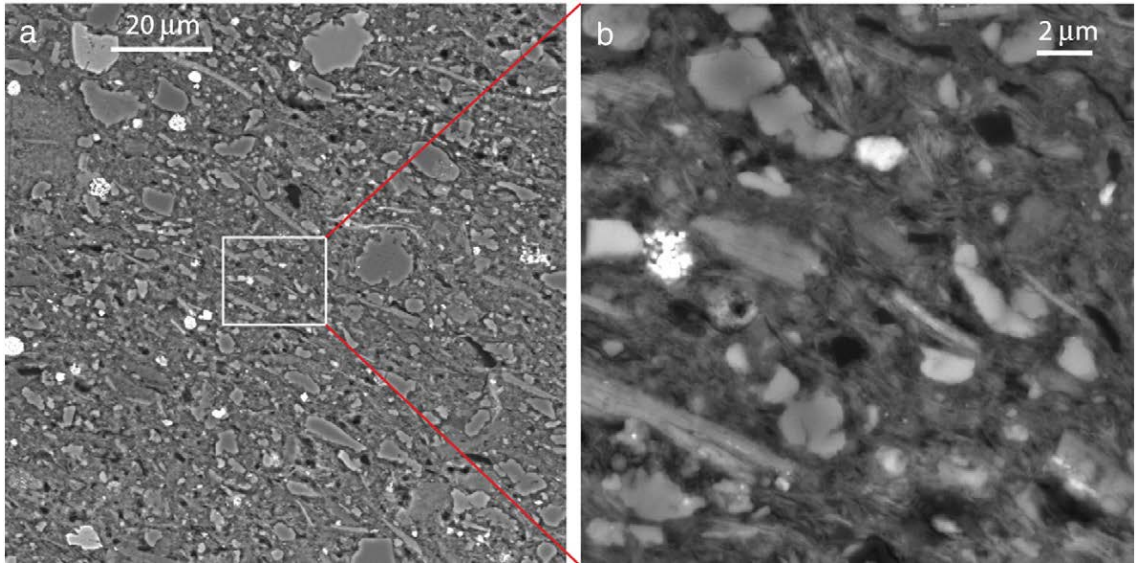
Different Types of Fields to Describe the Earth

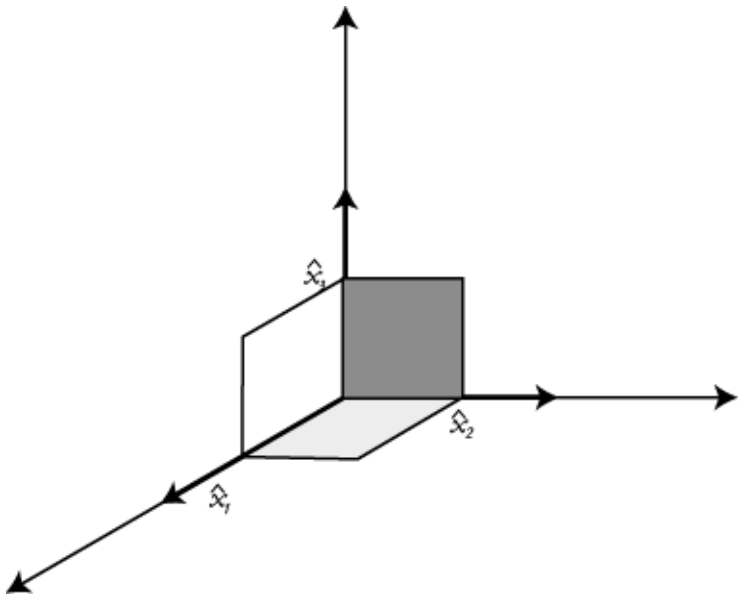
Experimental Property	Model Property	Model
$u, \dot{u}, \ddot{u}$	ρ, V_P, V_S	Wave Equation
flow rate, T, P	ϕ, k (porosity, permeability)	Diffusion Equation
E, B, i	σ (conductivity)	Maxwell's Eqns.

Anisotropy, heterogeneity



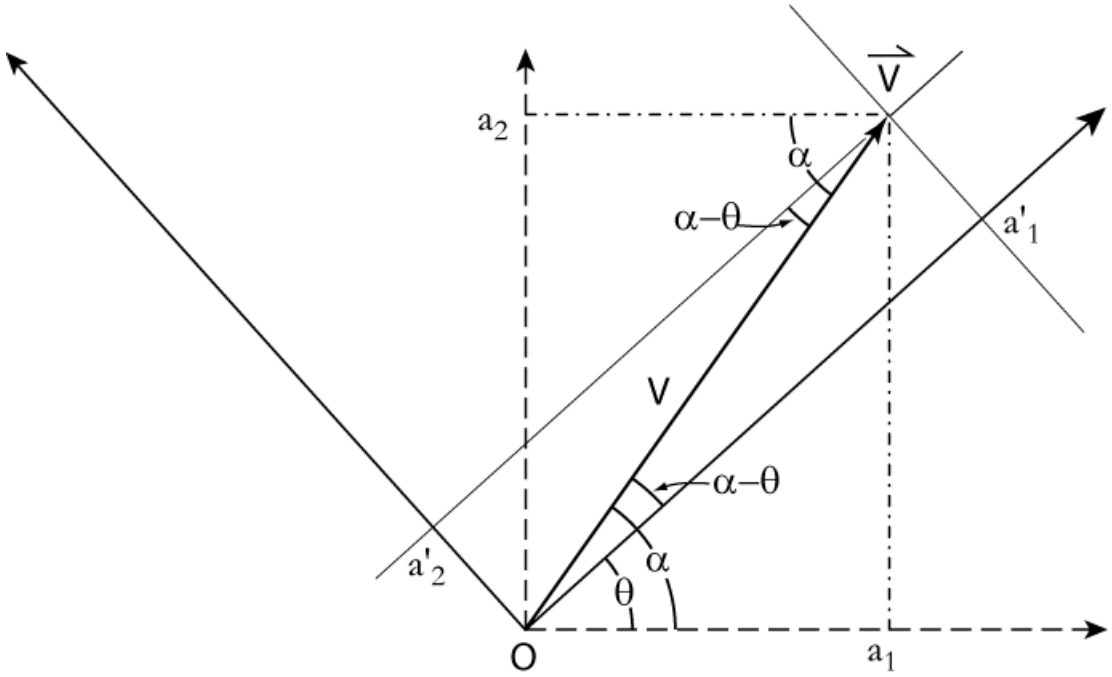
SEM of shale (Josh et al., 2012)

Right-handed systems



3-component geophones are often right-handed

Rotations



Matrix Multiplication

- Multiplication of two matrices consists of multiplying over the columns and adding over the rows
- For A*B, the number of rows in B must equal the number of columns in A

Matrix Multiplication

$$C_{ij} = \sum_{k}^{n} A_{ik} B_{kj}$$

$$= A_{ik} B_{kj}$$

For example

$$A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix} \qquad B = \begin{bmatrix} 2 & 0 & 3 \\ 1 & 3 & 3 \\ 1 & 2 & 2 \end{bmatrix}$$

$$C_{12} = A_{21} B_{11} + A_{22} B_{21} + A_{23} B_{31}$$

Matrix Multiplication: In Matlab


```
>> A = [1 0 1; 0 0 0]
A =
     1     0     1
     0     0     0
>> B = [ 2 0 3; 1 3 3; 1 2 2]
B =
     2     0     3
     1     3     3
     1     2     2
>> A * B
ans =
     3     2     5
     0     0     0
>>
```

C