Sediment melt flux into the melting zone of the Northernmost Tonga island arc

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The lavas from the northernmost islands Tafahi and Niuatoputapu in the Tonga island arc are long known to differ in terms of composition from rocks from the central and southern volcanoes of this arc. The differences are believed to reflect either the influence of plume-type mantle from Samoa or the subduction of OIB-material from the Louisville Seamount Chain. Although the distance between the two islands is only 8 km we find significant differences between the lavas. Compared to lavas from the central Tonga arc the Tafahi-Niuatoputapu basaltic lavas have relatively high SiO_2 contents at a given MgO but are highly depleted in heavy rare earths, Ti and Zr, thus resembling boninites. This implies a highly depleted mantle wedge composition beneath the northern Tonga arc.

Radiogenic isotope variations indicate that binary mixing of different slab components occurs in the melting zones beneath each island. The Niuatoputapu lavas have slightly U-shaped REE patterns with significant negative Ce anomalies that are less pronounced in the lavas from Tafahi. The Ce anomaly probably reflects a prevailing influx of sedimentary components. Most samples also show superchondritic Nb/Ta indicating residual rutile in the sedimentary component. This component also has relatively high Pb isotope ratios and most likely represents a partial melt of subducted volcaniclastic sediments from the Louisville Seamount Chain. The sedimentary component mixes with a hydrous fluid from altered mid-ocean ridge basalts. Seismic studies show that the slab beneath the northern Tonga arc is only about 70 km deep which may lead to the prevailing influence of sediment melts relative to fluids from altered basaltic crust.

Subduction and exhumation of the UHP Western Gneiss Region: Petrology, structural geology, and LASS petrochronology

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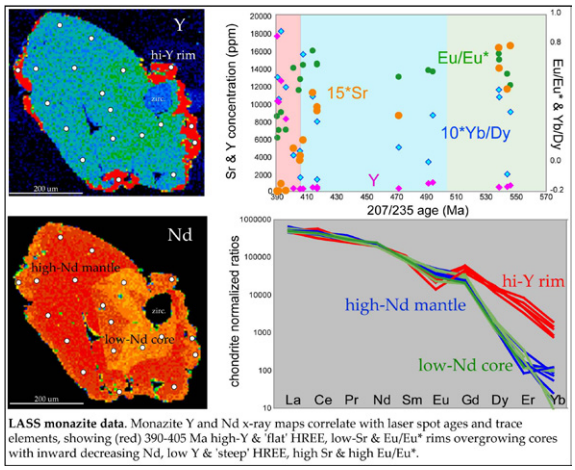
The Western Gneiss Region of Norway is one of Earth's two giant UHP terranes, with eclogites distributed across an area ~150 x 200 km. A new LASS petrochronology dataset of more than 200 samples now rivals structural, petrological, and $^{40}Ar/^{39}Ar$ datasets in richness and information content. The half of the WGR that is close to the foreland shows weak Caledonian deformation and preserves Precambrian Sm-Nd garnet ages, Precambrian U-Pb zircon ages, partially reset U-Pb titanite ages, 398–397 Ma U/Th-Pb monazite ages, and muscovite $^{40}Ar/^{39}Ar$ ages that decrease monotonically away from the foreland from 400 to 390 Ma.

The hinterland portion is variably deformed and preserves three distinct UHP domains that are marked by 420–400 Ma Lu-Hf and Sm-Nd eclogite ages, 418–407 Ma Sm-Nd garnet ages from HP gneiss, 425–405 Ma monazite U/Th-Pb ages from garnet-stable gneiss, 430–415 Ma U-Pb zircon ages from HP gneiss, 407–392 Ma U-Pb zircon ages from exhumation-related leucocratic intrusions, 405–394 Ma U/Th-Pb monazite ages from post-UHP gneiss, 400–398 Ma U-Pb zircon ages from post-UHP gneiss, 395–381 Ma U-Pb rutile ages, and 390–375 Ma muscovite $^{40}Ar/^{39}Ar$ ages. In general, coherence among the age gradients defined by the different isotopic systems indicates simple east-directed exhumation. In detail, however, differences among the ages within the three UHP domains indicate juxtaposition of the central and northern UHP domains against the southern UHP domain after titanite and rutile closure and prior to muscovite closure.



LASS monazite data. Monazite Y and Nd x-ray maps correlate with laser spot ages and trace elements, showing (red) 390-405 Ma high-Y & 'flat' HREE, low-Sr & Eu/Eu* rims overgrowing cores with inward decreasing Nd, low Y & 'steep' HREE, high Sr & high Eu/Eu*.