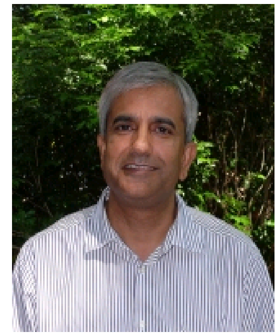
DR BALWANT SINGH



Summary

My current research focus is to create sustainable management systems for soil carbon resources and to find cost-effective technologies to manage and remediate soils contaminated with trace elements (so-called heavy metals). We employ state of the art techniques including synchrotron-based XAFS, XRD and XRF, and electron microscopy in our research to understand the complex interactions of trace elements and organic matter with soil minerals.

Research interests

Chemical reactivity in soils is largely controlled by minerals directly or via interactions with organic fraction of soil. My research has advanced our understanding of the structural and chemical properties of soil clay minerals, especially iron oxides and kaolinite in highly weathered soils. The research on iron oxides has established that a major proportion of trace elements in soil are associated with the two most common iron oxides, goethite and hematite. We have produced direct and unambiguous evidence on the substitution of Cr, Cd, Cu, Mn, Ni, Pb, V and Zn in goethite using synchrotron based XAFS and XRD. These advances are of environmental and economic significance, since goethite is the most common and abundant iron mineral in soils. Our research has also revealed the reaction mechanisms of trace elements with kaolinite and goethite; and we have established that ageing process decreases the desorption of these elements especially Cd.

More recently we discovered a fern naturalised in Australia that accumulates up to 0.3% As in shoots. We have also established that arsenate (AsV) is reduced to arsenite (AsIII) in fern roots almost immediately after plant uptake. Further field studies are currently underway to assess the potential of the fern species to remediate As contaminated soil near disused cattle dip-sites.

In relation to soil carbon, our research is focused on mineral-biochar interaction in soil, soil carbon accounting, and soil mineral-organic matter interactions. The aim of the research is to understand the nature of interactions between minerals and organic matter in soil, and use this knowledge to maximize soil carbon sequestration.

Background

Balwant Singh did his BSc (Hons) Agr and MSc Agr from Haryana Agricultural University, Hisar, India. He completed his PhD in Soil Science in 1991 from The University of Western Australia. After completing his PhD and a two-year stint as an Assistant Scientist in the Department of Soil Science, Haryana Agricultural University, Hisar, he was a Lecturer in Soil Mineralogy at the University of Reading, UK for 5 years. He joined the University of Sydney in 1998 as a lecturer. He is currently Associate Professor in Soil Chemistry in the Faculty of Agriculture, Food and Natural Resources. Balwant is Chair of the Editorial Advisory Committee of the Australian Journal of Soil Science and an Associate Editor of Clay Minerals. He has been elected Vice-Chair- Soil Mineralogy Commission of International Union of Soil Sciences for 2011-2015. He also chairs the sub-committee EV009-2 (Analysis of Soil) of Standards Australia.

Balwant has supervised 11 completed PhD students, and several Masters and honours students. He has published more than 120 refereed publications in international journals and conference proceedings, and book chapters. He has co-edited a book ‘Synchrotron-based techniques in Soils and Sediments’ that was published by Elsevier in 2010.

Recent publications

- Singh, B and Gräfe, M (Eds) (2010). Synchrotron-based techniques in Soils and Sediments. ISBN-13: 978-0-44-453261-9. Elsevier, Burlington, USA.
- Singh, B., Gräfe, G., Kaur, N. and Liese, A. (2010). Applications of synchrotron-based X-ray diffraction and X-ray absorption spectroscopy to the understanding of poorly crystalline and metal-substituted iron oxides. In: Singh, B and Gräfe, M (Editors) (2010). Synchrotron-based techniques in Soils and Sediments. Pp 199-254. Elsevier, Burlington, USA.
- Xu, W. Kachenko, A.G., and Singh B. (2010). Effect of soil properties on arsenic hyperaccumulation in Pteris vittata and Pityrogramma calomelanos var. Austroamericana. International Journal of Phytoremediation 12, 174–187.

- Nursita, A.I., Singh, Balwant and Lees, E. (2009). Cadmium bioaccumulation in Prisotoma minuta in relation to bioavailability in soils. Ecotoxicology and Environmental Safety 72, 1767-1773.
- Kaur, N., Gräfe, M., Singh, B., and Kennedy, B.J. (2009). Simultaneous incorporation of Cr, Zn, Cd, and Pb in the goethite structure. Clays Clay Minerals 57, 234-250.
- Kaur, N., Singh, B., and Kennedy, B.J. (2009). Copper substitution alone and in the presence of chromium, zinc, cadmium and lead in goethite (α-FeOOH). Clay Minerals 44, 293-309.
- Kachenko, A.G., Bhatia, N.P., Siegele, N., Walsh, K.B., Singh, B. (2009). Nickel, Zn and Cd localisation in seeds of metal hyperaccumulators using µ-PIXE spectroscopy. Nuclear Instruments and Methods in Physics Research B 267, 2176–2180.
- Kaur, N., Singh, B., Kennedy, B.J. and Gräfe, M. (2009). The preparation and characterization of vanadium-substituted goethite: The importance of temperature. Geochimica et Cosmochimica Acta 73, 582-593.
- Gräfe, M, Beattie, D.A., Smith, E., Skinner, W.M. and Singh, Balwant (2008). Copper and arsenate co-sorption at the mineral–water interfaces of goethite and jarosite. Journal of Colloid and Interface Science 322, 399–413.
- Markus Gräfe, Balwant Singh and M. Balasubramaniam (2007). Surface speciation of Cd(II) and Pb(II) on kaolinite by XAFS spectroscopy. Journal of Colloid and Interface Science 315, 21–32.

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