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Pressure-temperature and isotopic constraints on the progressive, fluid enhanced eclogitisation of granulites in the Bergen Arcs, western Norway.

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PRESSURE-TEMPERATURE AND ISOTOPIC CONSTRAINTS ON THE PROGRESSIVE, FLUID ENHANCED ECLOGATISATION OF GRANULITES IN THE BERGEN ARCS, WESTERN NORWAY.

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Exhumed eclogitic crust is rare and exposures that preserve both protoliths and altered domains are limited around the world. On Holsnøy Island, in the Bergen Arcs Norway, Neoproterozoic anorthositic granulites are exposed juxtaposing hydrous Ordovicio-Silurian eclogites which formed during well documented progressive fluid infiltration and deformation. Four stages of deformation for this progressive eclogitisation process can be identified based on structural overprinting relationships: 1) brittle deformation which formed pseudotachylite arrays in the granulite which are now recrystallised to K-feldpar–kyanite–plagioclase–clinopyroxene–garnet–quartz–rutile; 2) the development of discrete, small-scale shear zones associated with increased fluid–rock interaction, resulting in the formation of clinopyoxene–zoisite–kynaite–phengite–albitic plagioclase assemblages that partially to completely retrogressed garnets in the granulite protolith 3) the complete large-scale replacement of granulite by hydrous eclogite with interpreted peak metamorphic assemblage phengite–zoisite–omphacite–garnet–kyanite–rutile ; and 4) the retrogression of completely eclogitised domains resulting in coarse phengite dominated mineral assemblages (phengite–zoisite–omphacite–garnet–kyanite–amphibole–rutile–quartz), due to a significant availability of fluid. P–T constraints, determined by phase equilibria forward modelling, indicated that recrystallisation of the pseudotachylite occurred at around 15.5 kbar and 675 °C, peak eclogite assemblages formed at around 21.5 kbar and 680 °C and high-P retrogression at 16.5 kbar and 700 °C. As described by a number of workers, the transition from granulite to eclogite was catalysed by fluid. However limitations in fluid availability resulted in the recrystallised domains evolving to a fluid absent state, thereby freezing in the mineral assemblage and recording the P–T conditions associated with fluid ingress as the slab was subducted.

Preliminary isotopic data from fluid affected volumes and their wall rocks shows a significant positive shift in the deuterium isotopic signature associated with fluid ingress. Oxygen isotopes show only limited shifts to more positive δ18O values. Nd data indicates that the most fluid affected rocks interacted with fluid sourced from significantly more juvenile sources than represented by the protolith granulites, conceivably fluids sourced from dehydration of Cambrian ophiolite and metasedimentary successions that structurally underly the eclogitic rocks.