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LETTER

Interface coupled dissolution-reprecipitation in garnet from subducted granulites and ultrahigh-pressure rocks revealed by phosphorous, sodium, and titanium zonation

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ABSTRACT

Garnet zonation provides an unparalleled record of the pressure-temperature-time-fluid evolution of metamorphic rocks. At extreme temperature conditions >900 °C, however, most elements preserve little zonation due to intracrystalline diffusional relaxation. Under these conditions, slowly diffusing trace elements including P, Na, and Ti have the best chance of recording metamorphic histories. Here we map dramatic zoning patterns of these elements in subducted high-pressure felsic granulite (Saxon Granulite Massif) and ultrahigh-pressure diamondiferous "saidenbachite" (Saxonian Erzgebirge, Bohemian Massif). The results show that garnet replacement via interface coupled dissolution-reprecipitation can strongly affect garnet compositions in subduction zones and that P, Na, and Ti record burial and exhumation histories that are otherwise lost to diffusion. In these samples, P diffuses the slowest, and Ti the fastest.

Keywords: Metamorphic petrology, garnet, trace elements and REE, diffusion, major and minor elements, kinetics