

2024_23_ESE_MR: Cadmium Enrichments in Cocoa Beans – A Stable Isotope Investigation of Cd Sources and Mitigation Strategies

Supervisors: Mark Rehkämper (markrehk@imperial.ac.uk); Rebekah Moore (r.moore13@imperial.ac.uk)

Department: Department of Earth Science and Engineering

Cadmium (Cd) is a highly toxic trace metal that accumulates in the body with a residence time of several decades. To reduce dietary intake of the element, the European Union recently implemented stricter limits for Cd in various foods, including cocoa products. As a consequence, cocoa producers in many countries, and particularly in Latin America, are now struggling to meet these levels. This is of concern as cocoa is produced almost exclusively in developing countries, where it often plays an important economic role. In particular, more than 80% of cacao is harvested on family-owned farms, such that it supports the livelihoods of about 40 million rural workers and their families.

The current project will employ novel analytical approaches to investigate the cause of the observed Cd enrichments in cocoa. To this end, the research encompasses bulk and in-situ Cd concentration and stable isotope analyses of soil–cocoa systems from various localities where cacao beans with problematic Cd contents are harvested. The accumulation of Cd in cacao at least in part reflects that the element uses molecular pathways designed for the uptake and transport of essential metals, such as zinc and iron. The project will therefore also investigate the relationships of Cd with zinc, iron and other essential elements. The novel isotopic results will provide improved constraints on whether high concentrations of plant-available Cd in soils are of natural or anthropogenic origin and explore mitigation techniques that could be employed to reduce Cd accumulation in cacao. As such, the research will support on-going efforts to develop improved practices for sustainable production of cacao beans with safe levels of Cd.

The project may involve fieldwork in Latin America for sample collection. The analytical studies, which constitute the backbone of the research, will be carried out in the clean room and mass spectrometry facilities of the MAGIC Laboratories at the Department of Earth Science & Engineering of Imperial College London (<http://www.imperial.ac.uk/earth-science/research/research-groups/magic/>).

The project is suitable for students with a background in geology, chemistry, biology, agronomy or equivalent experience. Further information on the planned research can be obtained directly from Mark Rehkämper (markrehk@imperial.ac.uk) and Rebekah Moore (r.moore13@imperial.ac.uk). Please don't hesitate to get in touch if you are interested.

For more information on how to apply to us please visit: <https://www.imperial.ac.uk/grantham/education>