Timing constraints on the deep crustal residence and uplift of the Repulse Bay block, Nunavut

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5f. Characterizing mid- to lower-crustal flow related to orogenic processes

The Repulse Bay block of Melville Peninsula, Nunavut, is hypothesized to be a crustal block that accreted to the Rae craton prior to terminal collision of the Superior craton during the Trans Hudson orogeny. The block consists primarily of Archean granitoid lithologies with interleaved sedimentary sequences that were deformed and metamorphosed at amphibolite to granulite facies. Within what is known as a central granulite facies domain, two different units were chosen for this study: a 2670 Ma enderbitic intrusion and a younger migmatitic metapelitic gneiss. The timing of 1) prograde and peak metamorphism, 2) deep crustal residence and 3) subsequent uplift of the Repulse Bay block are constrained using *in situ* LA-(MC)-ICPMS studies of Sm-Nd in apatite, and U-Pb in apatite and monazite from the study units. Within the migmatitic metapelitic gneiss, the timing of muscovite dehydration is well constrained by ca. 1847 Ma monazite and zircon in leucosomes, and the timing of biotite dehydration, interpreted to represent peak metamorphism having reached 800˚C and 9.5 kbar, is constrained by **ca.** 1811 Ma large monazite grains partially enclosed by peritectic garnet. The duration of deep crustal residence is documented by *in situ* Sm-Nd analyses on 50-200 μm magmatic apatite grains in the enderbite that reveal complete resetting of the Sm-Nd system during peak Trans-Hudson metamorphism. Based on the experimental diffusion data for Nd in apatite of Cherniak (2000), complete loss of radiogenic ^{143}Nd is expected to occur over a crustal residence time >2 myr for temperatures of 800˚C; quantitative accumulation of radiogenic ^{143}Nd is not expected until cooling below 725˚C for the apatite diameters we encountered. The decompression path is also recorded in the metapelitic gneiss by cordierite + spinel coronas surrounding garnet, indicative of near-isothermal decompression. Abundant small (< 10 μm) monazite inclusions within these coronas have a ^{207}Pb/^{206}Pb age of ca. 1770 Ma, interpreted to represent the timing of near- isothermal uplift to 4.5 kbar. Finally, preliminary U-Pb apatite geochronology demonstrates that the granulite facies domain then cooled to 450˚C by ca. 1700 Ma.

Results and Conclusions

These results suggest that the Repulse Bay block encountered a classic Himalayan-style orogenic cycle that was marked by relatively rapid burial followed by slow cooling during subsequent uplift. The sub-horizontal ductile fabrics preserved in the block are interpreted to have formed during granulite-facies mid-crustal flow between 1840-1810 Ma. The block was then uplifted to upper-crustal levels by 1700 Ma before final exhumation along major terrain-bounding shear zones.

Re-suspension of lead-contaminated soils a major health burden in cities

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Introduction

Soils in older areas of cities are highly contaminated by lead, due largely to past use of lead additives in gasoline, the use of lead in exterior paints, and industrial lead sources. Soils are not passive repositories and periodic re-suspension of fine lead contaminated soil dust particulates (or aerosols) may create seasonal variations of lead exposure for urban dwellers.

Results and Discussion

Atmospheric soil and lead aerosol data from the Interagency Monitoring of Protected Visual Environments (IMPROVE) database were obtained for Pittsburgh, Detroit, Chicago, and Birmingham (Alabama), USA [1]. The temporal variations of atmospheric soil and lead aerosols in these four US cities were examined to determine whether re-suspended lead contaminated urban soil was the dominant source of atmospheric lead. Soil and lead-in-air concentrations were examined to ascertain whether lead aerosols follow seasonal patterns with highest concentrations during the summer and/or autumn. Atmospheric soil and lead aerosol concentrations on weekends and Federal holidays were compared to weekdays to evaluate the possibility that automotive turbulence results in re-suspension of lead contaminated urban soil. The results show that the natural logs of atmospheric soil and lead aerosols were associated in Pittsburgh from April 2004 to July 2005 (R^2=0.31, $p < 0.01$), Detroit from November 2003 to July 2005 (R^2=0.49, $p < 0.01$), Chicago from November 2003 to August 2005 (R^2=0.32, $p < 0.01$), and Birmingham from May 2004 to December 2006 (R^2=0.47, $p < 0.01$). Atmospheric soil and lead aerosols followed seasonal patterns with highest concentrations during the summer and/or autumn. Atmospheric soil and lead aerosols are 3.15 and 3.12 times higher, respectively, during weekdays than weekends and Federal Government holidays, suggesting that automotive traffic turbulence plays a significant role in re-suspension of contaminated roadside soils and dusts.

Conclusions and Recommendations

To decrease urban atmospheric Pb concentrations, subsequent Pb-rich dust deposition and penetration into homes, and its consequent deleterious effect in childhood Pb levels, it is necessary to remediate and or isolate urban soils contaminated with Pb. While the US Federal Government has enacted legislation covering clean air and clean water, there is no universal clean soil act, although there are several standards pertaining to acceptable values. These guidelines are inconsistent across the US and in light of the evidence, they need to be harmonized and re-evaluated so as to develop a unified strategy to mitigate an unnecessary and preventable exposure pathway.

[1] Laidlaw, Zahran, Mielke, Taylor & Filippelli, 2012. *Atmospheric Environment* **49**, 302-310.