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The physical and chemical interaction of the Ilimaussaq intrusive complex with sandstone and basaltic country rock of the Eriksfjord Formation, South Greenland

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The Gardar province of South Greenland hosts a number of peralkaline igneous centres associated with rifting between ca. 1350 and 1130 Ma. Due to its remarkable agpaitic ([Na+K]/Al > 1.2) mineralogy and economic potential by enrichment in REE and U, the Ilimaussaq intrusive complex has been the subject of intense study and is dated at 1160 Ma, representing late-Gardar magmatism. While the complex is famed for its extreme composition, resulting from extended fractionation, little consideration has been given to the interaction of this rare magma with its surrounding country rock, the Eriksfjord Formation.

Current understanding dictates that the Ilimaussaq complex remained a sealed system throughout its emplacement and solidification, allowing for its extended fractionation and autometasomatism by volatile-rich magmatic fluids. Here we test this understanding and present data that provides evidence for both physical and chemical interaction of the agpaitic magma with surrounding country rock. Magmatic dykes and veins are observed permeating the country rock up to 300 m from the complex's contact. Multiple methods of chemical analysis of these features are utilised to determine the degree of contamination of the magma and the means of propagation of these fluids. Firstly, the bulk rock geochemistry of roof zone, dykes and country rock are compared to assess contamination/alteration; secondly, sulphur isotopic data are presented to further highlight contamination with variation from magmatic to surface signatures; and thirdly, mineral compositions within dykes are analysed to track variation in magmatic fluid composition with distance from the chamber wall.

The Ilimaussaq intrusive complex provides a unique opportunity to study the physical and chemical permeability of common rocks (sandstone and basalt of the Eriksfjord Fm.) when intruded by a low viscosity, low temperature magma. Quantifying the interaction of this intrusion with its country rock allows for a better understanding of the processes that allow these evolved systems to form and will aid in the recognition of similar systems of economic importance.