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Complexities in rift initiation and development within the Iceland Plateau, North-Atlantic.

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Spreading north of Iceland has been complex since the break-up of the North Atlantic in late Paleocene-early Eocene. Magnetic anomalies within the Iceland Plateau, west of the Ægir Ridge and along the Greenland-Iceland-Faeroe Ridge are irregular, formed by plate boundary complexities at breakup, branched accretion zones, westward rifting relocations, and large overlapping rifts. The 700 km long KRISE7 seismic refraction/reflection and gravity profile, straddles 66.5°N, between the Kolbeinsey and Ægir Ridges, crossing the three physiographic provinces that characterize this region: the Iceland Shelf, Iceland Plateau and Norway Basin. On the basis of crustal thickness and velocity structure, combined with older seismic reflection profiles and drill cores, these provinces correspond to three individual spreading rifts that were active at different time periods.

The deep, fan shaped Norway basin was formed during the initial opening of the Atlantic by spreading at the now extinct Ægir Ridge. The oldest crust in the western Norway Basin has thickness 8–10 km and this thins to 4–5 km at the Ægir Ridge reflecting the progressive abandonment of spreading at this rift axis. The eastern Iceland Plateau was the locus of an extinct spreading center, which was segmented and overlapped the Ægir Ridge by 300 km. Spreading on the Iceland Plateau rift occurred simultaneously with that on the Ægir Ridge prior to 26 Ma, when the Kolbeinsey Ridge was initiated by a westward rift jump. The Iceland Plateau rift formed by rifting along the continent-ocean transition at the former central E-Greenland margin, associated with the formation of the Jan Mayen Ridge. Lower crustal domes and corresponding gravity highs across the Iceland Plateau mark the location of the extinct rift axis. The crust at the Iceland Plateau rift is thicker (12–15 km) that that at the conjugate Ægir Ridge and formed under active upwelling conditions (normal lower crustal velocities), which we attribute to the influence of the Iceland plume. The overlapping geometry of the Ægir and Iceland Plateau rift, led to progressive south to north abandonment of spreading on the Ægir Ridge.

Rifting at the Kolbeinsey Ridge in the last 26 Ma formed the shallowest physiographic province, the Iceland Shelf. Initiation of the Kolbeinsey Ridge is recorded in very thick crust (24–28 km) at the eastern Iceland Shelf, due to significant increase in melt flux (active, plume driven upwelling) which caused the spreading axis to jump from the Iceland Plateau to the new Kolbeinsey ridge. Magmatism at the new Kolbeinsey Ridge was also associated with unusual large amounts of extrusive volcanism as recorded by an extremely thick (6 km) layer of low velocities in this region.

As the Iceland plume approached the Mid-Atlantic ridge from the west, three separate spreading centers formed - each progressively further west. Magma from the plume generated new zones of weakness at the continent-ocean boundary and thus facilitated new spreading rifts. The plume influence is documented in thicker crust as each successive spreading center was initiated.