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Diverse Manifestations of Convective Upwelling Beneath the North Atlantic Ocean

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The Icelandic Plume dominates the North Atlantic Ocean. Residual depth anomalies of oceanic lithosphere, long wavelength gravity anomalies, and seismic tomographic models show that this large upwelling reaches from Baffin Bay to Western Norway, and from offshore Newfoundland to Spitzbergen. At continental margins, there is excellent evidence for present-day dynamic support of crust beneath Scotland and Western Norway. It is generally agreed that the Icelandic Plume started at 62 Ma. In recent years, a quantitative understanding of the temporal evolution of this upwelling has begun to emerge. The best evidence occurs in the oceanic basins north and south of Iceland. Since the mid-oceanic ridge straddles the plume, it acts as a linear sampler of transient activity over the last 40–50 Ma. A pair of seismic reflection flowlines acquired in 2010 have enabled us to determine the detailed history of transient activity. The implications of this history are profound. Waxing and waning of convective upwelling beneath this important oceanic gateway appears to have modulated the overflow of the ancient precursor to North Atlantic Deep Water (NADW). The growth of contourite drifts which plaster deep-water margins can also be directly linked to changing vertical motions at this gateway. Finally, there is increasing evidence that the otherwise uniform thermal subsidence of sedimentary basins, which fringe both sides of the North Atlantic Ocean, has been periodically interrupted by transient uplift events which generated ephemeral landscapes. These geologic manifestations of convective activity should lead to improved insights into the fluid dynamics of the mantle.