THE CHEMICAL AND MINERALOGICAL RESPONSE OF ALLANITE TO HYDROTHERMAL ALTERATION, CASTO GRANITE, IDAHO

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The response of allanite, a REE- and Th-bearing silicate mineral, to hydrothermal activity in the Eocene Casto granite of central Idaho has been investigated using optical microscopy, quantitative electron microprobe analysis, and scanning electron microscopy (backscattered-electron imaging, x-ray elemental mapping, and qualitative energy dispersive analysis). This work has been carried out as an analogue approach to predicting the response of deeply buried nuclear waste to interaction with heated groundwater. Evidence of hydrothermal alteration of the samples examined in this study includes sericitization of feldspar, chloritization of biotite, corrosion and replacement of allanite, and the presence of fluorite veins. Slightly altered allanite crystals exhibit rims in which Th is enriched and La and Ce are depleted. Increasing degrees of alteration lead to extensive corrosion and replacement of allanite by fluorite, a REE-, Th- and P-rich phase, probably monazite or rhabdophane, and a Th-rich phase, probably thorianite. In spite of attack by fluoride-rich hydrothermal solutions, which should be capable of transporting Th and REE as fluoride complexes, much of the original content of these elements in allanite was not transported significant distances, but redeposited locally as secondary phases. The lack of significant REE and Th transport may be attributed to the ready availability of phosphorus, which allowed the REE and Th to be fixed in a secondary phosphate phase, and the removal of fluoride from the hydrothermal fluid by reaction of Ca in the allanite and other minerals with the fluoride in the fluid to form fluorite.