

Engineered Geologic Earthquake Reconnaissance

2002 Denali Earthquake



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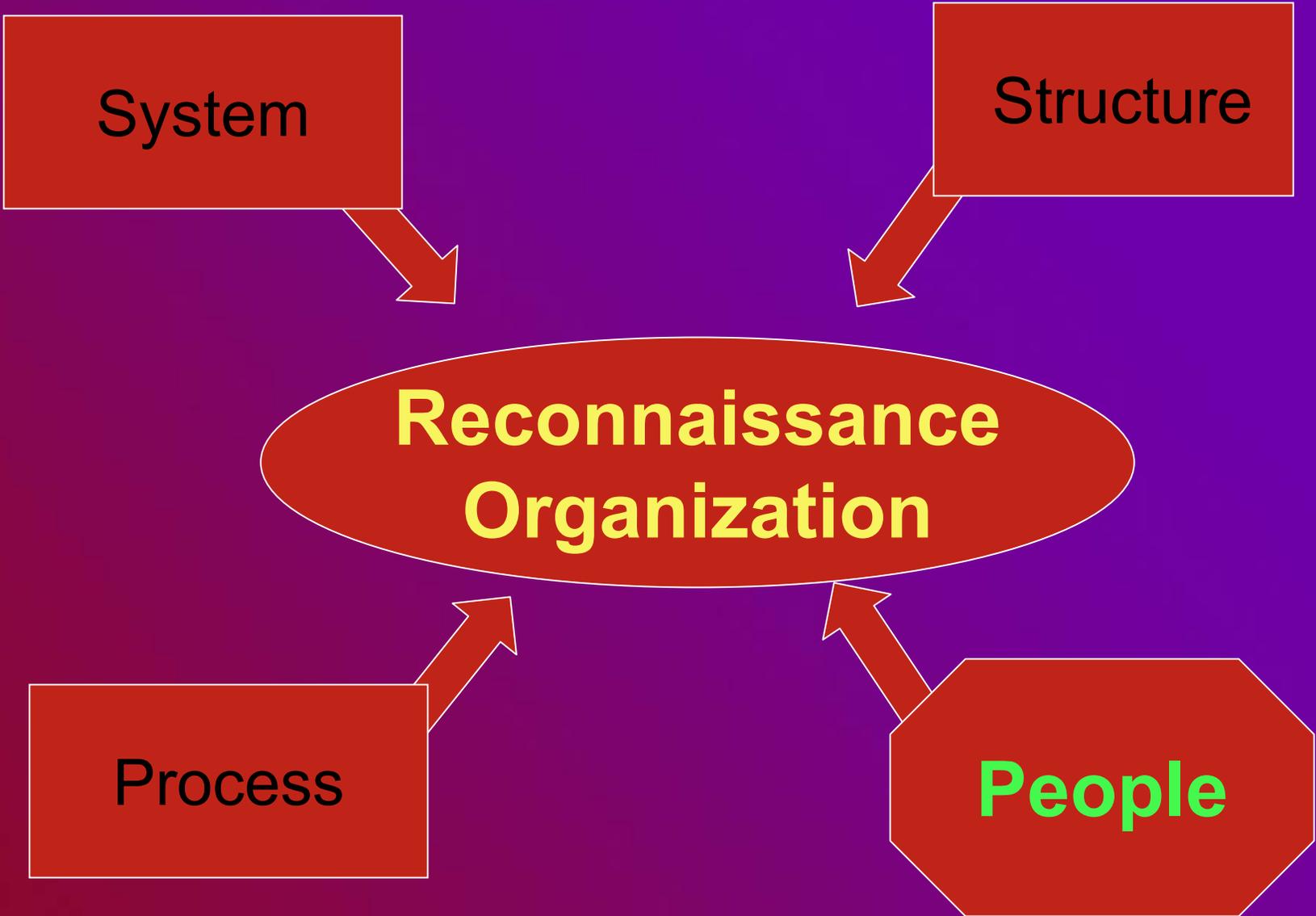
System

Structure

**Reconnaissance
Organization**

Process

People



People

- Skill
 - Knowledge
 - Technology
 - Experience
- Personality
- Political/National Sensitivities
- License/Registration/Affiliation

- Knowledge
 - Quaternary Geology & Geomorphology
 - Earthquake processes
 - Tectonics
- Technology
 - Location
 - Documentation
 - Communication
- Experience
 - Earthquake processes
 - Earthquake hazards
 - Built environment

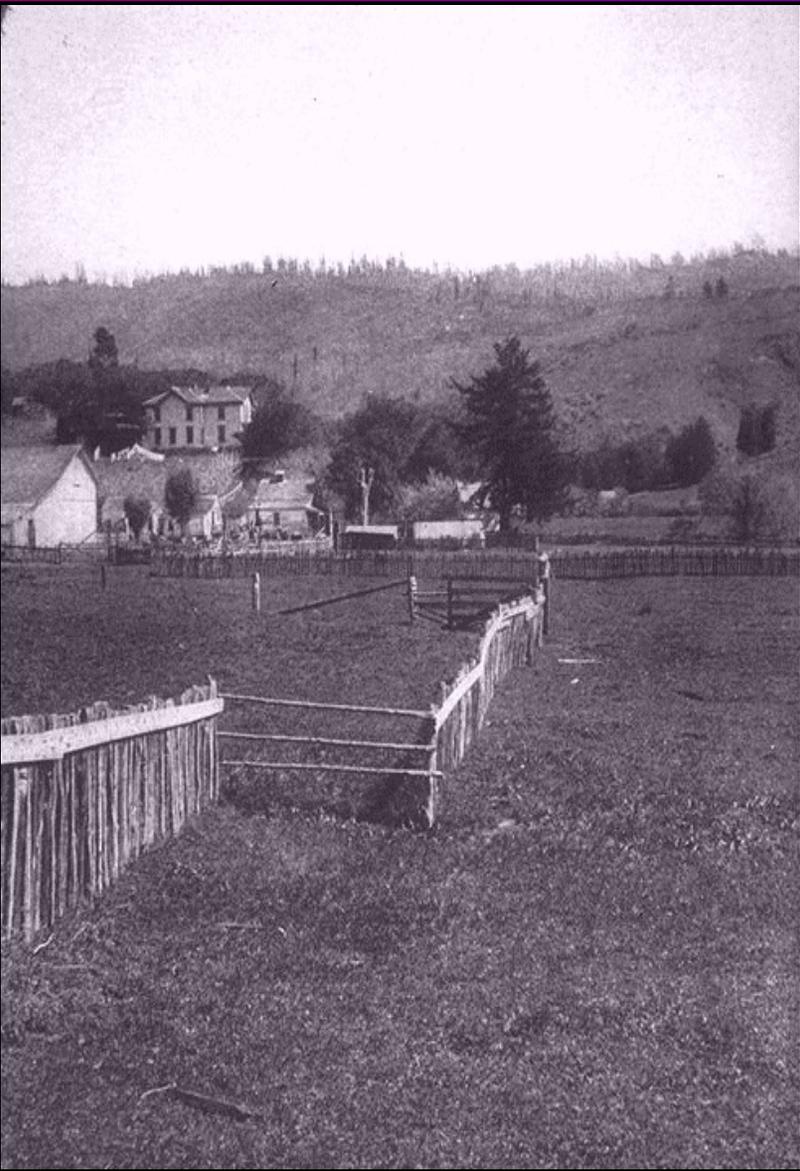
Skill



Information Required

- Earthquake Process/Cycle
- Permanent Ground Deformation
 - Effects on Built Environment

San Francisco, 1906





Rapid Response



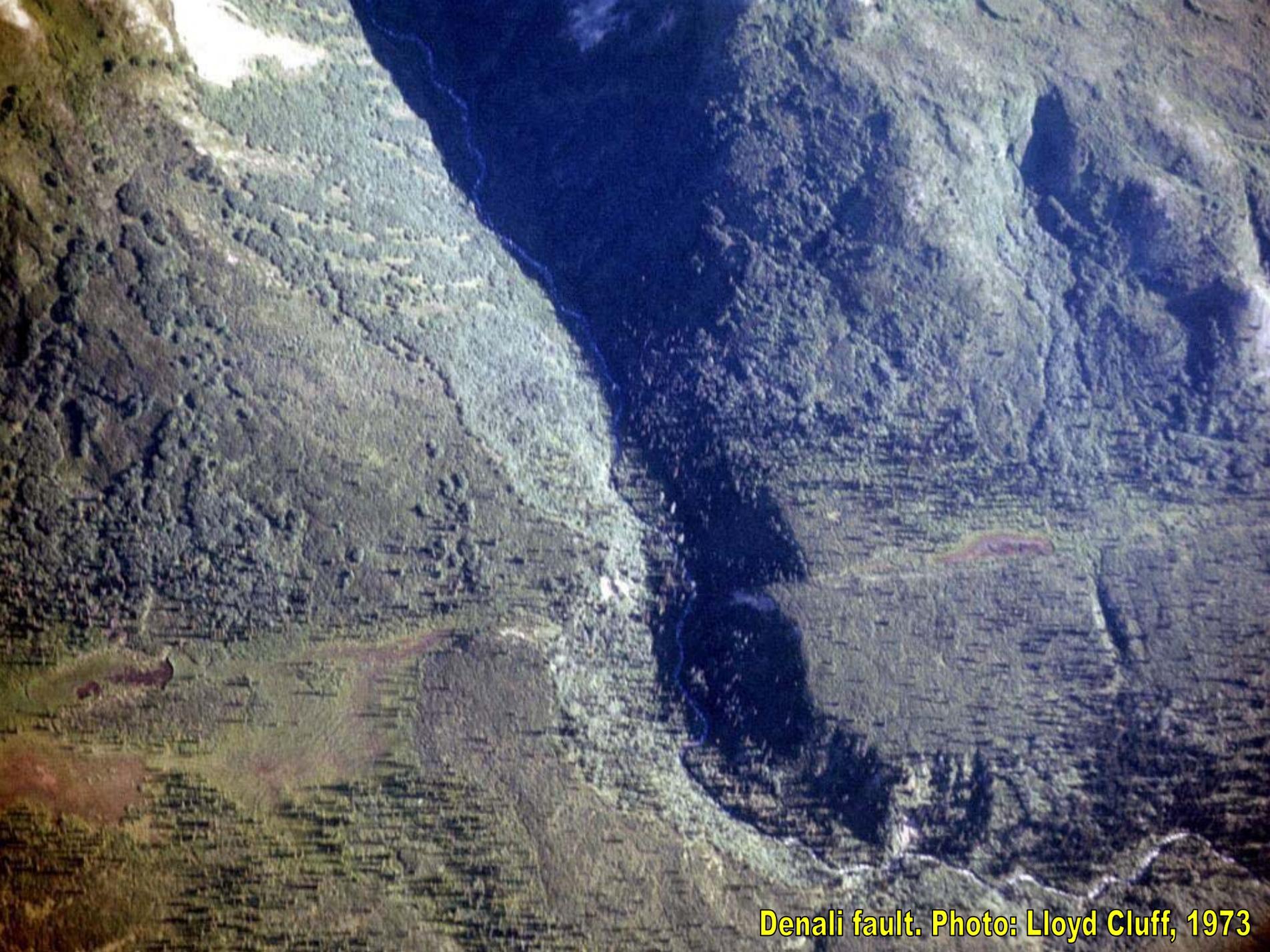
Km 197

Earthquake Process/Cycle

- Dimensions of fault rupture (also blind rupture)
- Distribution of slip (AND WHY)
- Fault interactions
- Geometry and Behavior
- Coseismic slip/After slip
- Rupture terminations
- Comparison to past ruptures



Km 184



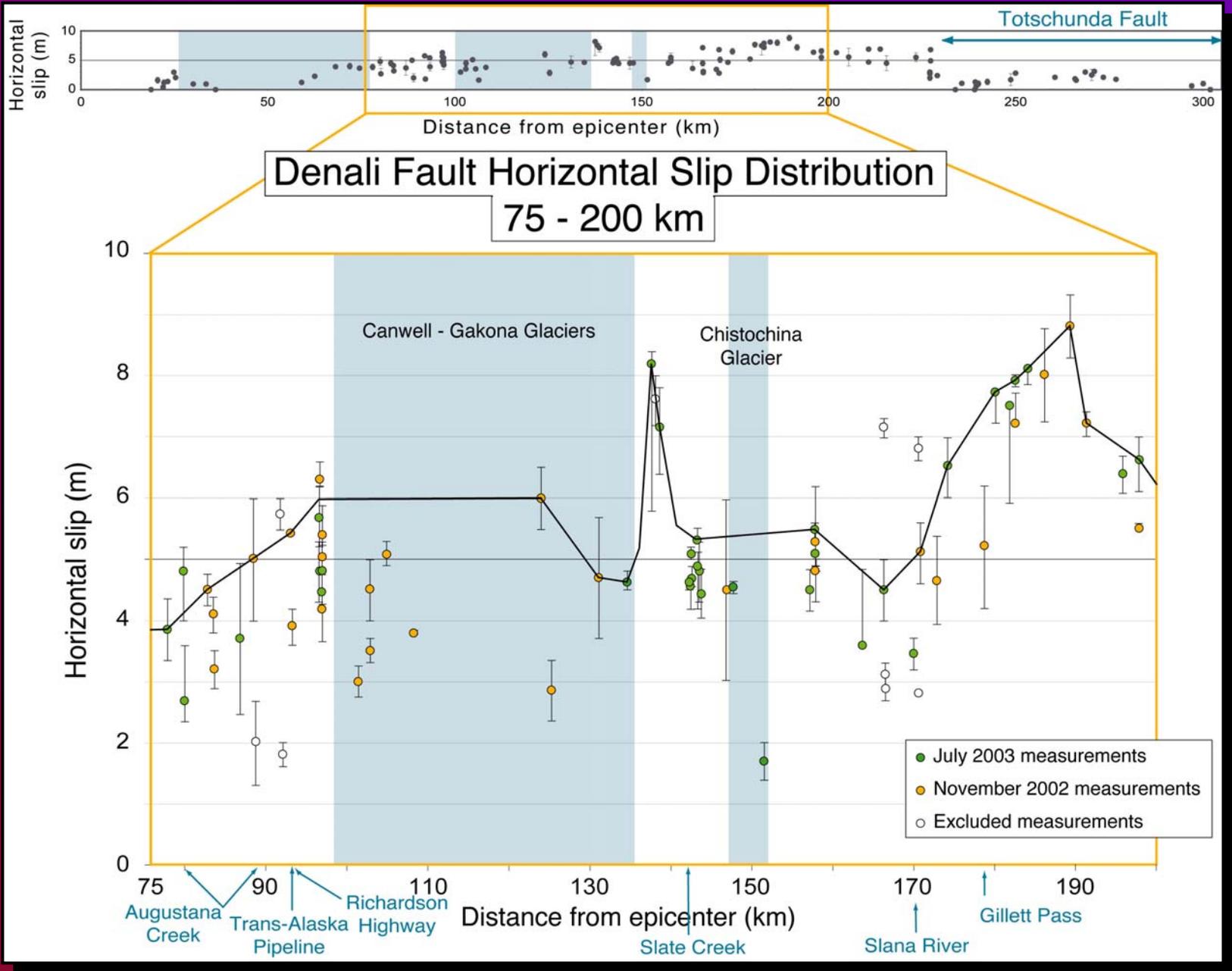
Denali fault. Photo: Lloyd Cluff, 1973

Km 143

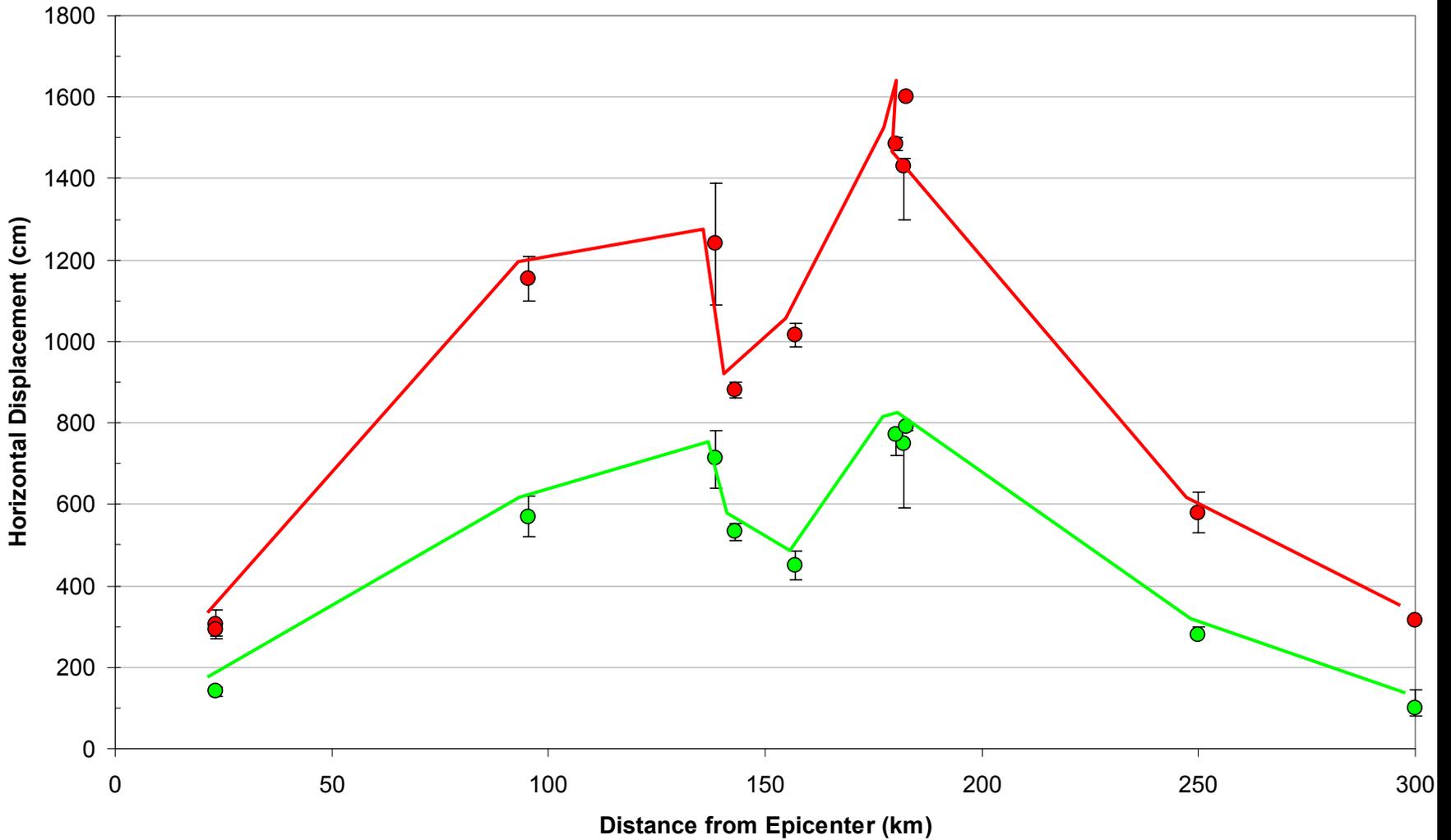
3.5

5.3





Denali-Totschunda Paleo-offsets



● 2002 offsets ● Paleo-offsets

Permanent Ground Deformation

- Fault Rupture
 - Primary, secondary, tertiary
 - Distribution of slip
 - Along strike and across strike
 - Width of rupture
- Constraints on variability
- Quantified with profiles and photos





Characterization of Fault Rupture

- Tectonic slip
 - Magnitude vs. displacement
 - Tip decay
 - Average vs. maximum
 - Uncertainty
- Surface manifestation
 - Rock/soil material properties
 - Fault geometry/complexity
 - Amount of slip
 - Saturation
 - Aseismic creep

Permanent Ground Deformation

- Tilting and warping
 - Especially reverse & normal faults
- Ridge crest deformation (Sachung & Shattering)
- Liquefaction – settlement, lateral spreading
 - Relationship to geology
- Slope failure
 - Type, type, type

Permanent Ground Deformation

- Effects on Structures
 - Especially foundations & lifelines
 - Requires experience
- Critical Interaction with Geotechnical and Structural Engineers

Techniques

- Observation, observation, observation
- Documentation, documentation, documentation
- Surveys – Quantify
 - Geometry (width, length, orientation)
 - Deformation (slip amount, orientation, distribution)
- Location
 - GPS, 1:24k scale maps (or better)

Techniques

- Photography
- Track lines (air and field)
 - Where did you go?
- Geologic context
 - “Sample” where appropriate
- Accurate sketch maps

Denali Fault Rupture

