

# 166-7 - INITIATION AND GROWTH OF STEEP TRANSPRESSIONAL SHEAR ZONES THROUGH A 65 KM THICK SECTION OF CONTINENTAL CRUST IN SW NEW ZEALAND

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Tuesday, 24 September 2019



9:40 AM - 9:55 AM



Phoenix Convention Center - Room 131ABC, North Building

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## Abstract

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The Fiordland block in SW New Zealand preserves a complete section of Cretaceous continental arc crust from depths of ~5 to ~65 km. The current architecture of this section was primarily assembled at 8-7 Ma when reverse faults uplifted and imbricated slices of Cretaceous lower, middle, and upper crust. These exposures allow us to directly observe how Cretaceous faulting in the upper crust was connected to Cretaceous deformation in the deep crust via the reactivation of inherited boundaries. Structural analyses, 44 new  $^{206}\text{U}$ - $^{238}\text{Pb}$  (SHRIMP-RG, LA-SF-ICPMS zircon) and  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  (hornblende, biotite) ages, and thermobarometric data show how two transpressional shear zones propagated through the entire crust during pulses of Mesozoic magmatism over a 40 m.y. period.

The first shear zone (Indecision Creek-Grebe) formed by 136-130 Ma on an inherited boundary at the edge of the Paleozoic Gondwana margin. Deformation was vertically continuous from the upper crust to at least the mid-crust at this time, forming a 1 to 5 km-thick shear zone that widened with depth. After ~130 Ma, the shear zone propagated continentward, reaching the root of another inherited boundary at ~65 km depth by ~124 Ma. At 123-121 Ma, a second (George Sound) shear zone initiated at the root of this second boundary and propagated upward, reaching the upper crust by 110-108 Ma. As the new shear zone formed, two 12-15 km thick, dioritic plutons intruded, vertically stratifying the lower crust and creating rheological and compositional boundaries at 32-35 km and 45-47 km depth. Differences in pluton age and location allowed us to track shear zone growth as it propagated through the intrusions. As the 123-121 Ma Worsley pluton intruded at 35-47 km depth, a >10 km-wide zone of steep, high-temperature ( $\geq 840^\circ\text{C}$ ) shear fabrics formed where deformation occurred by dislocation creep of plagioclase and pyroxene. Within 3-5 Ma, this zone had narrowed into a 2 km-wide region of hornblende-biotite mylonite. When the 118-115 Ma Misty pluton intruded at 30-45 km depth, the shear zone then propagated through it, forming branches that connected with a nascent mid-crustal thrust belt. Mid-crustal deformation then spread laterally, forming border zones where motion was partitioned onto widely spaced faults, some of which penetrated the upper crust along the inherited boundaries.

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