Feldspars in the Skaergaard Intrusion: Ternary Relationships, Zoning & Pb Isotope Geochemistry

JUNE O. CHO*, JAMES S. SCOATES, DOMINIQUE WEIS AND MARGHALERAY AMINI

PCIGR, Earth, Ocean & Atmospheric Sciences, University of British Columbia, Vancouver BC, V6T-1Z4, Canada (*correspondence: jcho@eoas.ubc.ca)

Feldspars in the Eocene Skaergaard intrusion of East Greenland preserve a remarkable compositional record of the diversity of magmatic and post-magmatic processes that occurred during crystallization of a high-level magma reservoir. The Skaergaard intrusion is related to the opening of the North Atlantic Ocean and eruption of coeval East Greenland flood basalts. Analyses (>2600) of texturally different occurrences of feldspar span nearly the entire possible range of ternary compositions (An-Ab-Or). These compositions include: 1) calcic plagioclase in reactive symplectites; 2) a wide range of intermediate-composition plagioclase primocrysts with different zoning patterns that track fractionation of the resident magma and processes in the crystal mush; 3) exsolved alkali feldspars in interstitial granophyres produced during silicate liquid immiscibility; and 4) replacement albite formed as a result of meteoric fluid circulation and subsequent alteration. The Pb isotope compositions (>750) of Skaergaard feldspar measured directly in thin section by LA-ICP-MS demonstrate that most of the Skaergaard intrusion has the same isotopic composition within analytical uncertainty. They confirm that crystallization occurred under essentially closed-system conditions with only minor incorporation (<1%) of amphibolitic crustal materials detectable in select hybrid rocks from the outermost margins (<5 m from the contact). The Pb isotope signature of the incoming Skaergaard magma, represented by the average Layered Series, is distinct from that of most of the overlying flood basalts and is consistent with prior assimilation of granulitic gneisses (<10%) at depth. Based on its Pb isotope geochemistry, the Skaergaard intrusion is provisionally linked to the eruption of basalts belonging to the Milne Land Formation, the lowermost and earliest of the voluminous and widespread 56-54 Ma flood basalt sequence. This integrated microanalytical study of feldspar from the Skaergaard intrusion provides new tools and avenues for petrologic research that can be applied to investigating the origin and evolution of mafic layered intrusions and other feldspar-bearing plutonic rocks in the Earth's crust.