


*Fault-zone structure and
weakening processes in basin-
scale reverse faults: The
Moonlight Fault Zone, South
Island, New Zealand*

A Presentation by Richard Butts

A photomicrograph showing a dense array of brown, prismatic crystals of kaersutite. The crystals are oriented vertically and exhibit a fibrous or columnar habit. They are surrounded by a matrix of smaller, darker, and more irregularly shaped minerals. The overall texture is highly crystalline and layered.

Titanium Rich
Amphibole
Kaersutite

R141092

2 mm



Pseudotachylite

A close-up, top-down view of a large quantity of gold nuggets. The nuggets are irregular in shape, ranging from small, pebble-like pieces to larger, more angular chunks. They exhibit a rich, metallic yellow-gold color with some darker, shadowed areas, suggesting a rough, unrefined texture. The nuggets are densely packed, filling the entire frame. In the center of the image, the word "Gold" is written in a large, bold, black, sans-serif font, serving as a clear label for the material.

Gold

Magnetite





Fig. 5. Field photos of structures in the Moonlight Fault from the Matukituki Valley to Twelve Mile Creek. a-b) Photos of the hanging-wall greenschists (a) and the footwall greenschists with chevron folds (b) in the Matukituki Valley. c) Foliation parallel pseudotachylyte fault vein in the Matukituki Valley. d) Late-stage cataclasite offsetting features in the hanging-wall greenschists, Matukituki Valley. e) Green and black fault gouges within the core of the Moonlight Fault Zone in Stony Creek. Brittle shears in the sedimentary package enter the gouge but do not offset the slip surface separating green and black gouges. f) Photo of the sedimentary package in Moonlight Creek. Outlined is a steeply west-dipping pebble bed. g) Foliation parallel breccia in the hanging-wall of the Moonlight Fault Zone in Fan Creek. h) Core of the Moonlight Fault in Twelve Mile Creek. Brecciated greyschist in the hanging-wall contacts ultracataclasites which lie in contact with a foliated gouge likely derived from the Bobs Cove Beds sediments. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

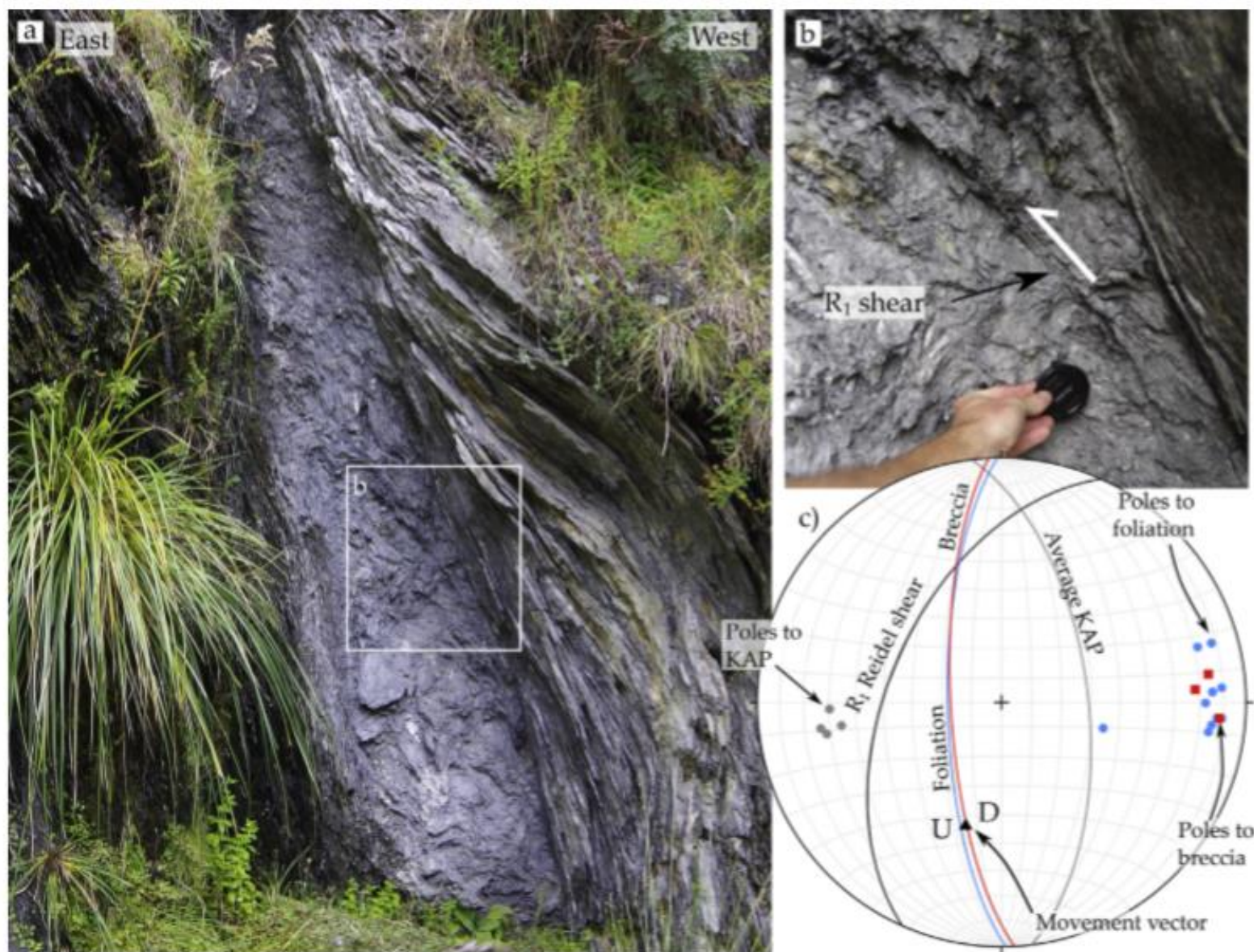


Fig. 6. Deformation in the footwall of the Moonlight Fault Zone in Moonlight Creek. a) An up to 1 m wide breccia layer c. 750 m from the main trace of the Moonlight Fault. The breccia lies subparallel to the surrounding greyschist foliation. b) R_1 -type Reidel shear that is orientated at c. 25° to the upper breccia margin. c) Equal area lower hemisphere projection shows the orientation of the main breccia body (red; $n = 3$), foliation (blue; $n = 10$) and kink axial planes (KAP; $n = 4$) in the surrounding greyschist, and one R_1 -type Reidel shear (black). Assuming the movement vector lies in the plane of the breccia layer and perpendicular to the intersection of the breccia and R_1 -shear, this indicates top-to-NNE oblique reverse movements (combined with asymmetric folds adjacent to the breccia). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

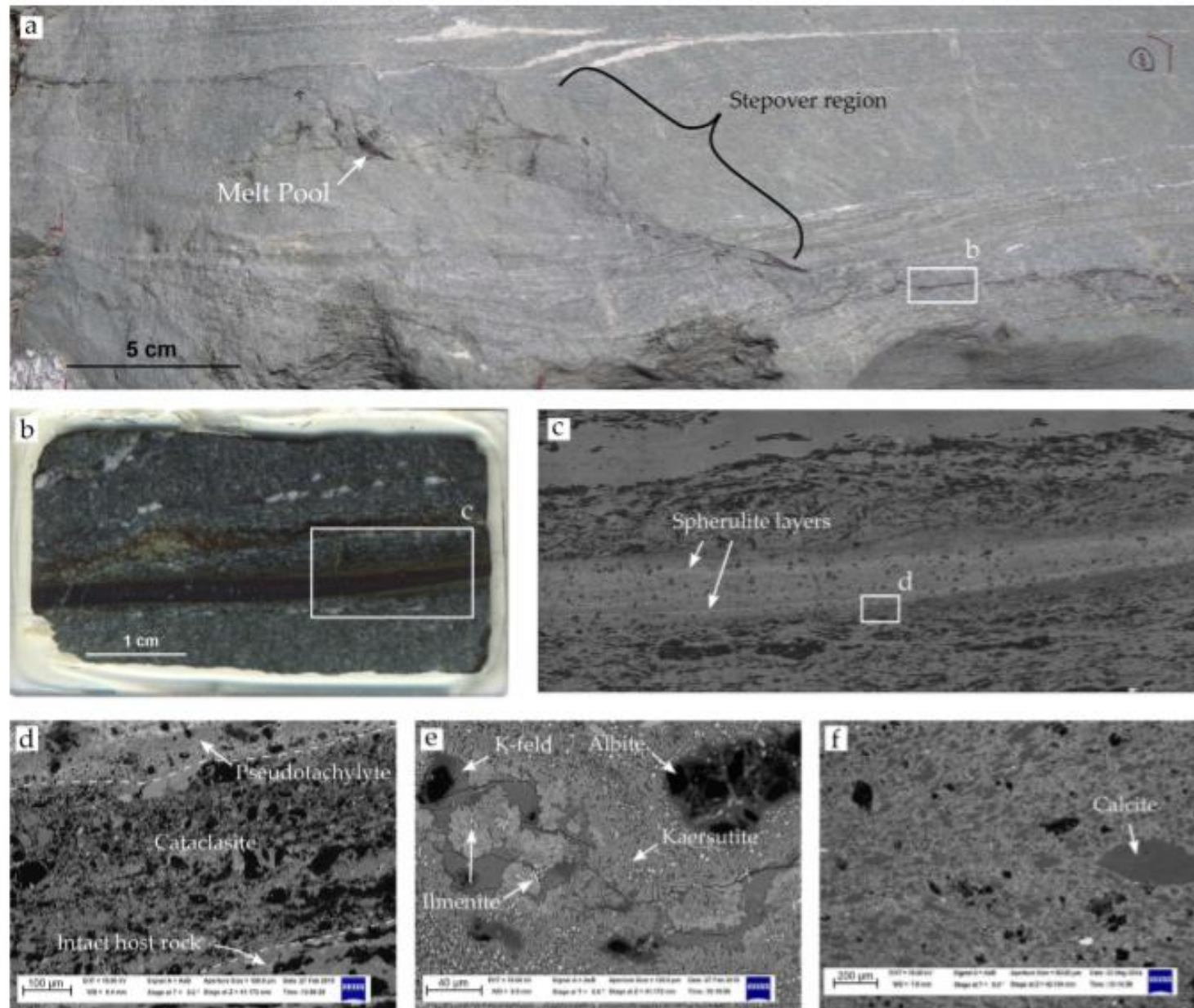


Fig. 8. Hanging-wall pseudotachylyte networks in the Matukituki Valley. Parts c-f are backscatter SEM images. a) Photo of foliation-parallel pseudotachylyte fault veins that are linked in a stepover region by a zone of pseudotachylyte breccia containing melt pools. b) Scanned thin section image of a foliation-parallel pseudotachylyte fault vein. Light green material along the margins of the fault vein is ultracataclasite. c) Foliation-parallel pseudotachylyte fault vein. Concentrations of spherulites define compositional and grain size bands that give the fault vein a layered appearance. d) Ultracataclasite adjacent to a pseudotachylyte vein margin indicating that cataclasis preceded frictional melting. e) Lithic albite grain breaking down to potassium feldspar. Kaersutite spherulites form around ilmenite microlites. f) Fault vein that hosts calcite-filled amygdules. The subparallel nature of the vesicle long axes defines flow paths within the fault vein. (For interpretation of colour in this figure legend, the reader is referred to the web version of this article.)

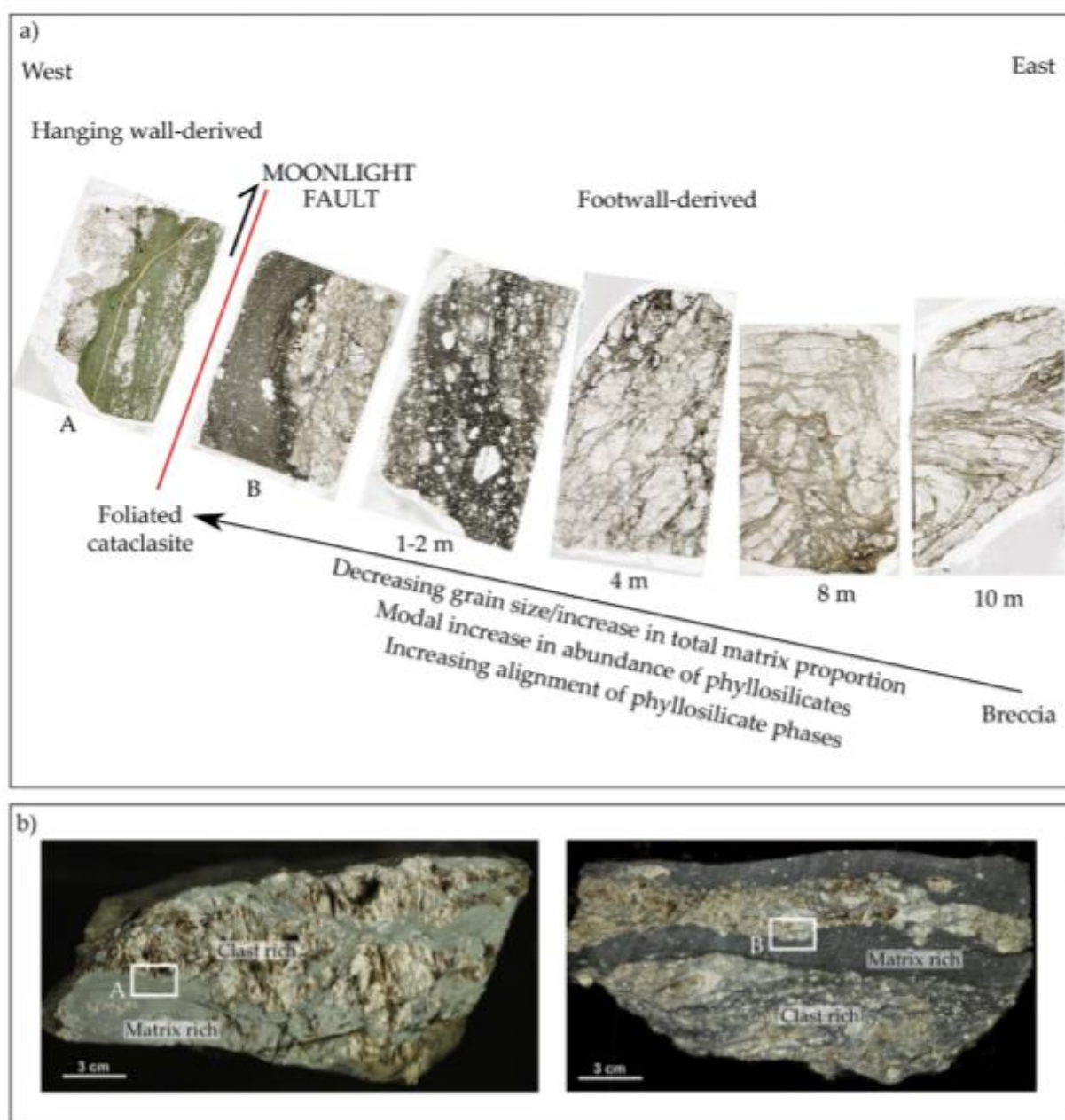
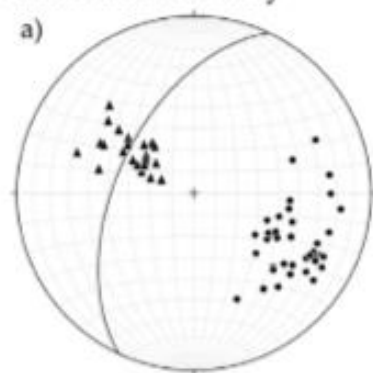
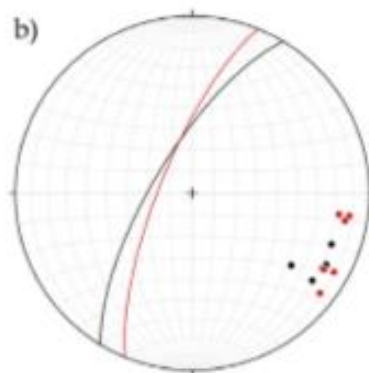


Fig. 9. Textural changes observed in fault rocks collected across the core of the Moonlight Fault Zone in the Matukituki Valley. a) Series of scanned thin sections from samples collected at distances of <10 m from the fault core illustrating the progression from intact footwall greyschist to breccia, cataclasite and foliated cataclasite. The fault core contains foliated cataclasites derived from the hanging-wall greenschists (A) and the footwall greyschists (B). b) Photographs of foliated cataclasites within the fault core illustrating the anastomosing and interconnected nature of the phyllosilicate-rich matrices. Clasts are dominated by quartz and albite. Green sample on the left is foliated cataclasite derived from the hanging-wall greenschists. Sample on the right is foliated cataclasite derived from footwall greyschists. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

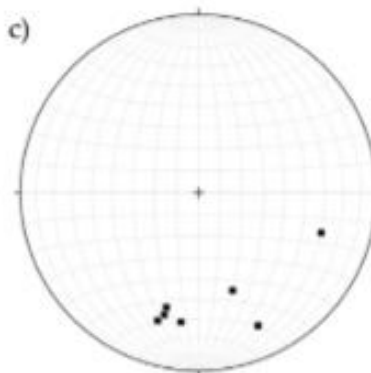
Matukituki Valley



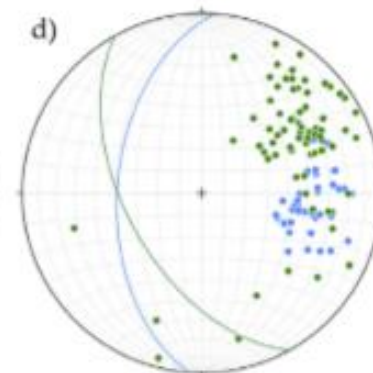
Hanging wall greenschist



Hanging wall greenschist adjacent to the Moonlight Fault

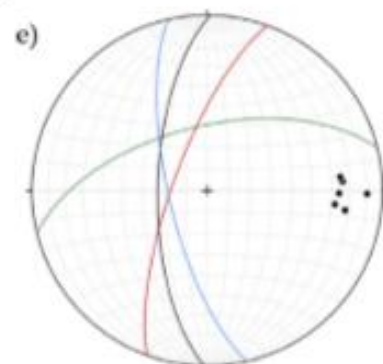


Footwall greyschist

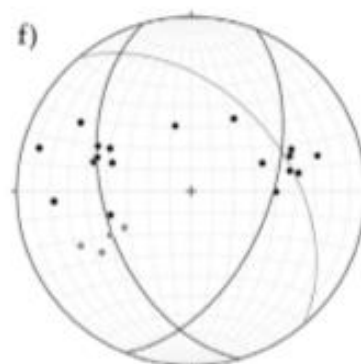


Fault-related hanging wall deformation

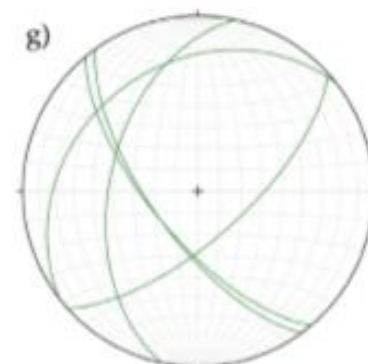
Stony Creek



Hanging wall greenschist deformation + Moonlight Fault

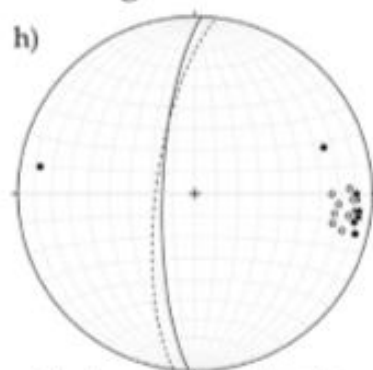


Footwall antiform limbs and brecciation

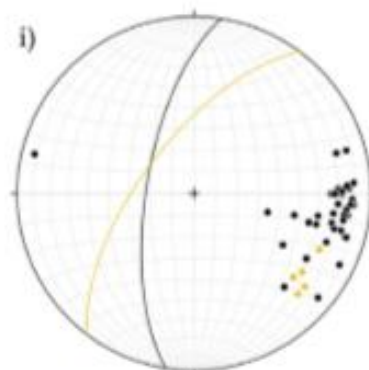


Sedimentary package deformation

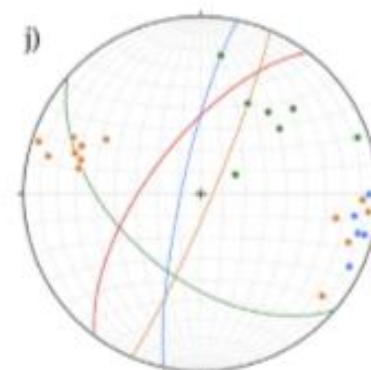
Moonlight Creek



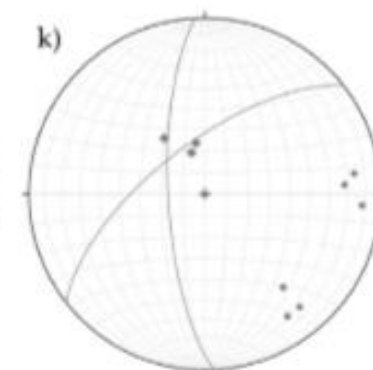
Hanging wall quartzofeldspathic gneiss and sheared greyschist



Footwall greyschist and Bobs Cove Beds

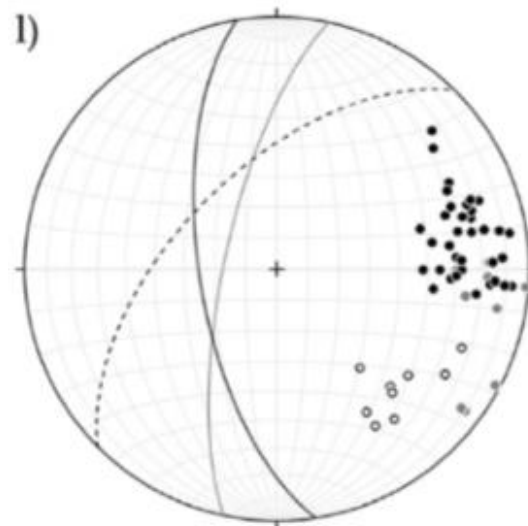


Hanging wall deformation + Moonlight Fault

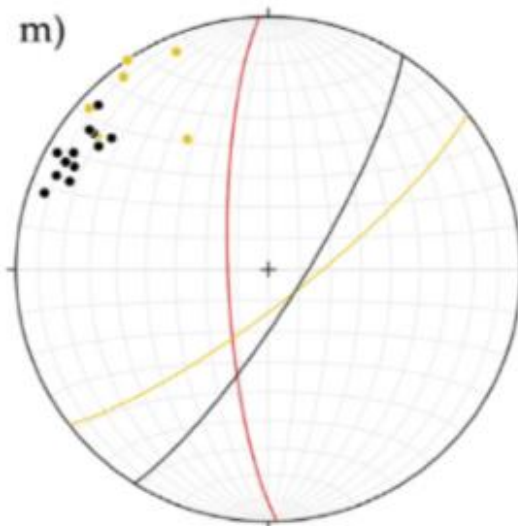


Footwall brecciation

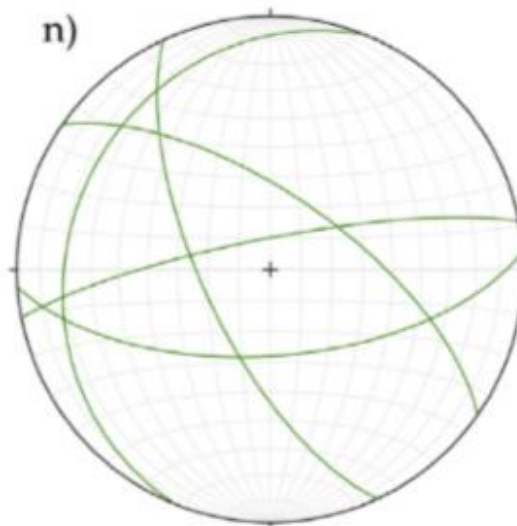
Fan Creek



Hanging wall greyschist deformation

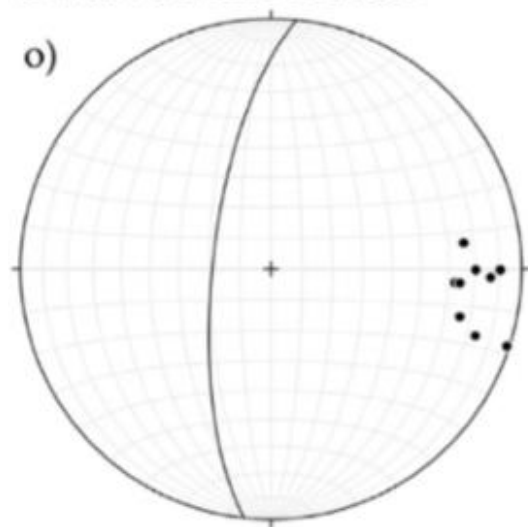


Footwall greyschist + Moonlight Fault
+ Bobs Cove Beds

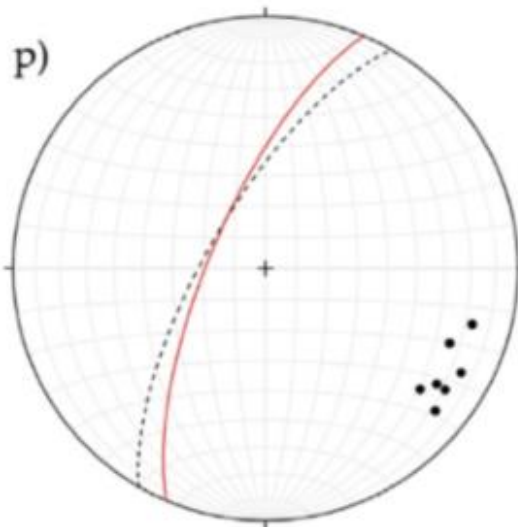


Footwall deformation

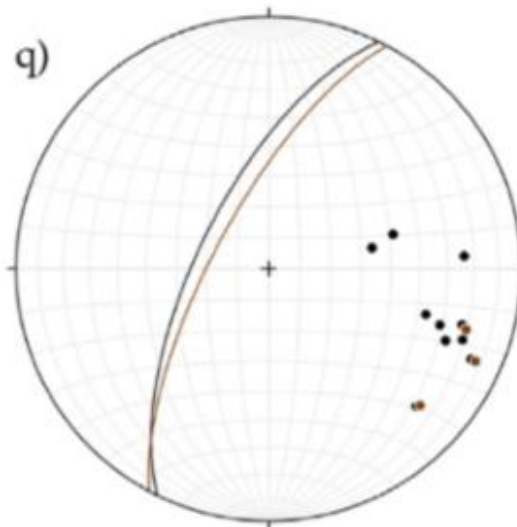
Twelve Mile Creek



Hanging wall greyschist



Hanging wall greyschist adjacent
to the Moonlight Fault



Footwall greenschist and
deformation

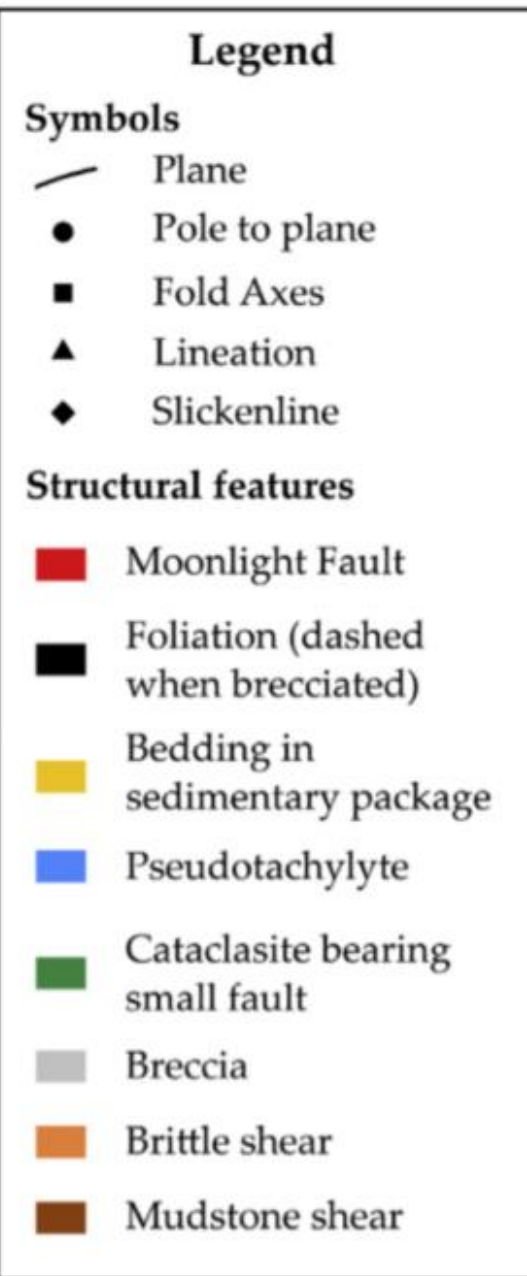


Fig. 4. Equal area lower hemisphere projections of host rock and fault-related deformation features associated with the MFZ.

Works Cited

Alder S., Smith S.A.F., Scott J.M. (2016). *Fault-zone structure and weakening processes in basin-scale reverse faults: The Moonlight Fault Zone, South Island, New Zealand*

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