GEOCHRONOLOGY OF GOLD-SILVER EPITHERMAL MINERALISATION ON WAR EAGLE MOUNTAIN AND CONTIGUOUS MINES IN THE SILVER CITY DISTRICT, IDAHO

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Abstract

Regional studies of the tectomagmatic and spatial-temporal relationship of epithermal gold-silver deposits in the Northern Great Basin (NGB) point to a coeval genetic relationship with regional Mid-Miocene bimodal basalt-rhyolite magmatism. This mineralization episode(s) has been linked to less evolved magmas associated with the initial emergence of the Yellowstone Hotspot (YHS). Our present study strives to compliment previous geochronological work conducted on deposits of War Eagle Mountain (WEM) and contiguous mines in the Silver City District. Previous work comprises K/Ar age dates (Panze, 1975; Halsor 1988); Halsor's age dates on adularia from Florida Mountain and WEM yielded ages ranging from ca. 15.2 to 16.6 Ma. Unger (2007) provided ten $^{40}Ar/^{39}Ar$ age spectrum ages from two locations on the Oro Fino vein on WEM. Unger's age dates produced a preferred age of 16.31 ± 0.04 Ma for one sample; whereas the second produced a preferred age of 15.61 ± 0.10 Ma. Variations in these ages may reflect either diverse timings of vein emplacement and/or continued secondary hydrothermal mineralization events. To test these earlier results, samples of rhyolite whole rock and adularia were collected from the Black Jack mine (~3 km west of the Orofino vein). Single crystal fusion of sanidine from the rhyolite yielded total-fusion ages varying from 16.1 to 15.5 Ma. Similar plateau ages were obtained by incremental heating of single crystals. Coarse adularia sampled from a vein yields similar ages to the host rhyolite, whereas a second adularia sample yields ages of 15.5 Ma. Collectively, the apparent age variation among these feldspars is interpreted to reflect differential retention of radiogenic argon among disparate sanidine crystals (likely as a function of grain size, lattice structure, and/or defect density) that experienced hydrothermal conditions beginning by at least 16.1 Ma and continuing until 15.5 Ma. These new results marry with earlier ranges in age established for WEM and the Silver City District, and suggest mineralization and magmatic activity coeval with the early volcanism of the YHS. The current study uses a broader based sample array, with a focus of constraining the timing of vein formation by examining different deposit and ores, as well as the host volcanic package of this important gold-producing district

Epithermal Deposits Re-visited

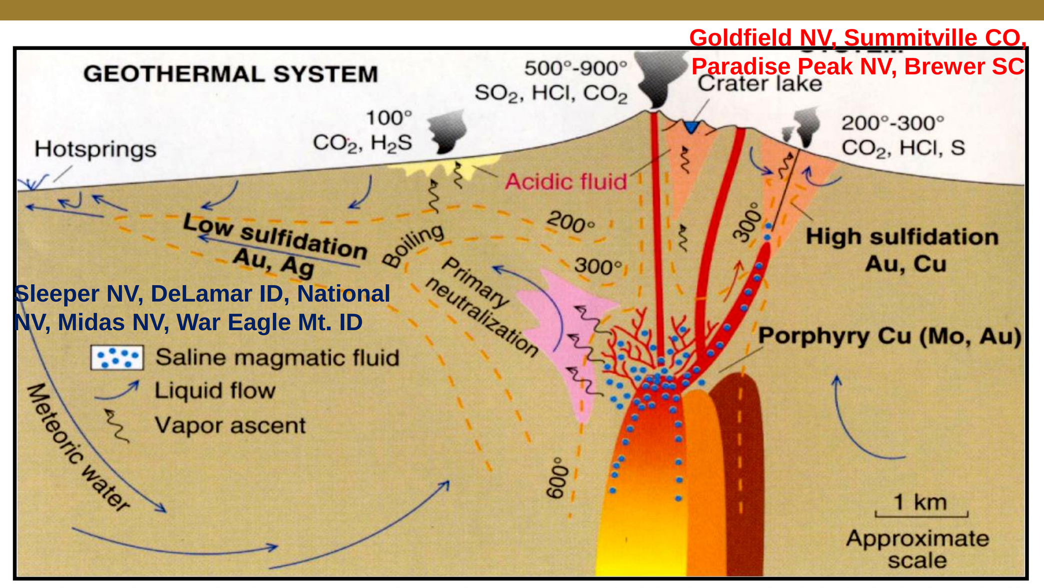


Fig 1: Epithermal deposits have two end members i.e Low Sulfidaion and High Sulfidation. (Sillitoe and Hedenquist, 2003).

-**Low sulfidation deposits** (Fig 1) are usually formed from circum-neutral pH solutions at distal locations from the magmatic source and are typically related to extensional regimes.

-Conversely, **high sulfidation deposits** are typically proximal to their magmatic source. (Sillitoe and Hedenquist, 2003).

Study Objective

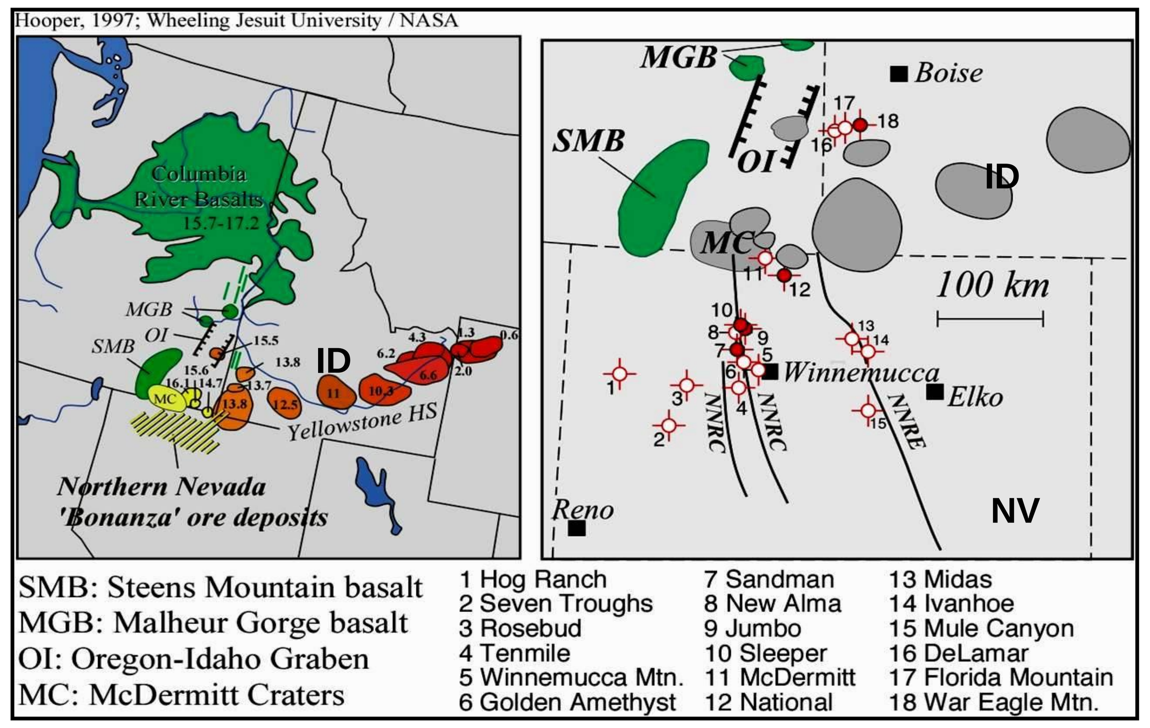


Fig 2: Left shows the Yellowstone hotspot track with Ages in millions of years. Right shows the study area marked(18) in relation to other Epithermal deposits in the vicinity.

1.Ascertain a genetic link between the Au-Ag epithermal mineralization to nascent Yellowstone Hotspot. (Fig 2 Left)

2. Attempt to draw a spatial-temporal association to primitive magmatic source rocks as well as other low-sulfidation systems in the region. i.e SMB,MGB and Columbia River Basalts. (Fig 2 Left and Right).

NB. Only two $^{40}Ar/^{39}Ar$ age dates (Unger, 2008) exist, that attempt to constrain geological and temporal controls on the mineralization in the district

3. Use the new geological and spatial-temporal data to guide future mineral exploration targeting in the western USA and beyond.

Why Silver City District?

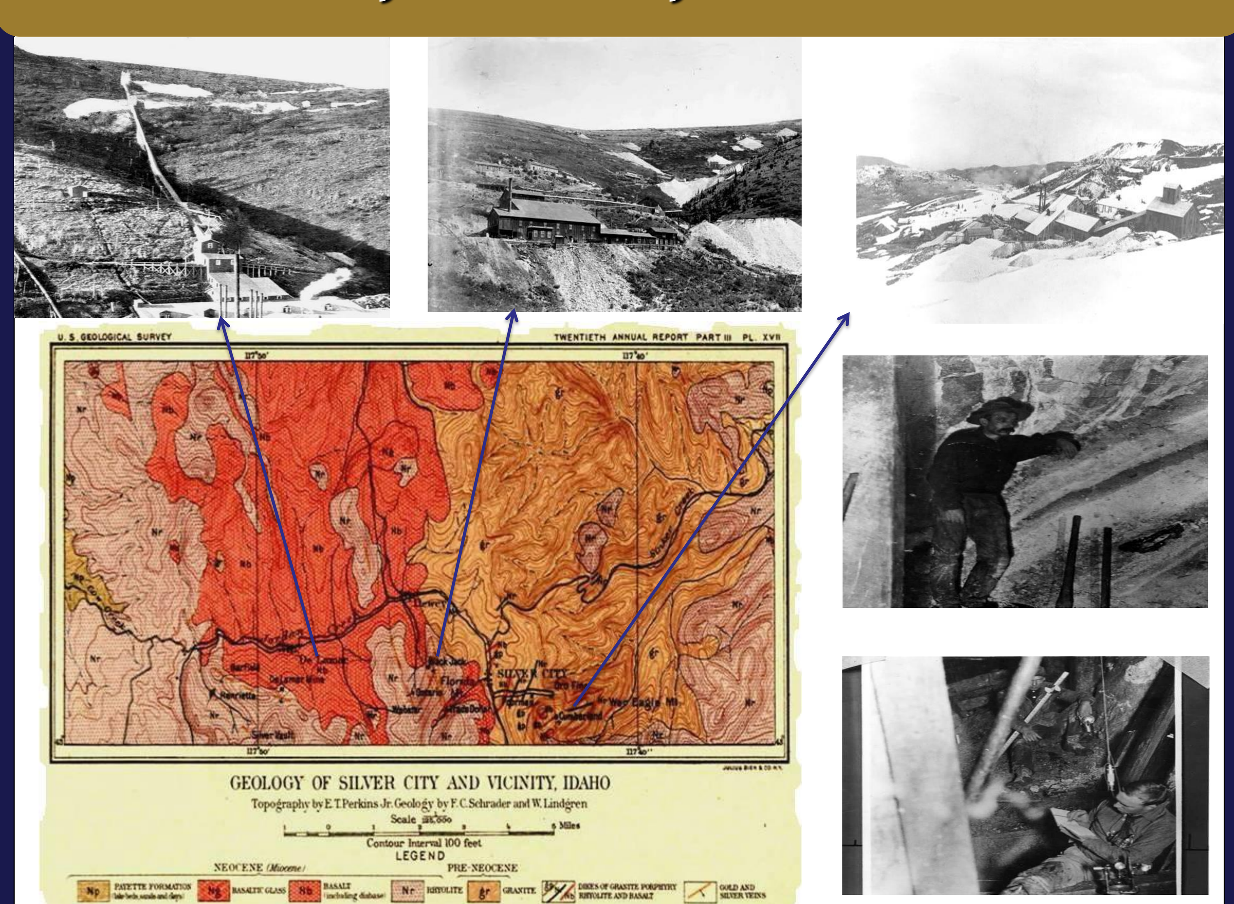


Fig 3: Clockwise from top left: De Lamar Mine and Mill, Black Jack Mine and Mill, Cumberland Mill (late 1800 to early 1900s). Right Center De Lamar vein. Right bottom. De Lamar surveyors at work (1910) Credits:Idaho Historical Society. Bottom Left: Geology of Silver City and Vicinity, Idaho, after Lindgren.

-Though Silver City is an important historic mining district, having fuelled Lindgren's initial concepts on epithermal deposits, there is a dearth of modern **geochronological** and geochemistry data.

Method & Preliminary Results

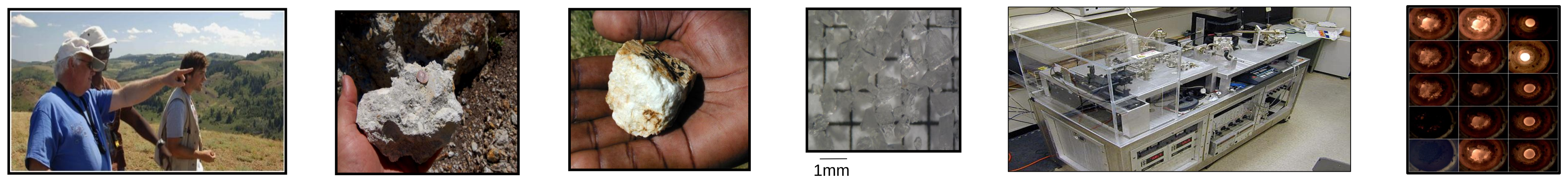
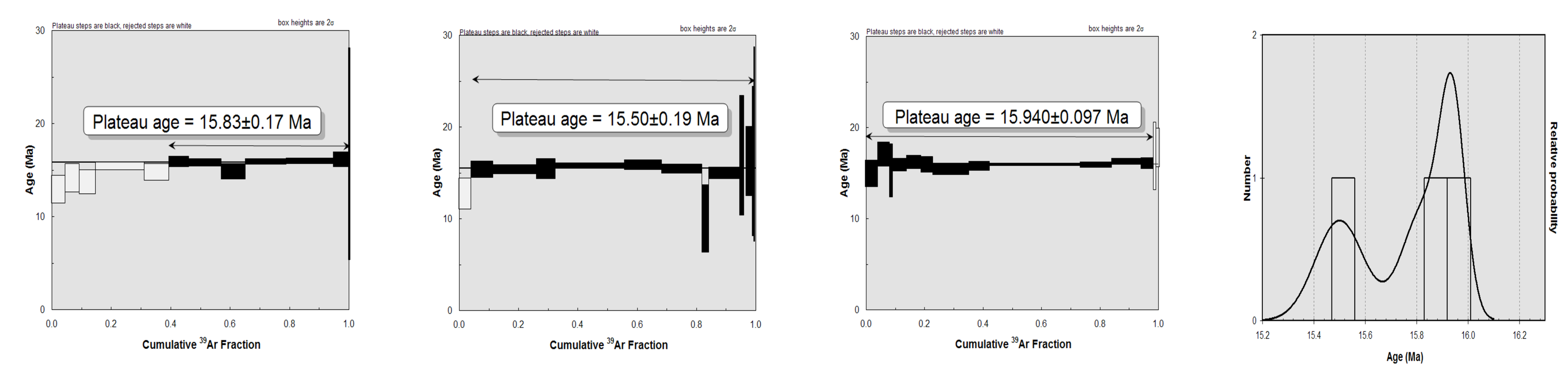


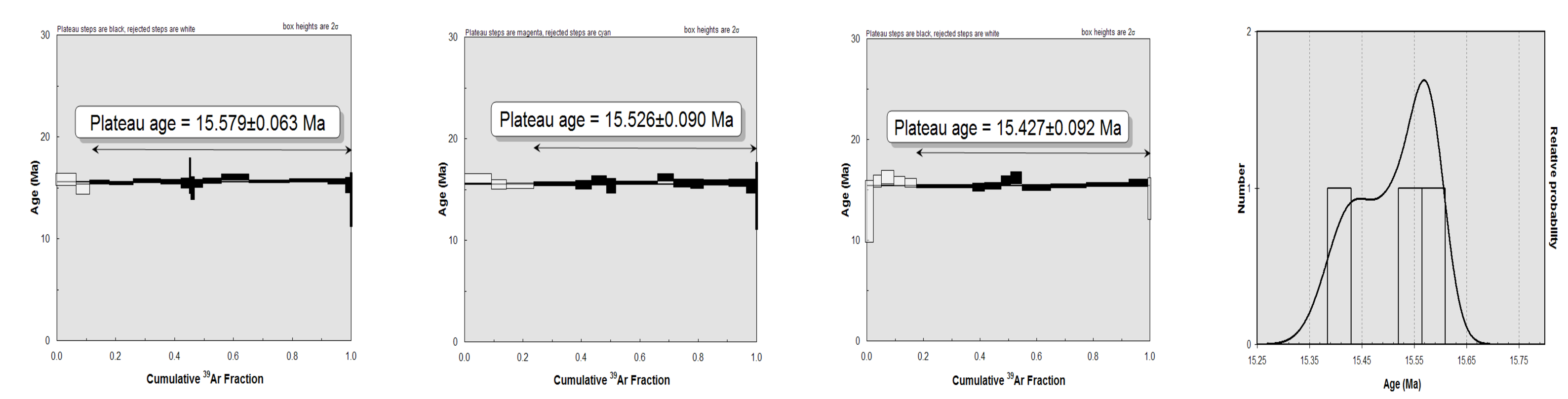
Fig 4: Left to Right: Dr. James Saunders, Collins Aseto, and Alex Steiner in the Silver City district, Summer 2010. Second from left, rhyolite Sample MB08. Third from left adularia in quartz vein from the Black Jack mine. Fourth from left ,Irradiated adularia. Fifth from left, the "ANIMAL" Facility. Laser Incremental heating of adularia in the ANIMAL facility

Laser Incremental Heating Analysis

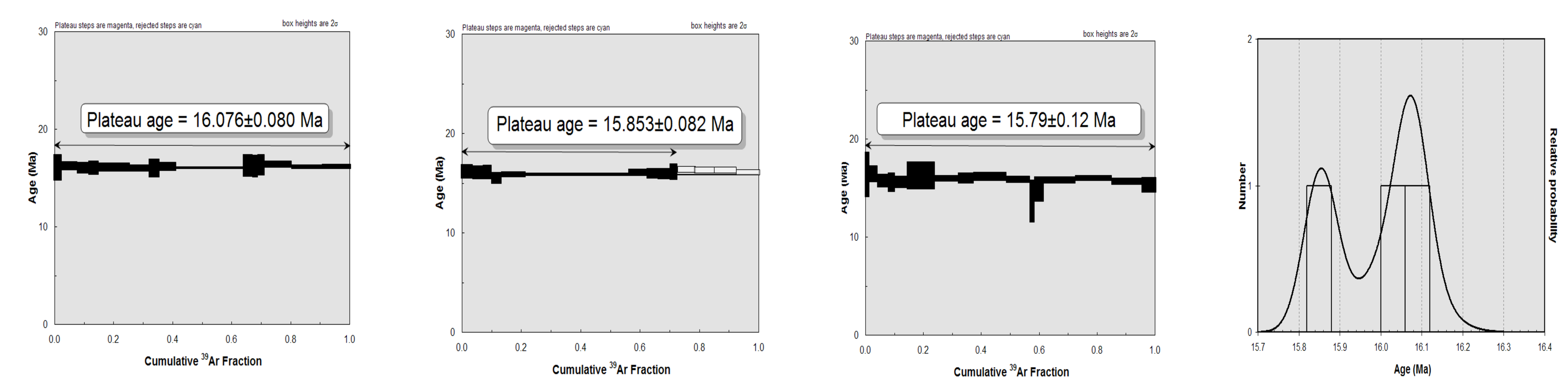
Sample # MB07; Rhyolite from Black Jack Mine, Silver City District



Sample # NV-08-09; Adularia Black Jack Mine, Silver City District

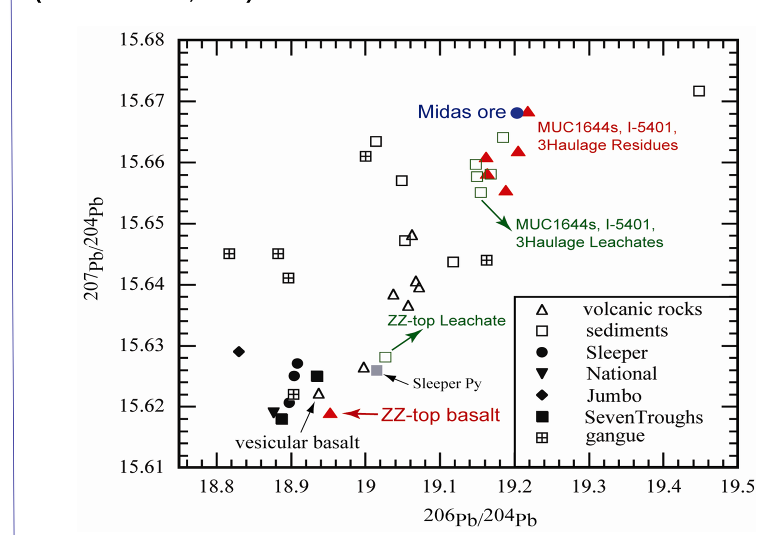


Sample # NV-09-09; Adularia Black Jack Mine, Silver City District

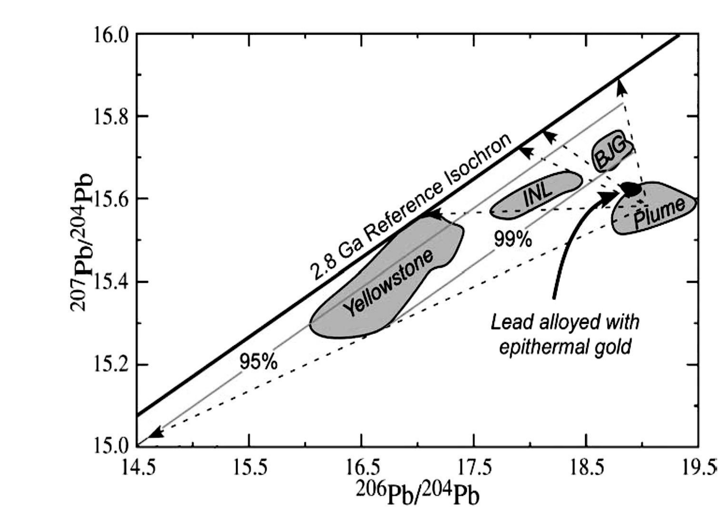


Pb alloyed with Au is more primitive (Mantle like) In western deposits:

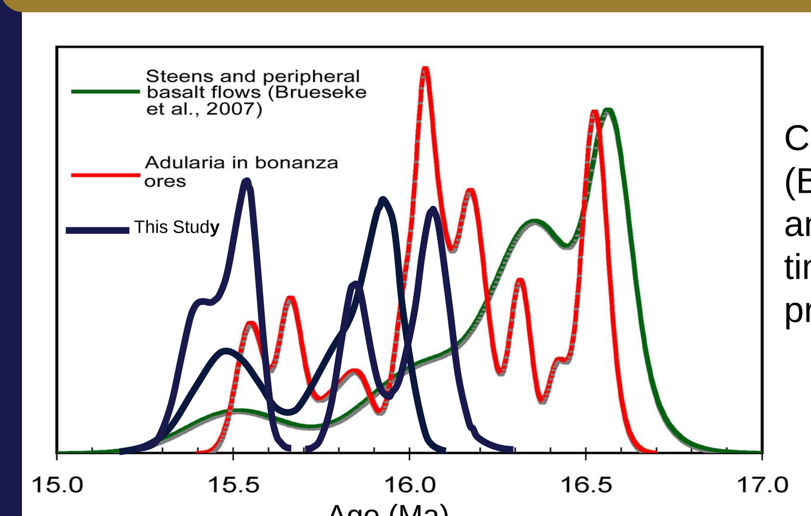
Isotopic Data for Volcanic, Sedimentary, Gangue, and Gold samples from the Northern Great Basin (NGB) (Kamenov et al., 2007)



Isotopic Ratios of Pb Alloyed With NGB Epithermal Au, Compared With Pb Isotopic Compositions of Time and Distance –Transgressive Basalts of the Migrating Yellowstone Hotspot (Kamenov et al., 2007)



Comparison of Volcanism & Mineralization



Comparison of volcanism (Bruseke et al., 2007) and mineralization timings from this and previous studies.

Conclusions

-Preliminary mineralization and extrusive volcanic ages complement the Age of the nascent Yellowstone Hotspot (16.5 Ma).

-Preliminary results indicate that a mineralization and tecto-magmatic nexus (16.5-15.5 Ma) has been realized

Selected Refs and Acknowledgments:

Bruseke, M.E., Heizler, M.T., Hart, W.K., Mertzman, S.K., 2007, Distribution of Oregon Plateau (U.S.A.) flood basalt volcanism: The steens basalts revisited: Journal of Volcanology and Geothermal Research, v. 161, p 187-214.

Kamenov, G.D., Saunders, J.A, Hames, W.E., and Unger, D.L., 2007, Mafic magmas as sources for gold in middle Miocene epithermal deposits of the northern Great Basin, United States: Evidence from Pb-isotope compositions of native gold: Economic Geology, v. 102, p.1191-1195.

Hames, W., Unger., D., Saunders, J., Kamenov, G., 2009, Early Yellowstone hotspot magmatism and gold metallogeny: Journal of Volcanology and Geothermal Research 188, p. 214 – 224.

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