

Cenozoic Alkali-rich Alteration in the Basin and Range: Contrasting Styles, Origins and Metallogenic Implications

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Recent field and synthesis studies show that distinctive styles of Cenozoic Na-K(-Ca) metasomatism are widespread in the Basin and Range province of the southwestern USA where they can be linked to several types of mineral systems (IOCG, Au) and related brine sources (marine, playa, connate; rarely magmatic). Alteration includes K-feldspar or sodic plagioclase (rarely scapolite or Ca phases such as epidote) replacing preexisting alkali feldspars and plagioclase, and chlorite/amphibole/pyroxene (locally peralkaline) replacing mafic minerals. Transition metals are commonly (but not always) removed. Stratabound K-rich and variably discordant Na($\pm$ Ca) alteration are affiliated with detachment-type IOCG systems of the southern Basin and Range. Discordant intrusion-centered Na($\pm$ Ca) alteration with lesser K-rich alteration links to IOCG systems (e.g., Iron Springs, UT) and some gold-systems (e.g., Battle Mtn, NV). Locally peralkaline Na alteration can be related to non-magmatic fluids (e.g., Lake Mead, AZ-NV) whereas in other cases (e.g., La Sal Mtns, UT) the source is ambiguous – either magmatic or redissolved evaporites.

Although a saline fluid (brine) is shared by all (as evidenced by fluid inclusions, mass balance, etc.), the differences reflect fluid types, sources and paths. Cl-dominated fluids, the most common, derive from local connate, contemporaneous evaporitic or redissolved evaporite sources; infiltration of contemporaneous brines generates low-T stratabound K-alteration; upwelling/cooling precipitates sulfide-poor metal suites. Rare sodic amphibole or pyroxene requires unusual (alkali carbonate/sulfate-bearing) fluid compositions which could reflect either peralkaline evaporitic components (e.g., Mono Lake or Green River Fm), a magmatic source or, conceptually, path-dependent mineral reactions such as dissolution of iron oxides in the absence of another mineral buffer. Weakly alkaline fluids should favor for gold-only mobility and should be considered in areas such as NE Nevada where favorable conditions and sources coincide.