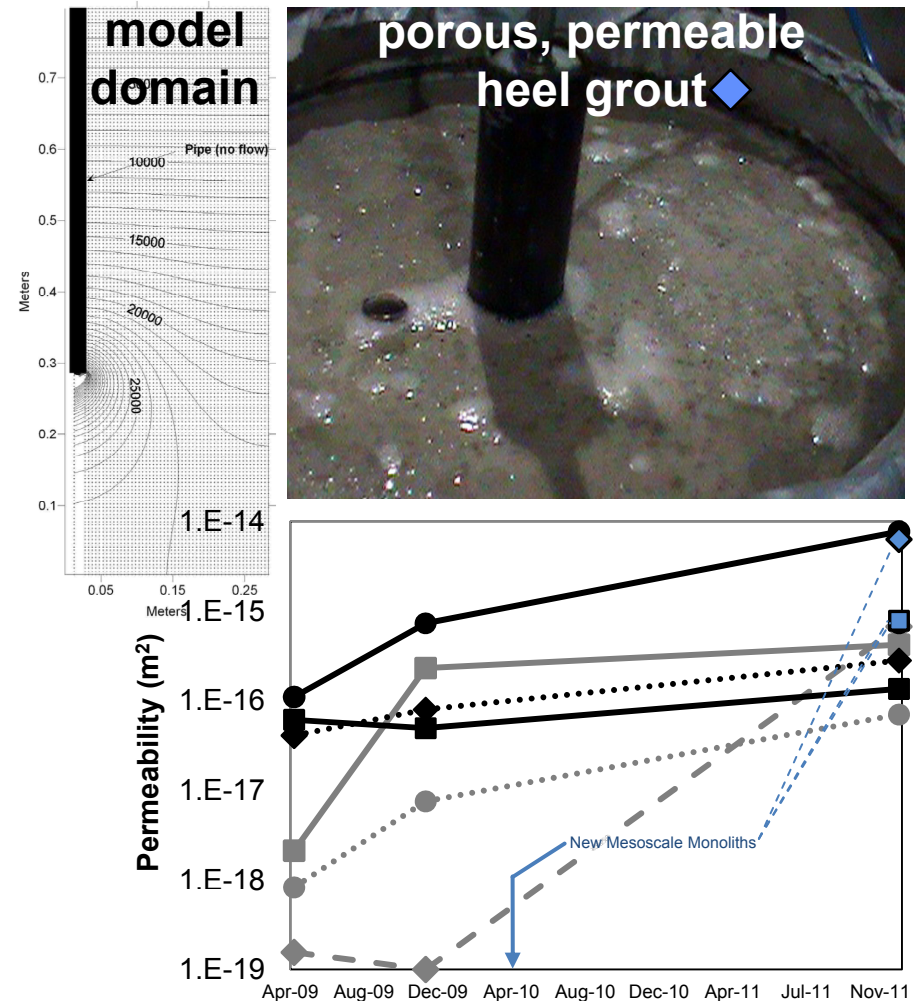


Evolution of Bulk Permeability

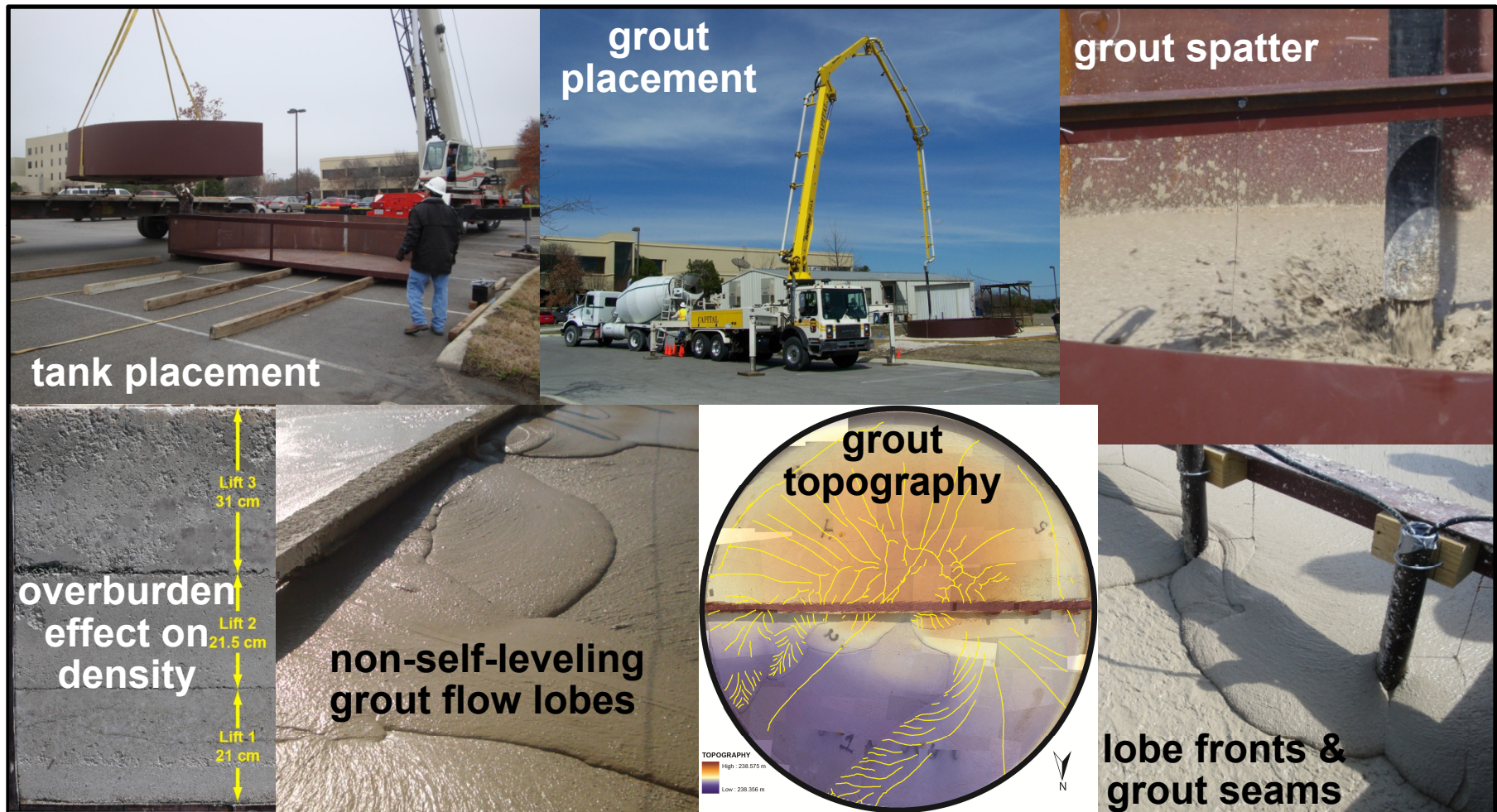


- ◆ Delayed microcracking and drying shrinkage occurred in some specimens
- ◆ Gas flow observed through cracks and grout lobe seams, in addition to flow through porous and permeable surfaces
- ◆ Bulk grout permeability generally increased with time post-placement due to microcracking and shrinkage at
 - Grout lobe seams
 - Lift interfaces



Intermediate-Scale Alternative 1

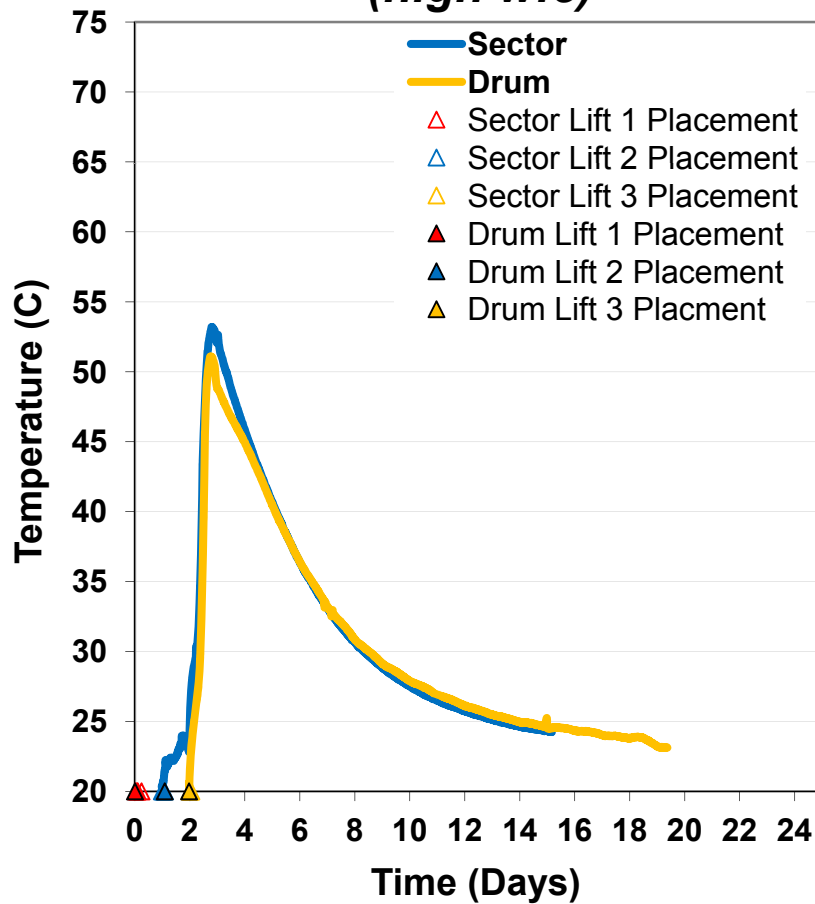
Reducing-Grout Specimen: Preparation & Observations



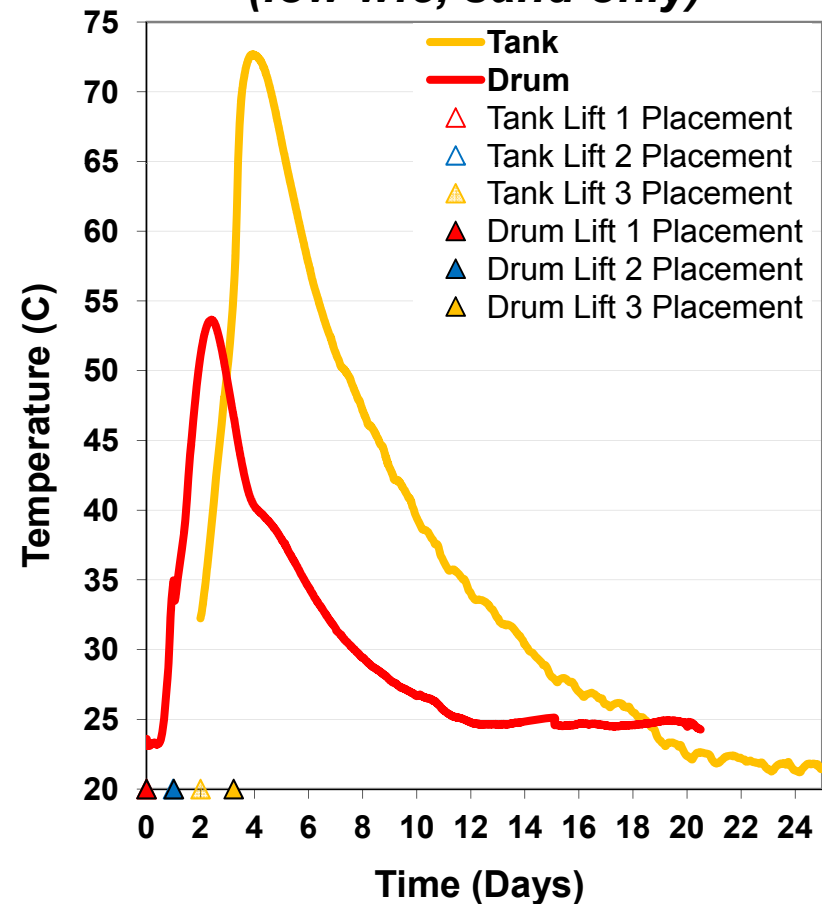
Peak Temperatures Scale with Specimen Size



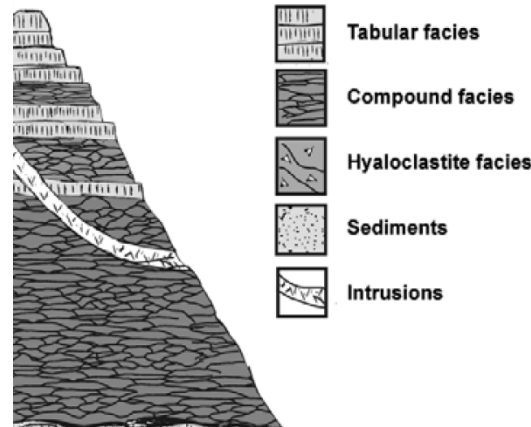
**SRS-like Strong Grout
(high w:c)**



**Alternative 1 Reducing Grout
(low w:c, sand only)**



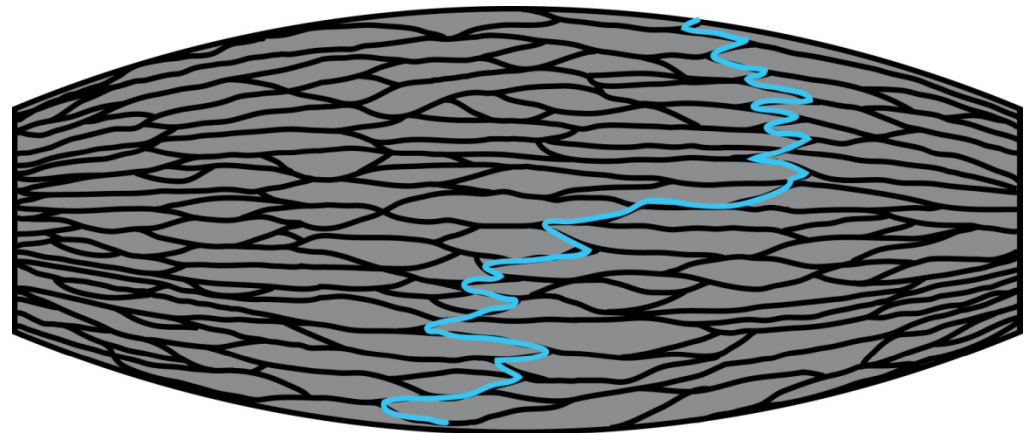
Grout Facies Architecture & Heterogeneity: Insights From Compound-Braided Basaltic Flows



Jerram et al. *Geol. Mag.* 2009

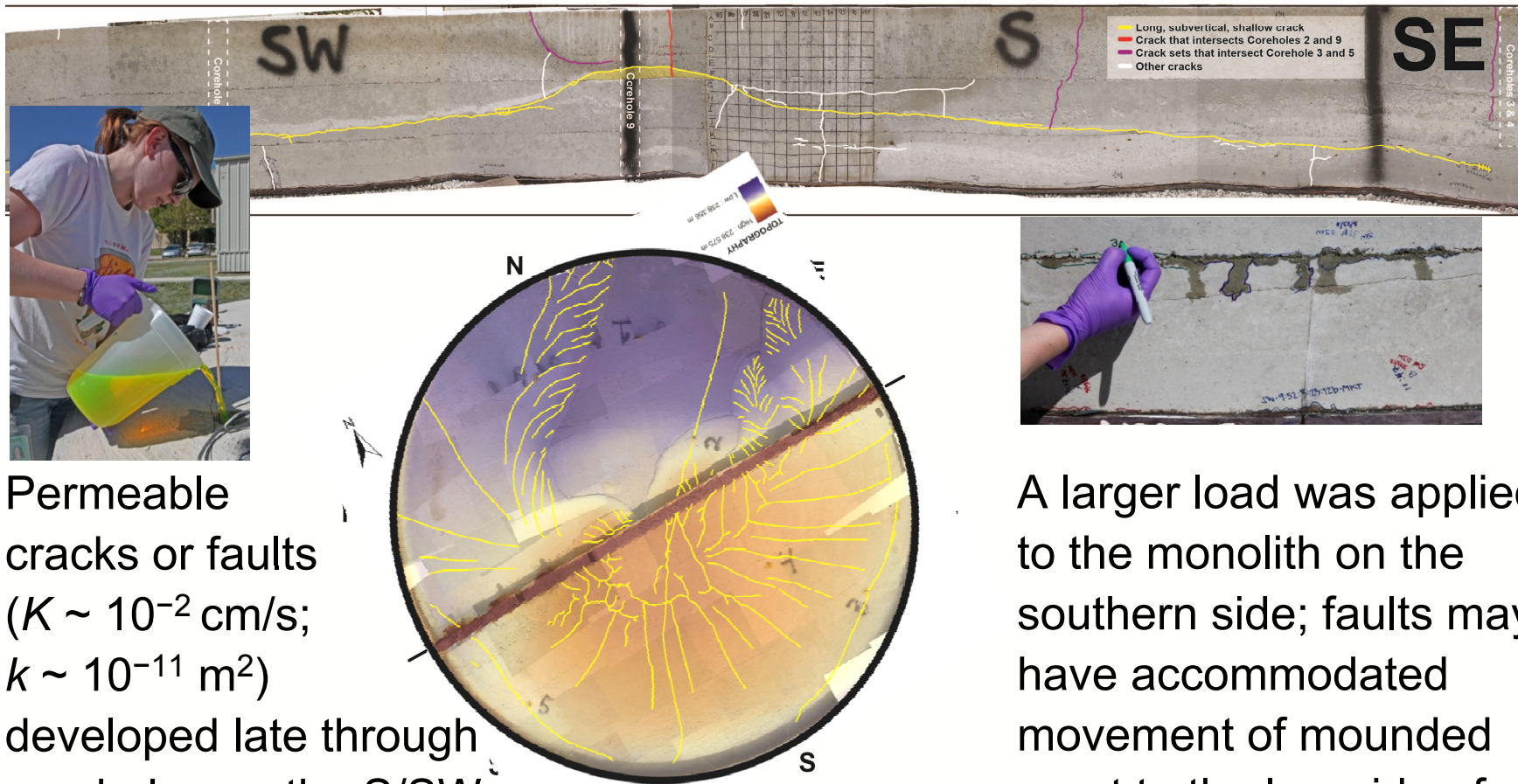
Likewise, grout monoliths of non-self-leveling grout are laterally/vertically heterogeneous, consisting of thousands of grout flow lobes prone to localized shrinkage and fast flow at their seams

The rheology of pahoehoe basaltic lava is somewhat similar to ropy grout; its facies architecture consists of thin, interfingering, compound-braided lava flow sheets and channels sourced by an episodic supply of magma.





Faults May Develop from Differential Loading of Non-Self-Leveling Grout



Permeable
cracks or faults
($K \sim 10^{-2}$ cm/s;
 $k \sim 10^{-11}$ m²)
developed late through
coreholes on the S/SW
side of the monolith

A larger load was applied
to the monolith on the
southern side; faults may
have accommodated
movement of mounded
grout to the low side of
the monolith

Fast Flow Pathways & Performance Impact



- ◆ Staff identified these likely fast flow paths through grout monoliths:
 - Annular shrinkage gaps along tank steel liners, embedded pipes, cooling coils, and equipment
 - Shrinkage gaps at grout flow lobe seams and grout lift interfaces
 - Plastic differential settlement cracks that form above embedded items
 - Plastic shrinkage cracks (early) + drying shrinkage cracks (later)
 - Faults formed as a result of differential loading of non-self-leveling grout
- ◆ If infiltrating groundwater is unable to react significantly with reducing grout due to rapid bypass flow through cracks and shrinkage gaps, the relatively low solubility of key radionuclides that was assumed in DOE's PA may not be achieved and risk-significant releases may occur earlier than assumed

Conclusions

- ◆ Staff interpretations of grout flow behavior during placement, grout facies architecture, and data that describe the evolution of shrinkage gaps and hydrologic properties provide risk insights and identify uncertainties about grout performance
- ◆ Project results help NRC and CNWRA staff evaluate credit taken for similar engineered waste containment systems, such as those located at INL INTEC Tank Farm Facility (Idaho) and at the SRS F- and H-Tank Farms (South Carolina)