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Record of magma chamber processes preserved in accessory mineral assemblages, Aztec Wash pluton, Nevada

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ABSTRACT

Field relations and geochemistry indicate that Aztec Wash pluton had a complex, open-system history. The tilted pluton represents a 2.5 km thick chamber that was recharged with both felsic and mafic magma. The lower portion is highly heterogeneous, with mafic sheets; cumulates; hybrid rocks; mafic, felsic, and composite dikes; and sheets and pods of granite (heterogeneous [H] zone). The upper part is granite that is generally homogeneous in texture and geochemistry (granite [G] zone). At the base of the G zone, a discontinuous zone (buffer [B] zone) records interaction between the G and H zones. Complexity of the H zone makes detailed reconstruction of magma chamber history difficult, and the relatively homogeneous G zone appears to offer few clues about the evolution of the pluton or the interaction between the felsic and underlying more mafic magmas. Accessory mineral textures, zoning, and assemblages in the G zone, however, are far from homogeneous and provide clear evidence for fluctuating conditions that elucidates magma chamber history.

Mafic rocks of the H zone contain the accessory mineral assemblage ilmenite + magnetite + quench apatite ± late sphene and zircon. G zone rocks have magnetite + apatite + sphene + zircon ± allanite, ilmenite, and chevkinite. The magnetite + allanite + early sphene, apatite, and zircon association that characterizes much of the G zone indicates a lower temperature and possibly higher f_{O_2} than the H zone assemblage. Mineral textures and zoning, however, document fluctuations in the stable G zone assemblage: (1) as many as five rounded surfaces truncate internal zones in zircon, each indicating a dissolution event; (2) in addition to euhedral concentric zoning, sphene contains regions of highly irregular zoning that are rich in inclusions, especially anhedral ilmenite; (3) ilmenite and allanite are mutually exclusive, but allanite is present in the matrix of rocks that contain sphene with ilmenite inclusions, and sphene grains in some samples have alternating regions with allanite and ilmenite inclusions.

We attribute fluctuations in the stable G zone accessory assemblage to fluctuations in temperature and possibly f_{O_2}, with appearance of the high-*T*, reduced assemblage indicating interaction with hot, mafic, H zone magma. These interactions certainly involve heat transfer and may involve limited chemical contamination. We infer that they must have taken place near the H zone-G zone boundary. The most frequent and intense fluctuations (marked by zircon with the highest number of truncation surfaces, and by sphene with irregular zoning and abundant ilmenite inclusions) affected rocks that are near the boundary, but ilmenite inclusions in sphene and truncation surfaces in zircon are present to the top of the pluton. We conclude that granitic magma was subjected to multiple cycles of thermally induced vertical transfer—convection—that, at least initially, affected the entire upper part of the chamber.