

U–Pb geochronology and geologic significance of the two oldest known mafic dyke swarms on earth: 3659 Ma Inaluk dykes and 3490 Ma Tarssartôq dykes, southern west Greenland

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Mafic dyke swarms are valuable time markers in the Archean craton of southern west Greenland. The Ameralik dykes in the Godthåbsfjord region are particularly useful for differentiating early Archean rocks and tectonic events from late Archean rocks and events. The only age constraint on these dykes in their type locality (outer Godthåbsfjord) is that they intruded between suites of rocks formed at 3.6 Ga and 3.0 Ga. In outer Godthåbsfjord, the dykes were strongly deformed and metamorphosed in the late Archean.

In the vicinity of Isua, located 160 km NW of outer Godthåbsfjord, a dyke swarm that has been correlated with the Ameralik swarm was largely unaffected by late Archean events. The dolerite dykes at Isua, known as the Tarssartôq dykes, are least deformed to the north of the Isua greenstone belt, where they cut tonalitic gneiss with a protolith age of 3700 Ma. The dykes form two swarms, an E-W swarm that is cut by a N-S swarm.

U–Pb accessory minerals are rare in these dykes, but a coarser grained and more felsic dyke with an E-W orientation contains abundant zircon, zircon overgrowths of baddeleyite, and baddeleyite. Three single grain U–Pb analyses of zircon and zircon overgrowths of baddeleyite yield a discordia line with upper and lower intercepts of 3490 ± 2 and 1305 ± 19 Ma (MSWD = 0.04). Discordance is 3–18%. Three other single grain analyses of zircon overgrowths of baddeleyite and

baddeleyite yield ages that lie just above or below the discordia. The upper intercept of 3490 ± 2 Ma is interpreted as the crystallization age of the E-W Tarssartôq dykes.

It remains unproven whether the Ameralik dykes in outer Godthåbsfjord are also 3490 Ma. However, it is certain that metamorphism and deformation of gneisses north of the Isua greenstone predate 3490 Ma and that rocks adjacent to and within the greenstone belt were metamorphosed and deformed after 3490 Ma.

The host gneisses of the Tarssartôq dykes contain an older dyke swarm, known as the Inaluk dykes, which were metamorphosed and deformed before intrusion of the Tarssartôq dykes. In low strain zones, it is recognized that the Inaluk dykes postdate an older gneissosity in the host gneiss yet they were strained by the deformation that formed the regional gneissosity. Four U–Pb analyses of single zircon grains with an igneous morphology yield concordant ages of 3659 ± 2 Ma, the interpreted crystallization age of the Inaluk dykes.

This study of the dykes is being carried out in conjunction with our detailed studies of the field relationships, structure, petrology, and geochemistry of the diverse components of the gneisses and greenstone belt at Isua. These studies will further improve our knowledge of the geological history of Earth's oldest preserved crust.