Surface break-through by repeated seismic slip during compressional inversion of an inherited fault. The Ostler Fault, South Island, New Zealand

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Shortening across the plate boundary in the South Island of New Zealand is accommodated not just along the right-lateral transpressive Alpine Fault, but also on an array of N-S reverse faults in both the Australian and Pacific crust. The Ostler Fault is such a structure, developed in the piedmont of the Southern Alps, east of the Alpine Fault. The question addressed here is whether the fault is an entirely new structure formed in the current stress regime, or a reactivated fault inherited from earlier episodes of deformation. New data on the geometry and deformation history of the Ostler Fault have been acquired by integrating surface geological mapping (scale 1:25,000), structural and morphotectonic investigations, and two seismic reflection profiles across the most active segments of the fault. The geological and morphotectonic data constrain the long-term evolution of the fault system coeval with deposition of a late Pliocene-Pleistocene lacustrine-fluvial terrestrial sequence, and the overlying glacial and peri-glacial deposits 128-186 to 16-18 ka old. Sets of faults scarps define a segmented zone (50 km long and 2-3 km wide) of N-S reverse faults dipping ~ 50º W, with a strongly deformed hanging wall panel, where the uplifted

terrestrial units are uplifted, back-tilted up to 60º W, and folded. Gradients in elevation and thickness of the hanging wall sequence, shifting of crosscutting paleodrainages, and younging age of displaced markers, all consistently indicate the progressive propagation of the surface trace of the fault from south to north. The interpretation of the new seismic reflection profiles, consistent existing gravity data (Kleffmann and Stern, in prep.) and surface geology, suggests that the Ostler Fault belongs to a set of sub-parallel splays joining, at depths of >1.5-2 km, a buried high-angle normal fault that underwent compressional reactivation during sedimentation of the Plio-Pleistocene and Holocene cover sequence. Repeated reactivation of the inherited fault system through cycles of seismic deformation eventually culminated in the surface break-through of the buried fault, resulting in its strong control on sediment deposition, intra-basinal morphology and drainage. This evolution discloses the history of progressive reactivation and propagation of seismogenic basement faults that may remain undetected in absence of clear surface exposure, especially in countries - like New Zealand – where the historical seismic catalogue is very short.