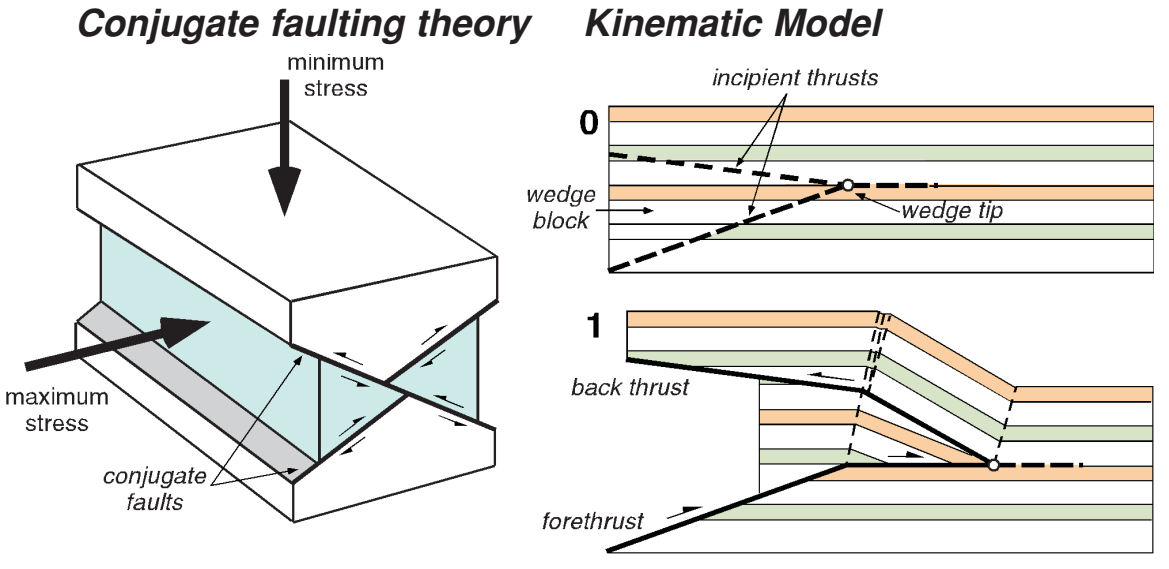
Basic concept



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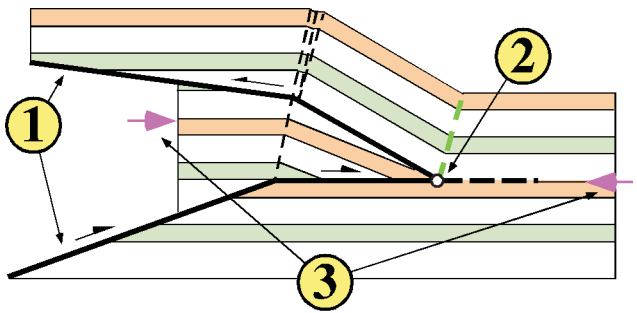
Section 1B-6: Structural wedges

John H. Shaw, Christopher Connors, and John Suppe

Basic concept



Common characteristics

Wedges exhibit a wide range of geometries. However, several characteristics are common to most wedge structure, including:

1) presence of coeval fore- and back-thrusts;

2) folding localized along an active axial surface pinned to the wedge tip; and

3) folds may exist in the footwall of the back thrust that produce structural relief.

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Field Example

Structural wedge in Carboniferous Rundle Formation, Front Ranges of the Canadian Rockies. Note the highly deformed rocks near the wedge tip. Several smaller wedges are contained within the larger wedge structure. (J. H. Shaw and F. Bilotti)

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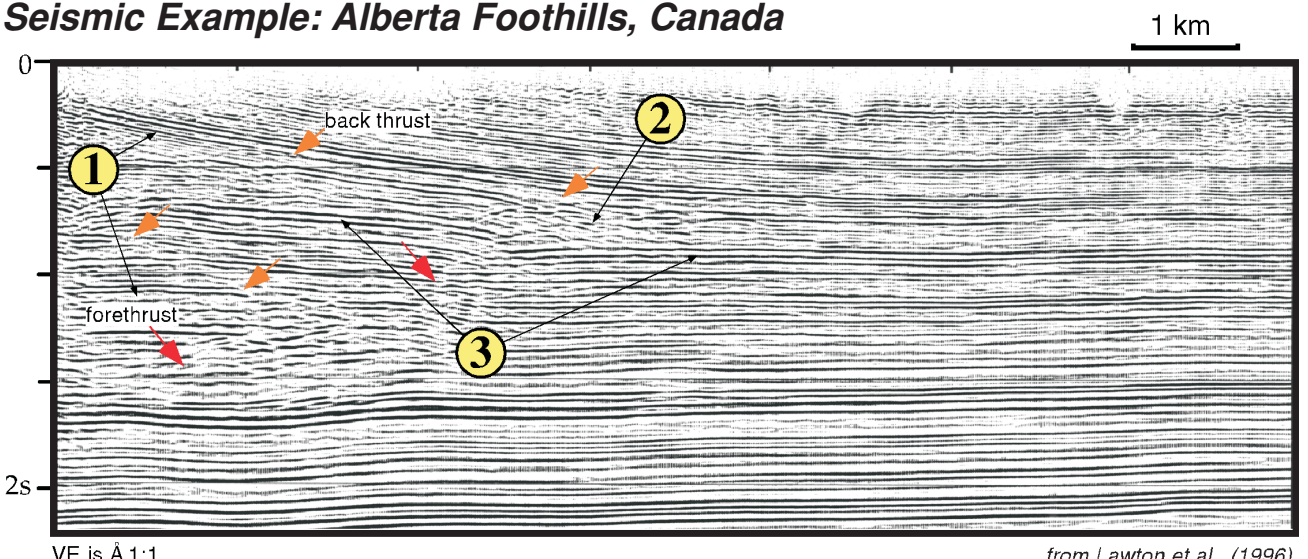
Basic concept

Seismic Example: Alberta Foothills, Canada



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Section 1B-6: Structural wedges

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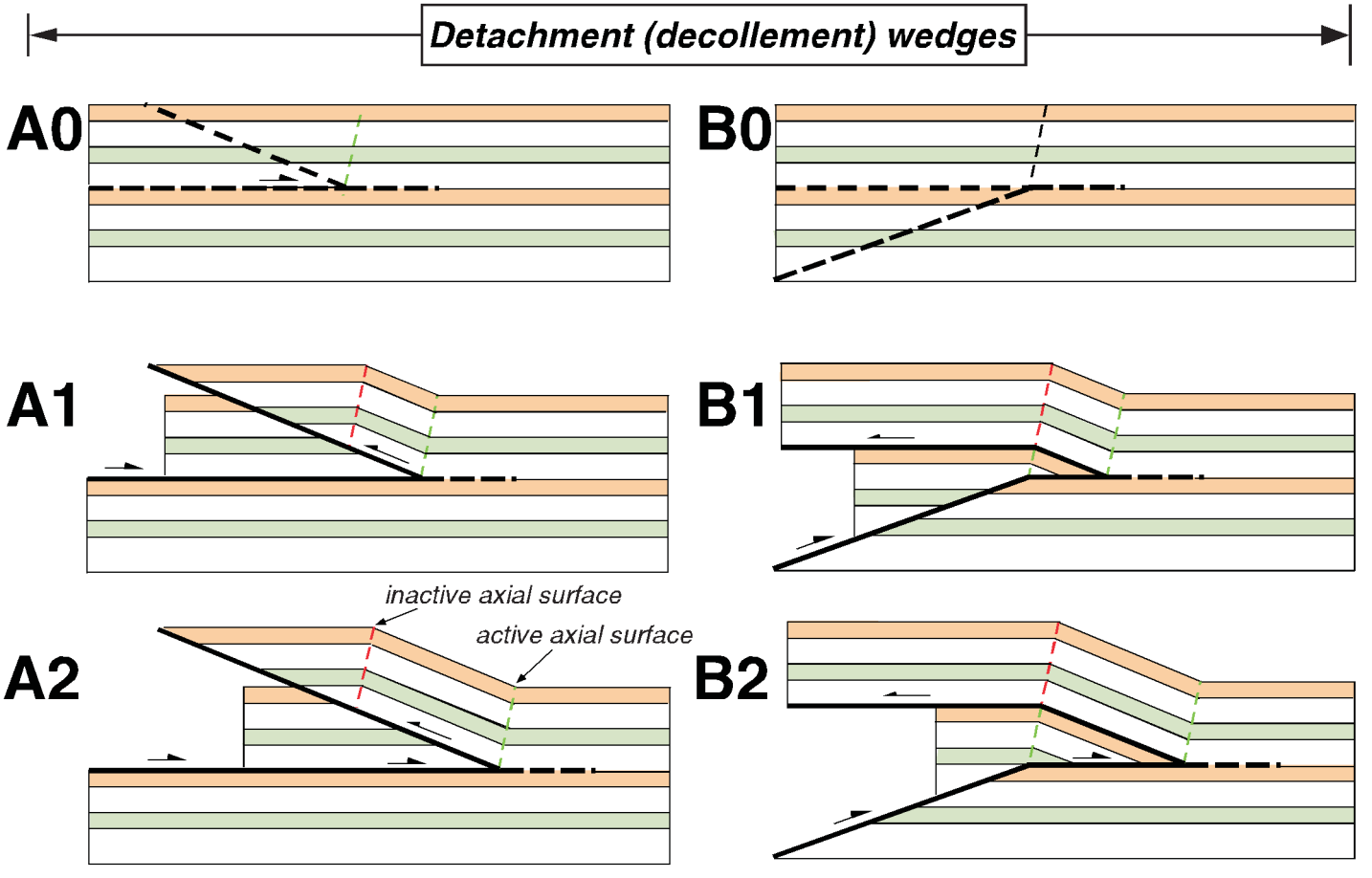
Wedge models developed using fault-bend fold theory



A (0–2): Simple wedge with a detachment and back thrust. Propagation of the wedge tip forms a kink band above the back thrust that is bounded by an active axial surface, which is pinned to the wedge tip. Strata in the kink band are parallel to the back thrust ($\beta = 0$) because the fault rises from a detachment ($\theta = 0$).

B (0–2): Wedge with a lower forethrust ramp and an upper detachment that acts as the back thrust. With slip, the wedge tip propagates along the detachment surface. Strata within the wedge are folded in an anticlinal fault-bend fold that deforms the detachment or back thrust. A kink band develops above the back thrust with strata that are parallel to the underlying fault and fault-bend fold. The synclinal axial surface pinned to the wedge tip is active, as is the anticlinal axial surface within the wedge block. The anticlinal axial surface above the back thrust, however, is inactive.

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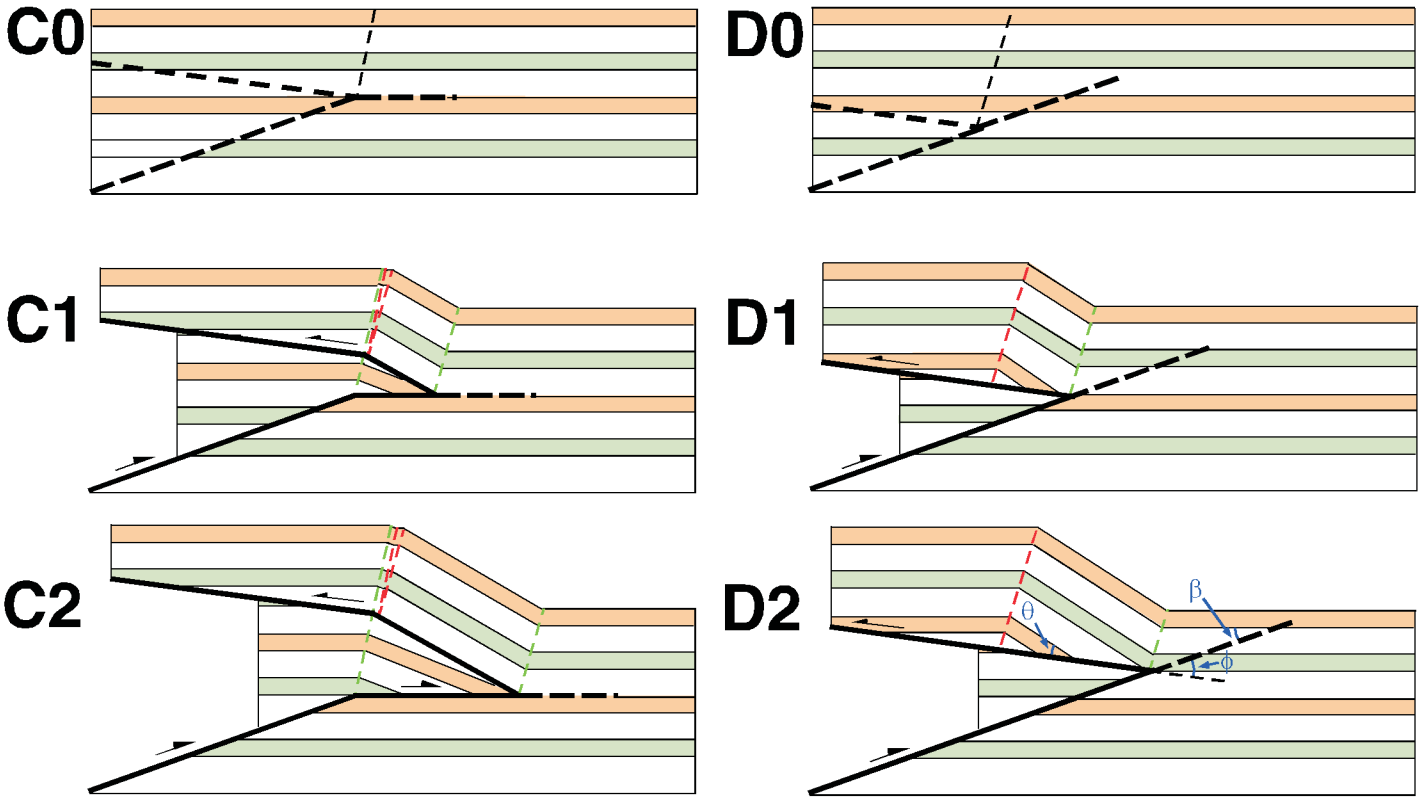
Detachment (decollement) wedges



C (0–2): Wedge formed by a dipping forethrust and back thrust. With slip, the wedge tip propagates along a detachment surface. Strata within the wedge are folded in an anticlinal fault-bend fold that deforms the back thrust. A kink band develops above the back thrust with strata that are parallel to the underlying fault, but that dip more steeply than the beds within the wedge block. Both the synclinal axial surface pinned to the wedge tip and the anticlinal axial surface pinned to the fault bends are active. The anticlinal axial surface in the hanging wall of the back thrust is active (in contrast to model B) because a small amount of strata is folded from the crest into limb, thus passing through the axial surface. These kinematics facilitate the conservation of bed length. Alternatively, a small amount of shear or bed-parallel extension could accommodate fault slip without moving strata from the fold crest into the limb.

D (0–2): Wedge formed by a dipping forethrust and back thrust. With slip, the wedge tip propagates along the trajectory of the forethrust. Strata within the wedge are not folded, as they do not pass over a fault bend. A kink band develops above the back thrust with strata that dip more steeply than the fault. The geometry of the kink band (θ) is governed by fault-bend fold theory (see section 1B-1), with ϕ equal to the acute angle between the back thrust and the propagation direction, and β as the hanging wall cutoff angle relative to the propagation direction.

Note that in this wedge the roof thrust locally cuts down the stratigraphic section as it extends upward. This is an unusual relationship for thrust faults, but nevertheless may occur in non-decollement wedges.

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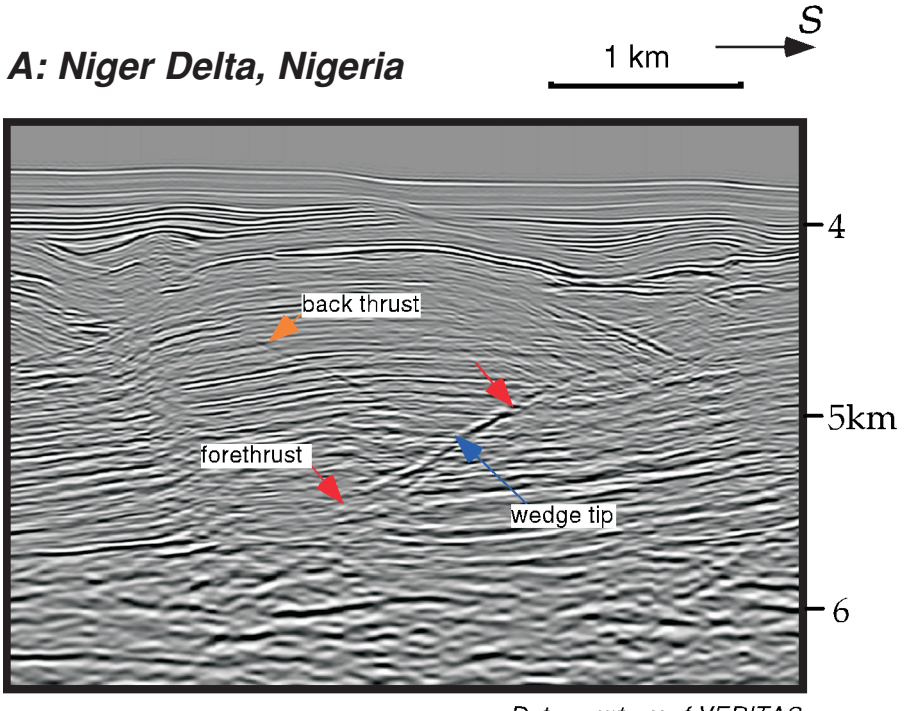
Seismic examples of structural wedges

A: Niger Delta, Nigeria



Data courtesy of VERITAS

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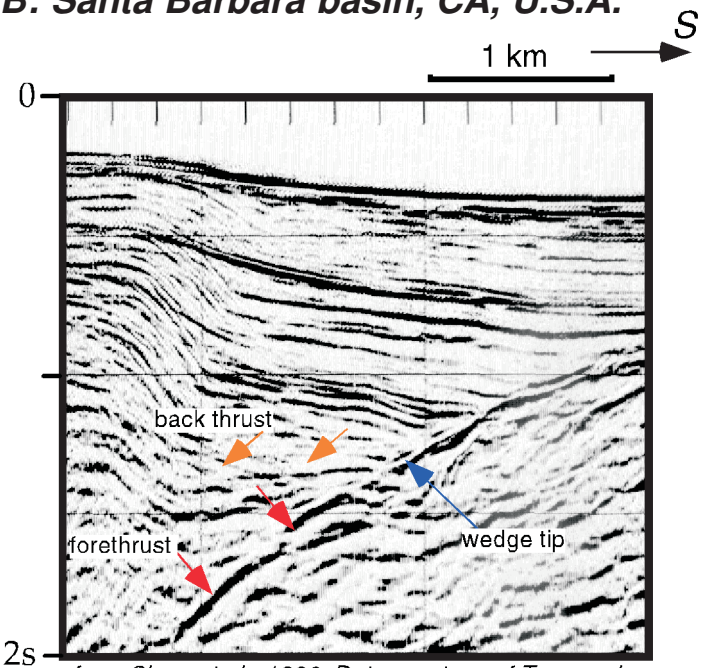
Seismic examples of structural wedges

B: Santa Barbara basin, CA, U.S.A.



from Shaw et al., 1996. Data courtesy of Texaco, Inc.

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Section 1B-6: Structural wedges

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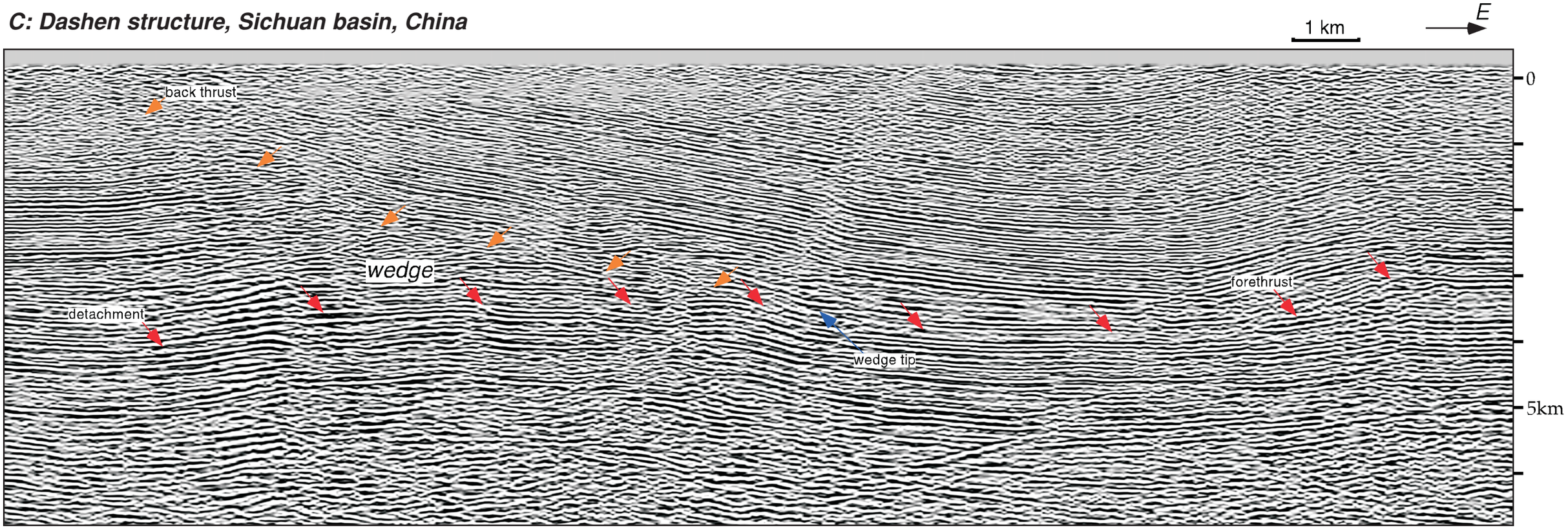
Seismic examples of structural wedges

C: Dashen structure, Sichuan basin, China



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Section 1B-6: Structural wedges

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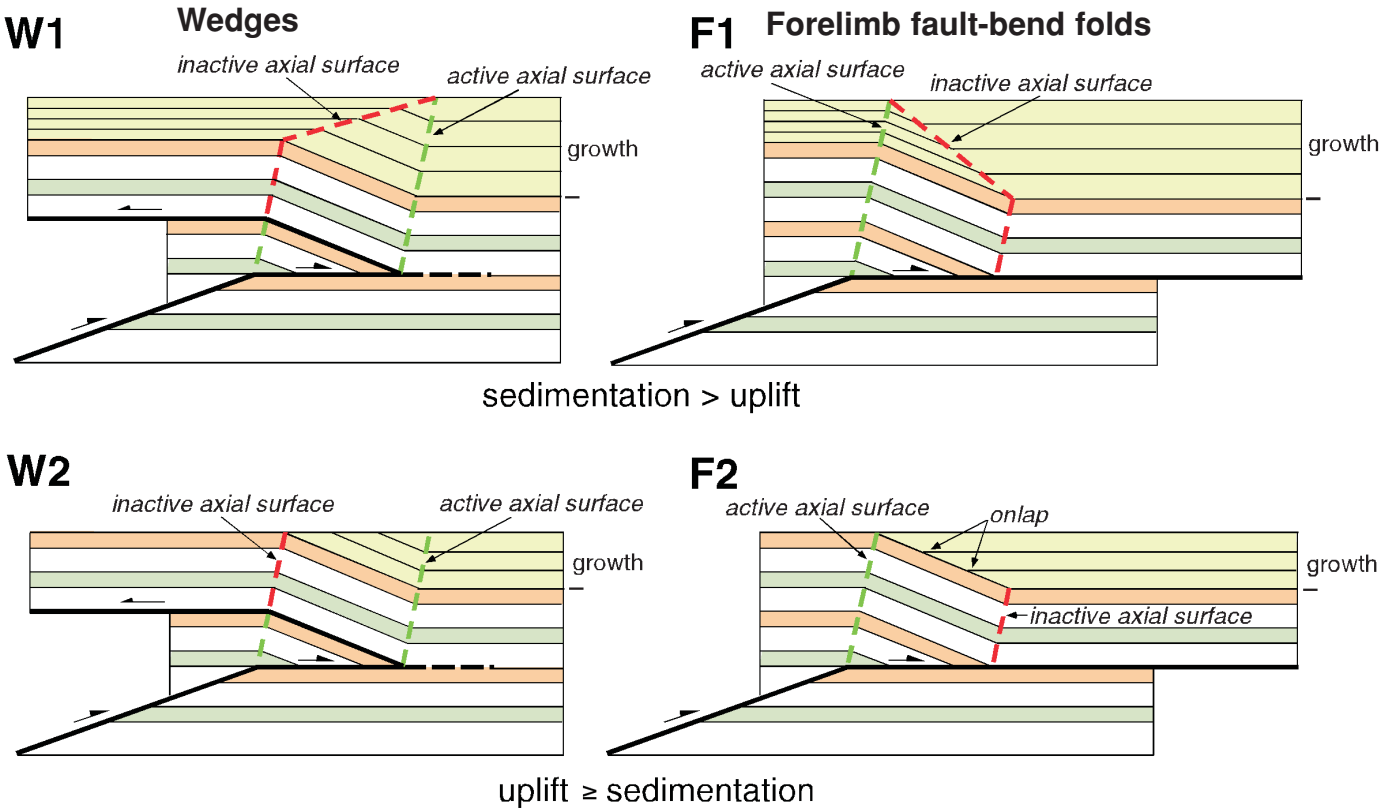
Growth structure in wedges

Kinematic models



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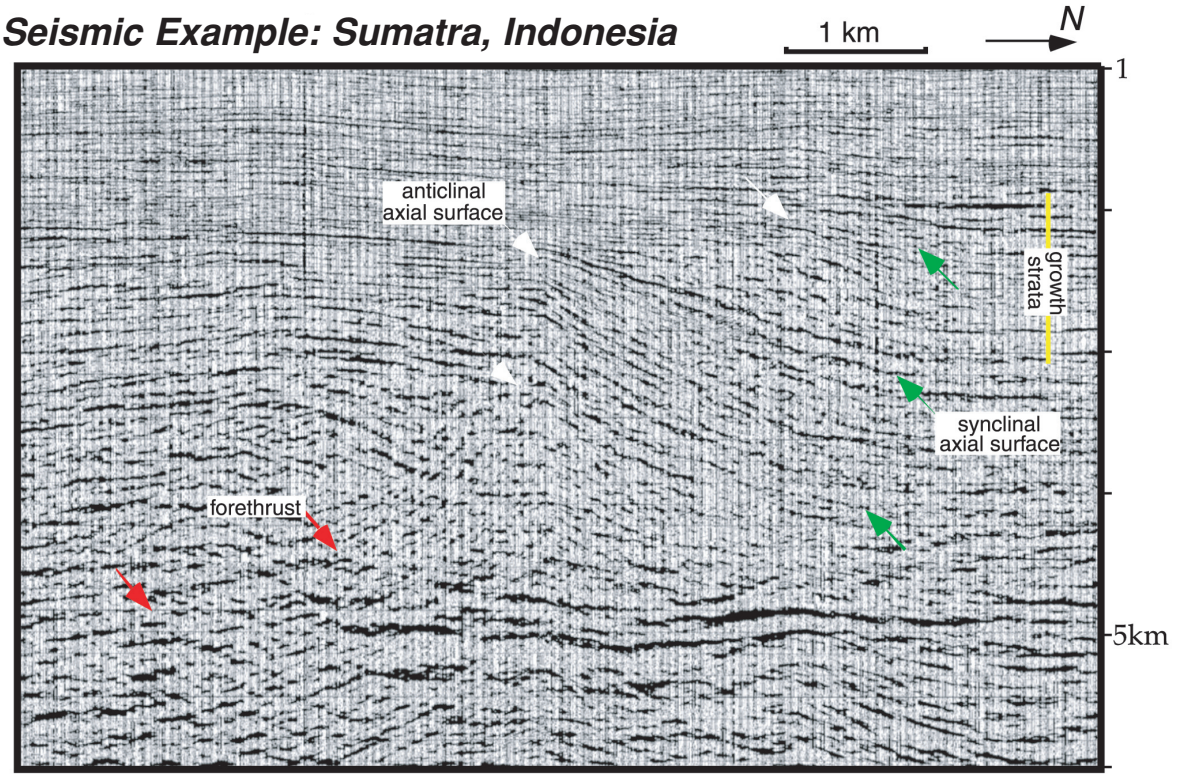
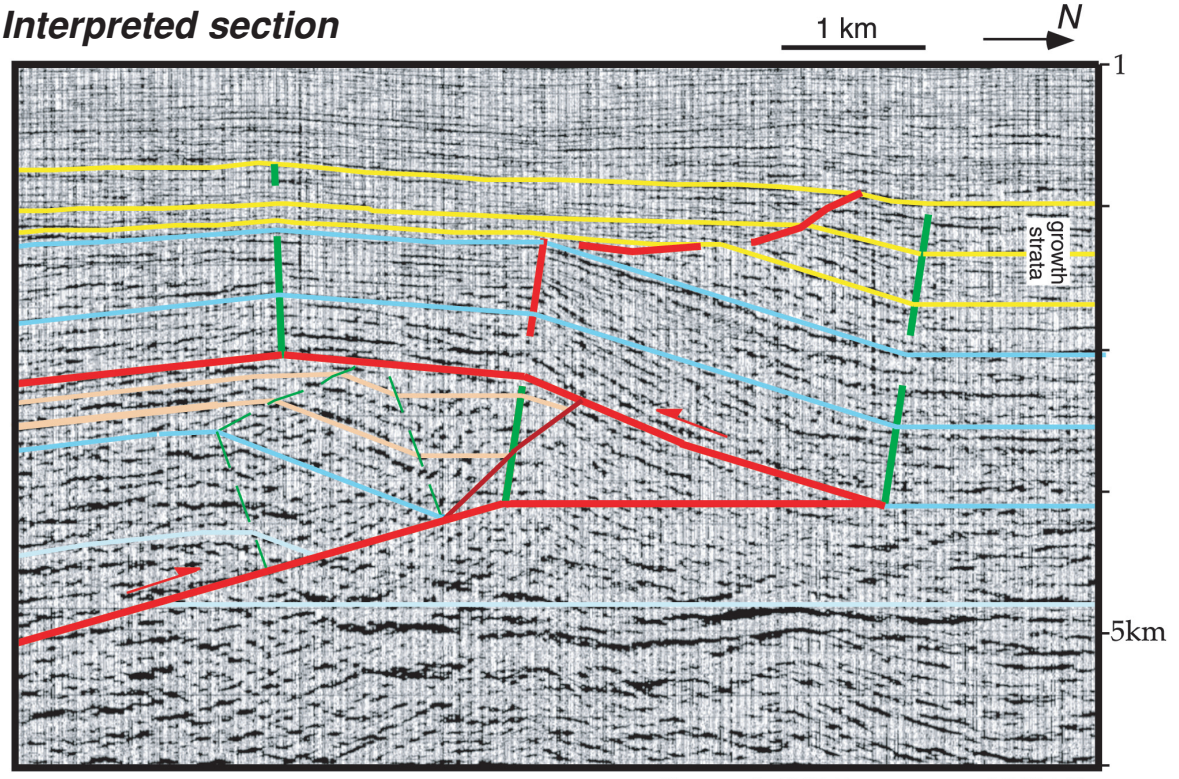
Growth structure in wedges

Seismic Example: Sumatra, Indonesia



Interpreted section



Shaw et al., 1997. Data courtesy of CALTEX

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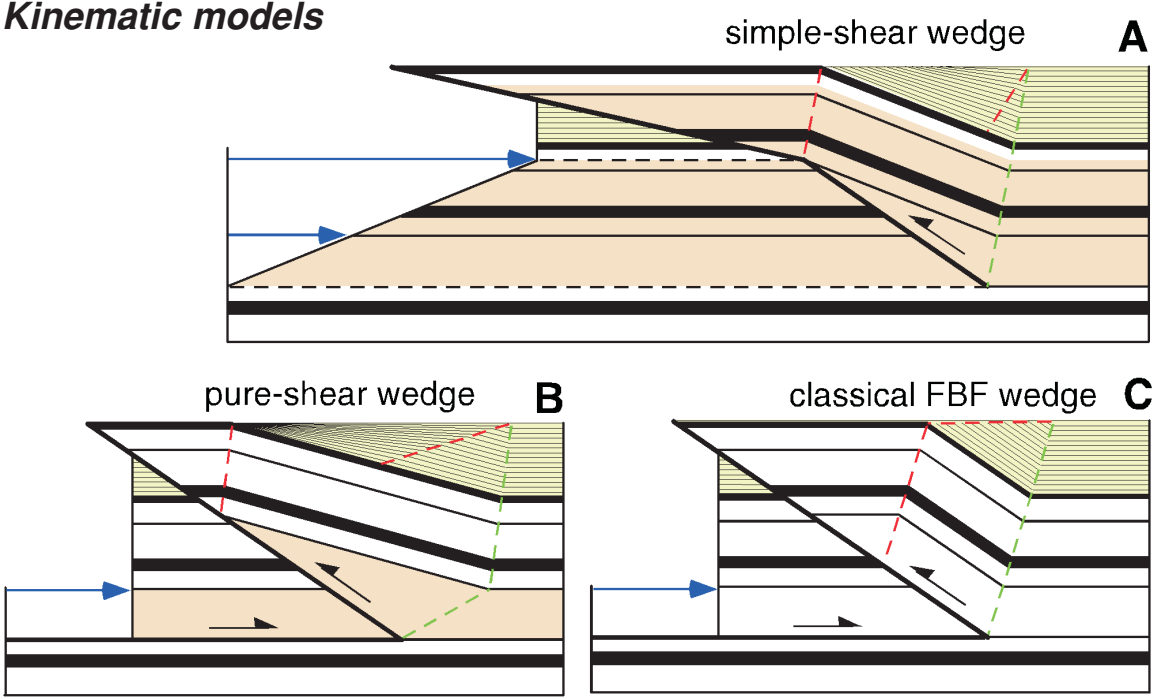
Section 1B-6: Structural wedges

John H. Shaw, Christopher Connors, and John Suppe

Shear fault-bend fold wedges

Kinematic models



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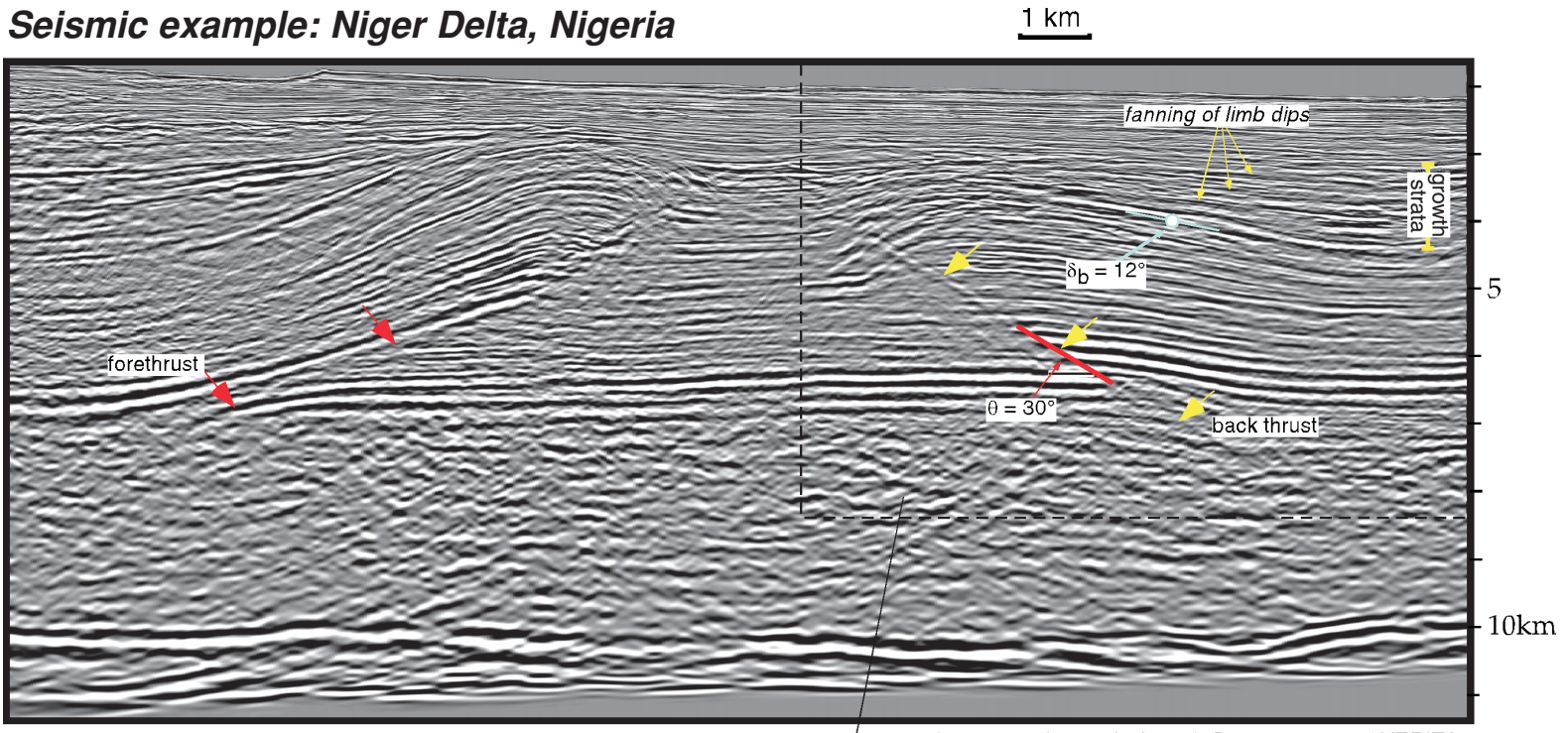
Shear fault-bend fold wedges

Seismic example: Niger Delta, Nigeria



from Corredor et al., (2002). Data courtesy of VERITAS

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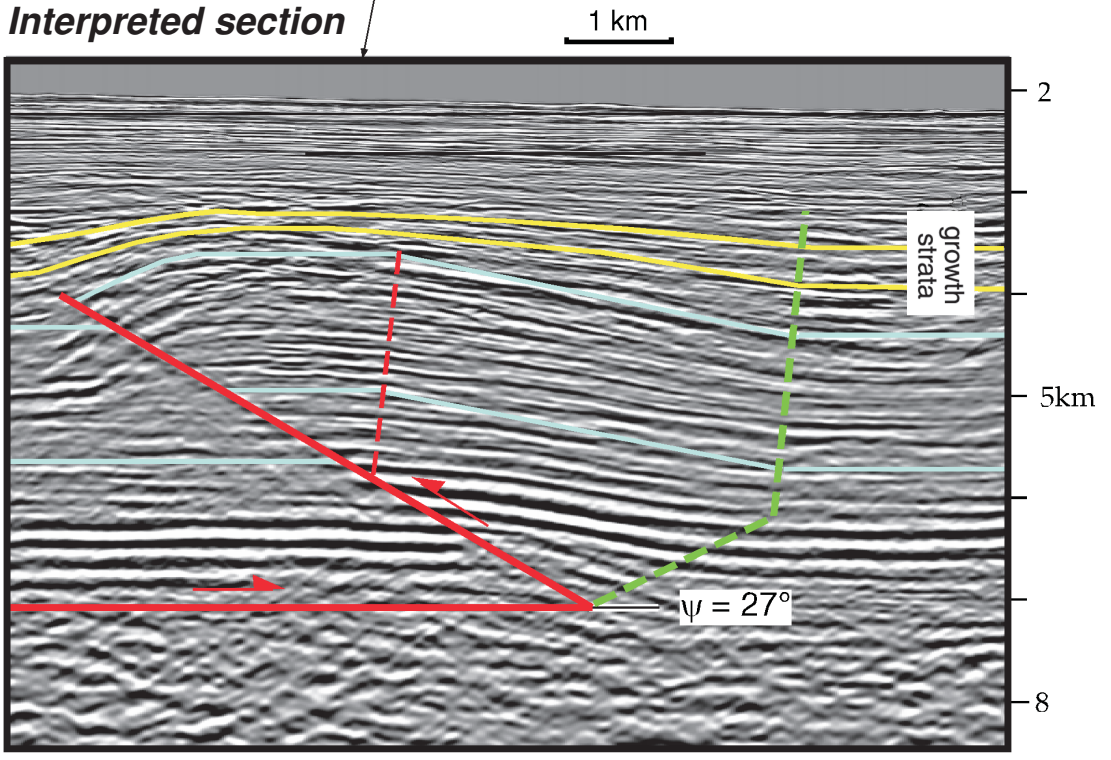

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