

Cordilleran Section - 116th Annual Meeting - 2020

Paper No. 3-2

Presentation Time: 8:30 AM

GEOCHRONOLOGY IN THE BOWELS OF MAGMATIC ARCS: A TALE OF TWO MINERALS, FIORDLAND NEW ZEALAND

STOWELL, Harold H.¹, SCHWARTZ, Joshua J.², BOLLEN, Elizabeth M.¹, TULLOCH, Andy³, KLEPEIS, Keith A.⁴ and RAMEZANI, J.⁵, (1)Geological Sciences, University of Alabama, Tuscaloosa, AL 35487, (2)Department of Geological Sciences, California State University Northridge, 18111 Nordhoff St., Northridge, CA 91330, (3)GNS Science, Private Bag 1930, Dunedin, 9054, New Zealand, (4)Department of Geology, University of Vermont, Trinity Campus, Delehanty Hall, 180 Colchester Ave, Burlington, VT 05405, (5)Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139

Precise and meaningful ages are essential for understanding thermal and mass fluxes within magmatic arcs and between arc crust and adjacent mantle. Isotopic dates are readily determined; however, direct ties between ages, magmatism, and metamorphism may not be apparent. SHRIMP-RG and CA-TIMS zircon, and ID-TIMS garnet ages outline the possibilities and limitations in rocks from the lower crust of the Fiordland magmatic arc where metamorphic temperatures were >850°C at ~14 kbar.

We present data for 3 migmatitic orthogneiss samples containing melt veins, garnet selvages, and garnet reaction zones (GRZ): 09NZ22-Crooked Arm, 15NZ25-Bligh, & 13NZ34b-Acheron. In 09NZ22, U-Pb zircon ages from the host and GRZ range from c. 121 to c. 116 Ma and do not define distinct populations based on age, morphology, or CL. Ten CA-TIMS zircon ages ranging from 118.3±.13 to 115.7±.18 Ma record episodic magmatism. The larger range of SHRIMP-RG ages record magma emplacement, metamorphic dissolution-reprecipitation, and local Pb loss. Garnet Sm-Nd ages range from 113.1±2.3 to 103.6±2.3 Ma and display systematic correlation with grain size. Ages for c. 1 cm garnet record growth during metamorphism, while the 0.1-0.3 cm grains with younger ages reflect intracrystalline diffusion and Sm-Nd closure. In 15NZ25, LA-ICPMS U-Pb zircon ages from the matrix and inclusions in large garnet porphyroblasts are 121.4±1.5 Ma (N=11) and 114.7±1.1 Ma (N=25/26), respectively. We interpret older zircon to record magma emplacement and younger zircon to record metamorphism. Sm-Nd ages for >1 cm garnet record growth during metamorphism at 112.3±2.0 (core-mantle, N=4) followed by overgrowth and/or diffusion at 106.9±3.1 Ma (rim, N=2). In 13NZ34, Sm-Nd ages for 1 cm garnet record growth from 115.9±1.1 Ma (core, N=5) to 111.3±1.8 Ma (rim, N=4), while c. 0.2 cm grains record closure of Sm-Nd to diffusion at 103.9±1.8 Ma (N=7).

The 3 migmatitic orthogneiss samples illustrate that: 1) large age uncertainties for SHRIMP-RG U-Pb zircon give estimates for magma emplacement but cannot resolve protracted magmatic processes, 2) CA-TIMS U-Pb zircon dates document timescales of protracted magmatism, 3) Sm-Nd ages for ca. 1 cm garnet grains reflect garnet growth at peak temperature, and 4) Sm-Nd ages for 0.1 to 0.3 cm garnet grains reflect cooling through c. 750°C.

Session No. 3

[T16. Metamorphic Processes in Cordilleran Arc Systems](#)

Tuesday, 12 May 2020: 8:00 AM-12:00 PM

Madera Room (The Westin Pasadena)

Geological Society of America *Abstracts with Programs*. Vol. 52, No. 4
doi: 10.1130/abs/2020CD-347006

© Copyright 2020 The Geological Society of America (GSA), all rights reserved. Permission is hereby granted to the author(s) of this abstract to reproduce and distribute it freely, for noncommercial purposes. Permission is hereby granted to any individual scientist to download a single copy of this electronic file and reproduce up to 20 paper copies for noncommercial purposes advancing science and education, including classroom use, providing all reproductions include the complete content shown here, including the author information. All other forms of reproduction and/or transmittal are prohibited without written permission from GSA Copyright Permissions.

[Back to: T16. Metamorphic Processes in Cordilleran Arc Systems](#)

[<< Previous Abstract](#) | [Next Abstract >>](#)