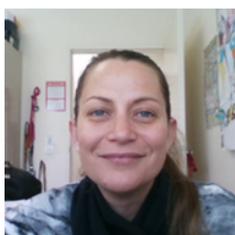
SHORT BIOGRAPHIES OF THE SPEAKERS



Dr Sandrine Isnard (sandrine.isnard@ird.fr) is tropical plant biologist whose researches focus on functional traits and ecological factors involved in the diversification of plant forms. Her approaches include plant architecture, biomechanics, ecophysiology and anatomy. In New Caledonia her projects focus on the originality and disharmony of the flora. Her recent interest in hyperaccumulator plants rest on the convergence of this phenomenon in New Caledonia, crossing a wide phylogenetic spectrum, and the underlying diversity of mechanisms and adaptations involved in hyperaccumulation.



Associate Professor Bruno Fogliani (fogliani@iac.nc) is the Deputy Director of the New Caledonian Agronomic Institute and was previously Assistant Professor at the University of New Caledonia. He is involved in the coordination of several research contracts engaged with New Caledonian Institutions as well as with Mining Industries dedicated to conservation, revegetation and/or ecological restoration. His scientific interests focuses on ecology of seed used for ecological restoration of mining site in New Caledonia. He also develops research programs on hyperaccumulator plants to understand their ecophysiology from seed to adult plant. He actually participates to a phytomining project dedicated to the use of this kind of plant for revegetation of degraded mining site and for utilization of the metal contained in their leaves for green chemistry.



Dr Valerie Burtet (valerie.sarramegna@univ-nc.nc) is an Associate Professor of Biochemistry and Molecular Biology at the University of New-Caledonia, and member of the ISEA laboratory (Institute for Exact and Applied Sciences). Her research interests focus on *Amborella trichopoda*, the ancestor of all flowering plants which has survived only in New-Caledonia and focuses on dissecting the molecular mechanisms of metal hyperaccumulation (more specifically nickel) using multi-disciplinary and comparative approaches.



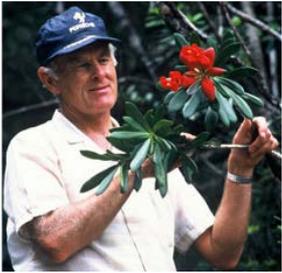
Dr Stéphane McCoy (stephane.mccoy@vale.nc) is a tropical plant biologist who manages the native species nursery and mine restoration program of Vale New Caledonia since 2000. His work includes testing native species for revegetation of different mine environments based on their adaptive traits for propagation and growth. More recently he was worked on evaluating potential (Ni and Mn) hyperaccumulators in nursery and revegetation trials to underline challenges and potential long term uses for mine restoration in New Caledonia.



Dr Cyril Poullain (cyril.poullain@cnr.fr) is a chemist and an ecologist from the Laboratory of bio-inspired chemistry and ecological innovations (ChimEco) of CNRS in France and in New Caledonia. Precisely, he has an interest on the development of hyperaccumulators plants (Ni and Mn) and the valorisation of their leaves into catalysts named ecocatalysts. The aim of Ecocatalysis is the implementation of breakthrough innovation and cross-disciplinary research in ecological restoration, organic chemistry and green catalysis to overcome this paradox.



Professor Alan Baker (ajmb@unimelb.edu.au) is a 'retired' Professor of Botany (Ecology & Environmental Science) from The University of Melbourne, Australia where he remains an Honorary Professor, and also at the Centre for Mined Land Rehabilitation, Sustainable Mineral Institute, The University of Queensland. He is a Visiting Professor and member of the LSE/INRA agromining team at the University of Lorraine, Nancy, France. His research career of over 45 years has been devoted to the study of ecophysiological and evolutionary aspects of metal uptake, tolerance and (hyper)accumulation in plants and has worked with Roger Reeves and others around the world in the search for new hyperaccumulator plants. He is currently actively involved in the development of phytomining metals and metalloids elements and the ecological restoration of mined lands.



Professor Roger Reeves was formerly Lecturer and Professor in Chemistry, Massey University, Palmerston North, New Zealand. With a background in Physical and Analytical Chemistry, specializing in trace element analysis techniques, he began studying metal accumulation by plants through his association with the late Professor Robert Brooks. Since joining a project with Brooks and Tanguy Jaffré in New Caledonia in 1975, he has worked on plant and soil composition of metallophytes with collaborators in many European countries, USA, Cuba, Brazil and Turkey, paying particular attention to hyperaccumulators and to rare and threatened species. From analysis of both herbarium specimens and freshly collected field materials, the hyperaccumulation of nickel and some other elements by approximately 300 plant species has become known through the work of the Massey laboratory.



Professor Guillaume Echevarria (guillaume.echevarria@univ-lorraine.fr) is a biogeochemist at University of Lorraine at the Laboratory of Soil and Environment Studies. After being offered a tenured position (1998 - 2008), he was appointed full Professor at the University of Lorraine at the Laboratory of Soil and Environment Studies (LSE) where he led the Phytoremediation team up to 2017. His skills include ecophysiology, biogeochemistry using stable and radioactive isotopes, pedology, mineralogy, synchrotron X-ray techniques for imaging and studying speciation. He contributed to the characterization of the ultramafic flora of several regions of the world (Balkans, South East Asia, Central America, Brazil) by active participation in many field surveys and discovery and study of metal hyperaccumulator species worldwide. He is also a pioneer in the development of cropping systems for Ni hyperaccumulators for agromining purposes. He is currently leading two European projects on the development of nickel agromining in Europe ('LIFE AGROMINE' and 'Agronickel') that involve ten partners from seven countries.



Dr Antony van der Ent (a.vanderent@uq.edu.au) is an ecophysiological and biogeochemist whose research focuses on the biopathways of trace elements (Ni, Co, Cr, Mn, Cd, Pb, Zn and REE) in soil and plant systems. He has a specific interest in the application of phytotechnologies that utilise hyperaccumulator plants (phytomining). He has had the opportunity to study metallophytes and hyperaccumulator plants on five continents including in the Chilean Andes, the Copper belt of Northern Zambia, Broken Hill in Australia, Borneo, Sulawesi, Halmahera and New Guinea in the Asia-Pacific Region, South Africa, New Caledonia and various countries in Europe.



Mr Adrian Paul (adrian.paul@uq.edu.au) is a PhD student, whose research focus on the biogeochemical cycling of nickel and the fundamental mechanisms underlying hyperaccumulation. He firstly focused on copper and arsenic hyperaccumulation in the Philippines before orienting his research towards Ni phytomining at the United States department of Agriculture in collaboration with Rufus Chaney. He is currently at the Sustainable Mineral Institute (University of Queensland) under the supervision of Antony van der Ent and focuses.



SPECIAL GUEST : The Lecture is organised with the contribution of Dr Tanguy Jaffré, IRD Emeritus Professor, whose pioneering research on the New Caledonia flora has been tremendous, including the discovery of hyperaccumulator Plants. Now retired yet still active, Tanguy Jaffré was granted the medal of the Legion of Honour for his achievements in 2018.