Motivation

Fractures or cracks with preferential orientation → anisotropy

Increase reliability (2002 methods)

- Fracture orientation
- Fracture density
- Fluid properties (type, \( S_w \) and \( P_e \))
- Fracture size
- Fracture spacing
- Fracture aperture

Measurement setup

Polarization recording

Sample preparation

Rubber strip cracks

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Results

P-wave signatures

S-wave seismograms

Source frequency : 90 kHz

Anisotropy parameter \( \gamma \) (Thomsen, 1986)

\[ \gamma_{s1,s2} = \frac{1}{2} \left( \frac{V_{x1}^2}{V_{x2}^2} - 1 \right) \]

Cross-correlation technique (Kennett, 2002)

Taking two traces \( (S,H) = (S(S_1,S_2),H(S_1,S_2)) \)

P-wave velocities

Anisotropy parameter \( \varepsilon \) (Thomsen, 1986)

\[ \varepsilon_{ij} = \frac{1}{2} \left( \frac{V_{ij}^2}{V_{jk}^2} - 1 \right) \]

Isotropic model - Reference

\[ S(\theta,t) = S1(t) \cos(\theta) - S2(t + \delta) \sin(\theta), \]

\[ H(\theta,t) = S1(t) \sin(\theta) + S2(t + \delta) \cos(\theta), \]

\[ R(\theta,t) = \sum_{i=1}^{n} S(\theta,t_i) H(\theta,t_i + \delta) \]
Results

- S-wave is more influenced than P-wave by preferential orientation of cracks;
- The crack orientation was found by integrating cross-correlation with analysis of anisotropy parameter $\gamma$;
- The anisotropy parameter $\gamma$ is more efficient to estimate the fracture zone;

Conclusions

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