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Extreme Neoarchean Pb isotope variability in the Slave craton, Canada: Evidence from >50 granitoid feldspar and whole-rock pairs

BENJAMIN NEIL[1], D. GRAHAM PEARSON[1], BRUCE KJARSGAARD[2], RASMUS HAUGAARD[3], JOHN KETCHUM[1], THOMAS CHACKO[1], JESSE R. REIMINK[4] AND MICHAEL ACKERSON[5]

[1]University of Alberta
[2]Geological Survey of Canada, Ottawa
[3]Laurentian University
[4]Pennsylvania State University
[5]Smithsonian National Museum of Natural History

Lead isotopes offer unique constraints on Archean crust-mantle differentiation, but efforts to obtain initial Pb isotope ratios from Archean rocks are hampered by the relative mobility of U and Pb, and by the propensity for K-feldspar, the main repository of common Pb in granitoids, to be reset. Neoarchean VMS-galena Pb isotope data from the Slave craton reveal a major isotopic boundary in the central part of the craton, with comparatively juvenile compositions (low $^{207}Pb/^{204}Pb$) in the eastern Slave and evolved compositions (high $^{207}Pb/^{204}Pb$) in the central and western Slave [1]. Existing feldspar Pb isotope data reveal a similar pattern [2, 3], but are of limited geographic extent and have not been rigorously evaluated for closed-system behavior.

We acquired feldspar and whole-rock Pb isotope data by (LA-)MC-ICPMS from 2.7–2.6 Ga granitoids throughout the Slave craton. Most samples (37/58) yield two-point (feldspar and whole-rock) Pb-Pb dates that are consistent with closed-system behavior. Two-point dates older than the granitoid's crystallization age are associated with low whole-rock U/Pb ratios, and likely reflect ancient U loss. Two-point dates younger than the granitoid's crystallization age reflect deformation- or thermally-induced Pb exchange between feldspar and rock. Secondary feldspar isochrons indicate that some of the feldspar-rock Pb exchange took place at 1.9–1.8 Ga. Feldspar data from samples that pass the "two-point-isochron test" define a linear array in $^{206}Pb/^{204}Pb$ vs. $^{207}Pb/^{204}Pb$ space that parallels the array of VMS-galena data, and confirms the comparative juvenile and evolved character of the eastern and western/central Slave craton basement, respectively. The most radiogenic ($^{207}Pb/^{204}Pb$ >15.0) compositions require sources that were extracted from the mantle before 3.6 Ga. Samples with these compositions are more widespread than previously recognized, and their spatial association with the 3.3–2.9 Ga central Slave basement complex (CSBC) indicates that Eoarchean crust in the CSBC was either destroyed or remains to be discovered.

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[2] Davis et al. (1996) Chemical Geology, 130, 255–259.

[3] Yamashita et al. (1999) Canadian Journal of Earth Sciences, 36, 1131–1147.