ESTIMATES OF CRITICAL MINIMUM DYKE WIDTHS ON EUROPA

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Recent studies of Europa have shown that a liquid water ocean may exist beneath a water ice - MgSO4 crust, and that water and other materials such as salts and coloured radiolytic products forming lenticulae are erupted periodically at its surface, or intruded into the crust to form possible saline magma chambers. For this to happen, melts must be transported by some mechanism from the source region to the site of extrusion. Two fundamental but mechanically opposed ascent mechanisms capable of transporting cryomagmas and melts on Europa are diapiric upwelling and dyke flow. Diapiric rise appears to be a favoured mechanism, with the formation of deep cracks in the Europan crust apparently problematic due to high overburden pressures that act to close the fissure at shallow depths. However, by analogy to Earth, diapiric rise through an upper later of super cool and brittle ice may not be achievable, leaving dyke or conduit flow as the more likely ascent mechanism. Using thermal and thermal properties appropriate for water-ice-salt mixtures, along with published estimates of the material and rheological properties of the upper European crust, we present the results of a preliminary investigation into the rates of buoyancy-driven dyke ascent of cryomagmas from a source near the ocean lower crust interface, to the surface. Our models are based on similar investigations devised to predict the critical minimum dyke widths required for high temperature magma flow on terrestrial planets using a Stefan number approximation1, and may help place further constraints on a number of important cryomagma transport properties including density contrast, far-field crustal temperature, mixture viscosity and ascent rate. Initial results suggest that for a transport distance of 30 - 50 km, the minimum critical dyke widths are of the order of several metres or less.