Zircon record of alkaline magmatism associated with the Mountain Pass carbonatite REE deposit, southeast Mojave Desert, California, USA

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Mountain Pass is one of the largest and most economically important REE deposits in the world. The ore body is a carbonatite stock within a shonkinite and syenite plutonic complex, which is part of a ~130 km long trend of Mesoproterozoic alkaline igneous rocks in the southeast Mojave Desert [1]. Zircons from a suite of shonkinite and syenite rocks at Mountain Pass were analyzed by SHRIMP-RG ($^{207}Pb/^{206}Pb$ ages and trace elements) and SIMS (O isotopes) to elucidate their petrogenesis and potential relationship to ore-forming carbonatite. Concordant $^{207}Pb/^{206}Pb$ dates define multimodal distributions from ~1370-1435 Ma and ~1530-1780 Ma. The youngest $^{207}Pb/^{206}Pb$ dates of ~1370-1380 Ma and ~1390-1400 Ma overlap published Th-Pb monazite ages of 1371 ± 10 Ma and 1396 ± 16 Ma for the carbonatite ore body and a smaller carbonatite dike at Mountain Pass [2]. The youngest (<1435 Ma) zircons, interpreted to be magmatic (autocrystic), have REE up to ~10,000x chondrite values, subtle (~0.8) Eu/Eu* anomalies, generally low U (<500 ppm), moderate Hf (<11,000 ppm), and Ti-in-zircon temperatures that cluster at ~800 °C. Paleoproterozoic zircon xenocrysts have larger Eu/Eu* anomalies (~0.1-0.5) and extend to higher Hf contents (>11,000 ppm). Zircon $\delta^{18}O$ values in the <1435 Ma grains span from mantle (~5‰) to supracrustal (~7‰), and are mostly in the higher supracrustal end of the range. Paleoproterozoic zircons overlap this range as well as extend to higher $\delta^{18}O$ values (~9‰). Our new data support coeval and long-lived (20 Myr+) alkaline and carbonatite magmatism and underscore the relative importance of the crust in generating magmas associated with the world-class Mountain Pass REE deposit.

[1] Castor (2008) *Can. Min.* **46**, 779-806. [2] Poletti *et al.* (2016) *J. Petrol.* **57**, 1555-1598.