Isotopic evidence for Cretaceous- Paleocene upwelling from archaic crust in Snowbird-type deposits.

Rosenberg, Philip E., (rosenberg@wsu.edu) and Wilkie, Kurtis M., School of the Environment, Washington State University, Pullman, WA, 99164-2812

Introduction
Snowbird deposits are a series of small hydrothermal, quartz-carbonate veins that intrude Belt metasediments on a strike line extending NW-SE from the Coeur d’Alene Mining District along the Idaho-Montana border toward the Idaho Batholith (Fig. 1). Early carbonates and quartz are Mesoproterozoic (Ramos and Rosenberg, 2012). Purple(P) and green(G) fluorite occur in Snowbird-type deposits (Rosenberg and Wilkie, 2015). Masses of similar fluorite have also been reported in the Bitterroot lobe of the Idaho Batholith (Foord et al., 1993) at Crystal Mountain (Fig. 1).

Age and Origin
U-bearing xenotimes in calcite closely associated with fluorite at Wilson Gulch and the Swallow deposit (Fig. 1) yield concordia ages of late Cretaceous to early Paleocene (Figs. 2 and 3). Pb 207/204 - 206/204 ratios in closely associated, xenotime-free fluorites lie along a straight line (Fig 4) which corresponds to an age of 1341 ± 75 Ma (MSWD = 492). Pb-207/Pb-206 ratios in fluorite from the Idaho Batholith (Table 1, DB-F(G) also lie on this line which is thought to represent upwelling of fluids from underlying Archean to Paleoproterozoic crust. Proterozoic upwelling (1523 ± 41 Ma; Ramos and Rosenberg, 2012) was apparently renewed in late Cretaceous to early Paleocene times. U was scavenged by xenotime during crystallization from these fluids, thus setting the xenotime clock while leaving associated fluorites essentially U-free (Table 2). Xenotime is absent at DB-F(G) and, therefore, U is higher in this fluorite sample (Table 2).

For example, purple fluorite from Wilson Gulch north of the Snowbird deposit (Fig. 1) with a xenotime concordia age of ≈ 72 Ma (Fig. 2) has 206/204 - 207/204 ratios of 34.280 and 16.969 respectively (Table 1). U-bearing xenotime in calcite associated with purple fluorite at Wilson Gulch deposit. Age 72 Ma ± 27 (MSWD = 13). Data-point error ellipses are 2σ.

The concordia age of purple fluorite from the Snowbird deposit is 72 ± 1 Ma (Fig. 5). Initial 87Sr/86Sr ratios of fluorites are ≥0.80 (Table 2) suggesting relatively recent emplacement from an archaic source. Early Cretaceous jasperoid veins have also been reported at the Sunshine Mine in the Coeur d’Alene District (Fig. 1) which may represent an earlier periods of Cretaceous remobilization (Zartman and Smith, 2009).

Conclusions
Mesoproterozoic upwelling of fluids from underlying Archean-Paleoproterozoic crust in the Pacific NW has been discussed recently by Ramos and Rosenberg (2012). The present study documents renewed upwelling in late Cretaceous to early Paleocene times, contemporaneous with faulting on the Lewis-Clark Line (Wallace et al., 1990) and intrusion of the Bitterroot lobe of the Idaho Batholith (Foster and Fanning, 1997; Fig. 1).

References

Acknowledgements
We thank Charles Knaack and Chris Fisher of the GeoAnalytical Lab Washington State University for technical assistance.
We thank Frank C. Ramos, New Mexico State University for providing the Pb isotope data.
Note: Sample numbers refer to map in Metz et al. (1971) Econ. Geol., 80, 394-409.