

Improving Shallow Tunnel Detection from Surface Seismic Methods

Sandia National Laboratories

PI: Nedra Bonal, Org #6913; PM: Terry Stalker, Org #5447
Robert Abbott, Darin Desilets, Sharon Desilets, and Leigh Preston

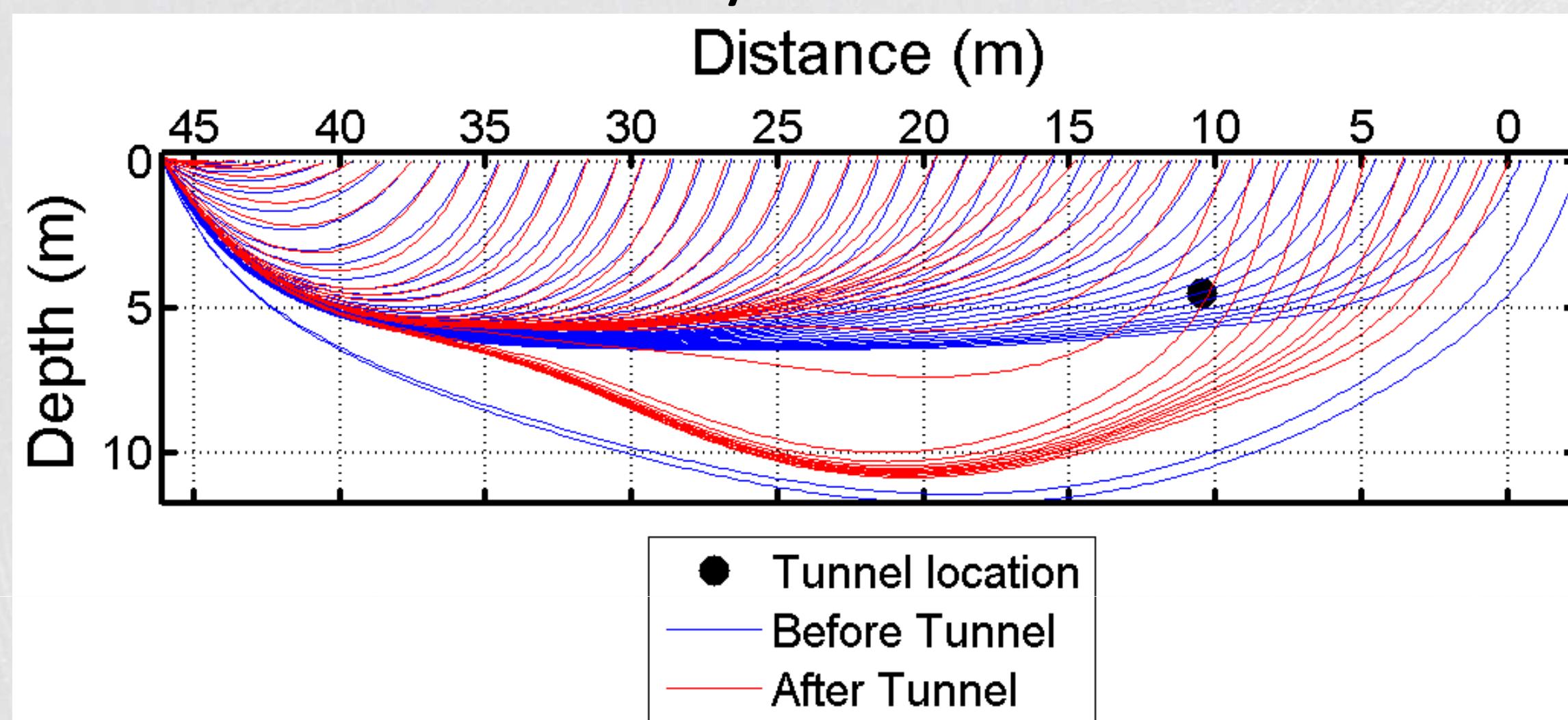


LABORATORY DIRECTED RESEARCH & DEVELOPMENT

Early Career R&D Program

Problem

- Clandestine tunnels are used to smuggle drugs, weapons, and people but detecting them has been problematic
- Traditional seismic reflections/refractions from tunnels are not always seen in the data



- Understanding of tunnel interface phenomena to improve detection of small and large tunnels
- Border security, force protection, & HDBT defeat

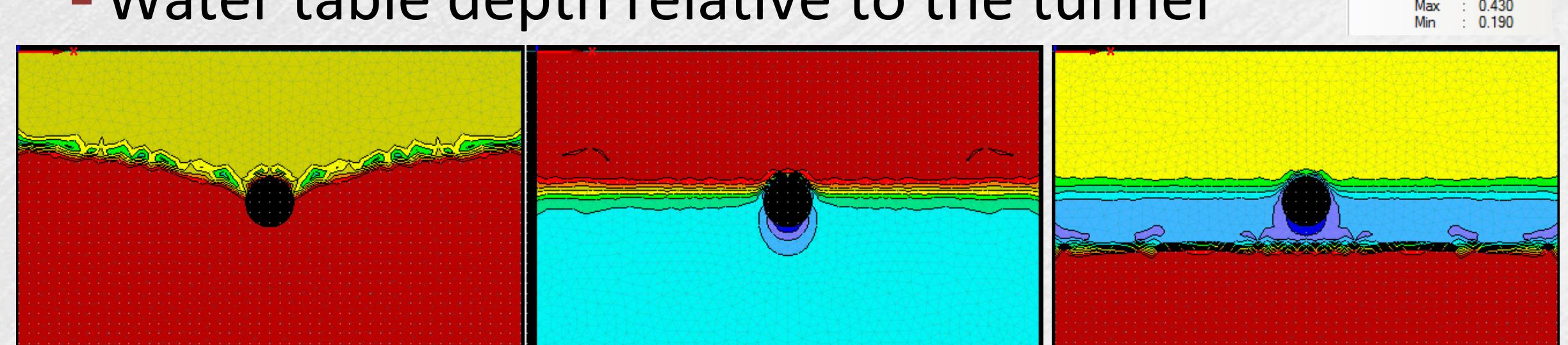
Approach

- Investigate the effects of tunnel construction on seismic waves by:
 1. Modeling fracturing and dewatering of pores around the tunnel
 2. Converting pore saturation to seismic velocities
 3. Modeling seismic wave propagation through effective media
- Improve data processing techniques for tunnel detection
 - Surface and body wave diffractions
 - Reverse time migration (RTM)
 - Others
- Goals
 - Answer why seismic data detects tunnels in some cases but not others
 - Develop more robust techniques for tunnel detection, which is an issue of national security

Results

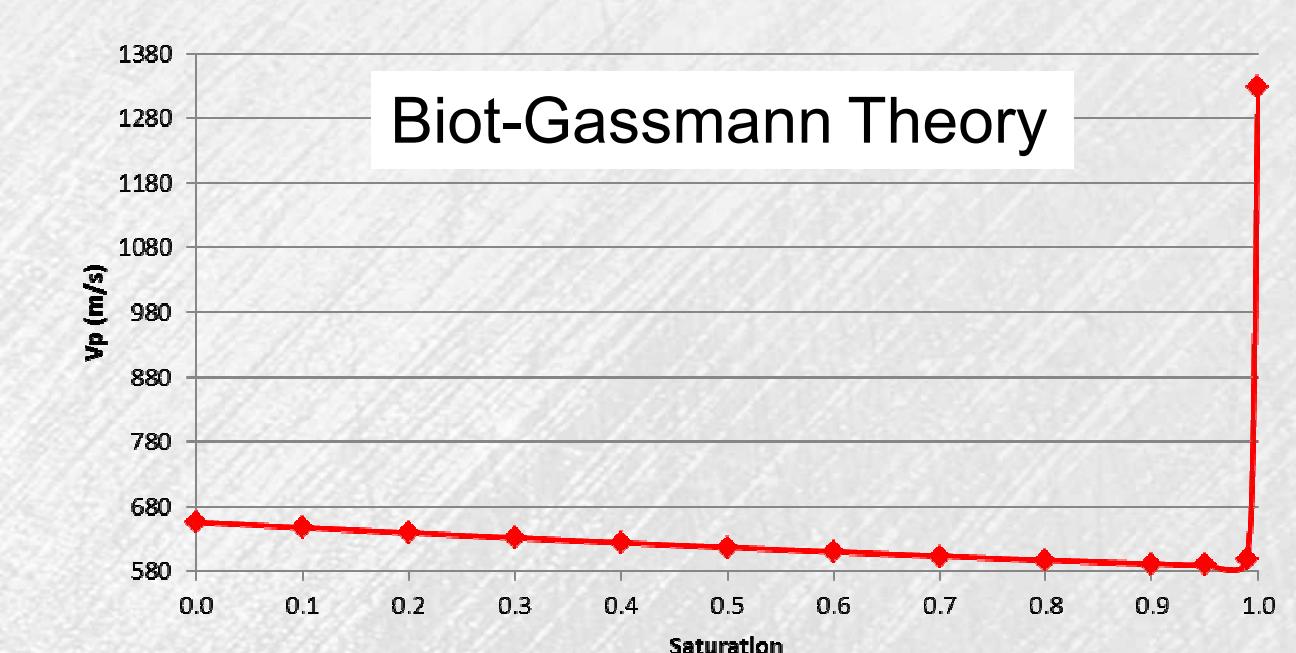
- Fluid flow models to show the influence of:

- Different subsurface materials
- Various tunnel shapes
- Water table depth relative to the tunnel



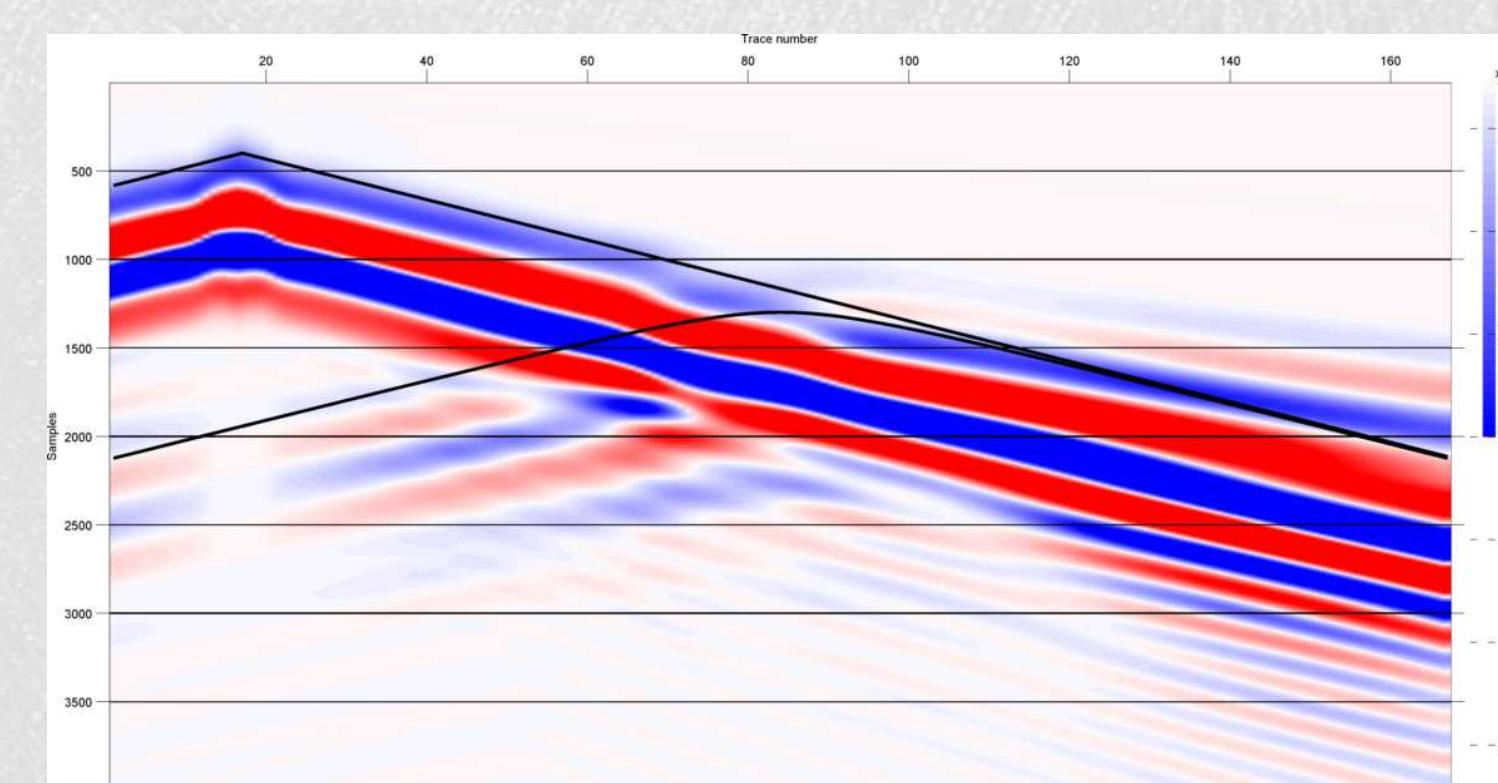
- Pore saturation versus seismic velocity

- Theoretical relationships perform poorly in shallow (>200m) materials
- Lab results show velocities decrease more rapidly than theory predicts



- Seismic data processing

- Reverse time migration code improvements
- Developed wavefield transformation algorithms



Significance

- This work can provide the basis for new tunnel detection capabilities, which can be applied to HDBT defeat, domestic and foreign border security, and force protection
- Subsurface saturation results will be useful for UXO and mine detection
- Potential customers for follow-on work include: DoD, DHS, DOE Nonproliferation, DARPA, DTRA, and OFA customers