

# Ultrapotassic mafic Dikes and Rare Earth Element- and Barium-Rich Carbonatite at Mountain Pass, Mojave Desert, Southern California: Summary and Field Trip Localities

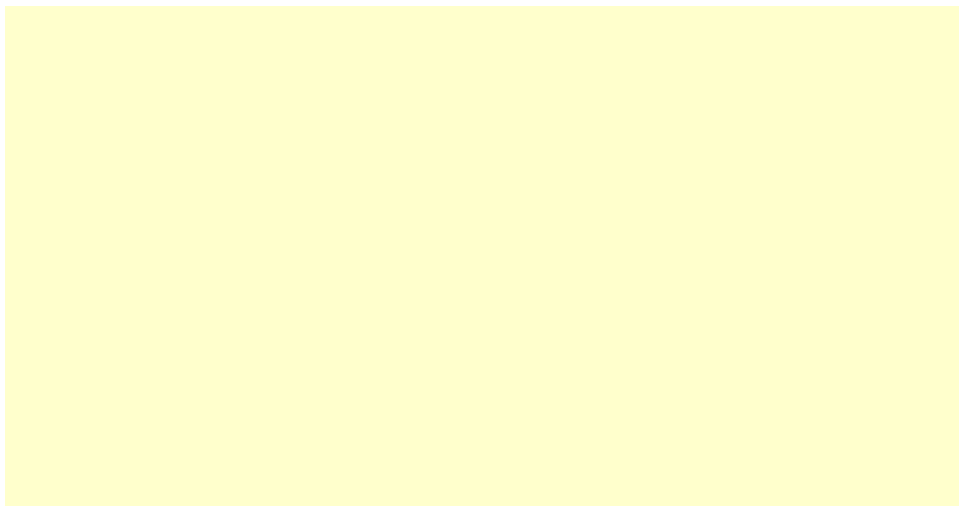
By Gordon B. Haxel

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cartoon of atomic structure



*Schematic representation of the probability density function for one of the f orbitals. Progressive filling of the 4f orbitals characterizes the fifteen lanthanide (rare earth) elements, lanthanum through lutetium.*



Mountain Pass, California is famous for its world-class rare earth element deposit, hosted by a compositionally unique carbonatite stock. This carbonatite contains extraordinary large concentrations of the lighter rare earth elements (La - Gd) and Ba, and is one of the most compositionally extreme, even bizarre, igneous rocks known on Earth. Mountain Pass also features a remarkable suite of silicate alkaline igneous rocks, distinguished by their ultrapotassic character and exceptionally high abundances of rare earth elements, F, Th, and large-ion-lithophile elements (K, Ba, Rb, Cs). Of particular interest are certain phlogopite shonkinite (melanosyenite) dikes that evidently represent the primary, parental silicate magmas at Mountain Pass.

I prepared this informal article to provide petrologic and geochemical background for a field trip to the Mountain Pass district by the Arizona Geological Society in October 2004. The highlight of this trip was a tour of the Mountain Pass rare earth element mine, including the open pit and processing facilities, lead by Geoff Nason and Ed McNew of Molycorp, the company that owns and operates the mine. Following the mine tour, we visited two other geologic features: a carbonatite dike at Birthday, the discovery locality for the district; and synplutonic shonkinite dikes within a shonkinite-syenite stock. We concluded the field trip by driving up a nearby hill for an overview of the Mountain Pass district. The synplutonic-dike and overview localities, and a couple of others nearby, are described in the Appendix.

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Also of interest: [USGS Fact Sheet 087-02](#). "Rare Earth Elements—Critical Resources for High Technology"

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