Tectonic Deformation of a Lacustrine Mudstone at Soda Lake Geothermal Field, W. Nevada, USA, from 3D Seismic Interpretation

Tyler Kent & John N. Louie
Nevada Seismological Laboratory, University of Nevada, Reno, Nevada, USA

Thanks to:
Sadiq Zarrouk (Univ. of Auckland); Jim Echols & Dick Benoit (Magma Energy); Jim Faulds (UNR); Holly McLachlan (UNR)
- 34 sq km (13 sq mi) 3-D reflection seismic survey
- Three 28,000 kg (62,000 lb) vibrators into 8,374 source points, 8-72 Hz sweeps
- 3001 simultaneous 3-comp receivers

$100M US-DoE investment in Nevada geothermal since 2008
- Basaltic lopolith at ~550 m
- Thickest basalt at center of production
- East-dipping normal faults
- Faults line up with thermal anomalies in wireline T data
Median filter

To smooth reflections

Fault enhancement by Diffusion toward lower similarity

P-P Processing in OpendTect from dGBES
Faulted 0.3-1.5 Ma Mudstone

- Pluvial mudstone
- Exposed at basin margins
- Good reflector ties to wells
Horizontal Sections, Fault Picking

Mudstone faulting shows current tectonics

Picked faults above similarity at 290 m depth

Horiz. similarity section, from fault-enhanced volume

1 km
Pull-Apart Basin Geometry:

- 1.8% Recent extension
- No Strike Slip needed
- Production from Accommodation Zone
Seismic Anisotropy from 3-Component Data

S2
Fast S-wave

S1
Slow S-wave

Time/Depth Shift

AAPG April 2011

University of Nevada, Reno

Great Basin Center for Geothermal Energy
Seismic Anisotropy from 3-Component Data

Shear-wave splitting as a seismic attribute

C-wave S1 (Fast S-wave)

C-wave Time Shift from S1-S2

C-wave S1 Smoothed (RMS)

University of Nevada, Reno
3D View Down into Azimuthal Anisotropy

- Well tracks in red
- Gray regions >1% anisotropy, from shallow normal faults all N-strike
- Accom. zone with production has multiple fault & fracture azimuths, <1% anisotropy
Questions?