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Preface on Physicochemical and Electromechanical Interactions in Porous Media

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Abstract. The focus of science and engineering shifts towards smaller length scales. Porous media mechanics has a vital role to play in the translation of microstructural data into macroscopic models of multicomponent systems. As the length scales shrink, more fundamental levels of understanding of natural laws, cause the boundaries between disciplines to blur. In particular, geosciences, polymer sciences and biosciences find a common ground of interest in high specific surface mixtures.

Key words: living cells, biomechanics, geomechanics, high specific surface.

The focus of technological development is shifting towards smaller length scales. The development of advanced experimental techniques allows us to fathom more subtle levels of the material than ever before. The advent of cheap and high computational power opens the way to translate measured material properties on the molecular level towards workable macroscopic models which are useful for technological applications in industry and medical practice. A spin-off of these developments is that as one moves towards the molecular level, the boundaries between the different disciplines of engineering fade away. Multi-physics problems are the rule rather than the exception on that level. Engineers and scientists are bumping into major problems of communication between entirely different disciplines, calling for a rethinking of the educational curricula. Porous media mechanics and mixture theory have a major role to play in the translation of the nano to the micro and the macro level of the material. The purpose of this special issue is to bring together a number of high quality papers that deal with the interface between mechanics of porous media and other sciences. In the choice of subjects, we deliberately distributed our attention between geomechanical and biomedical applications. The high adsorption forces in the low porosity stratum corneum of the human skin which are shown so important for the water management of our own body (van Kemenade *et al.*, 2003), is closely related to the adsorption forces measured in the low porosity, high specific surface rocks like shales which are main building

block of the earth crust (Moyne and Murad, 2003; van Meerveld *et al*., 2003). The Donnan osmotic pressure in cartilage discussed in detail by Athesian *et al*. (2003), is a macroscopic form of the double layer theory used by Dormieux *et al*. (2003) in the context of clays. DiMicco and Sah (2003) discuss cartilage as a porous medium including metabolic events. Cowin (2003) presents a matrix formulation of anisotropic poroelasticity, that refers repeatedly to work of previous authors in the field of rock mechanics, while his own work concentrates on the poromechanics of bone and its relationship to the stress sensing ability of bone. While the understanding of coupling between electrostatics and poromechanics starts to converge towards established theories, the coupling between electrodynamics and wave propagation in porous media is still difficult to unravel. Santamarina and Fratta (2003) are presenting some experimental data, and interprete their results in the light of present understanding of electrical–mechanical coupling. Recent developments in the field of cell biomechanics (Tasaki, 1999), seem to indicate that subcellular events, which are essential building blocks of life, may also call for porous media description, as direct interaction between intracellular ions, intracellular water and the cytoskeleton are in some ways comparable to interactions of ions, water and polymeric chains in hydrogels (Pollack, 2001). In order to give further impetus to the rising interest in porous mechanics of high specific surface and molecular mixtures, the guest editors of this special issue have decided to organise a IUTAM-symposium on 18–23 May 2003, in Kerkrade, The Netherlands on the subject of "Mechanics of physicochemical and electromechanical interactions in porous media".

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