Constraining mantle volatiles in Fiordland and Puyssegur with an MT experiment

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Mini-Workshop for the South Island, New Zealand Primary Site coordination
New Zealand: A Subduction Scissor
- Highly oblique convergence has induced opposing subduction zones
- Puységur/Fiordland subduction incipient with solitary arc volcano (Sol. Is)
- Ideal to study initiation of plate eclogitization, hot mantle wedge process

(Pysklywec et al., 2010)
Mature Subduction: Fluids, Melting and Thermal Regime
- Classic 2D view at depth exhibits subducted hydrous mineral breakdown, circulating high-T mantle wedge, subduction fluid flux melting to form arc
- Unclear when these processes develop during subduction initiation
Source Fields for the Magnetotelluric Method

Regional and Global Lightning Activity for $f > 1$ Hz
Solar Wind-Magnetospheric Interactions for $f < 1$ Hz
Segmentation of Seismicity, Plate Locking, ETS, and Arc Magmatism in Cascadia Investigated with MT
Slab Eclogitization, Upward Fluid Egress, Position of Wedge Front, Arc Flux Melting, Relation to ETS - All Resolvable with MT
Crustal-Scale Fluid Evolution and Transport in Transpression (Wannamaker et al. 2009)
Plan and Section Views Through 3D MT Inversion of Mt St Helens Data
Produced using Deformable Edge Finite Element Algorithm (Kordy, Wannamaker, et al., 2014)
Potential MT Station Distribution, Puyssegur-Fiordland

Sutherland et al, 2009
60 land receivers
35 marine receivers
receiver no 23; LAND, elevation: 863m
receiver no 53; LAND, elevation: 13m
receiver no 68; MARINE, depth: 443m

Re(Zxx)/|Z_noob|

Im(Zxx)/|Z_noob|

Re(Zxy)/|Z_noob|

Im(Zxy)/|Z_noob|

Re(Zyx)/|Z_noob|

Im(Zyx)/|Z_noob|

Re(Zyy)/|Z_noob|

Im(Zyy)/|Z_noob|

Re(Kzx)

Im(Kzx)

Re(Kzy)

Im(Kzy)
Conclusions

- Puységur/Fiordland subduction system a compelling candidate for birth of subduction system.
- When do eclogitization fluids begin releasing?
- When does circulating mantle wedge form?
- How are those affected by prior lithosphere variations (i.e., transition to Fiordland?)
- Previous MT campaigns show strong effect of subduction processes on conductivity variation.
- Start of eclogitization and ETS, fluid egress, position of wedge front, arc flux melting all resolvable with MT.
- Thermal/fluid/melt inferences complement seismology.
- Pertinent subduction processes affect MT in the 10-10000 s period range; responses strongly anomalous.
- Wedge melting separable from broader fluidization.
- Strongly 3D geometry, requires land/seafloor deployment.