Laser $^{40}Ar/^{39}Ar$ dating of supervolcanoes and super gold deposits along the trace of the Miocene Yellowstone Hotspot

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Early volcanism of the Yellowstone hotspot began at ca. 16.5 Ma and produced abundant and extensive bimodal volcanics in northern Nevada and adjacent portions of Idaho and Utah along with some of earth's richest gold deposits. Within eruptive centers studied, volcanism tended to occur over a ~1.5 Ma interval. Tholeiitic flood basalts in this region, that are typical of the earliest Columbia River Large Igneous Province (LIP) lavas, are typically the earliest volcanics, though they were extruded in multiple events that overlap rhyolitic magmatism. Although coarse plagioclase phenocrysts are conspicuously abundant in these basalts, they tend to be low in potassium content and have high amounts of inherited, extraneous argon, such that the most robust age dating results are for laser incremental heating of the basalt's phenocryst-free, subophitic matrix. Single crystal laser fusion ages of sanidine from the rhyolites are very precise, with some samples that yield a distribution of ages with a single mode that is consistent with analytical uncertainty. However, sanidine from rhyolites in some eruptive centers yield more complex distributions of ages that are less than ~16.5 Ma, but that range beyond analytical uncertainty and comprise multiple age modes. Single crystal incremental heating analysis of sanidines from these more complex samples tend to result in release spectra with plateau and indicate the samples are not affected by extraneous, non-atmospheric argon. We interpret that the duration of magmatism and high geothermal gradients locally promoted isotopic closure at different times, in sanidine crystals of differing size and effective diffusion dimension. Adularia is associated with gold in many of the epithermal Au-Ag deposits and ores, and is commonly of sufficient grainsize to permit single crystal dating. $^{40}Ar/^{39}Ar$ fusion and plateau ages for adularia from many deposits in northern Nevada produce age distributions that are the same as the bimodal volcanics, however adularia from the Silver City district (southern Idaho) and associated Au-Ag deposits formed in one brief episode ~ 1 Ma after the earliest 16.5 Ma volcanics. In contrast with earlier models that invoke shallow crustal sources, the gold in these deposits is interpreted to have originated from a deep lithospheric or mantle source, and to have been transported by fluids to the epithermal systems as colloids.

Sensitivity boost for ICP-MS to enhance isotope ratio determinations

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ICP-MS is a powerful technique for the determination of trace elements in various matrices. Beyond that ICP-MS is able to determine isotope ratios with high accuracy and precision. In principle three intrumental ICP-MS solutions exist: Quadrupole based ICP-MS, single collector magnetic sector field ICP-MS and multicollector magnetic sector field ICP-MS. General assumption is that precision and accuracy for isotope ratio measurements increases with complexity of technology used. The work will describe the achievements in isotope ratio analysis by a new quadrupole based ICP-MS (Bruker aurora Elite). Key characteristic is a very high ion transmission achieved by an optimized interface, and a unique ion optical system with low chromatic and spherical aberrations, which focuses ions into one focal point. In result sensitivites of up to 4 Mio cps / ppb can be obtained, which exceeds sensitivities of magnetic sector field ICP-MS significantly. The high sensitivity attainable allows utilization of the fast scanspeed and short integration times (0.1 msec) without the limitation due to counting statistic.

The presentation will discuss all relevant instrumental characteristics, such as:

- Abundance sensitivity
- Scan speed
- Ion detection system
- Plasma robustness

which are important to obtain highest isotope ratio precision and accuracy.

Finally results accomplished for e.g. lead and uranium isotope ratios and lead / uranium ratios will be shown.

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