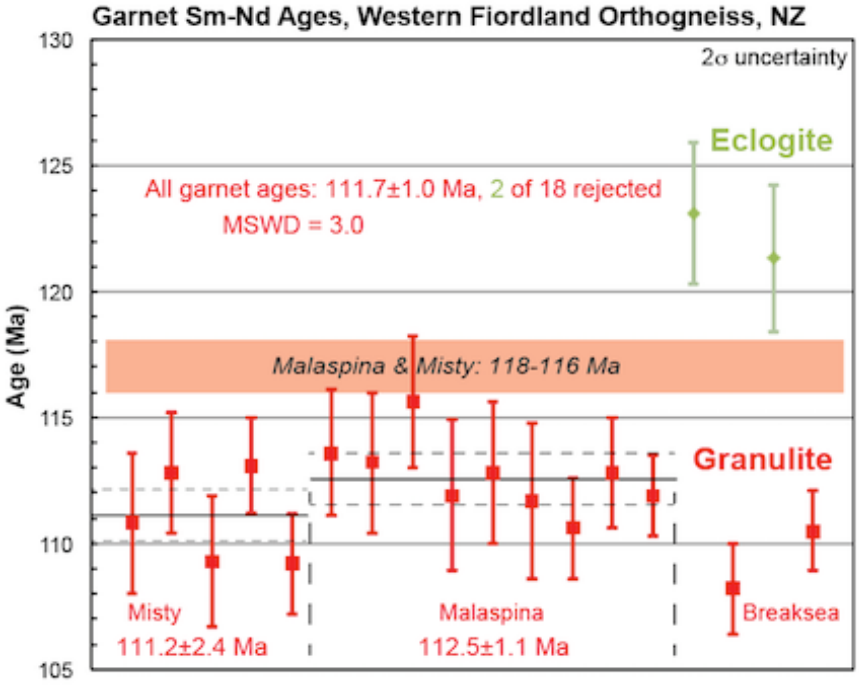
V31D-08: Metamorphic ages constrain the timing and nature of heat flow into the lower crust of a magmatic arc, Fiordland New Zealand

Wednesday, 13 December 2017
09:45 - 10:00
New Orleans Ernest N. Morial Convention Center - 210

Garnet ages for eclogite and granulite from the Western Fiordland Orthogneiss (WFO) provide a precise age for high-grade metamorphism and partial melting of the lower crust in a Cretaceous magmatic arc currently exposed in Fiordland, New Zealand. U/Pb zircon ages and pluton areas indicate that a high magmatic flux event between 118 and 115 Ma added >3,000 km^2 of mid- to lower-crustal plutons. The high flux event was followed by high temperature metamorphism and partial melting which resulted in pervasive leucosomes, and trondhjemite layers and veins. At least 1,800 km^2 of the newly added crust was metamorphosed to garnet granulite facies orthogneiss. Thermobarometry and phase diagram models indicate that garnet grew at 850 to 1,000°C and 12 to 14 kbar in this monzodiorite and diorite gneiss of the Misty, Malaspina, and Breaksea plutons. Sm-Nd garnet-rock isochrons for these three plutons of the WFO (>700 km^{2}of lower crust) indicate that peak temperatures were reached at 111.7±1.0 Ma (N=16).

The isotopic and chemical composition of zircon indicate that the Cretaceous arc flare-up was most likely triggered by partial melting and hybridization of subducted oceanic crust and enriched subcontinental lithospheric mantle directly prior to cessation of arc magmatism. The driving mechanism for the terminal magmatic surge is inferred to be propagation of a discontinuous slab tear beneath the arc, or a ridge-trench collision event between 136 and 128 Ma. The lack of ca. 112 Ma plutons in the western part of Fiordland negates a magmatic heat source for garnet granulite metamorphism. Therefore, we infer that high heat flow associated with mantle advection at the base of the arc after the magmatic surge continued for several m.y., heating the lower crust to granulite facies temperatures.



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