Assembly of Magmas in Earth's Upper Crust: Insights at the Micro and Macro Scale from Granitic Batholiths

MCLEOD, C. L.[1], SHAULIS, B.J.[2], BRYDON, R. J.[1], HALEY, M.[1], ANGI-O'BRIEN, E.[1], TRØONES, R. G.[3]

[1] Department of Geology and Environmental Earth Science, 203 Shideler Hall, Miami University, Oxford, OH, 45056.
[2] Department of Geosciences, 267 Gearhart Hall, University of Arkansas, Fayetteville, AR, 72701.
[3] Center for Earth Evolution and Dynamics (CEED), University of Oslo, Blindern, NO-0316, Oslo, Norway.

Understanding the magmatic assembly of voluminous granitic bodies is fundamental to unravelling the processes through which Earth's Upper Continental Crust has evolved. Here we report results from a detailed petrological and geochemical study of the crystal cargoes from two voluminous batholiths within the Oslo Rift, Norway. The major (biotite, amphibole, feldspar) and accessory phases (titanite, apatite, and zircon) are being investigated for their chemical compositions, and where appropriate, their U-Pb geochronology. This approach ultimately aims to evaluate the processes associated with the magmatic assembly of intrusive granitic suites and assess the extent of petrographic and chemical diversity throughout each batholith. Sampled lithologies are subalkaline at 70-80 wt. SiO_2 and 7-11 wt. % total alkalis, and mildly metaluminous to peraluminous (Al/(Na+K) at 1.01 to 1.3, Al/(Na+K+Ca) at 0.95 to 1.2). Feldspar which is ubiquitous throughout are predominantly of Ab-Or compositions (n=533) and range in Eu/Eu* from 0.1 to 1000, with two distinct populations clustering at corresponding Ce/Ce* of 0.02-0.05 (corresponding Cs up to 2000ppm) and 0.12-1. Biotites are phlogopitic in nature (Fe/(Fe+Mg)<0.5 at total Al a.p.f.u <4) and consistent with an anorogenic (A-type) granite. Apatite, titanite, and zircon all exhibit characteristic REE chondrite-normalized profiles reflecting REE behavior during melt-crystal partitioning. Specifically, inter-element ratios in apatite (e.g. Eu/Eu* vs. $(Sm/Nd)_N$ and $(La/Sm)N$ vs. $(La/Y)_N$) are consistent with derivation from an oxidized magmatic source, and consistent with I-types granites. Zircon textures (via CL) are consistently magmatic in origin and preliminary U-Pb data constrains crystallization to 273.2±2.3 Ma (n=33). No role for crustal recycling in the petrogensis of these intra-rift granites has been indentified (yet).

Batholith construction in intra-plate tectonic settings through incremental assembly is tentatively proposed here.