

Abstract Submitted
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Mechanisms of ice lens formation in freezing soils. STEPHEN PEP-
PIN, M. GRAE WORSTER, University of Cambridge — Frost heave is a process in
which the ground swells upon freezing. This phenomenon plays a central role in the
formation of unique geological features in permafrost areas. Frost heave also causes
annual damage to roads and buildings in northern climates. During the freezing
process regions of nearly pure ice (ice lenses) form in the soil. Similar phenomena
occur during the freezing of tissue, food products, and many other materials. In the
last several years, the first experiments capable of viewing the formation of ice lenses
in a well-characterized model soil consisting of glass beads in water have been per-
formed. These experiments have yielded insight into the basic mechanisms behind
frost heave. Recently we have developed mathematical models of these experiments.
Our models indicate that ice lenses can form via three distinct mechanisms: nucle-
ation of ice beyond a compacted layer of particles, periodic rejection and engulfment
of particles by the ice front, and (in highly colloidal soils) morphological instability
of the solidification front. The interplay between these mechanisms could explain
some of the great variation in ice lens structure and orientation seen in real soils.

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