The ultrahigh temperature evolution of the Napier Complex as revealed by zircon geochemistry

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The multiple geochemical systems contained within zircon allow the complex geological histories in high-grade terranes to be unravelled. In the Napier Complex zircon U-Pb geochronology, REE and Ti geochemistry provides evidence of two metamorphic events. The first, at 2.8 Ga, is a low-pressure, UHT event with peak pressures below the stability of garnet. The second event also occurs under UHT conditions but is at higher pressure with garnet being stable.

T_{DM} Hf ages obtained from zircons from a number of metasedimentary rocks range up to 4.2 Ga, prividing evidence of some of the oldest crust. The bulk of the detritus in the samples have T_{DM} of between 3.4 and 3.8 Ga. The large vertical arrays in eHf space at 2.8 and 2.5 Ga are consistent with two potential scenarios. The vertical arrays are both related to juvenile/mantle inputs coincident with metamorphism, something that is not obvious in the field relationships and is often absent in UHT terrains in general. Thus the eHf is pointing us to the heat source – mantle magmatism. A second and possibly more intriguing interpretation of the dataset is that the vertical array in eHf in the 2.5 Ga zircon is representative of a mix between total resetting of juvenile 2.8 Ga zircons and the Hf compositions from the older crustal components. This has the potential to answer a couple of the outstanding questions in the Napier Complex and may well be consistent with the thermal evolution. The existence of juvenile 2.8 Ga grains in metasediments means that they have been deposited after the 2.8 Ga event. Therefore a cover sequence exists in the Napier Complex. This cover sequence has been incorporated into the orogen during the higher pressure 2.5 Ga event. The existence of a < 2.8 Ga sedimentary sequence would explain the "patchiness" in the previous recognition of the lower pressure 2.8 Ga UHT event in the terrain. The magma driven low pressure event is the 2.8 Ga event, whereas the second higher pressure 2.5 Ga event in a result of thickening and as the bulk of the orogen has been pre-conditioned by a previous UHT event it didn't take as much thermal energy to get back up to 1000 °C.