



MINOTAUR
EXPLORATION

MINOTAUR EXPLORATION LIMITED
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Agricultural Applications for Halloysite Nanotubes

Summary

- Minotaur Exploration and Andromeda Metals participate in a new agricultural research project utilising halloysite nanoclays to enhance nutrient value in cropping soils.
- The three year, \$2.4M project, led by University of Newcastle's Professor Ajayan Vinu, commences in June spurred by a successful research grant application through the Cooperative Research Centre for High Performance Soils (Soil CRC).
- The project will include a consortium of soil scientists, agronomists and industry partners under the Soil CRC umbrella (including amongst others University of Newcastle, Murdoch University and the NSW Department of Primary Industries).
- Project to focus on engineered nanomaterials derived from Great White halloysite as novel nutrient delivery vehicles for the Australian cropping industry.

Background

Natural Nanotech Pty Ltd (NNT) is a research and commercialisation venture jointly owned (50:50) by Minotaur Exploration Limited (ASX: MEP, Minotaur) and Andromeda Metals Limited (ASX: ADN, Andromeda), formed to investigate advanced nanotechnology applications for halloysite. NNT is working with the University of Newcastle's Global Innovative Center for Advanced Nanomaterials (GICAN) on high-tech applications for halloysite - a natural clay nanotube form of kaolinite - from the Great White Kaolin high-grade kaolin-halloysite deposits in South Australia.

Natural Nanotech's projects with GICAN are directed at developing commercially attractive solutions for a range of environmental issues using nano-porous materials synthesised from natural halloysite-kaolin mixtures. Recent research highlights outstanding potential for adsorbent-related applications in a broad range of areas including carbon capture and conversion, hydrogen storage and transport, remediation of water and wastewater, energy storage technologies, and antibacterial and agricultural applications. The unique properties of Great White Project halloysite-derived nanomaterials that make them so amenable to these applications are their enormous surface area per unit weight, their porous nature and differential charge capabilities between inner and outer surfaces.

A number of parallel research grant applications are in the pipeline to provide additional funding to accelerate activity in these key areas. This successful agricultural grant application by Minotaur, Andromeda and GICAN through the Soil CRC relates to novel technologies for nutrient delivery into cropping soils.

Soil CRC Research Grant

The research project "Engineered carbon-clay composite based novel fertilisers to overcome nutrient stratification in soils" will test the ability of halloysite nanoclays from the Great White deposits in South Australia to contribute to novel fertiliser formulations for solving the huge problem of phosphorous stratification in Australian soils.

This is a \$2.4m project over 3 years, with most of the cash and in-kind support coming through the Soil CRC. Minotaur and Andromeda are to each contribute \$50,000 p.a. and supply the required halloysite nanoclays from their extensive sample base from the Great White halloysite-kaolin deposits.

The researchers will design and evaluate specifically engineered nanocomposite materials for enhanced nutrient delivery into the subsoil, particularly P and Zn, and quantify improved crop productivity. The Soil CRC has extensive research facilities under controlled and field environments together with pre-eminent agronomic research experience.

Australia spends more than \$12 billion annually on fertiliser use in the agricultural sector. The use of phosphorous fertilisers is inefficient, particularly in minimum tillage operations with about 75% of applied P fertilisers wasted due to stratification barriers. The products developed under this project will create novel formulations to overcome the stratification issue and boost crop productivity. Innovative products developed from natural clay nanomaterials will present significant environmental benefits while improving farm outcomes.

Minotaur's director of Research and Development, Dr Tony Belperio commented: This new research project is another step in demonstrating the enormous potential of the natural nanotube component of the Great White halloysite-kaolin project with a clear focus on commercial outcomes. We look forward to rapid progress by the Soil CRC team.

Professor Ajayan Vinu, Director of GICAN commented: It is an amazing way of using naturally available nanostructures for nutrient delivery to cropping soils. A successful outcome will offer a highly efficient fertilizer product, positively impacting the agricultural industry.

Dr Michael Crawford, CEO of the Soil CRC, said "We are very excited to be entering into research partnerships with industry collaborators such as Minotaur and Andromeda. The purpose of Cooperative Research Centres is for industry and research to work together to solve real world problems and create opportunities. This research will ultimately help farmers to improve their soil management and increase their productivity and profitability

Authorisation

This report is authorised by Mr Andrew Woskett, Managing Director of Minotaur Exploration Ltd.

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