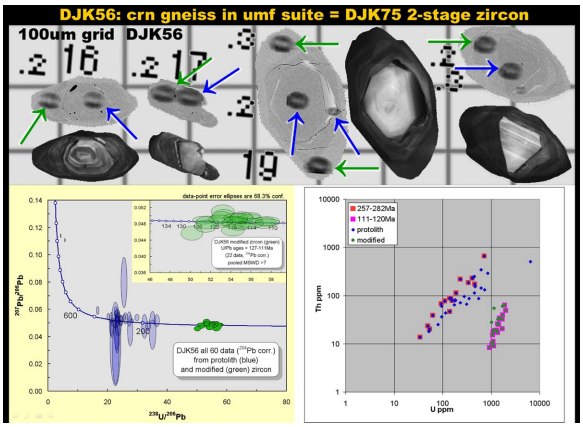
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Are sapphirine granulites metasediments or metasomatites? A zirconologist's admittedly slanted view

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Gneisses, migmatites and granulites that contain the aluminous mineral sapphirine are in themselves almost invariably peraluminous, as as such, are generally regarded as deriving from metapelitic sediments. However, there are other ways to produce aluminous assemblages. Sapphirine in high-grade rocks associated with anorthosites (Sittampundi, India; Fiskenæsset, Greenland) and mantle derived rocks (Finero, Italy) are likely to be the products of metasomatism, either in magmatic [1] or metamorphic stages. HIgh-T mineral associations indicating excess Al (corundum, sapphirine, spinel) with highly magnesian varieties (enstatite, phlogopite, diopside) are found in association with halogen-rich contact metamorphism [2] and as granulite-grade enclaves in high-T plutons [3], but also with metamorphised ultramafics that indicate petrogenesis through metasomatism. In the Higo Complex of Japan, corundum and sapphirine bearing gneiss hosted by tremolite-actinolite-rich ultramafics and contain zircon with ca. 260Ma cores that are magmatic, with hydrothermal metasomatism having occurred either in gabbroic protoliths during emplacement or subsequent incorporation in a high-T complex in the Cretaceous [4]. In the late Neoproterozoic Lützow-Holm Complex of east Antarctica [5], granitic veins intruding dolomitic units were desilicated and dismembered during granulite-grade metamorphism on the edge of the Cambrian, as recorded by coupled dissolution-reprecipitation textures in magmatic zircon and neoblastic growth interstitial to phlogopite in metasomatic rinds. The diversity of contexts for sapphirine-bearing and other aluminous minerals show that such rocks have much to say about fluids processes in the crust and mantle beyond the presumation of peltic sedimentary origins.

[1] Giovanardi (2020), Lithos 356-7, 105366.
[2] Palin et al. (2023), Lithos 440-1, 107024.
[3] Dunkley et al. (1999) Contrib. Min. Pet. 172, 1-23.
[4] Dunkley et al. (2007), *Gondwana Res.* 14, 624–643.
[5] Dunkley et al. (2020), *Polar Science* 26, 100606.