SORPTION AND TRANSPORT PROCESSES IN RELATION TO SOIL STRUCTURE, WATER RETENTION, SOLUTE MOBILITY AND WATER UPTAKE BY PLANT ROOTS

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Selected Research Publications

Submitted to The University of Adelaide

for the

DEGREE OF DOCTOR OF SCIENCE

VOLUME 1 No. 1 - 50

April, 2002
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SUMMARY

The research described in this submission has provided a number of major advances in knowledge and practical outcomes including in particular:

1. The detailed description of the microporous structure of clay mineral systems by gas and vapour sorption leading to the recognition of quasi-crystals and clay domains as the assemblages of primary particles which constitute the operational elements in determining soil physical behaviour.

2. An enhanced understanding of electro-kinetic phenomena and the effects of ions on water structure and movement near the charged surfaces of clay particles.

3. A comprehensive analysis and theoretical description of the mechanisms involved in solute transport in soils including in particular, the effects of competitive adsorption between species and time dependency of sorption.

4. The detailed elucidation of the factors determining the persistence and mobility of pesticides in the soil profile and their potential for groundwater pollution leading to the development of a practical management model.

5. The adaption of computer assisted tomography applied to the attenuation of X- and gamma radiation (CAT Scanning), to the non-destructive in situ measurement of soil water content and structural changes and in particular to water uptake by plant roots. Coupled with the innovative use of ion specific microelectrodes, these studies provided the first detailed measurements of the temporal and spatial distribution of soil water and solute contents close to single plant roots.

6. The development of the Modulus of Rupture – Exchangeable Sodium Percentage (MOR – ESP) approach as a practical method for evaluating the structural status of soils and the influence of management practices. The method allows separate quantitative assessment of the roles of dispersive and non-dispersive mechanisms in contributing to structural instability in hard setting soils.
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VOLUME 2 Nos. 51 - 105

April, 2002