UT-AUSTIN EDGER FORUM

EDGER

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Dissemination of Results

Participants in the Forum are invited to attend the Annual Research Symposium each spring, which focuses on research results. Members are welcome to provide input of specific industry research and/or educational needs. Results will also be shared with sponsors through personal on-site visits, preprints of research papers, compilations of educational activities and results, and research computer codes from individual projects. For more information, please contact:

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Currently Available Software developed by students

- Basis pursuit inversion (BPI)
- Greedy annealed importance sampling (GAIS)
- Rock physics modeling for unconventional reservoirs
- Bayesian rock physics analysis

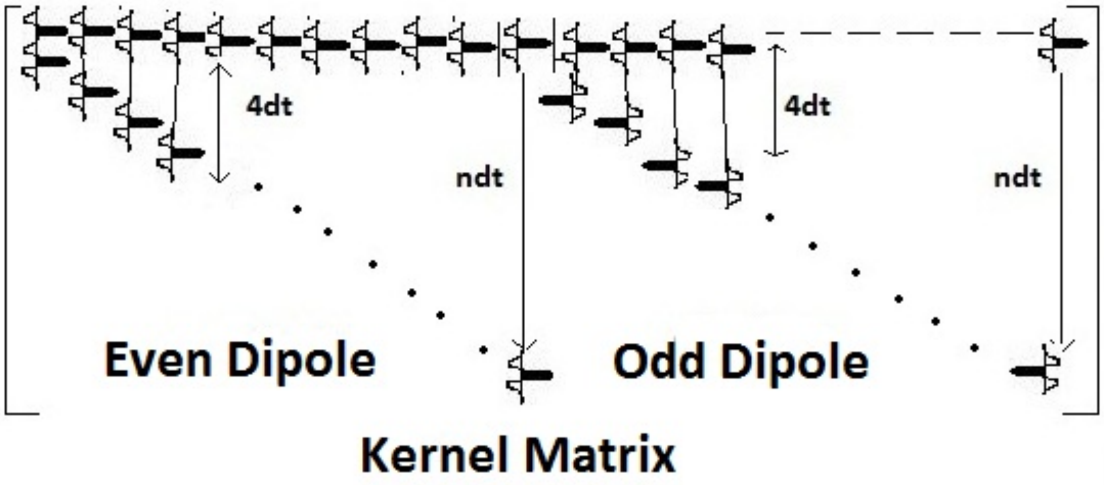
BPI - Reflectivity Inversion

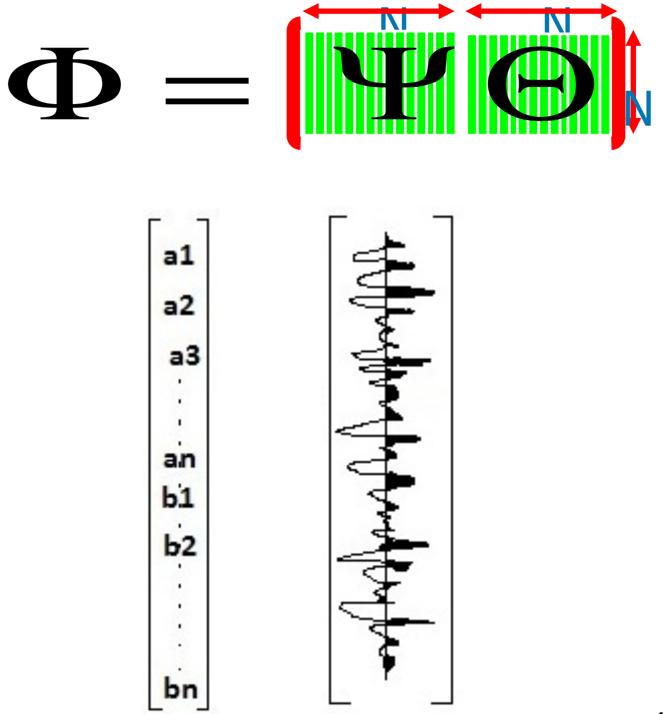
Pictorial representation of Kernel Matrix

Where: - Kernel Matrix

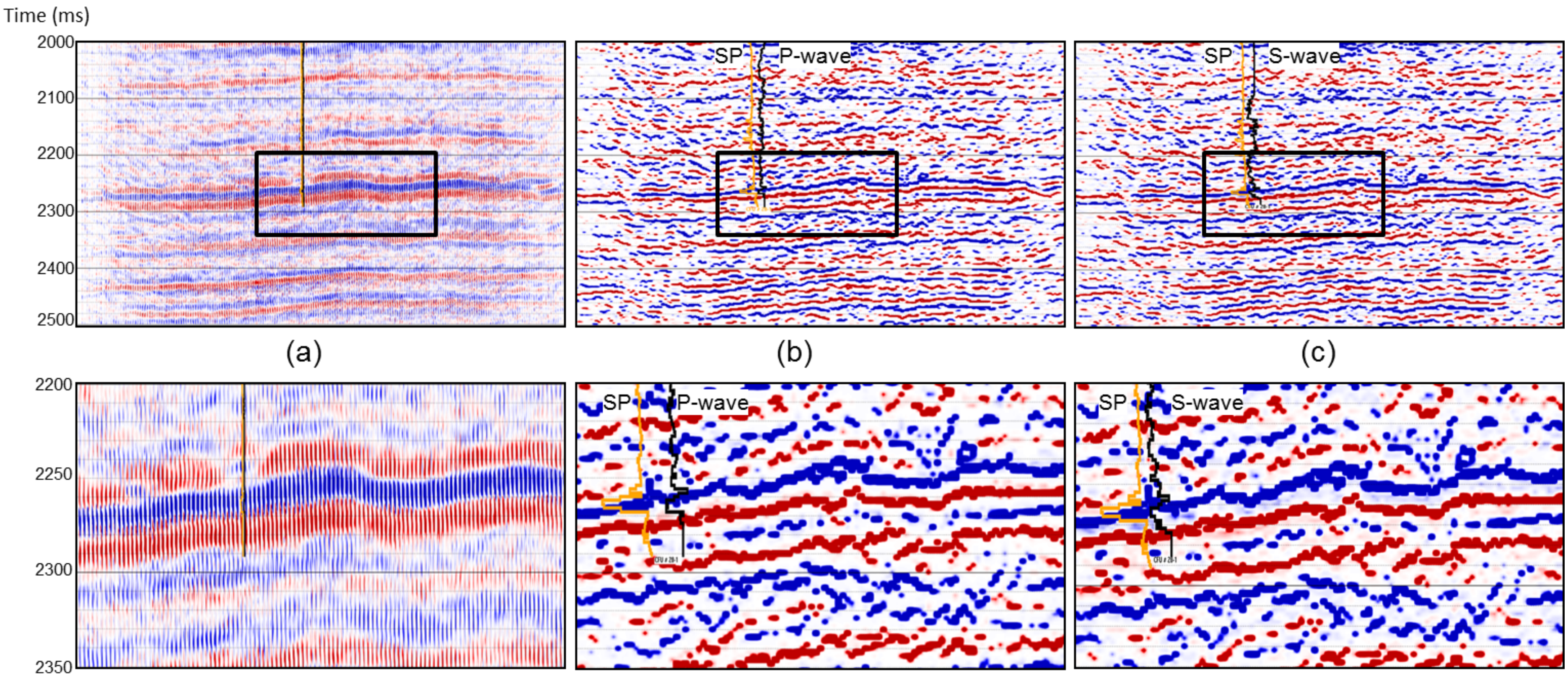
- Even Seismic response

- Odd Seismic response





BPI - Inverted Reflection Coefficients



(a) (b) (c)

(d) (e) (f)

Greedy Annealed Importance Sampling (GAIS)

Step 1: draw samples $\mathbf{m}$ independently from Q.

Step 2: For each m_i, let $m_{i,1} = m_i$. Compute block $B_i = \{m_{i,1}, m_{i,2}, \ldots, m_{i,n}\}$ by taking local search steps in the direction of maximum $|f(m)P(m)|$ until a local maximum or $n-1$ steps.

Step 3: Create the final sample from the blocks of points $m_{1,1}, \ldots, m_{1,n}, m_{2,1}, \ldots, m_{2,n}, \ldots, m_{q,1}, \ldots, m_{q,n}$.

Step 4: Assign each point $m_j \in B_i$ with a weight

$w_i(m_j) = P(m_j)\alpha_{i,j} / Q(m_i)$,

where m_i is the initial point of block B_i, m_j is one of the successors in its block and α_{ij} is relative arbitrary except they must satisfy $\sum_{m_i \in M} \alpha_{ij} I_{ij} = 1$

with $I_{ij} = 1$ if $m_j \in B_i$ and $I_{ij} = 0$ if $m_j \notin B_i$

Step 5: Estimate the expectation value of $f(m)$ by assembling all the weighted samples together.

$$E_{f(m)} = \frac{1}{n} \sum_{i=1}^{n} \sum_{j=1}^{k} f(m_{ij}) w_i(m_j).$$

Figure 1. Workflow of greedy importance sampling (modified from Schuurmans and Southey 2000).

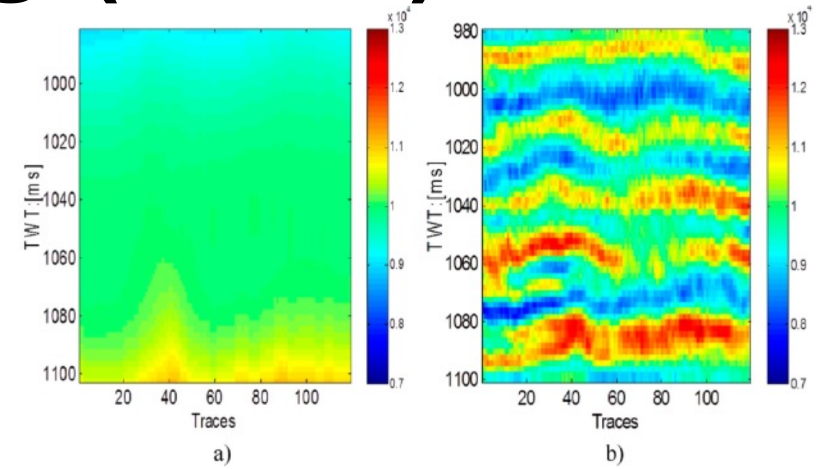


Figure 12. (a) Initial P impedance model (m s^{-1} * g cc^{-1}); (b) inverted P impedance (m s^{-1} * g cc^{-1}) profile from HRS strata

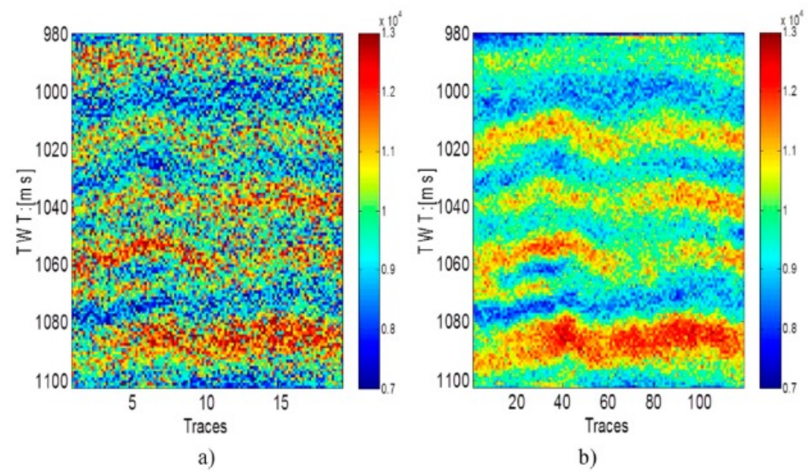
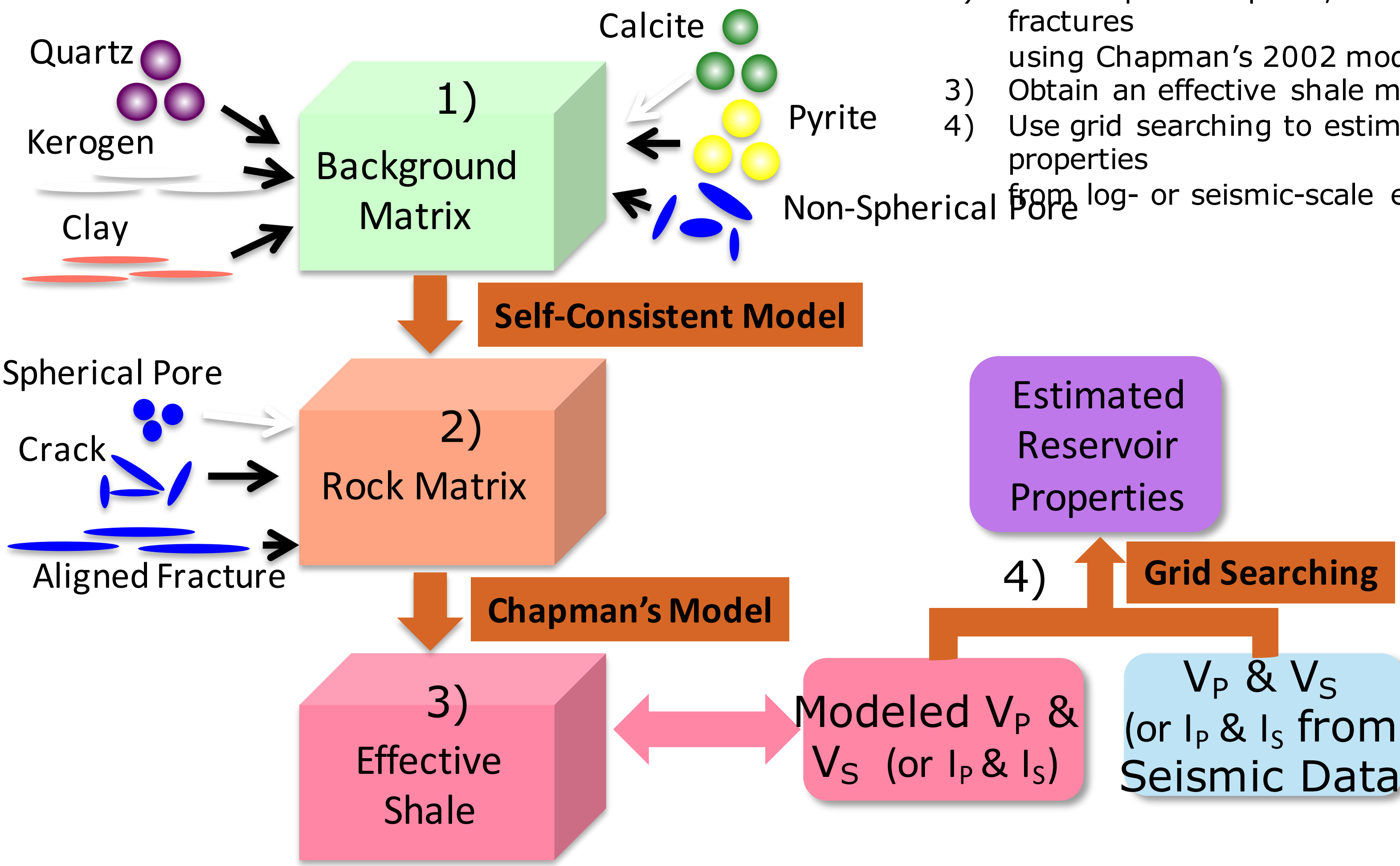


Figure 13. Estimated expectation value of P impedance (m s^{-1} * g cc^{-1}) profile from VFSA (a) and from GAIS (b).

ROCK-PHYSICS MODELING AND GRID SEARCHING WORKFLOW

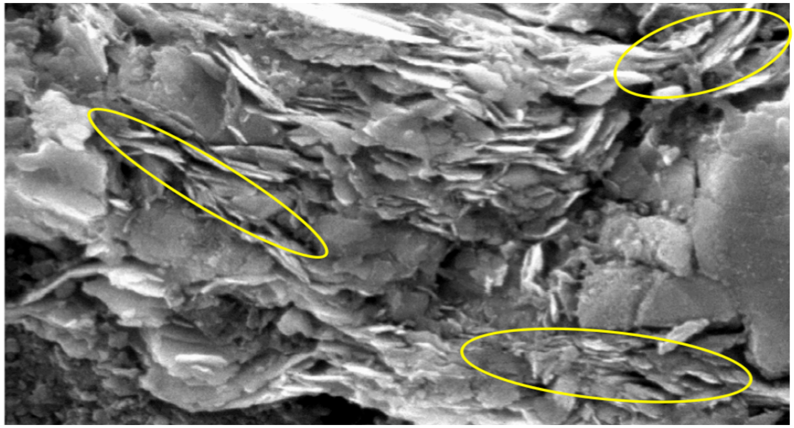
1) Input minerals and pores in the self consistent model
   to form the background matrix
2) Imbed spherical pores, cracks, and aligned fractures
   using Chapman's 2002 model
3) Obtain an effective shale model
4) Use grid searching to estimate reservoir properties
   from log- or seismic-scale elastic properties



THREE-STEP DEM METHOD

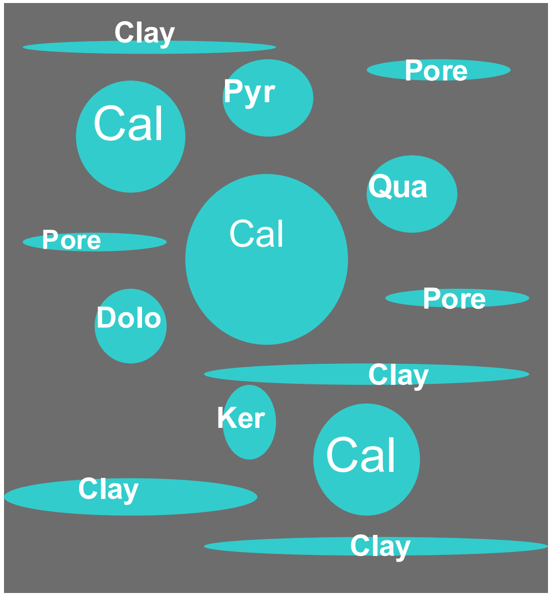
Step 2

Re-orient soft inclusions so that they are not aligned, thus reducing modeled anisotropy



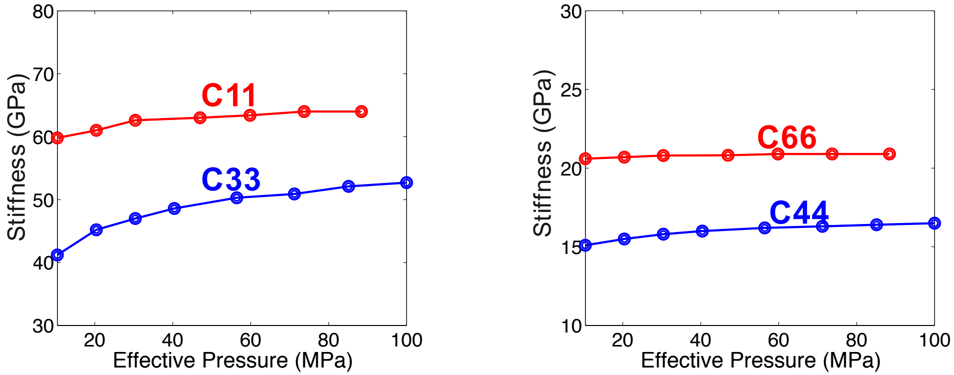
Step 1

Input stiff inclusions (round) and soft (ellipsoidal) inclusions)



Step 3

Use Vp/Vs relationships to account for effective pressure



In Progress

- Modeling of seismic response of discrete fracture networks based on integral formulation.
- Quantum annealing (QA) inversion of angle gathers.
- Probabilistic rock physics templates.
- Combined Biot and squirt-flow modeling for sonic wave modes.
- Neural-network based image segmentation.

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