PHYTOMINES— **P**lant **HY**peraccumulators **TO MI**ne **N**ickel-**E**nriched **S**oils

PROJECT DESCRIPTIONS

University of Arizona – Tucson, AZ

Systematic Elemental Screening of Herbarium and Field Plants to Create a Comprehensive U.S. Plant Inventory for Metal Hyperaccumulators - $999,679

University of Arizona is conducting a large-scale herbarium x-ray fluorescence (XRF) scanning project, with more than 100,000 scans to discover new metal-harvesting hyperaccumulating plants in the U.S. Using a portable XRF spectrometer, this project will improve the accuracy of elemental analysis and provide critical insight into the potential of native U.S. flora for phytomining. The results will not only identify new hyperaccumulators, but also optimize metal uptake under native geographic conditions, investigate soil-microbe interactions beneficial to phytomining, and develop the first open-access database of metal hyperaccumulator plants.

University of Wisconsin–Madison – Madison, WI

Design and Application of a Genetic Toolbox to Domesticate Odontarrhena corsica and Odontarrhena chalcidica for Nickel Phytomining in the United States - $1,471,665

University of Wisconsin–Madison is developing molecular and genetic tools to domesticate wild *Odontarrhena corsica* and *Odontarrhena chalcidica* for an efficient phytomining system adapted to domestic climatic conditions and requirements for biosafety. The project targets increasing nickel yield per hectare to greater than 250 kilogram per hectare and to mitigate the invasive behavior of *Odontarrhena*. The project will create a biomolecular toolkit, including an annotated genome sequence, an atlas of expressed genes, plant transformation, and gene editing systems.

University of Massachusetts Amherst – Amherst, MA

Camelina sativa for Hyperaccumulator of Nickel (CaSH-Ni) - $1,297,056

University of Massachusetts–Amherst is developing a high biomass, fast growing, non-food crop as a nickel hyperaccumulating plant. Through understanding the molecular mechanisms for nickel hyperaccumulation in plants, a genetically engineered species will be developed, and its growth conditions will be optimized. Advanced characterization of soil chemistry will inform potential biodegradable soil amendments that increase nickel bioavailability.

Michigan Technological University – Houghton, MI

Chemically and Biologically Catalyzed Phytomining of Nickel from Serpentine Barren Soils - $1,900,000

Michigan Technological Institute in collaboration with Stevens Institute of Technology is developing a chemically and microbiologically catalyzed phytomining technology system to make nickel more available for uptake by hyperaccumulator plants growing in nickel-enriched marginal soils. Technology objectives include optimizing biodegradable chelating agents to mobilize nickel for plant uptake, prescribing plant rhizospheric bacteria to aid in nickel

uptake and enhance plant growth, and identifying biochemical mechanisms of nickel accumulation in hyperaccumulator plants. Furthermore, the team will investigate novel biosensors to measure nickel accumulation in plants in real-time and perform analyses to demonstrate economic and environmental sustainability of its approach.

University of Florida – Gainesville, FL

Nickel Farming: Improving a U.S.-native Hyperaccumulator Plant for Commercial Cultivation - $1,900,000

University of Florida is domesticating a native metal-harvesting hyperaccumulator plant for the commercial production of nickel. The project will apply advanced plant science and artificial intelligence-driven growth monitoring systems to increase the nickel concentration and biomass yield of the plant. The project will include technology transfer and commercialization activities to develop U.S. nickel production from lands that cannot be mined conventionally and are of marginal agricultural value.

Advanced Environmental Technologies – Fort Collins, CO

Development of an Alfalfa/Biodigested Lignite/Fungal Bioleaching-Based System to Enhance Phytomining of Nickel from Soil - $600,000

Advanced Environmental Technologies is optimizing agronomic practices to increase the annual yield of nickel extracted from marginal soils. The modifications will focus on increasing the absorption of insoluble nickel, the biomass, and growth rate of metal-harvesting plants using sustainable nitrogen addition and carbonaceous amendments. If successful, the project will serve as an important source for the increasing mineral demands for lithium batteries.

Verinomics – New Haven, CT

Developing a Sterile, High-Yield Phytomining Platform to Bring Low-Carbon Nickel Production to the United States - $1,722,000

Verinomics and Metalplant are collaborating to domesticate and improve two foreign nickel hyperaccumulator species. The team will use gene editing and genomics technologies to prevent invasive behavior while enabling an increase in yield. The resulting plants will be candidates for phytomining nickel resources in the United States.