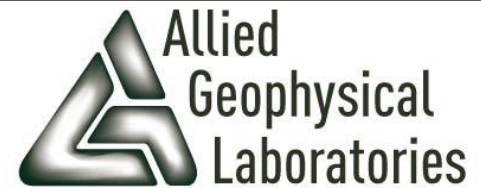


Allied Geophysical Lab @ UH



Robert R. Stewart
Director, AGL

AGL Meeting – Wrap-up
Houston April 2nd, 2014



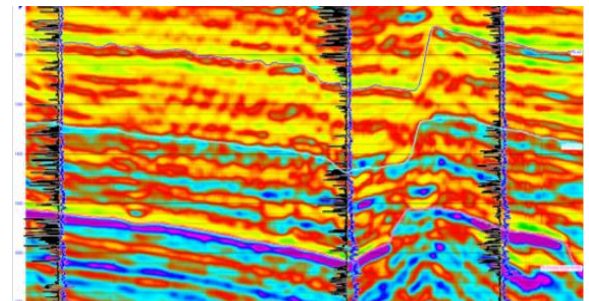
UNIVERSITY of HOUSTON

AGL Directions

- **Goal:** Make major contributions to geophysics via graduates, publications, software, & data
- **Science:** Understand & fully use the complete seismic wavefield (plus logs, GPR, gravity) for improved subsurface imaging and assessment
- **Application:** Help find and responsibly produce energy and other resources
- **Strategy:** Experimental geophysics, industry collaboration, advanced analysis, & full team

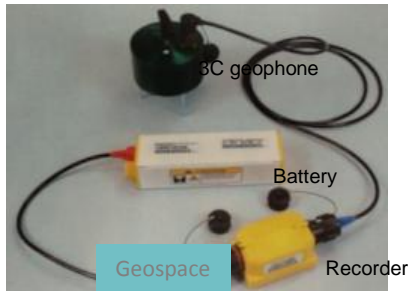
Allied Geophysical Lab

- Scaled surveying
 - Acoustic emissions/microseismic
 - Time-lapse anisotropy
- Field acquisition
 - DAS systems; Rolling vibe sources and receivers
 - Marine boomer, MicroEel streamer, sonars
- Data modeling & processing
 - Anisotropy, surface waves, VSP imaging
 - 3D-3D processing & inversions
- Case histories
 - Bakken (Nesson), Marcellus, Golden Lane (MX)
 - Faulted areas, salt domes, unconventional



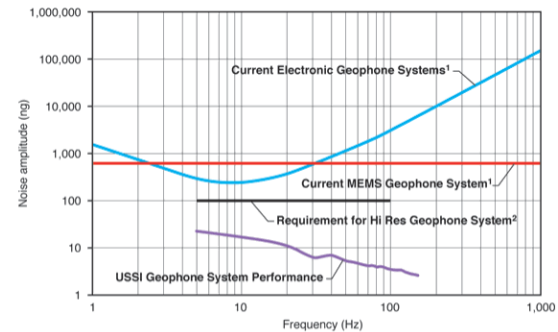
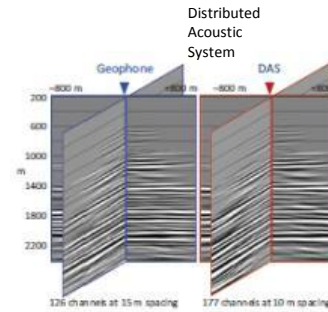
Two key sensing advancements!

- Nodes (autonomous)



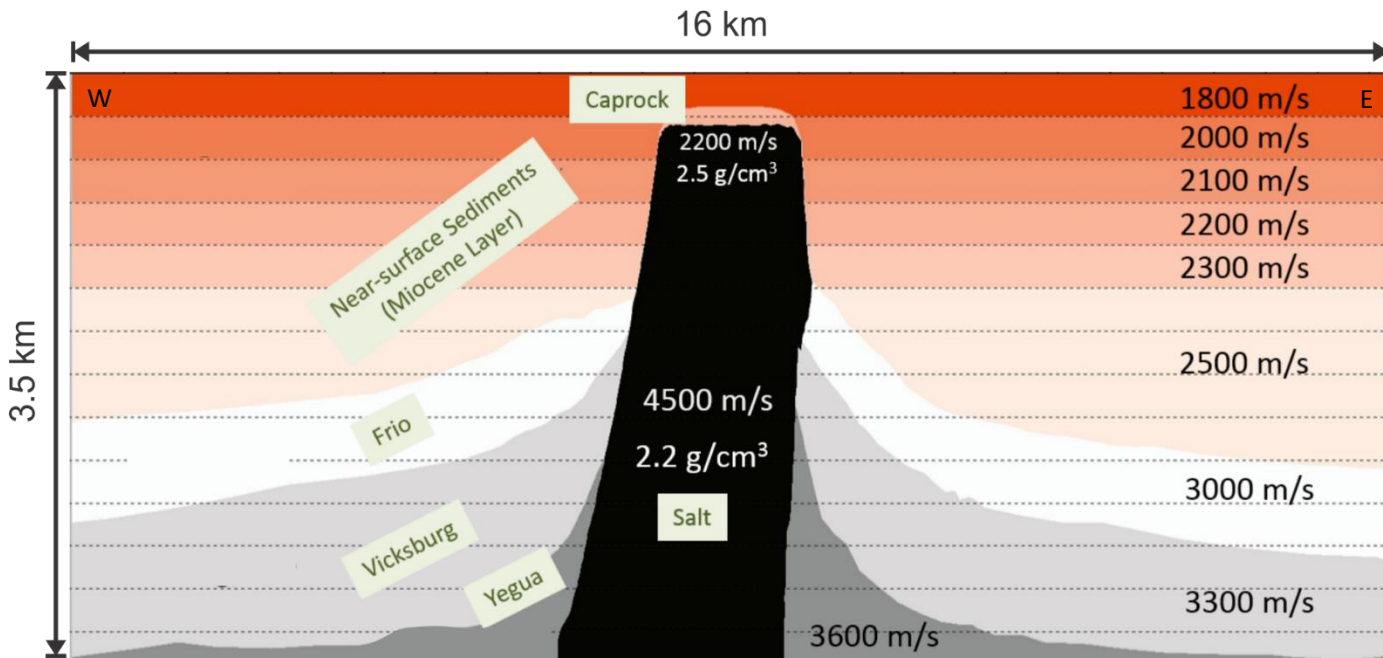
- 1 to 4C
- GPS
- No or little cabling
- ~ Month recording
- ~ Wireless download

- Fibre-optics



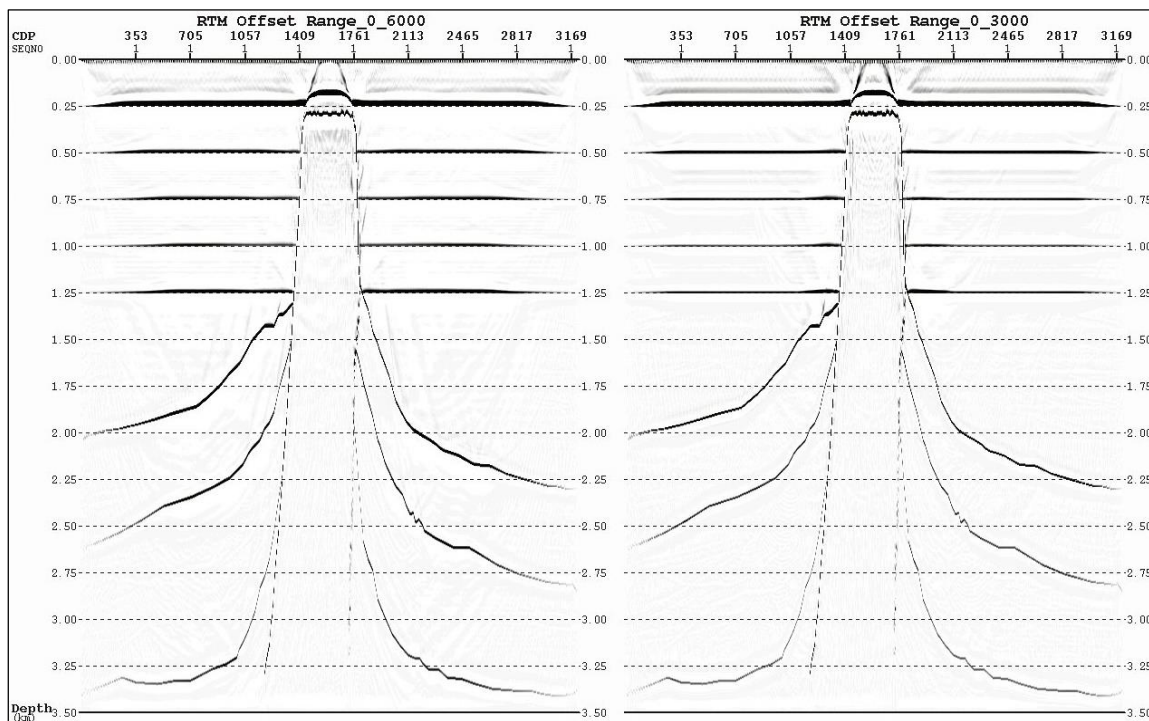
USSSI Geophone System has the lowest noise floor vs. all competing systems

Velocity models –Pierce Junction (Houston): Coskun (2014)



2D (and 3D) seismic survey design via elastic modeling and RTM migration (Coskun, M.S. 2014)

Thank you, Dr. Edip Baysal and Paradigm



Concept of 3D time-lapse PP & PS inversion

P-P time lapse data

$$\begin{bmatrix} d_{PP02} \\ d_{PP06} \end{bmatrix} = \begin{bmatrix} A_{\alpha 1} & A_{\beta 1} & A_{\rho 1} & 0 & 0 & 0 \\ A_{\alpha 2} & A_{\beta 2} & A_{\rho 2} & A_{\alpha 2} & A_{\beta 2} & A_{\rho 2} \end{bmatrix} \begin{bmatrix} L_{\alpha} \\ L_{\beta} \\ L_{\rho} \\ \Delta L_{\alpha} \\ \Delta L_{\beta} \\ \Delta L_{\rho} \end{bmatrix}$$

$$\begin{aligned} R_{PP} &= A_{\alpha}(\theta)L_{\alpha} + A_{\beta}(\theta)L_{\beta} + A_{\rho}(\theta)L_{\rho} \\ R_{PS} &= B_{\beta}(\theta)L_{\beta} + B_{\rho}(\theta)L_{\rho} \end{aligned}$$

When P-S data is available

$$\begin{bmatrix} d_{PP02} \\ d_{PP06} \\ d_{PS06} \end{bmatrix} = \begin{bmatrix} A_{\alpha 1} & A_{\beta 1} & A_{\rho 1} & 0 & 0 & 0 \\ A_{\alpha 2} & A_{\beta 2} & A_{\rho 2} & A_{\alpha 2} & A_{\beta 2} & A_{\rho 2} \\ 0 & B_{\beta 2} & B_{\rho 2} & 0 & B_{\beta 2} & B_{\rho 2} \end{bmatrix} \begin{bmatrix} L_{\alpha} \\ L_{\beta} \\ L_{\rho} \\ \Delta L_{\alpha} \\ \Delta L_{\beta} \\ \Delta L_{\rho} \end{bmatrix}$$

Observation
Data

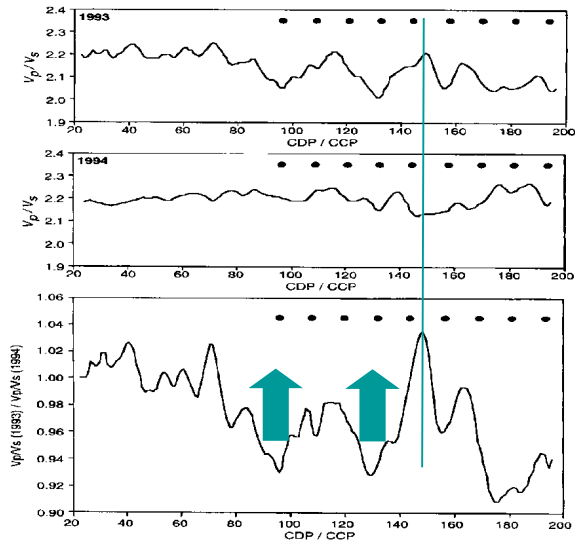
Forward Modeling Operator

Model Parameters

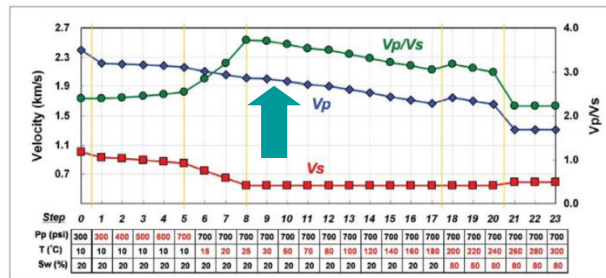
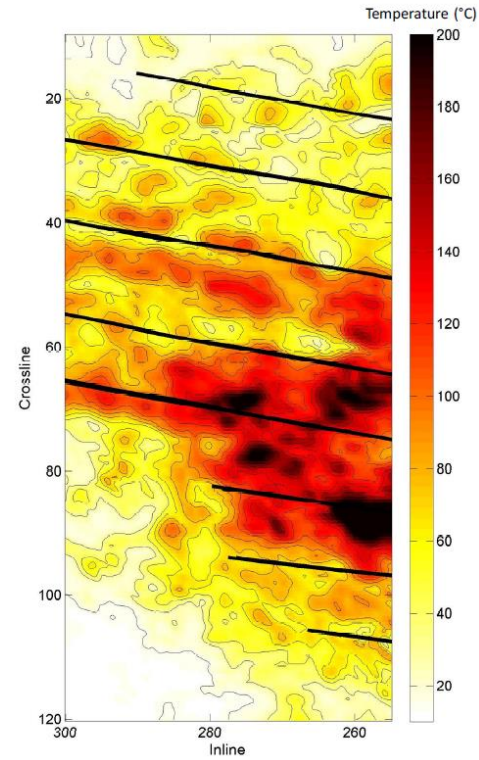
Linear system

$$d = Gm$$

This process is repeated at each time step for angle-dependent amplitude data



Time-lapse 3C-2D results: Cold Lake, AB (Isaacs, 1996)



Lab & field (3C-4D inversion) results – Fort McMurray oil sands (Kato et al., 2008; Kato & Stewart, 2011)

We're very grateful to our AGL supporters:



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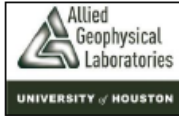
Schlumberger

We're keen to make advancements & seek your challenges, wisdom, & support

- Consider joining AGL (\$45k)
- Set up a joint research project
- Support a student (\$25k)
- Contribute a gift (nsm.uh.edu)



AGL Questionnaire – Your interests



1. What are your geophysical interests?

2. What would be appropriate topics for AGL research?

3. What would be the best deliverables from us to you?

4. Would you like us to give a technical presentation at your company?

5. Would you be interested in joining AGL? Collaborating? Serving on an AGL Advisory Board?

6. Other comments?

Name (optional): _____

Company (optional): _____

Thank you for your comments and support!

Robert Stewart Director, Allied Geophysical Lab (rrstewart@uh.edu)

What would be interesting & useful to you and your company?



Denver SEG Meeting 2010