U-Pb laser ablation dating of skarn garnet: A case-study of Jurassic skarns from the Sierra Nevada, California, USA

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A case-study of the Black Rock Mine skarn (BRMS; Jurassic portion of the Sierra Nevada volcanic arc, eastern California) demonstrates the utility and effectivness of a new LA-ICP-MS based U-Pb geochronologic method for grossular-andradite skarn garnets [1]. Skarn grossular-andradite garnets are commonly rich in U (1 to 100 ppm); micron-scale common-Pb heterogeneities permit construction of robust discordia lines on a Tera-Wasserberg diagram. Directly dating skarn garnet provides a formation age independent of an assumed causative pluton crystallization age, and is important because skarns are hypothesized to form quickly despite pluton emplacment taking several million years. Although others have dated skarn accessory minerals (e.g., molyebdinite, titanite, vesuvanite, allanite), garnet U-Pb dates are especially powerful because garnet resists alteration, and its growth is early and nearly ubiquitous in most skarns.

The BRMS, is located in the Benton Range on the eastern flank of the Sierra Nevada batholith. Regional intrusions of multiple plutons have been shown to range from ~220 to ~150 Ma. Ambiguous surficial field relations complicate accurate determination of a causative pluton. A robust skarn garnet U-Pb age of 172.0 ± 2.8 Ma, based on 6 garnets and 180 analytical spots, confirms the middle Jurassic formation age for the BRMS. Investigation of two potential causative plutons yield zircon U-Pb ages of 168 ±3 Ma, and 221 ±6 Ma. Although the former plutonic zircon age confirms local magmatic activity at the time of skarn formation, assuming the later pluton age would result in an inaccurate skarn age.

U-Pb data were collected using the UTChron ThermoFisher Element II, single collector, magnetic sector ICP-MS fitted with a Photonmachines Analyte G2 193nm ArF excimer laser with a two-volume Helex cell. Additional successful grossular-andradite garnet U-Pb laser ablation dates have been obtained on two Jurassic skarns from the Mojave Desert, California, with future analyses planned for a number of Sierra Nevadan skarns.

[1] Seman, et al. *U-Pb geochronology of grossular-andradite garnet*; in prep.