Outstanding questions at subduction zones

- Changes in megathrust properties and earthquake behavior downdip and along-strike
- Water and volatile cycling
- Pluming beneath volcanoes and creating of new crust
Imaging requirements

- Deep imaging of megathrust and other crustal structure with long streamers and large sources
- 3D imaging of complex structures
- Deep, long offset recordings of refractions and wide-angle reflections
Long streamers and large, well-tuned sources

Examples from:

- Aleutians
- Sumatra
Deep imaging of Alaska subduction zone from MGL1110

Li et al, JGR, in revision
Single reflection from the plate interface

Li et al., JGR, in revision
Wide band of reflections from the plate interface

Li et al, JGR, in revision
Line 3, OBS 319

megathrust reflection
Comparison of 1994 Ewing data with 2011 Langsesth data

Courtsey of John Miller, USGS
Comparison of 3300 and 6600 cu in source on Langseth from MGL14
Sumatra

R/V Sonne 2008
12 – G-guns (5420 in³)
192 channel, 2.4 km streamer

Short offset streamers:
- Poor deep imaging
- Poor velocity control
- Poor multiple suppression
CGGVeritas survey

M/V Geowave Champion

Long offset streamer (15 km)
- improves velocity control
- improves imaging
- improves multiple suppression
Subducted seamount beneath S. Sumatra forearc basin

Singh et al., 2011
3D imaging of complex structures at subduction zones

Examples from:

- Nankai
- Costa Rica
2D Seismic Image of Splay System

Acquired by Fugro in ~2000
6000 m 480-channel streamer
4240 cu. in airgun array
Overlapping 3D Seismic Image of Splay System

Acquired by PGS in 2006
4500 m 360-channel streamer
3090 cu. in airgun array
Overlapping 3D Seismic Image of Splay System

Acquired by PGS in 2006
4500 m 360-channel streamer
3090 cu. in airgun array

Megathrust
Splay fault branches
Top of subduction crust
NantroSEIZE 3D Volume

Large structural variations along strike and dip directions
3D PreStack Depth Migration, Southern Costa Rica
InLine 2400

Normal offset at depth, thrust
Offset shallow
Neural Network, dip steering, filtered

525 m (620 ms)
Fluid Percentage Probability on Neural Network Fault cube
L1 Z Values
Upslope M1
Mid 1 unconformity (approximately 2 Ma)
Upslope U1
Future needs for 3D imaging

Example from:

- Hikurangi margin, New Zealand
3D Seismic Image of Splay System

Captured by PGS in 2006

360-channel streamer

cu. in airgun array
3D
3D
Sediment properties from long offset streamers

Cascadia Subduction Zone
(COAST project)

Long offsets allow waveform inversion
- bulk property changes
- localized property anomalies
Cascadia Subduction Zone (COAST project)

Better velocities
- improved images
- multiple suppression