Alpine Fault, New Zealand

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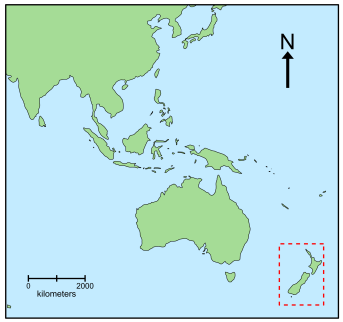
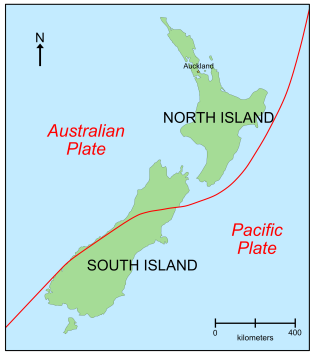
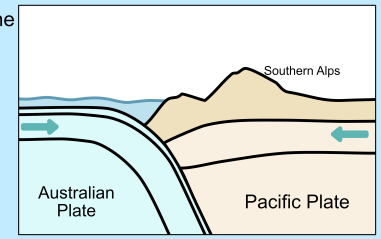
Location





Tectonics

- The Alpine Fault is a transform fault along the boundary between the Australian Plate and Pacific Plate
- The fault connects two trenches, dipping in opposite directions
- Along the fault, the Australian Plate is subducting under the Pacific Plate with right lateral movement



- Strike-slip displacement along the Alpine Fault accounts for about 75% of the inter-plate slip
- Other faults east of the Alpine Fault take up additional slip

- Around 25 Ma, motion was entirely strike slip
- Around 12 Ma, motion became more oblique and New Zealand rose above sea level and the Southern Alps began to form

References

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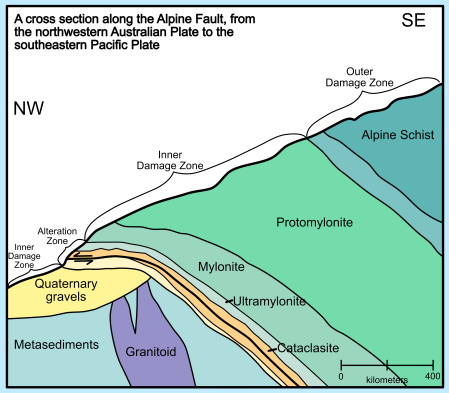
- Leitner, B., Eberhart-Phillips, D., Anderson, H., and Nabelek, J. A focused look at the Alpine fault, New Zealand: Seismicity focal mechanisms, and stress observations. Journal of Geophysical Research Vol.106, NO. B2, pages 2193-2220, February 10,200
- Norris, R., and Cooper, A. Late Quaternary slip rates and slip partitioning on the Alpine Fault, New Zealand. Journal of Structural Geology 23, July 20, 2000.
- Schuck, B., Schleicher, A. M., Janssen, C., Toy, V. G., and Dresen, G.: Fault zone architecture of a large plate-bounding strike-slip fault: a case study from the Alpine Fault, New Zealand, Solid Earth, 11, 95–124, https://doi.org/10.5194/se-11-95-2020, 2020.

Cross Section



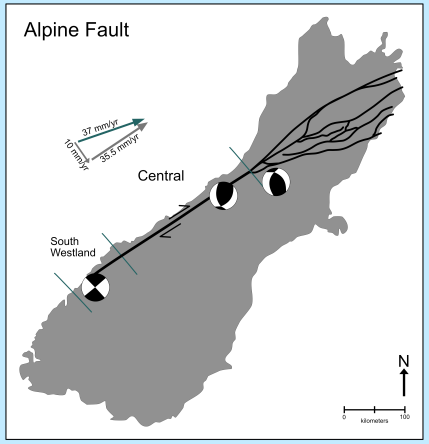
Adapted from Schuck et al. 2020

Kinematics

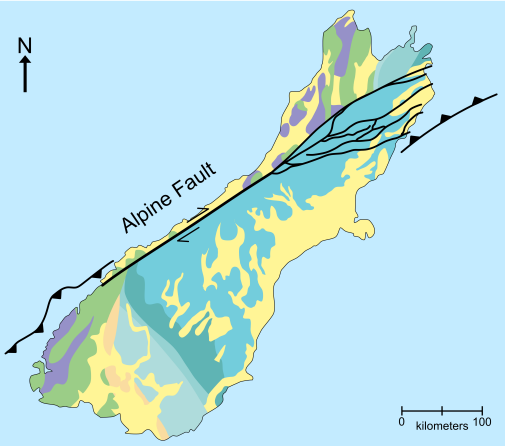
- Dominantly oblique thrusting in the central section
- Dominantly dextral strike-slip in the northern and southern sections
- Since it formed around 25 Ma, there has been 480km of right-lateral displacement and 90km of displacement-normal shortening
- Greatest stretch direction is NNE - SSW, approximately 208º
- Least principle stretch is sub-perpindicular to the fault at 120º

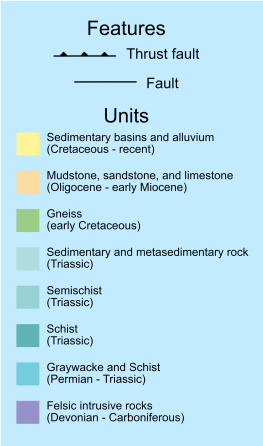
- Plate convergence is forming the Southern Alps mountain range, but uplift rates are balanced by erosion rates

- Earthquakes occur semi-periodically with recurrence intervals around 300 years
- The last major earthquake occurred in 1717
- Earthquakes can occur along the southern section, central section, or along both



Geologic Map

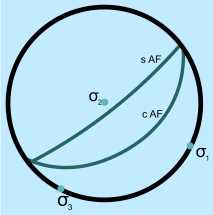




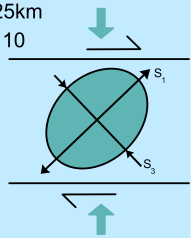
Fault Description

- 800 km length, along the boundary between the Australian Plate and the Pacific Plate
- Overall transpressional displacement (37 mm/yr)
- Constant NE/SW strike (~53º)
- Varying dip along the fault, including thrust faulting and very steep normal faulting
- The fault is visible from many different levels of scale
  - the Southern Alps mountain range can be seen from satellite
  - surface ruptures show displacement on the ground
  - outcrops show the boundary between the hanging wall and footwall
- It is a potential earthquake hazard for the South Island of New Zealand

Dynamics and Mechanics



- The greatest stress direction is ~120º
- The least stress is orientated ~208º

- The fault extends to depths of 25km
- Vertical displacement rates are 10 mm/yr on average
- Strike-slip rates average 27 mm/yr

- Transpressional motion combines simple shear and pure shear