Nd isotope and Trace Element Characteristics of the Mesoarchean (3075 Ma) Ivisaartoq Greenstone Belt, SW Greenland: Evidence for Two Distinct Subarc Mantle Sources

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The Mesoarchean (~3075 Ma) Ivisaartoq greenstone belt in SW Greenland contains well-preserved primary magmatic features, including pillow lavas, cpx-bearing ultramafic cumulates, volcanic breccias, and immiscible liquid textures. In addition there are variably deformed actinolite schists and serpentinites in the belt. Field relationships and petrographic observations indicate that all volcanic and intrusive rock types in the Ivisaartoq belt are part of the same lithotectonic assemblage, sharing a common history deformation and metamorphism. Field, petrographic and geochemical data suggest that the Ivisaartoq rocks underwent at least two stages of post-magmatic calc-silicate metasomatic alteration between 3075 and 2961 Ma, resulting mobilization of most major and trace elements. Given the geological similarities between the Ivisaartoq greenstone belt and Phanerozoic forearc ophiolites, we suggest that the Ivisaartoq greenstone belt represents a relic of a dismembered Mesoarchean supra-subduction zone oceanic crust. This crust might originally have been composed of an upper layer of pillow lavas, picritic flows, gabbroic to dioritic dykes and dunitic to wehrlitic sills, and a lower layer of leucogabbros and anorthosites.

The Sm-Nd isotope systems were disturbed in strongly altered actinolite schists, likely during 2800-2900 Ma tectonothermal events, whereas they appear to have remained relatively undisturbed in the pillow lavas, cumulates, and gabbros. Gabbros and pillow lavas have similar initial Nd isotope compositions (ε_{Nd}=0.30 to +3.04), consistent with a variably depleted, heterogeneous mantle source. Cumulates, on the other hand, were derived from a more depleted (ε_{Nd}=+4.23 to +4.97) mantle source. These isotopic characteristics indicate that two distinct Mesoarchean mantle sources existed beneath the Ivisaartoq belt (sensu lato). The lower ε_{Nd} (<+ 3.0) values in gabbros and pillow basalts may indicate an Nd-enriched component in the source region. We suggest that the enriched component had been added to the mantle wedge and into the mantle source of gabbros and pillow lavas at variable proportions by recycling of older continental material (sediments), with super-chondritic Nd/Sm ratios.