



## **Do great earthquakes occur on the Alpine fault in central South Island, New Zealand?**

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Geological observations require that episodic slip on the Alpine fault averages to a long-term displacement rate of 2-3 cm/yr. Patterns of seismicity and geodetic strain suggest the fault is locked above a depth of 6-12 km and will probably fail during an earthquake. High pore-fluid pressures in the deeper fault zone are inferred from low seismic P-wave velocity and high electrical conductivity in central South Island, and may limit the seismogenic zone east of the Alpine fault to depths as shallow as 6 km. A simplified dynamic rupture model suggests an episode of aseismic slip at depth may not inhibit later propagation of a fully developed earthquake rupture. Although it is difficult to resolve surface displacement during an ancient earthquake from displacements that occurred in the months and years that immediately surround the event, sufficient data exist to evaluate the extent of the last three Alpine fault ruptures: the 1717 AD event is inferred to have ruptured a 300-500 km length of fault; the 1620 AD event ruptured 200-300 km; and the 1430 AD event ruptured 350-600 km. The geologically estimated moment magnitudes are  $7.9 \pm 0.3$ ,  $7.6 \pm 0.3$ , and  $7.9 \pm 0.4$ , respectively. We conclude that large earthquakes ( $M_w > 7$ ) on the Alpine fault will almost certainly occur in future, and it is realistic to expect some great earthquakes ( $M_w \geq 8$ ).