Differentiation of silicic segregations in the Ferrar dolerites, Antarctica

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The upper parts of the 100–300 m thick Ferrar Dolerite sills in Antarctica contain coarse-grained leucocratic segregations, in the form of sharply defined, anastomosing, sub-horizontal 0.1–3 m thick lenses,which extend tens of meters along strike. Most segregations range in composition from diorite to granodiorite, are enriched in P_2O_5, TiO_2, and FeO_T, and have linear trends in Harker diagrams that are compatible with simultaneous crystallization of pyroxene and plagioclase from the host dolerite.

The Singular Value Decomposition (SVD) matrix technique and the thermodynamic program MELTS were used to determine the temperature and crystallization conditions at which these segregations formed. MELTS models show that segregation compositions are best approximated by wet fractional crystallization at 1 kb of the dolerite adjacent to the segregations. The segregations can be grouped according to the calculated temperatures at which they crystallized. A global crystallization path (GCP) can be defined from the most primitive segregations in each temperature group, and several local crystallization paths (LCPs) can be defined by the compositions of segregations formed at each temperature interval. Each segregation is described by one of five mass balance relationships (RC_1-RC_5). When they are plotted in a CaO versus SiO_2 plot, segregations above 6 wt % CaO are mushes represented by RC_1-RC_4, and below 6 wt% CaO are fractionated liquids represented by RC_5. The GCP represents differentiation during cooling of the sill to form mushes, and LCPs represents local differentiation involving subsequent segregation of the residual mush by an imperfect filter-pressing mechanism. Compositional variation within each *RC* group reflects addition or subtraction of varying amounts of crystals by this mechanism.