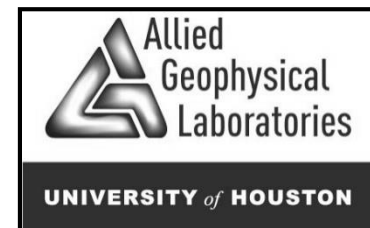# Allied Geophysical Lab @ UH

AGL Update Meeting
Houston   April 2nd, 2014
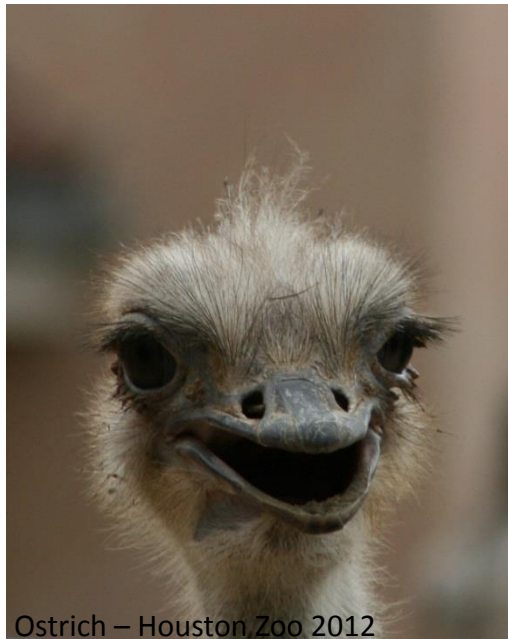
Robert R. Stewart
Director, AGL

Agenda

AGL Update Meeting

April 2, 2014

Ostrich – Houston Zoo 2012

ALLIED GEOPHYSICAL LAB (AGL)
Research Presentations & Update Meeting
Date: April 2nd, 2014
Time: 12 noon – 5:00pm
Location: University of Houston Hilton Hotel

Allied Geophysical Laboratories
UNIVERSITY *of* HOUSTON

AGENDA

Noon – 1:00 pm	*REGISTRATION and LUNCH* *Geophysical equipment & posters*
1:00 pm – 2:45 pm	*Technical Session I*

1) What's new at UH Geoscience? **Hua-wei Zhou (EAS Dept. Head)**
2) AGL – Overview **Robert Stewart (AGL Director)**
3) Guided waves in shallow water: Their use and filtering **Jiannan Wang**
4) Fault imaging using reflected ground roll **Craig Hyslop**
5) Searching for blind faults: the Haiti subsurface imaging project (*Geoscientists Without Borders*) - **Eray Kocel**
6) Salts of the Earth: Lab and log values – **Jingjing Zong & Nikolay Dyaur**
7) Petrophysics and pore pressure **Dan Ebrom (Statoil)**

2:45 pm	*Coffee Break – Field equipment and poster viewing*
3:15 pm – 5:00 pm	*Technical Session II*

8) Lessons from noise in elastic models **Fred Hilterman (Geokinetics)**
9) Fluid substitution and seismic anisotropy **Long Huang**
10) Ground-penetrating radar imaging: Processing & cases **Azie Aziz**
11) Transforming VSP into surface data **Yue Du**
12) Seismic attributes of the Bakken shale **Bode Omoboya**
13) Summary & looking forward **AGL group**

5:00 pm	*Tour - New stadium, student center, & Department*
5:30 pm – 7:30 pm	*The Dobrin Lecture with Dr. Dave Monk (Global advisor, Apache)*

UH/AGL geophysics faculty & their expertise

Robert Stewart
PhD, Massachusetts Institute of Technology
Chevron, ARCO, Veritas, University of Calgary

Borehole geophysics (well logging, VSP, crosswell analysis), multicomponent seismic methods

Aibing Li
PhD, Brown University
Woods Hole Institute

Seismic tomography, inversion, crustal structure

John Castagna
PhD, University of Texas at Austin
ARCO, Fusion Geophysical

Rock properties, seismic attributes, AVO

Evgeni Chesnokov
PhD, Moscow State University
University College of London, University of Oklahoma

Theoretical seismology, anisotropy, fracture m

Gennady Goloshubin
PhD, Institute of Solid Earth, Moscow
Western Siberian Institute

Seismic exploration, reservoir analysis, permeability prediction

Fred Hilterman
PhD, Colorado School of Mines
Geophysical Development Corp., Mobil

AVO, seismic processing, petrophysics

Leon Thomsen
PhD, Columbia University
Amoco, BP, Delta Geophysics

Anisotropy, seismic processing, EM analysis

Robert Wiley
PhD, Colorado School of Mines
Marathon Oil

Physical modeling, instrumentation, shallow seismic analysis

Further geophysics adjunct faculty and their interests:

Edip Baysal – seismic imaging

Colin Sayers – Petrophysics & logs

Pete Emmet – Seismic interpretation

Peter Bartok – Seismic interpretation

Hua-Wei Zhou - Rock physics, tomography, & migration: Department Head
Will Sager – Marine geophysics
Stuart Hall – gravity & magnetics
Bob Sheriff – exploration geophysics
Shuhab Khan – Remote sensing, GPR, GPS, GIS
**Bob Wang – Seismology, LiDAR, remote sensing**
TBA – New professor in exploration geophysics: Summer 2014

Allied Geophysical Lab & Staff

- ## Physical (robotic) modeling
  - New recording electronics, piezopins, and films
  - Laser-etched & 3D printed models, anisotropy, 4D

  Mr. Anoop William (systems manager)

  Dr. Nikolay Dyaur (research geophysicist)

  Dr. Robert Wiley (research professor)
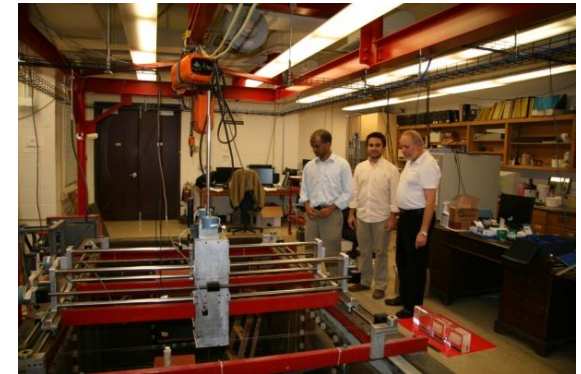
- ## Field acquisition
  - Vibe truck (P & S), Whackers, 240-channel Geodes, 120 Geospace nodes
  - VSP, downhole source, well logging tool suite
  - CG-5 gravimeter, three GPR systems
  - Leica total station, Trimble GPS
  - Marine boomer, MicroEel streamer, sonars

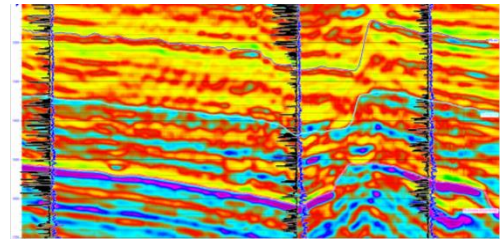 **Mr. Ady Geda (geotechnical supervisor)**

Allied Geophysical Lab & Staff

- ## Data processing & interpretation
  - GEDCO VISTA, Paradigm, SU, MATLAB, Hampson-Russell, SMT, Petrel, Landmark, KGS, home-grown code

  Mr. Jay Krishnan (Dept. systems manager)

- ## Geophysical surveys & case histories
  - Pierce Junction, LaMarque, Energy Research Park, Blue Lagoon, Hockley, Needville, Galveston
  - Meteor Crater, AZ; Sacramento, CA; Jemez Pueblo, NM; Elk Basin, MT; Bayou Corne, LA
  - Léogâne, Haiti; Antofagasta, Northern Chile
  - Dickman, OK; Barnett, TX; Bakken, ND; Marcellus, PA; GoMs;
  - Tenerife, Colombia; EOR, Oman; Golden Mile, MX

  Mr. Li Chang (application geophysicist)

AGL Directions

- *Goal:* **Make major contributions to exploration geophysics via: ideas, data, software, presentations, publications, & graduates**

- *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**

AGL Highlights

- Acquisition: Hockley salt dome; Montana; P & S Utah; La Marque; API Calibration Wells; Haiti
- Visits to Halliburton, Geospace (120 nodes), Fairfield
- >100 Geophysics Field Camp
- LaMarque Geophys. Observatory
- Bakken, Barnett, Marcellus 3Ds
- Monthly column, GSH Journal
- *SEG Gulf Chal. Bowl 1st & 2nd*
  - *Gulf AAPG IBA 3rd place*
- Graduated 50 MS & 15 PhDs
- Part of $50MM in 2014 proposals

Wavelets - *Probing the Past: Subsurface Imaging to Identify Burials at the Mueschke Cemetery, Houston*
By Azie Aziz and Robert Stewart

U.H. SEG WAVELETS

Figure 1: A University of Houston team member (Marcus Zinecker, with Lone Start's Janet Flores) is pushing the Noggin 250 MHz GPR SmartCart over one of the survey grids.
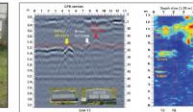
Figure 2: GPR section showing Nelson and Ernest Ligon burials (left). A GPR depth slice at 1.05 m (right) clearly indicates the two burials by the high amplitude areas.

Figure 3: Colorized pointcloud collected with a ground-based LiDAR scanner (located in the center) shows the headstones at the Cemetery.

While many geophysics students are enthusiastically investigating ways to find the next massive petroleum deposit, others have turned their attention to shallower targets. The Allied Geophysical Lab has partnered with Lone Star College-North Harris to collaboratively search for unmarked graves at the Mueschke Cemetery in northwest Houston. The project was motivated by the need to preserve and further document this historic cemetery. The effort is supported by the Mueschke Cemetery Association. The Cemetery is the final resting place for several notable Texas residents like Mueschke, Tautenhahn, West, Fussell, and Pennington. Veterans buried there are known to have served in the American Civil War, Spanish-American War, and World Wars I and II. The oldest known, but as yet un-located, grave is that of James R. West, who passed away in 1875 - we aspire to find it.

The collaborative work, which began in September 2013 is not only finding the unmarked graves, but also updating the existing 152 headstones. The project includes a 3D survey using ground penetrating radar (GPR) with various antennae (100 MHz, 250 MHz, 1000 MHz), along with LiDAR and electromagnetic profiling instruments. GPR is often an effective and non-intrusive tool to identify unmarked graves. A total of six survey grids were designed, with four completed to date. The geophysical project is scheduled to be finished by May 2014.

Surficially, the Mueschke cemetery area consists of the Middle Pleistocene and Quaternary Lissie Formation. The soil type is mainly silt, clay, and gravel. The study area is flat (only several inches of topography).

While there is a strong archaeological motivation for the project, we are also interested in developing and assessing

Figure 4: Project personnel from the University of Houston and Lone Star-North Harris College.

geophysical techniques, especially GPR's performance in detecting the characteristics of unmarked graves hosted in various soils.

The GPR data are processed using a standard processing flow (including de-wow, gain, and band-pass filtering). Initial results show a number of diagnostic diffraction hyperbolas which indicate the top of the coffins. The hyperbola tops are often recorded at about 1 m, which is consistent with the typical burial depth (Figure 2). The top of the graves can be clearly imaged even though the soil contains clay, which is often a limiting factor to GPR penetration. The 250 MHz antenna provides a vertical resolution of about 0.1 m and is the choice to image the graves.

We were also thrilled to use a terrestrial LiDAR (Light Detection and Ranging) scanner to create 3D point cloud datasets of the surface of the cemetery. This 3D volume of the cemetery area will be integrated with the subsurface images and headstone records.

It has been a little strange surveying over burials in a graveyard, but knowing that we were providing useful information to families, friends, and the historical associations made the science even more satisfying.

Acknowledgement

We would like to enthusiastically thank Mr. Brian Kyser and Ms. Janet Flores of Lone Star College-North Harris for this archeological research opportunity and associated geophysical application. We express our appreciation to Dr. Shuhab Khan for the EM profiler and Darren Hauser of the National Center for Airborne Laser Mapping (NCALM) for the LiDAR mapping.

28   Geophysical Society of Houston   April 2014

Where we're going

- **Acquisition:** Nodes, DAS, Rolling sources & receivers, Binary & simultaneous sweeps, Buried cables
- **Salt:** Lab properties (esp., anisotropy), well logs, survey design, field surveys, imaging
- **Surface and guided waves:** Theory, processing, removal, applications, software
- **Near-surface imaging:** GPR, gravity, seismic, LiDAR
- **Borehole seismic and microseismic:** Survey design, source characterization, 3D imaging, time-lapse algorithms
- **Multicomponent seismic methods:** Unconventional resource attributes and inversions

AGL Questionnaire – Your interests

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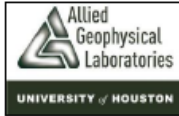
1. What are your geophysical interests?

   _____

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

We're very grateful to our AGL supporters:

We're striving to produce
& seek your support

- Join us at AGL ($45k)
- Set up a joint research project
- Support a student ($25k)
- Contribute a gift

Summary

- Pressing needs for better subsurface imaging & assessment plus education & personnel development

- Remarkable team of geophysical researchers and students assembled in the Allied Geophysical Lab

- Lots of exciting developments in land & marine acquisition, imaging, interpretation – research needed

- AGL is looking to create further collaborations and projects with you ('all)!

Bakken shale (Hess & AGL)

PP   PS
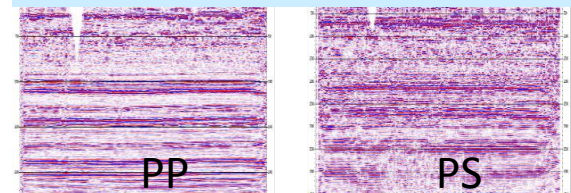
Thank you for your attention ...

... on with the program

UH Graduate Geophysics Courses Fall 2014

Seismic & Ray Theory	**Li**
Borehole Geophysics	**Stewart**
Computer Programming for Geophysicists	**Wiley**
Applied Geophysics Seminar	**New hire**
Seismic Migration	**Zhou**
Satellite Positioning & Geodesy	**Wang**
Rock Physics	**Castagna/Chesnokov**
3-D Seismic Exploration	**Emmet**
Geophysics of Porous Media	**Chesnokov**
Groundwater & Engineering Geophysics	*Hall*
Geophysics Field School – Analysis Capstone	*Stewart*
Introduction to Geophysics (undergrad)	*Wang*

Professional MS Program in Geophysics; Intensive Summer Courses in Exploration Geophysics