AASPI Attribute-Assisted Seismic Processing and Interpretation

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Diffraction imaging via constrained least-squares migration

-----Tentative workplan for 2012

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Motivation

The knowledge of natural and induced fracture orientation and intensity is essential for the reservoir property analysis and choice of drilling, Wide azimuth acquisition can provide the opportunity of anisotropy analysis for fracture detection. But it's not always the case that wide azimuth data is available due to high expenses. My research will focus on the diffraction image for the induced fractures using the narrow azimuth data on the basis of constrained least-squares migration.

Introduction

Perez and Marfurt (2008) proposed one new azimuth binning algorithm in Kirchhoff prestack migration, by sorting seismic data by the azimuth of average traveling path from source to subsurface image point and back to receiver, rather than the azimuth between source and receiver directly, the new binning allow us identify image contribution from out-of–the- plane steeply dipping reflectors, fractures, and faults.

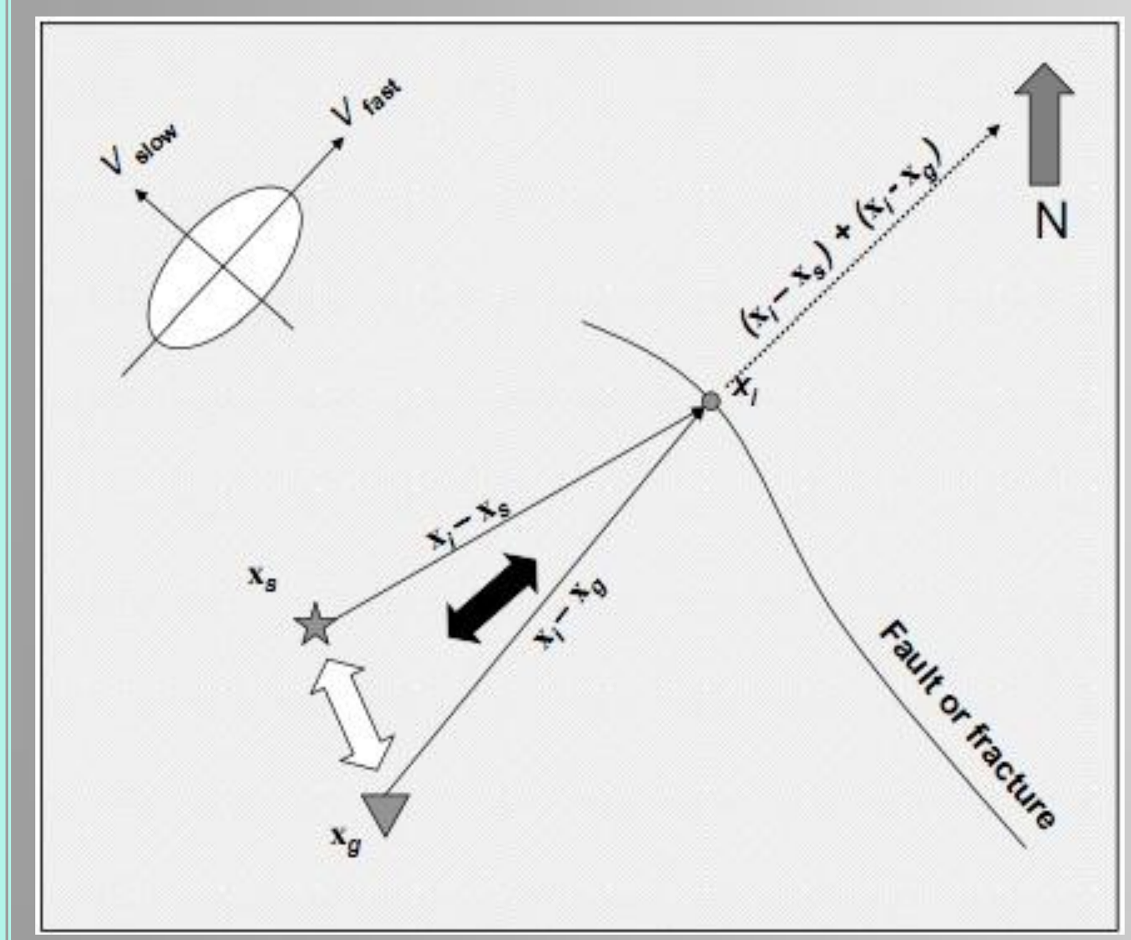


Fig 1 . New azimuth binning (Perez and Marfurt)

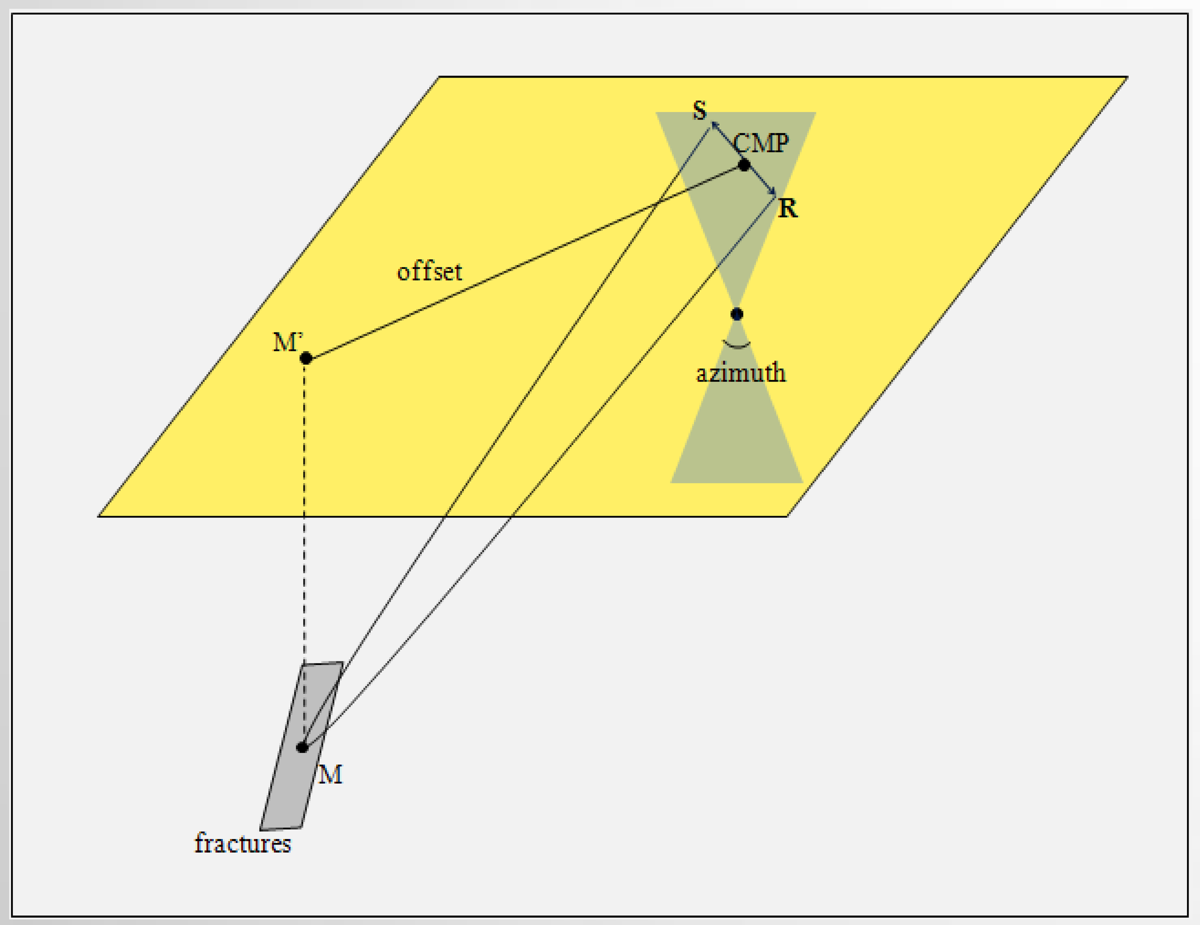


Fig 2. Ray-based mapping of fractures diffraction

Theory

When one layer is vertically aligned with parallel fractures, we can define it as HTI media. Seismic velocity will vary with azimuth in HTI media, also for example, AVO gradient, NMO velocity, etc, can vary with acoustic properties in an isotropic media.

Rüger (1998) parameterized amplitude vs azimuth (AVAz) by expressing the HTI symmetry with the Christoffel equation.

$$R_p(\theta,\phi) = A + B(\varphi)\sin^2\theta + C(\varphi)\sin^2\theta\tan^2\theta$$

$$R_p(i) = A^{iso} + B^{iso}\sin^2\theta + C^{iso}\sin^2\theta\tan^2\theta$$

$$B(\Phi) = B^{iso} + B^{ani}\cos^2(\phi-\psi)$$

Where A and A^{iso} are normal-incident reflectivity, B and B^{iso} are the gradient, and C and C^{iso} are third order, B^{ani} is the anisotropic gradient associated with fracture intensity, and ψ is the azimuth of the symmetry axis plane of the HTI media associated with fracture strike.

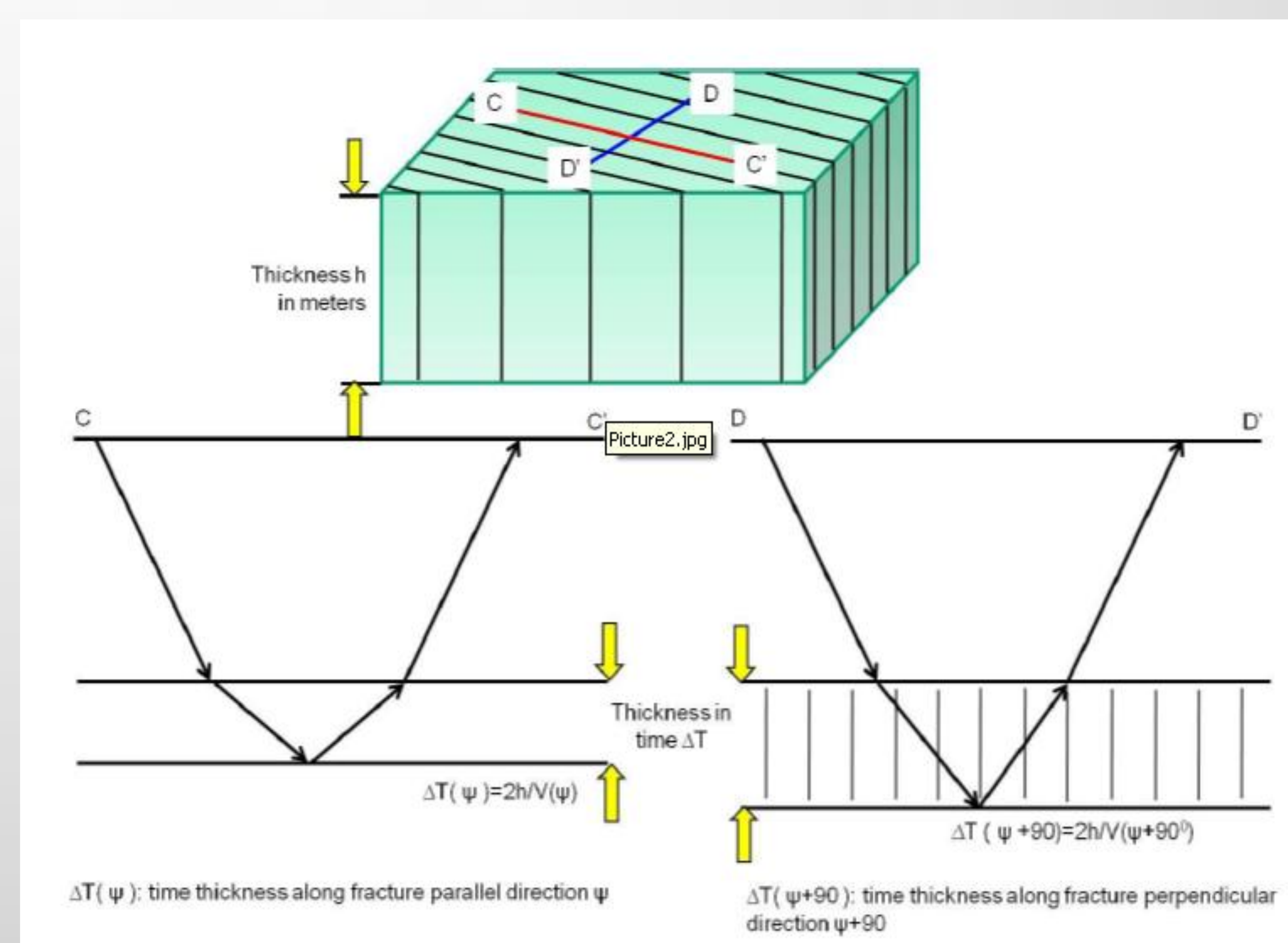
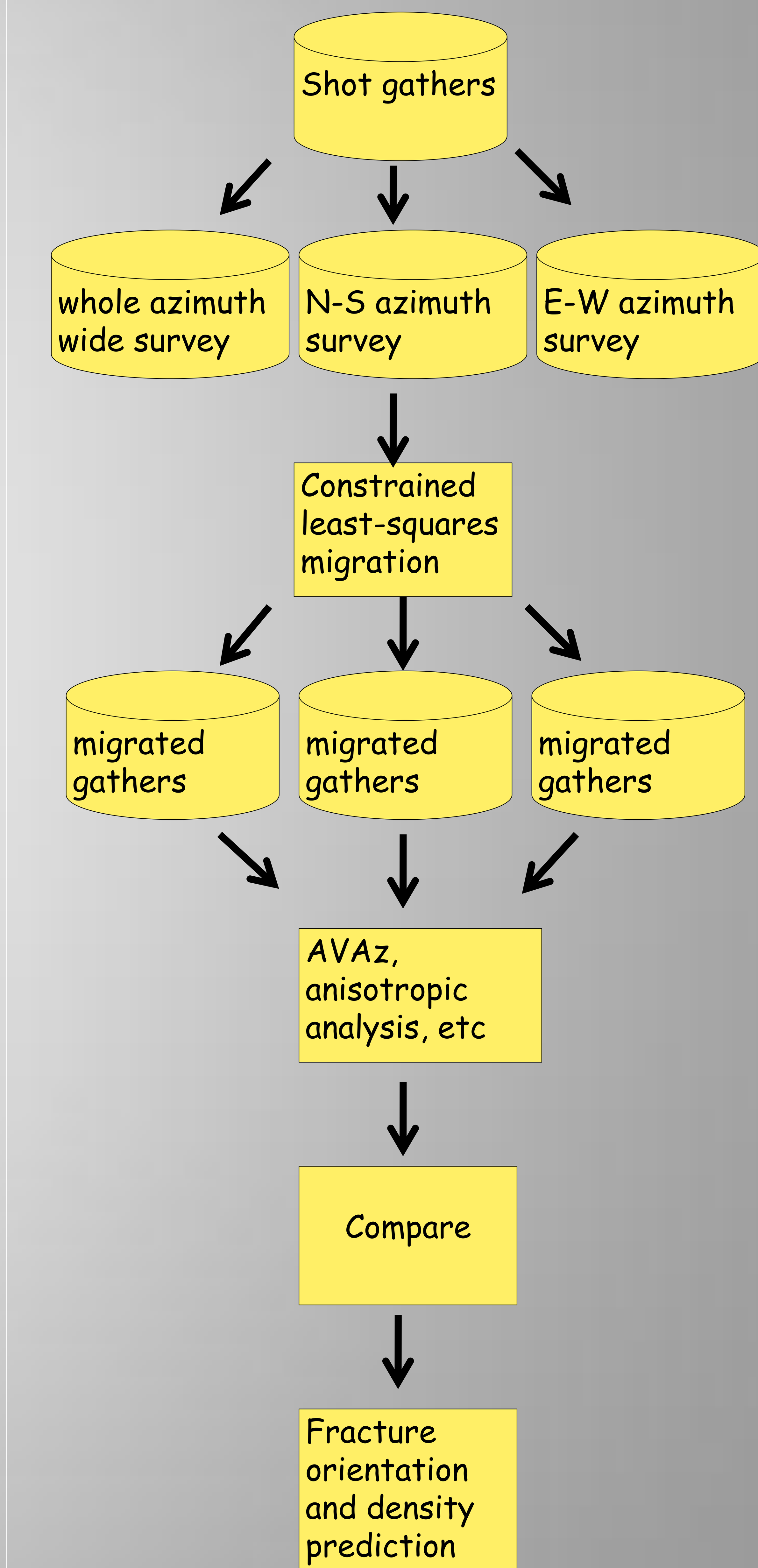


Fig 3. Anisotropy pattern for HTI media

Workflow



Acknowledgement

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Reference

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