non-specular backscatter imaging probes material properties of the earth

By design, AZ accentuates the rich content of the non-specular backscatter energy directly probing underlying geophysical properties of the earth; conventional migration accentuates specular reflections from ambiguous impedance changes in the subsurface:

- AZ reconstructs the complementary components of recorded energy that 3D seismic rejects as incoherent noise
- Non-specular returns detected by AZ have significantly lower coherent background interference because
  1. Coherent interference is highly attenuated due to the narrow beamwidth of the receiver array, and
  2. AZ’s beamformer method further suppresses coherent interference through the firm’s proprietary adaptive classification and filtering of specular energy using singular value decomposition (SVD) and advanced eigenstructure methods.

These steerable “pencil” beams represent the fundamental difference between AZ and conventional seismic: AZ allows for focused, high-resolution seismic detail associated with the diffused and/or diffracted character in areas of geological interest, while conventional seismic provides a broader, lower-resolution image with marginal focusing ability to resolve subtle complex discontinuities in formations such as caused by fractures.
ENERGY RETURNS EVIDENT IN FRACTURED REGION
Frequencies of up to 160 Hz were recorded, typically 140Hz at the Eagle Ford formation depth.

AZ successfully conducted a full-scale pilot investigation of the Eagle Ford over this region:
- The receiver array was deployed to intersect GGS’s survey
- A 12.5 sq. km area was imaged as part of the pilot
- Over two terabytes of data were acquired using a custom array of 4,000 receivers

Wilson County Texas over the prolific Eagle Ford (shale), Austin Chalk (chalk), and Buda (limestone) formations that was being imaged as part of Global’s Wrangler 3D multi-client survey.

AZ real high-resolution specular energy returns complement 3D seismic interpretations of the underlying geology when returns are associated with underlying material properties.
VIRTUAL WELL BORE: SYMMETRY AXIS OF UNDERLYING GEOLOGY
(AZ DATA SUPERPOSED ON 3D SEISMIC DATA)

Specular energy along the symmetry axis of the geology are real energy returns along a “virtual well bore.”

~250 msec two-way travel-time interval is equivalent to ~500 meters depth. Note the very high resolution in lateral (8m) and vertical (1 msec) dimensions.

New features not seen in 3D seismic

Increasing the gain extracts signals due to known geology

New Features
Known Features
large aperture imaging enhances signals and suppresses background (SSD-ON, R<1000M)

The original non-specular candidate energy is maintained roughly constant as aperture is increased and filters applied, to preserve normalization of non-specular energy returns while specular returns are suppressed.

Additional non-specular candidates emerge with larger aperture, application of specular filters, and image transforms (Hilbert transform enhances energy). Applying an energy threshold allows 3D seismic data to be compared to AZ data.
edge diffraction output exhibits considerably more structure

A slice in two-way travel-time at 1323 milliseconds displays the difference between the image output of an isotropic scatterer (left) and the edge diffraction output (right).

Edge detection beamformer output is a vector field indicating the strike direction of edge diffractions (two-headed arrows) and the magnitude of the edge diffraction signal (in color)
The Acoustic Zoom® imaging/mapping method was born out of the need to provide “earth scientists” with more localized information, the information arising from the presence of scattering due to sharp and localized material discontinuities such as tips or edges or geobodies possessing sufficiently large boundary curvature.

This method is designed to excel where conventional imaging and inversion methods perform poorly or fail altogether in capturing this subtle, yet essential information to the understanding fluid transport and “textured” subsurface character. The failure of conventional methods is mainly attributed to the “blending” of localized and spatially extensive subsurface features.