Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Dynamics of premelted liquid films GRAE WORSTER, University of Cambridge — On small scales, surface tension forces are enormously powerful. When such forces act on every grain of a fine soil, they can move mountains, quite literally, in a process called frost heave. In fact, it is not surface tension *per se* but the intermolecular forces that underlie surface tension that also cause frost heave in partially solidified soils. In detail, these forces cause the *premelting* of solids. For example, at temperatures below 0^oC, water is solid (ice) in bulk but remains liquid in thin films adjacent to surfaces in contact with many other materials, such as silica. The intermolecular forces, such as the van der Waals force, acting between the materials on either side of an interface can cause interfacial premelting and simultaneously produce a strong normal stress across the premelted film. Whether these stresses cause large-scale motions relies significantly on the fluid mechanics of the microscopic films. I shall introduce the fundamental thermodynamic principles of premelting and illustrate its fluid mechanical consequences with simple theoretical models and experimental results. Applications of these ideas include the rejection of particulate matter during solidification, with consequences for the fabrication of composite materials, the freezing of colloidal suspensions, with consequences for the cryopreservation of biological systems, and the evolution of grain boundaries, with consequences for the redistribution of climate proxies sequestered in the Earth's ice sheets.

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Date submitted: 17 Aug 2005 Electronic form version 1.4