Stratigraphic Analysis of Cretaceous Slope Channels: Tres Pasos Formation, Sierra Dorotea, Southern Chile*

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Abstract

The Cretaceous Tres Pasos Formation is interpreted as a continental slope depositional system because of sedimentary body architectures, facies associations, and stratigraphic position within the Magallanes foreland basin sedimentary fill. The continuous outcrop belt (~120 km) offers the exceptional opportunity to study the architecture and sand distribution of a seismic-scale slope succession. Detailed field analyses and outcrop mapping along the basin axis reveal evidence of various slope depositional processes in a series of outcrops 25-50 km north of the town of Puerto Natales. Laterally continuous outcrops provide the detailed dimensional and geometric data required for generating geologic models and identify key stratigraphic uncertainties.

Mass-transport deposits, thin-bedded siltstone- and shale- dominated units proportionally dominate the stratigraphic succession. However, a series of at least ten coarse-grained channel elements displaying a variety of architectures bear the most significance to reservoir exploration and exploitation models. The channels coalesce down-system (along the strike of the outcrop belt), resulting in an amalgamated stack of sandstone packages with a collective thickness of >300 m. Individual channel-complexes range from 250-450 m in width, with aspect ratios ranging from 8-23. The internal architecture of channels is complicated by erosional scours, mudstone drapes, and emplacement of fine-grained mass-transport deposits.

Up-slope pinch-out of channel sands is indicative of sediment back-filling during waning depositional episodes. Channels were sculpted by early by-pass phases, locally preserved in proximal, up-slope areas, as mudstone conglomerate lags in otherwise mud-filled channel-form sedimentary bodies. A basinward stratigraphic stepping of the channel bodies is related to the outward building, or progradation of the slope.

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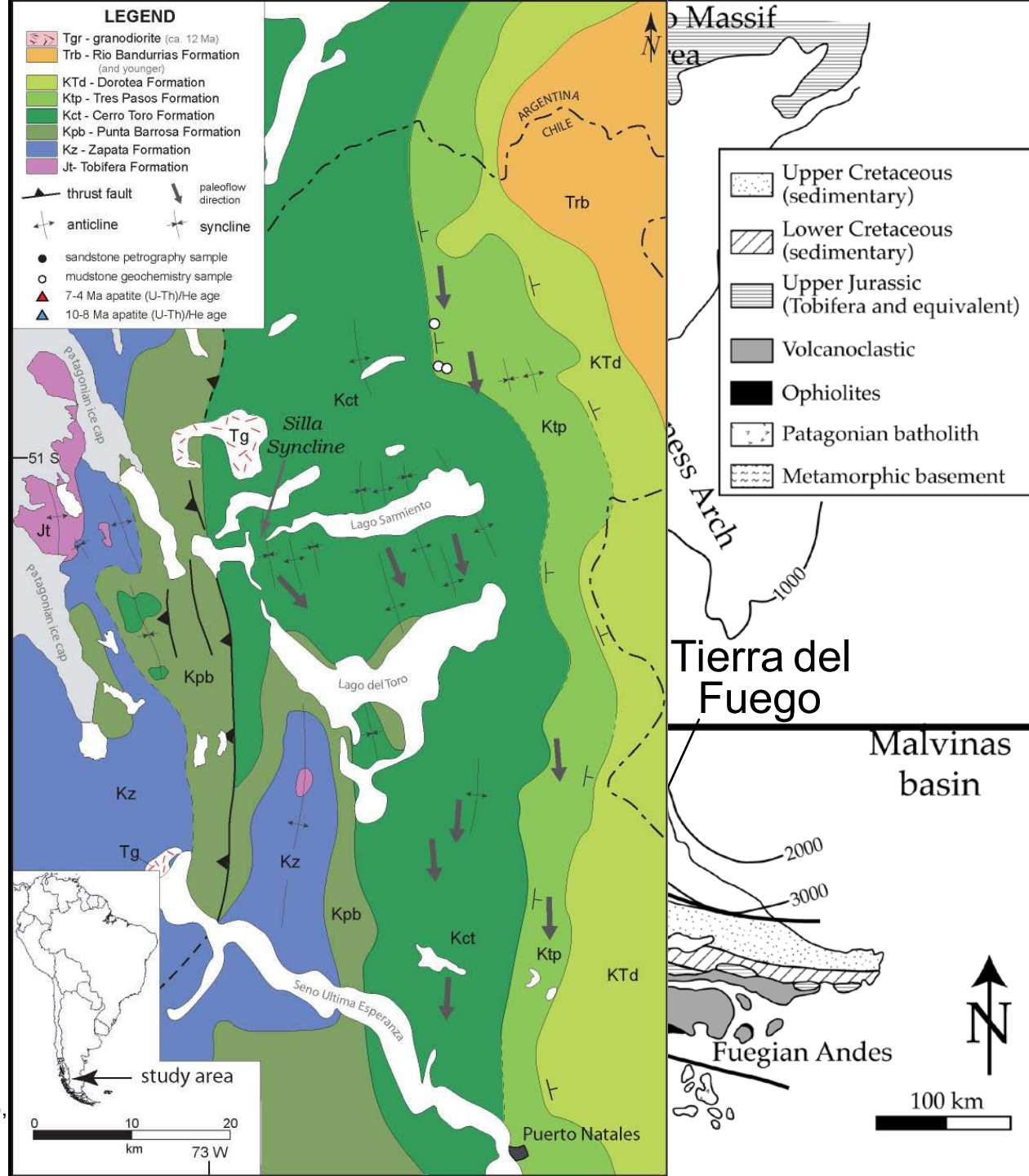
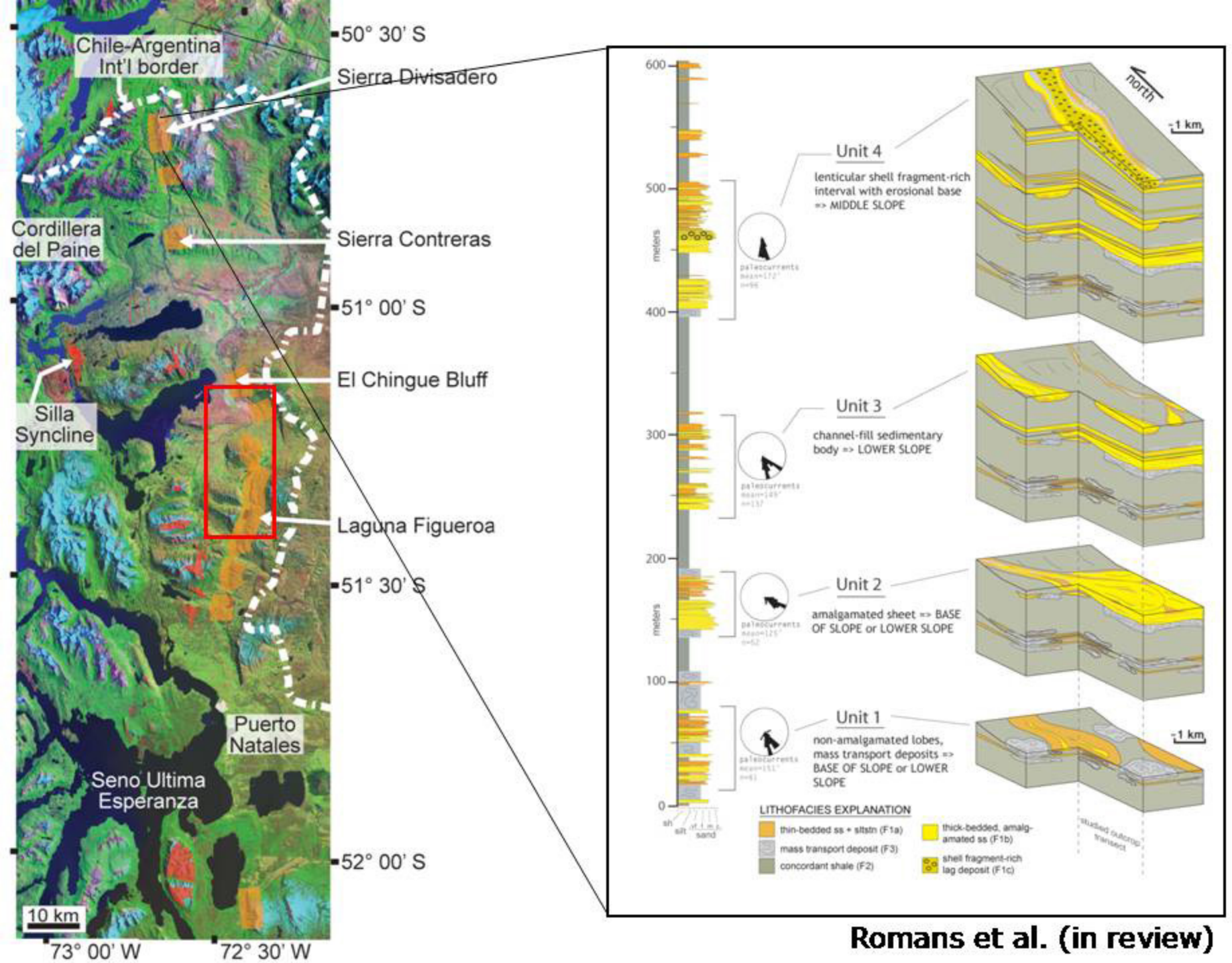
Magallanes Basin

- Foreland basin filled by >9 km of sediment
- At least 3,500 m are deposited in deep-water
- Deep-water systems are exposed in the Pre-Cordillera
- Three deep-water formations (Punta Barrosa, Cerro Toro and Tres Pasos) display different architectural styles and stacking patterns
- Tres Pasos Formation interpreted as a slope system (Shultz et al., 2005; Romans et al., in review)

Modified after Fildani and Hessler, 2005, Thompson et al. 2001, Wilson, 1991; Winslow, 1981

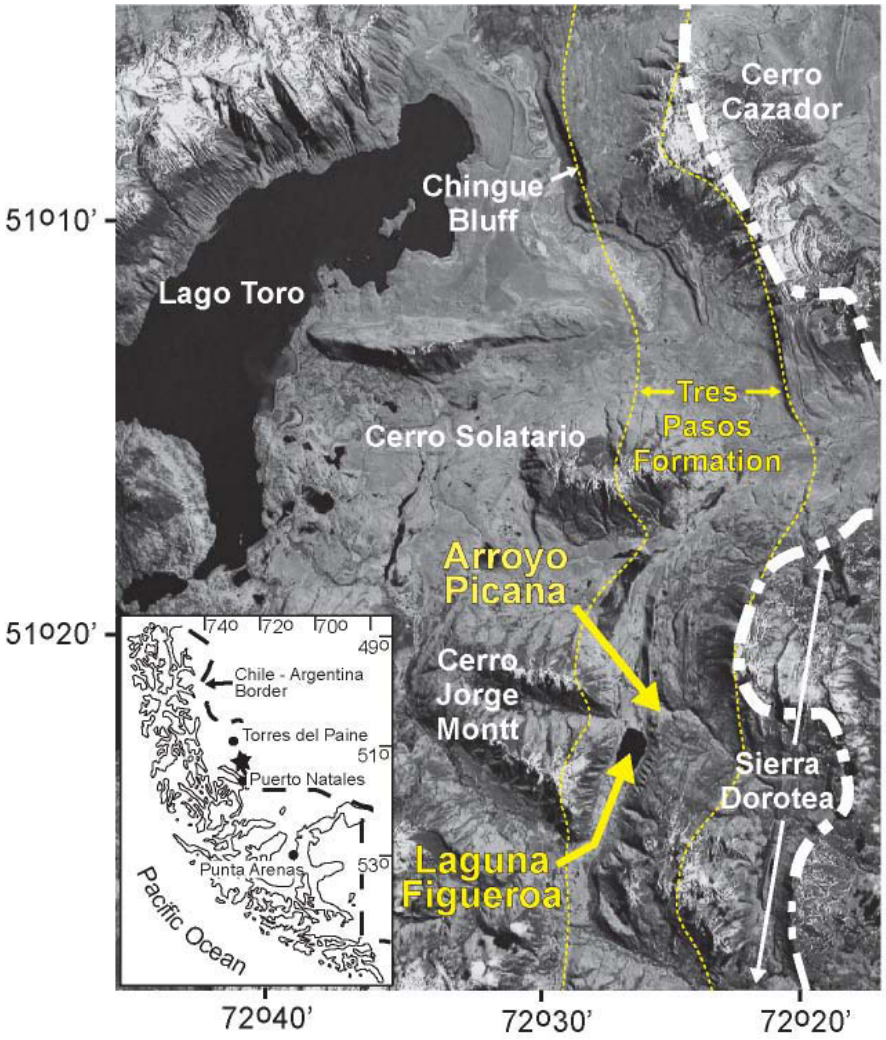


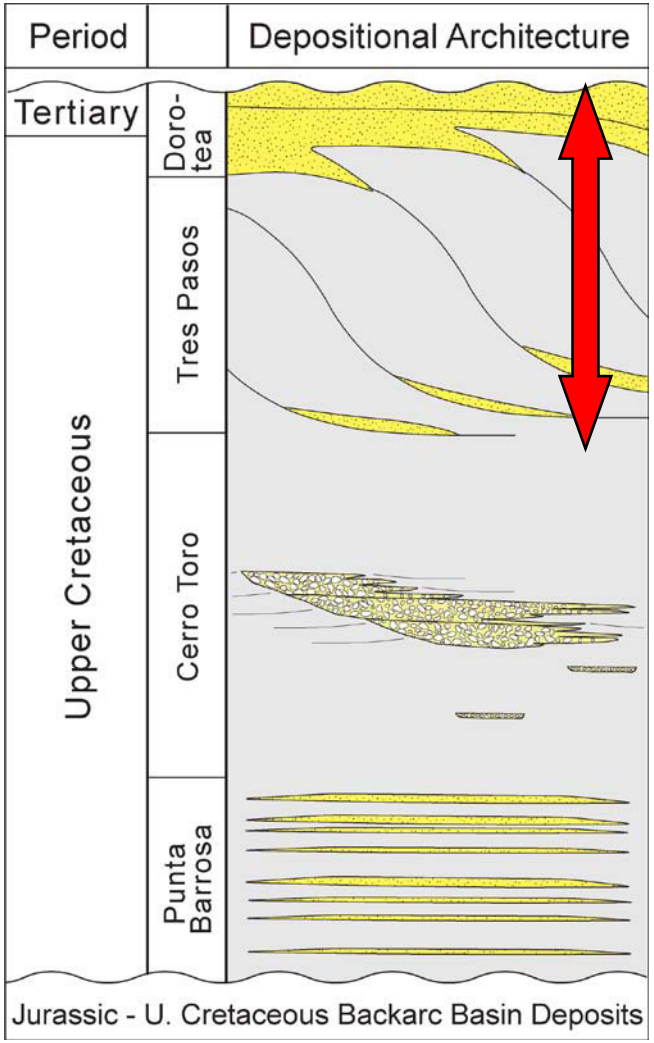


Romans et al. (in review)

Study Area and Stratigraphic Setting

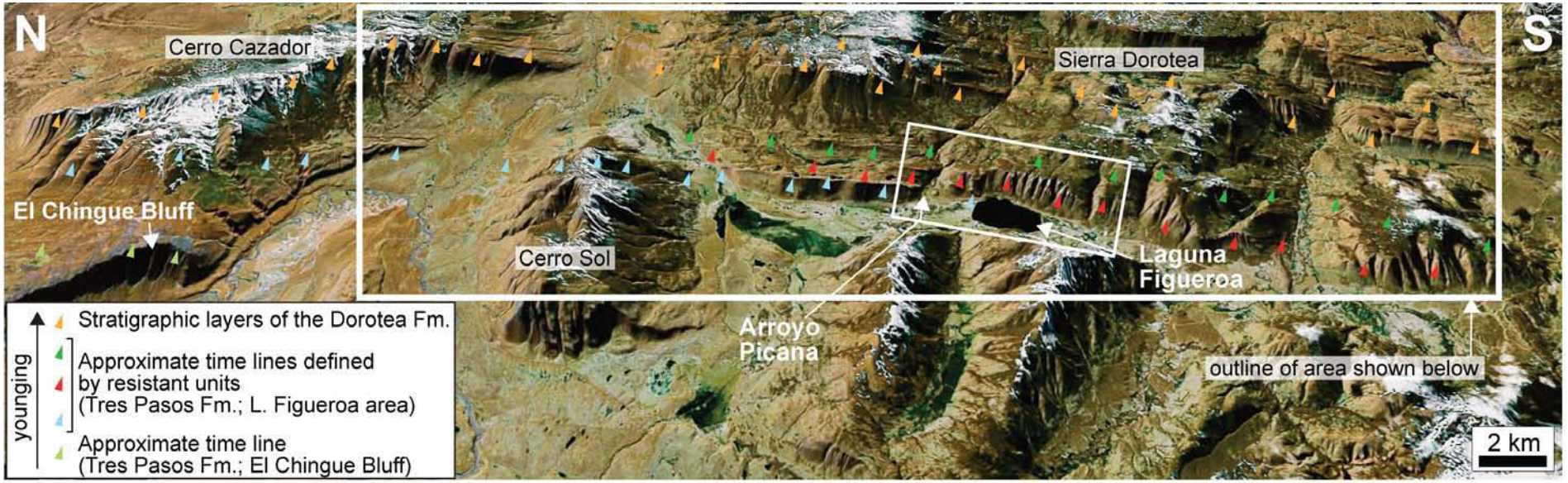
Dorotea-Tres Pasos
is a "coupled" system

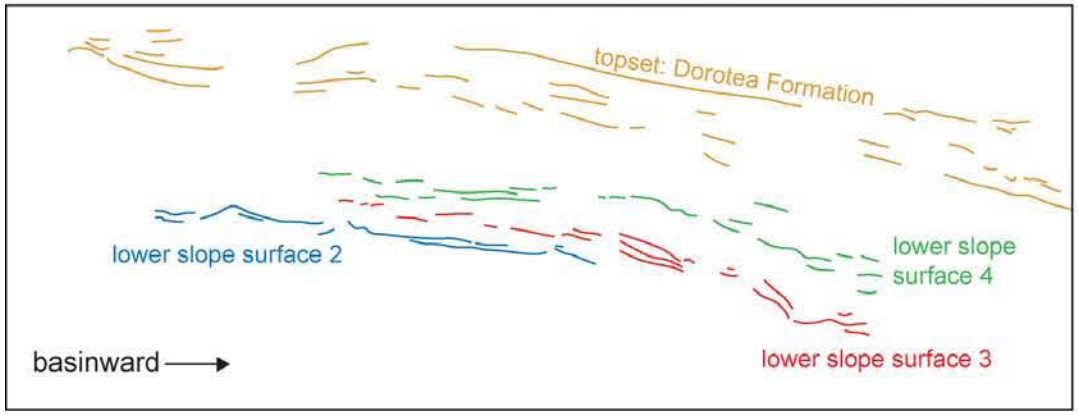


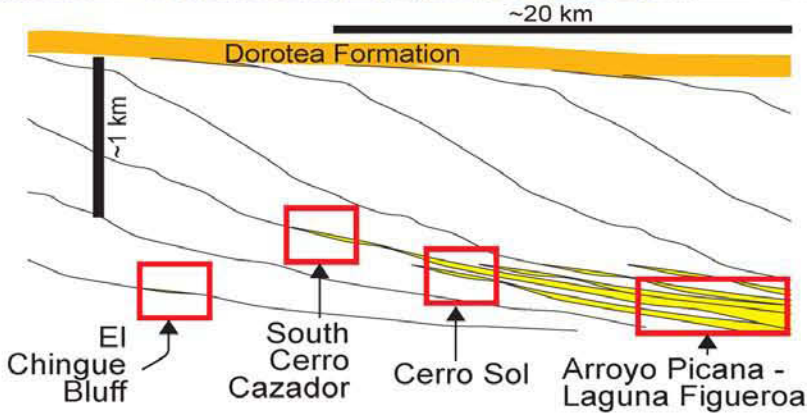


Slope Setting: Context

GoogleEarth TM





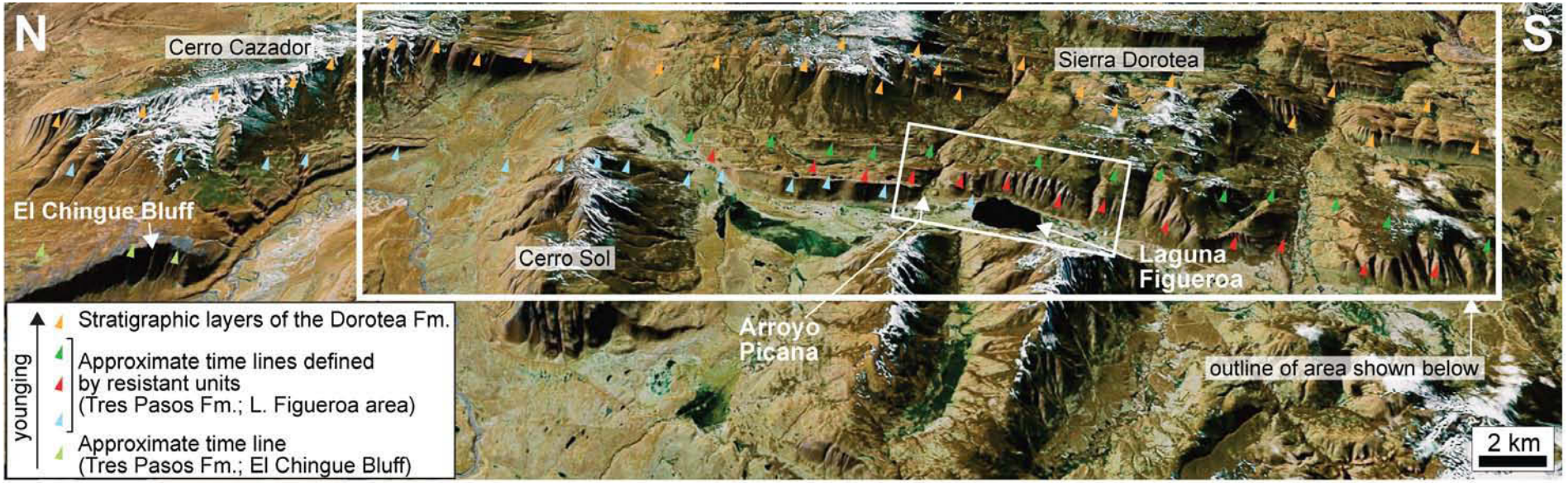


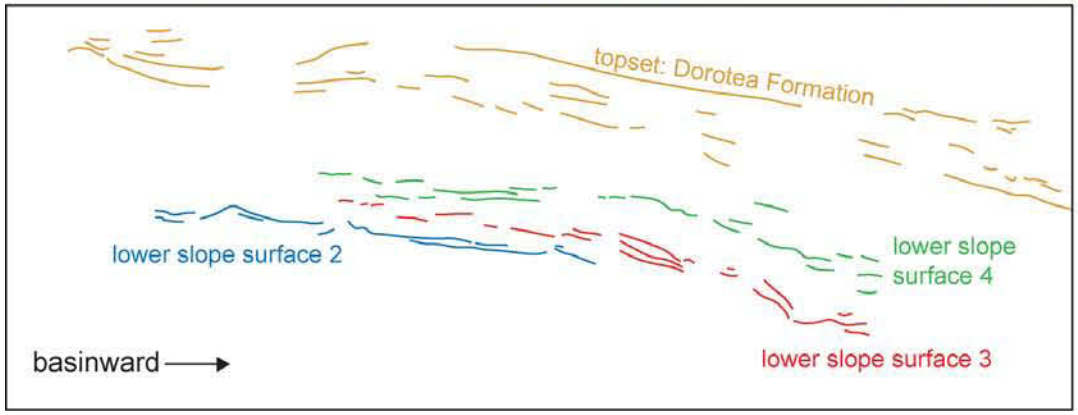
Study Objectives

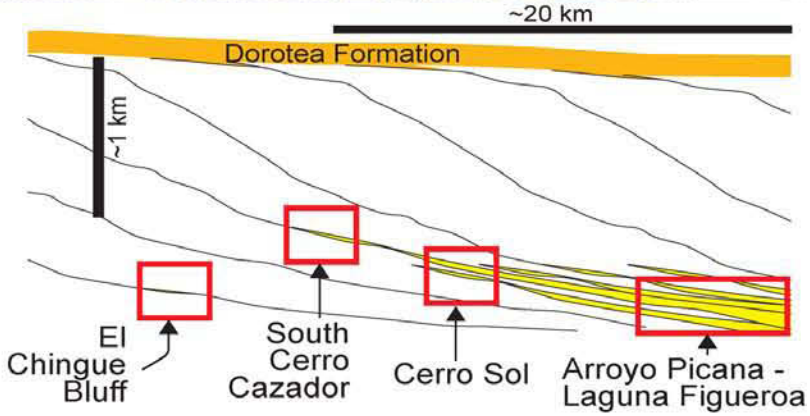
- characterize the depositional setting for thick sandstone bodies at the base of the Tres Pasos Fm.
- delineate and define architectural elements and corroborate them with detailed dimensional & geometric data
- record the vertical succession of facies present and the lateral variability of the depositional setting
- describe and interpret the internal heterogeneity of sandstone bodies
- identify key stratigraphic controls to construct predictive geologic models for both exploration plays and reservoir characterization

Slope Setting: Context

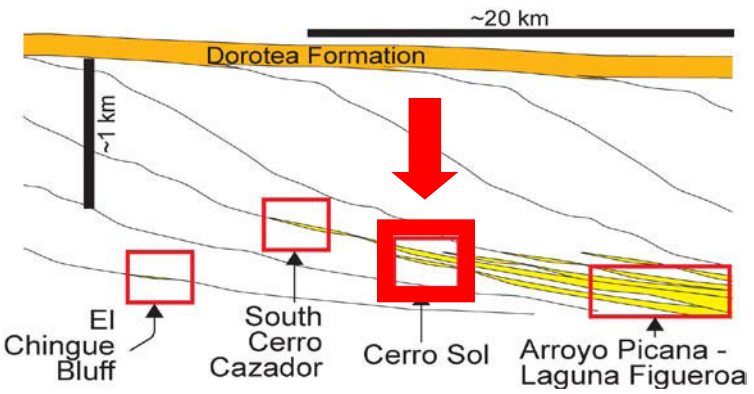
GoogleEarth TM



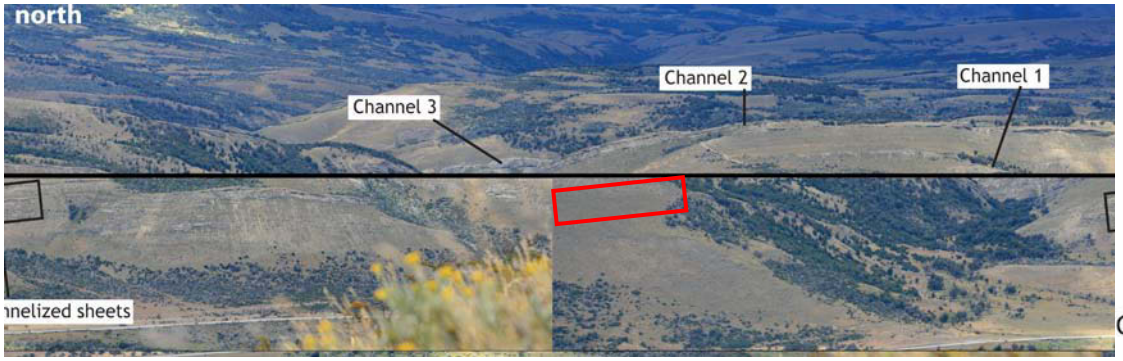


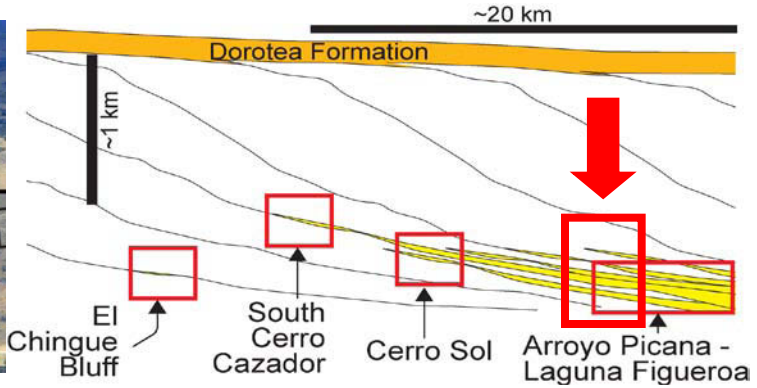


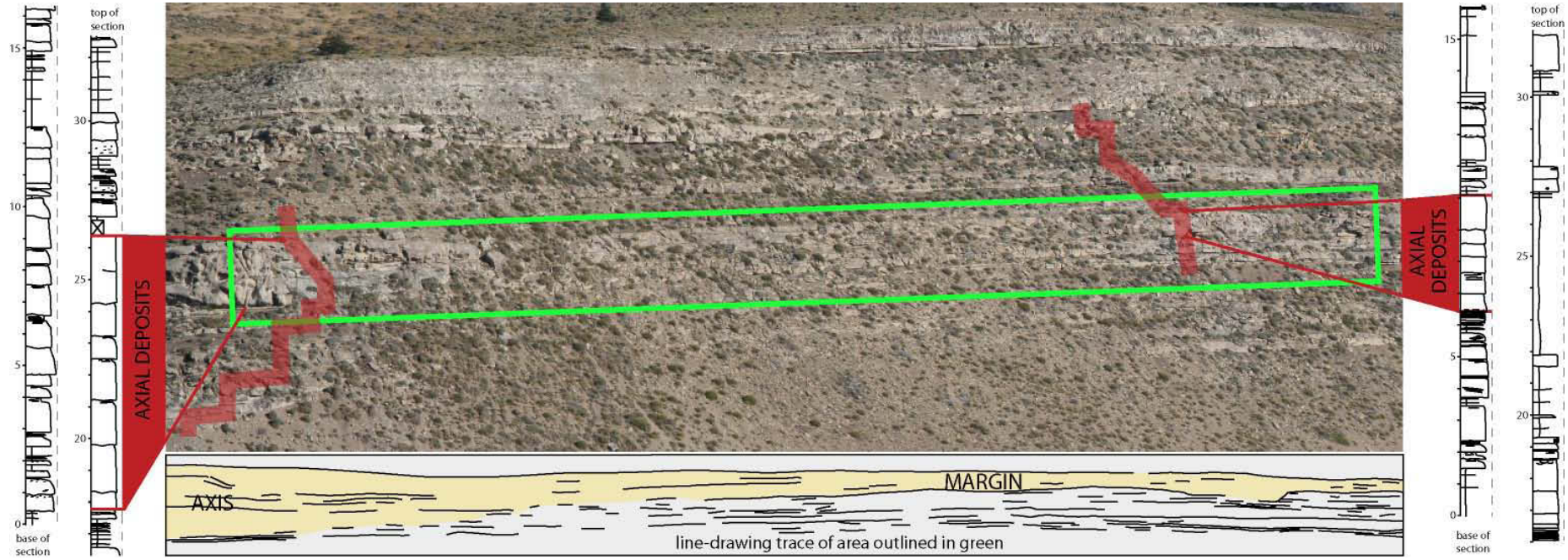
Tres Pasos Formation (Cerro Sol): By-pass slope channels



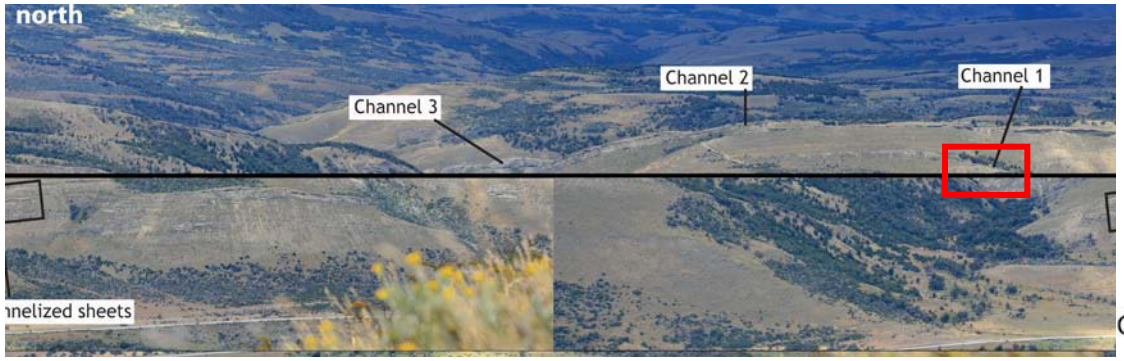
Tres Pasos Formation: channelized sheets (Arroyo Picana)

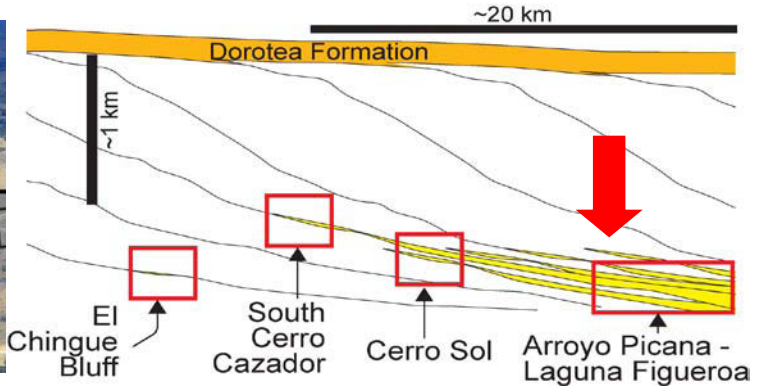


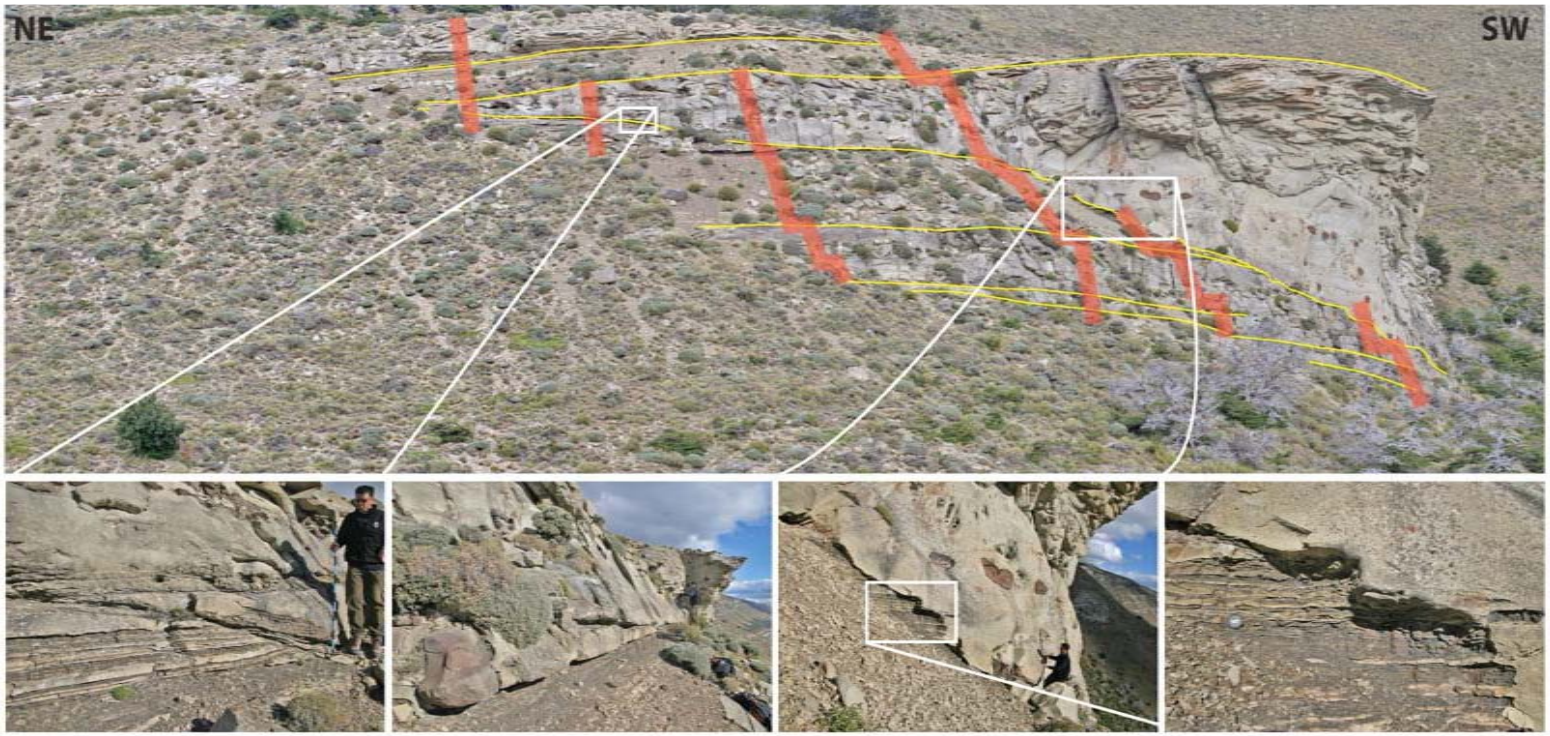




Tres Pasos Formation: channel complexes (Arroyo Picana)



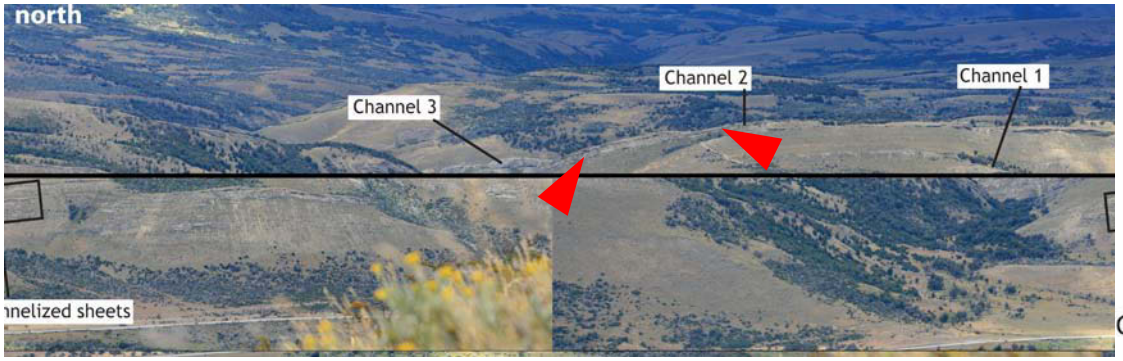


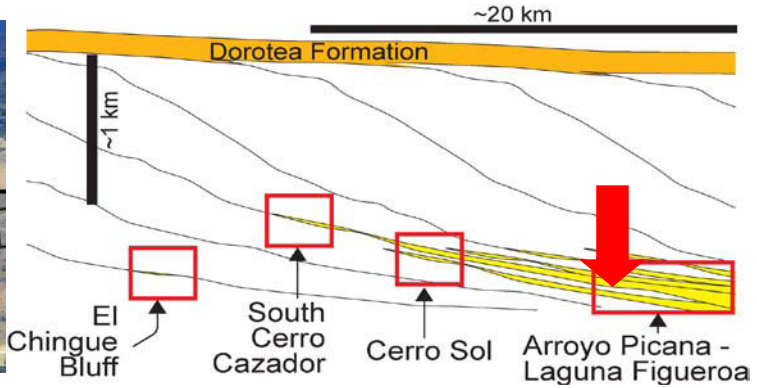


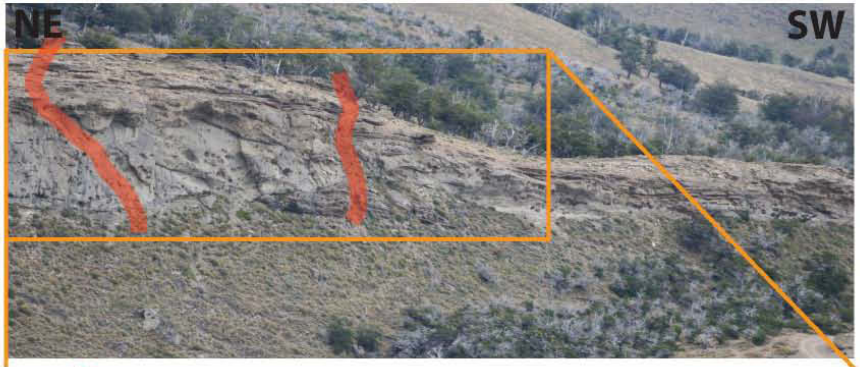
Channel Complex Parameters:

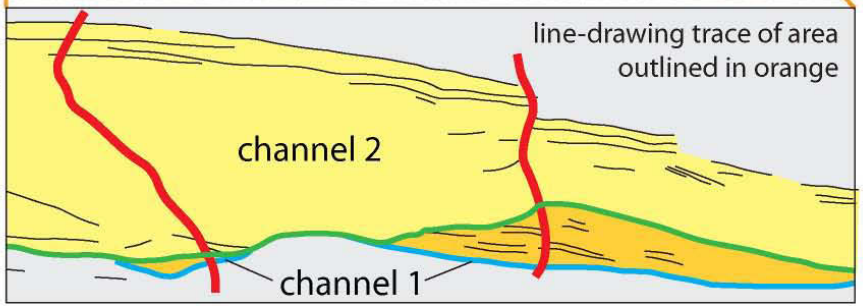
- **24 m thick**
- **195-270 m wide**
- **AR: 8-11**

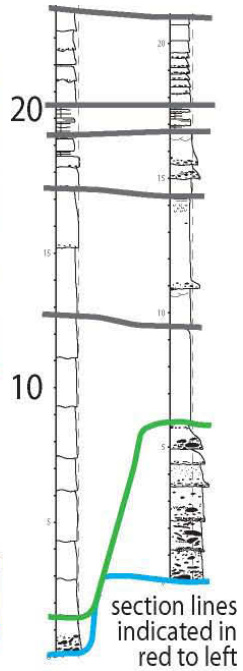
Tres Pasos Formation: channel complexes (Arroyo Picana)







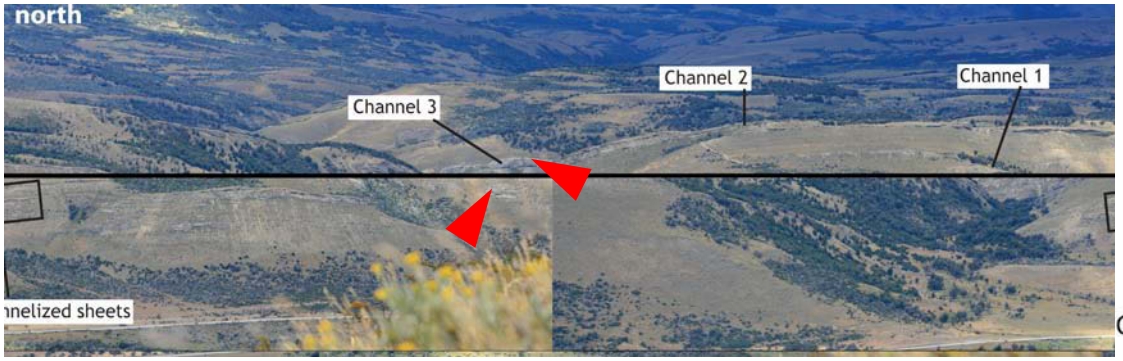


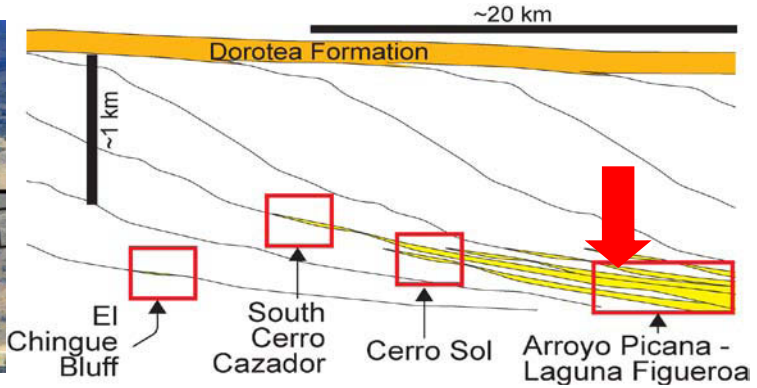


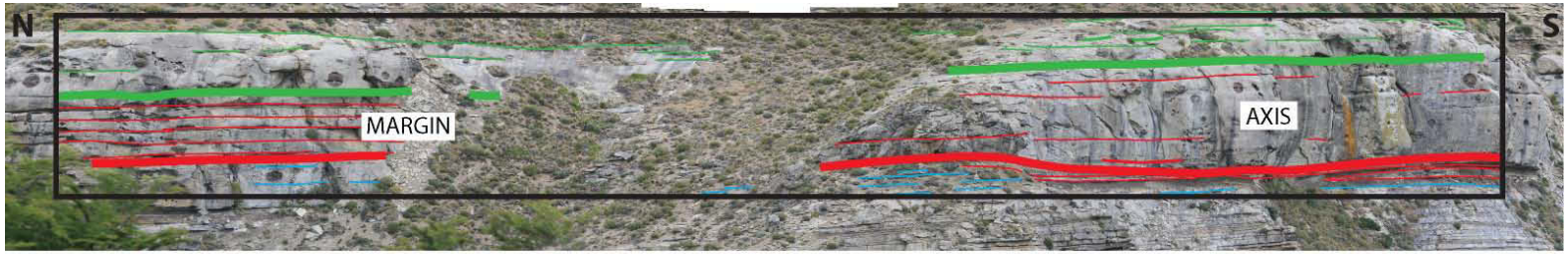
Channel Complex Parameters:

- **20 m thick**
- **450 m wide**
- **AR: 22-23**

Tres Pasos Formation: channel complexes (Arroyo Picana)



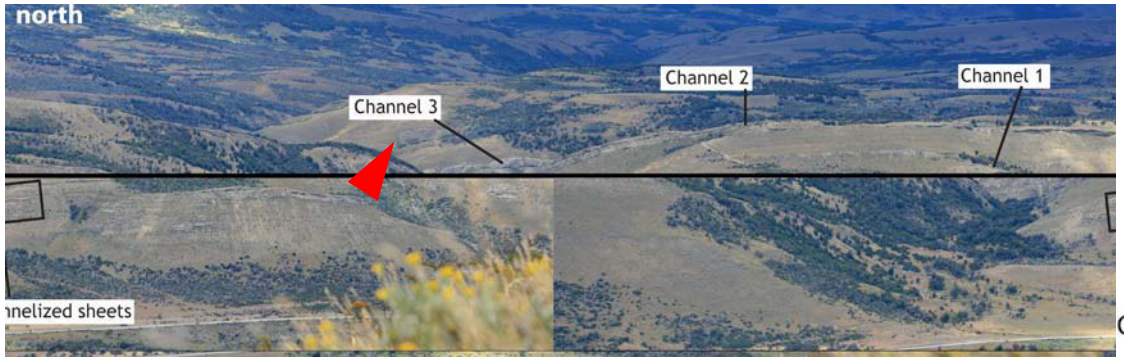


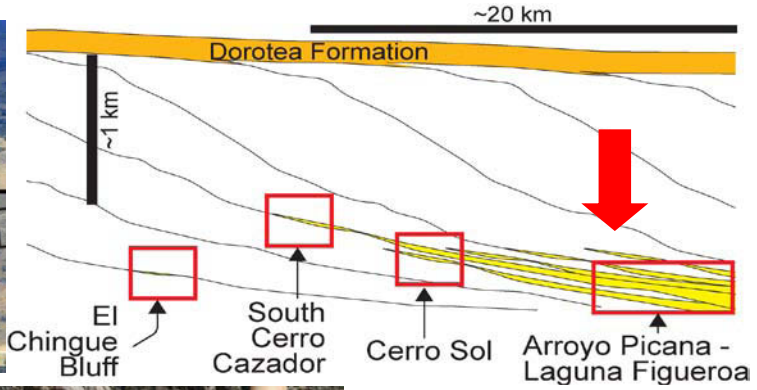


Channel Complex Parameters:

- **19 m thick**
- **370-450 m wide**
- **AR: 20-24**

Tres Pasos Formation: channel complexes



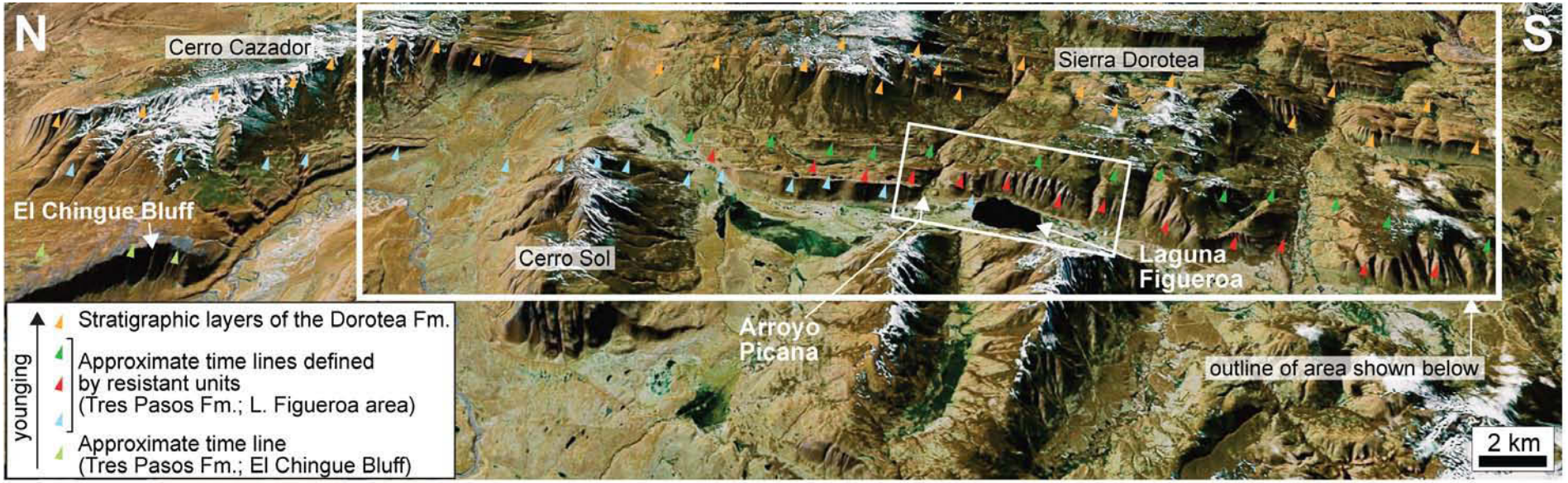


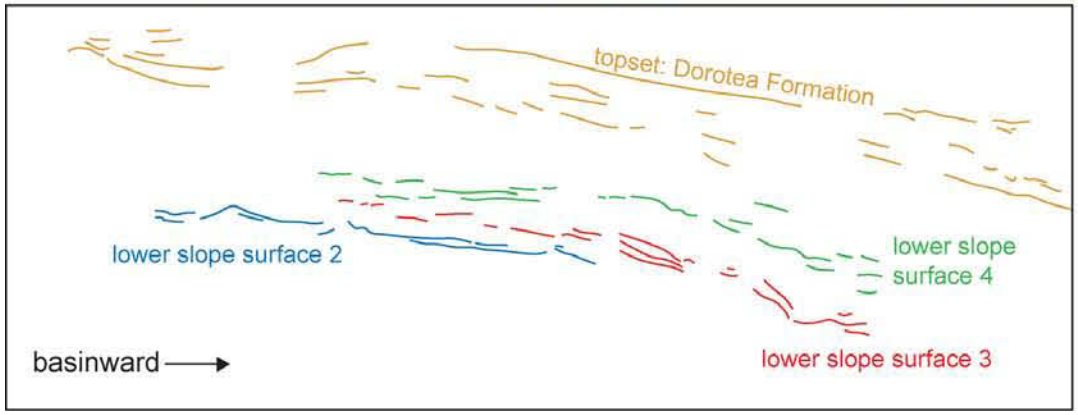
Middle Tres Pasos:

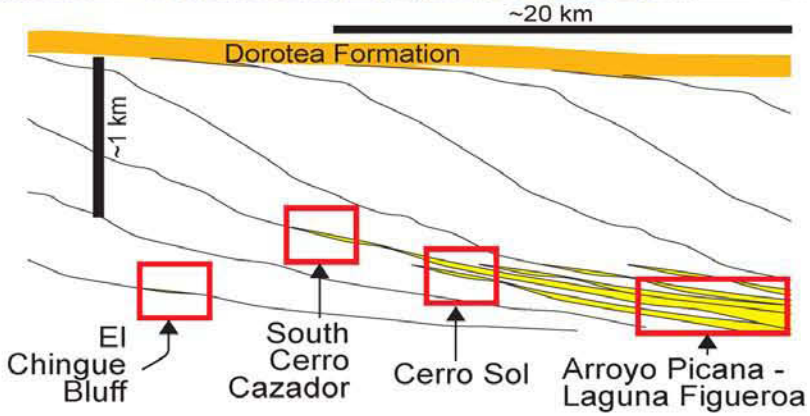
- **MTDs**
- **by-pass incl. conglomerate**
- **smaller conduits**

Slope Setting: Context

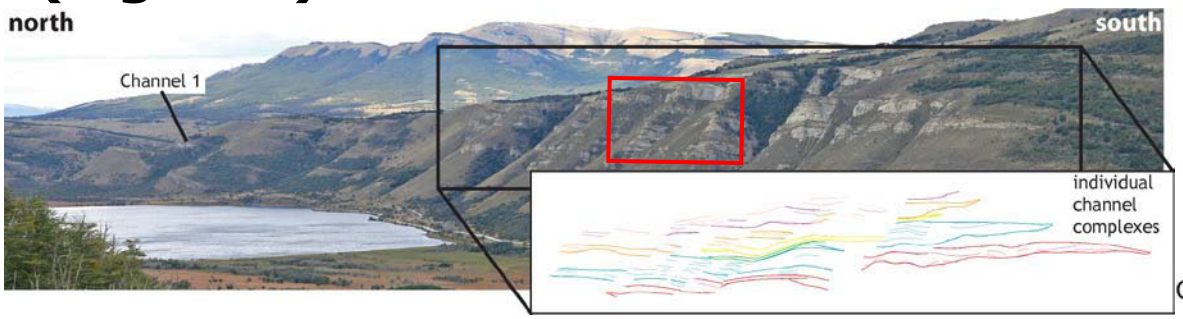
GoogleEarth TM

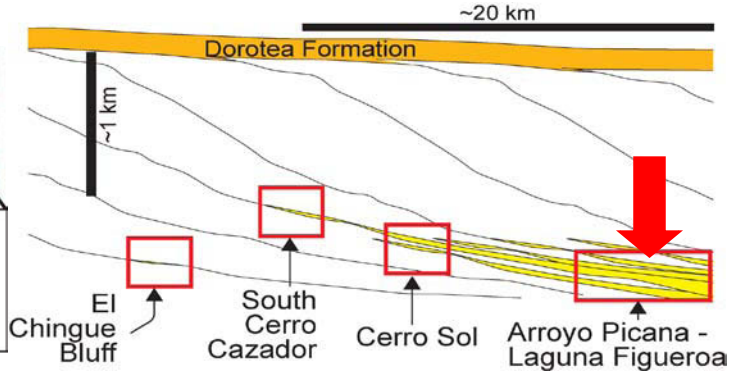




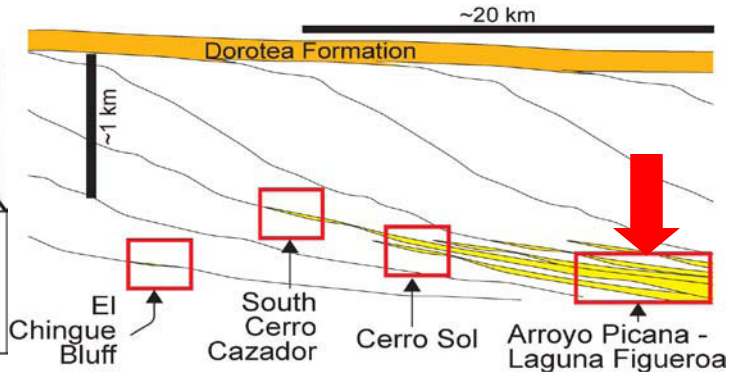


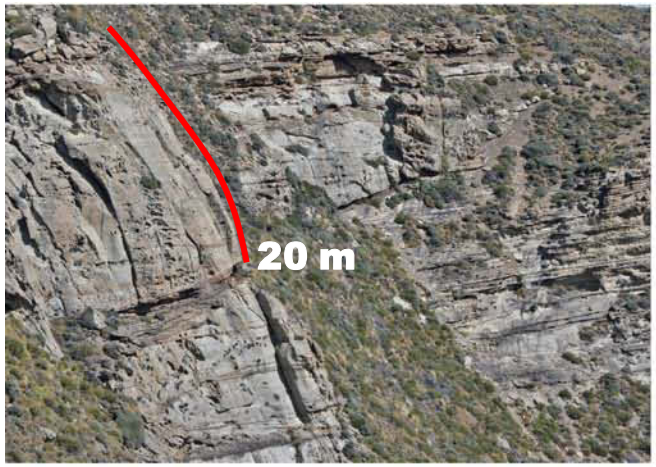
Tres Pasos Formation: Amalgamated channel complexes (Figuroa)

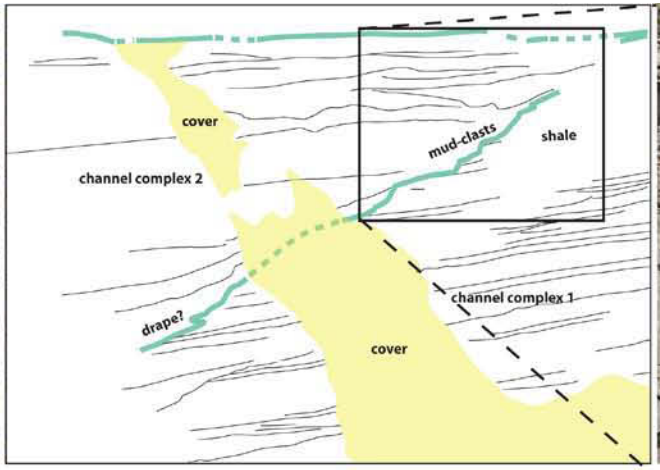




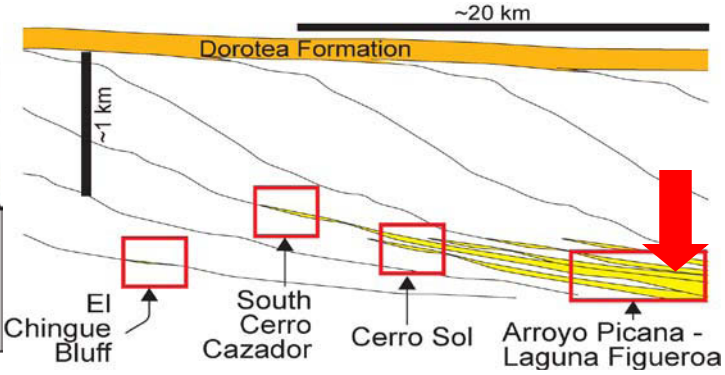
Tres Pasos Formation:

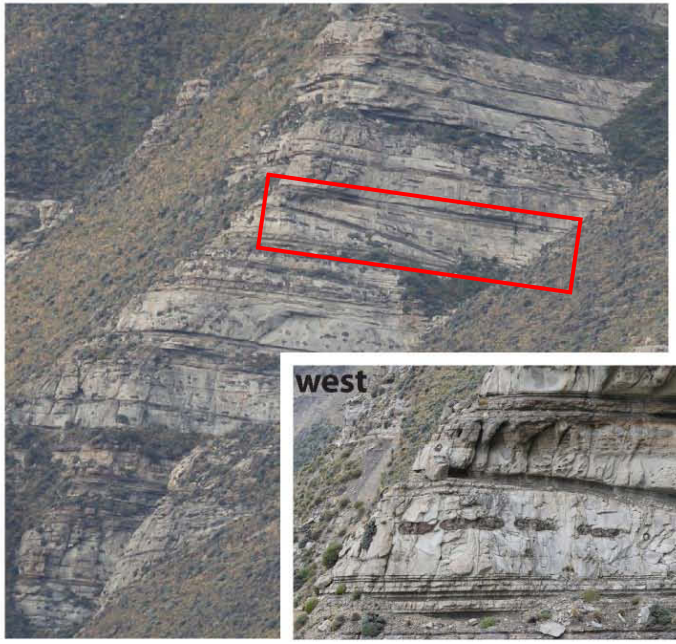






Lower Tres Pasos Formation:



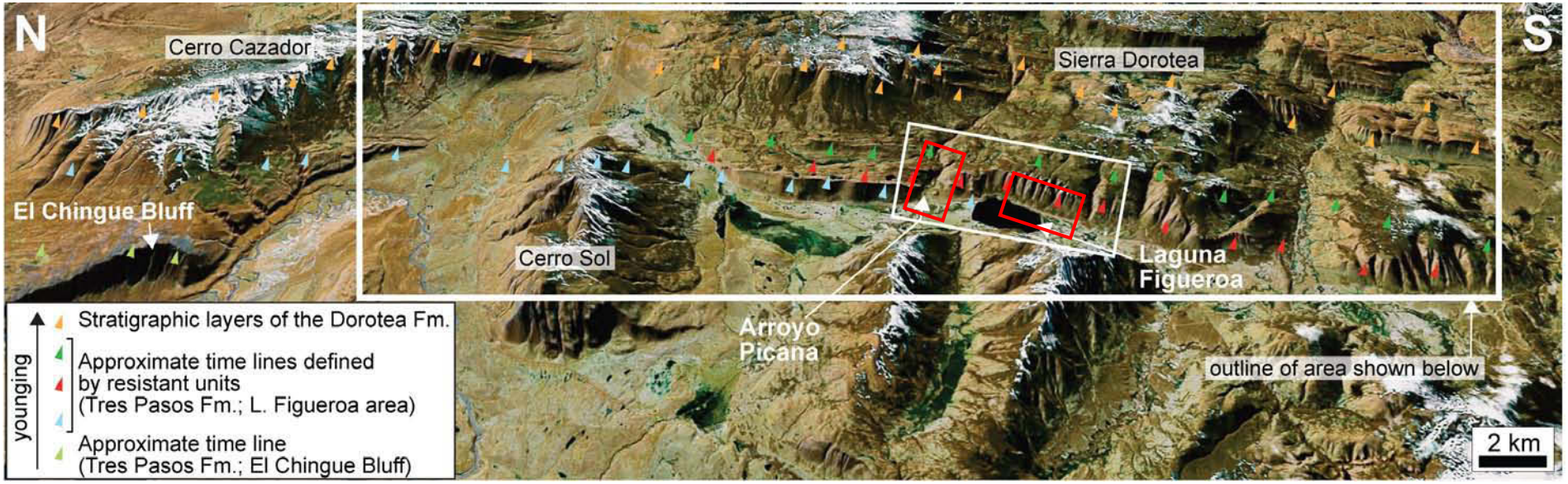


Distal Lower Tres Pasos:

- **amalgamation**
- **channel drapes and other by-pass facies cause heterogeneity**

Lower Tres Pasos Fm: Proximal-Distal Observations

GoogleEarth TM



Proximal locale (Picana):

- laterally offset channel complex stacking (overall N:G = 0.2-0.4)

Distal locale (Figueroa):

- coalesced, vertically amalgamamed channel complex stacking (overall N:G = 0.7-0.8)

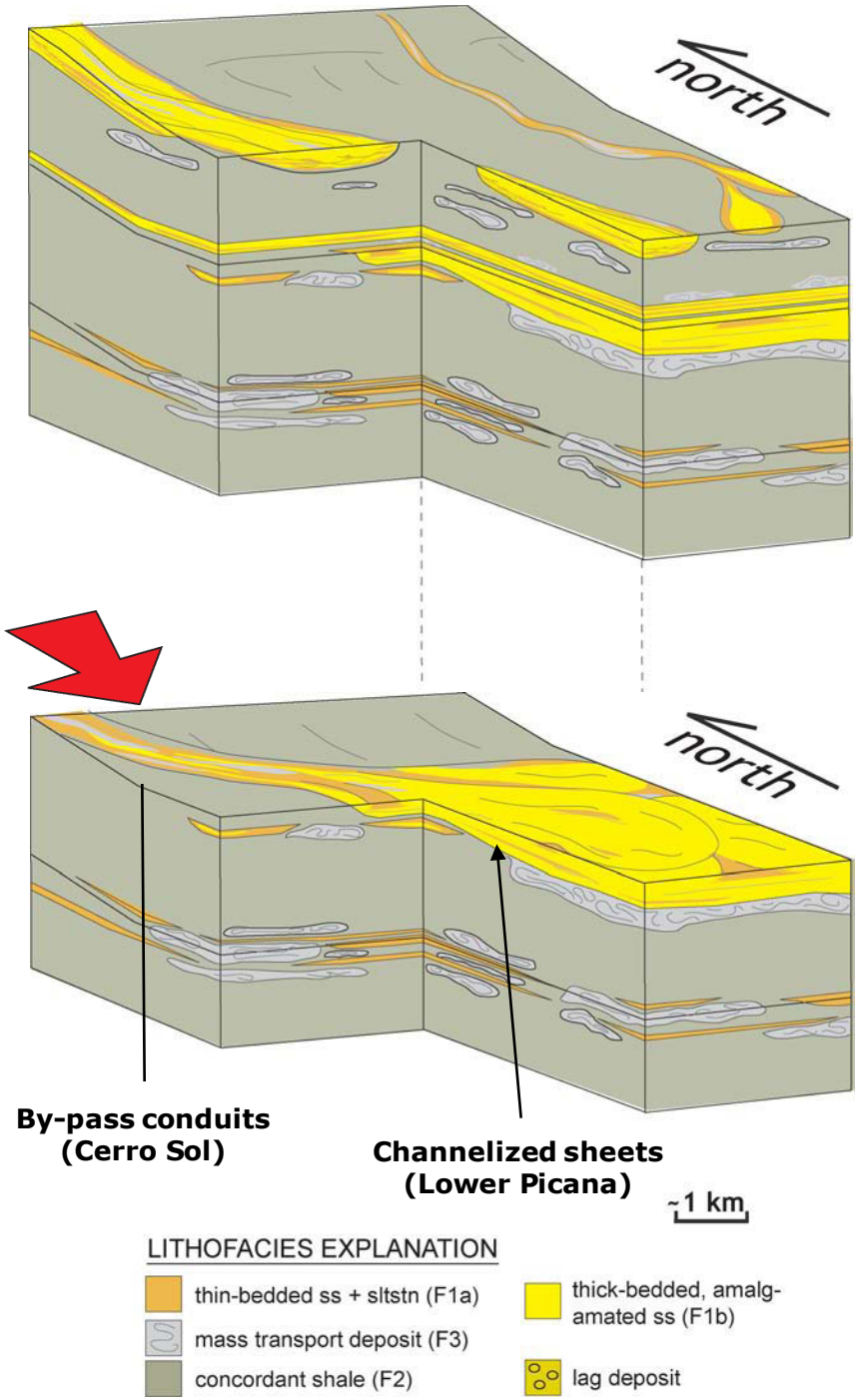
Summary:

The Dorotea to Tres Pasos Fms system is a coupled shallow to deep-water system

The Tres Pasos Fm. at Sierra Dorotea is a complicated slope to toe-of-slope system

Up-dip slope is characterized by by-pass

Basinward stepping slope successions favored channel amalgamation at the toe-of slope position



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