Oblique detachment tectonics and melt migration in the Fosdick Mountains, West Antarctica

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The Fosdick Mountains form an E-W trending migmatite dome in the northern Ford Ranges of Marie Byrd Land, Antarctica. Pervasively folded migmatites derived from lower Paleozoic greywacke and middle Paleozoic plutonic rocks constitute the dome. New field research documents a transition from melt-present to solid-state deformation upon the south flank of the dome, and a mylonitic shear zone mapped for 30 km between Mt. Iphigene and Mt Richardson. Kinematic shear sense is dextral normal oblique, with top-to-the-SW and -WSW transport. 24 km to the south in the Chester Mountains, correlative plutonic rocks are unmetamorphosed and unfoliated, but cut by sparse m-scale dikes of dolerite and two-mica granite and pervasive minor brittle faults that record NNE-SSW stretching. We here propose that the mylonitic zone represents a crustal-scale detachment fault on the south flank of the Fosdick Mountains, separating dome rocks dominated by melt-present deformation in the middle crust from the brittely deformed, hanging wall block of the Chester Mountains. The structure, here named the South Fosdick detachment fault, forms the south flank of the migmatite dome and was in part responsible for the exhumation of mid-crustal rocks.

Four structurally well defined samples from the South Fosdick detachment zone of the Fosdick Mountains migmatite dome, west Antarctica, yield sensitive, high-resolution ion-microprobe (SHRIMP) U-Pb zircon ages that constrain the time-scale of partial melt crystallization during melt migration in a melt-present shear zone to between ca. 109–102 Ma. (1) Zircons from a biotite granodiorite sigmoidal boudin, that is interpreted to be the protolith for the crystallized anatectic granitic rocks, yields two SHRIMP U-Pb ages of 109.1 ± 0.8 Ma and 105.4 ± 1.0 Ma. (2) A biotite granite from a 10 cm wide leucosome concordant to the shear zone foliation yields an age of 107.4 ± 0.8 Ma. (3) A biotite granite from a discordant dextral normal shear band yields an age of 107.3 ± 0.9 Ma. (4) A biotite granite from a 100 m wide syntectonic granite sheet yields an age of 102.4 ± 0.7 Ma.

The shear zone preserves evidence for melt-enhanced deformation and the analyzed samples all preserve features indicative of crystallization from melt. These samples represent the successive stages of melt migration in a migmatitic shear zone. The U-Pb SHRIMP zircon crystallization data, in conjunction with structural setting and zircon morphologies, indicate that the time required for melt to form, migrate through a network of dilational and shear sites, coalesce, and crystallize was on the order of 7×10^6 yr.