A detailed model for accretion of crust in Iceland

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The Icelandic crust, though oceanic in origin, is distinctively different from normal oceanic crust. Crustal thickness is on average ∼24 km, with a maximum value of ∼50km, but the transition to the mantle is not well defined. Seismic velocities are high, and have to be explained by thermal or chemical effects. For Iceland we define four source regions of crustal accretion: surface extrusion, intrusion in fissure swarms at shallow depth connected to volcanic centers, magma chambers at shallow to midcrustal level, and a deep accretion zone, where crust is produced by widespread dyke and sill emplacement and underplating. Knowing the spreading rate, the rate of crustal production can be estimated to ∼600 m^2/y per unit length along the ridge, but the site of emplacement is not obvious. We studied the process of crustal accretion in a dynamical, numerical model, prescribing different volumetrical source functions in space and time for crustal production in the four defined regio ns. The process of accretion is studied by solving the Navier-Stokes-, the heat tansport and the mass conservation equations including volumetric sources and identifying material from different source regions by a marker approach. After some time of spreading and accretion a characteristic temperature distribution and crustal layering evolves, which is compared to observation data, and indicates that shallow accretion and magma chamber accumulates play an important role in crustal formation in Iceland.