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North Atlantic volcanic rifts: from continental breakup to seafloor spreading [Invited talk]

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Breakup of the northern North Atlantic in the early Tertiary was accompanied by massive volcanism caused by interaction of the rift with the underlying Iceland mantle plume. Deep penetration seismic reflection and refraction profiles show that c. 80% of the melt is intruded as sills in the crust, with the remainder extruded to the surface. There the melt forms seaward dipping reflectors on the oceanic flank of the continental break and long sub-horizontal basalt flows across sediments on the landward side. Once a fully oceanic spreading ridge is established, small thickness variations in the igneous crustal thickness show that the plume temperature fluctuates by c. 10 degrees Celsius on timescales of a few million to tens of millions of years. Beneath present-day Iceland, a similar process to the original continental breakup can be imaged where the spreading rift (here called the neovolcanic zone) has jumped into c. 20 km thick old Icelandic crust in the past few million years and is now rifting the crust apart at 18 mm/a. The advantage of the present day Icelandic rift is that we can image the breakup in the act of occurring, through tens of thousands of local earthquakes generated as melt intrudes the crust, and through tomographic imaging that shows melt accumulating in a series of sills throughout the crustal sections as well as extruding from surface fissures.