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EMPLACEMENT OF THE LYNGDAL GRANODIORITE (SW NORWAY) AT THE BRITTLE-DUCTILE TRANSITION IN A HOT CRUST

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The 1.0–0.9 Ga plutons of the HBG suite (Hornblende-Biotite Granitoids) associated with the Rogaland anorthosites belong to the Sveconorwegian post-collisional magmatism in southwestern Norway. The comparison between experimental and natural phase equilibria indicates that the Lyngdal granodiorite (HBG suite) crystallized between 4 and 2 kbar, the magma having 6 wt% H_2O in melt at early stages and an fO_2 in the range NNO/NNO+1 (Bogaerts et al., 2002). We make the assumption that the least differentiated facies of the Lyngdal granodiorite (60% SiO_2) approximates the composition of the magma rising from a reservoir in the lower crust. The low viscosity (52 Pa s at 1000°C) and density (2450 kg/m^3 at 10 kbar and 1000°C) calculated for this sample imply an elastic response of the lower crust (Rubin, 1993) and therefore accord with dyking as the main ascent mechanism for the Lyngdal magma. Secondly, we calculate the magma driving pressure (P_d) in a vertical dyke which allow us to determine the controlling factors for ascent and emplacement. To do so, we need to define a tectonic setting in addition to the above physical parameters of our magma. The tectonic regime during the Sveconorwegian post-collisional period was probably extensional due to the collapse of the Sveconorwegian crust. Calculations are done for two geotherms: 60 and 100 mW/m^2 typical of this tectonic setting. We chose a two layers crustal model: a source depth at 40 km, an upper crust (18 km) represented by the Westerly Granite rheology and a lower crust (22 km) by a diabase rheology. Positive P_d at the surface indicate that the magma had the potential to erupt. To be

stored within the crust and build the Lyngdal pluton, the magma propagation in dyke must be stopped by e.g. a ductile layer (marble) or a horizontal crustal anisotropy. A horizontal crustal anisotropy may become an effective crustal magma trap if $P_d >$ lithostatic pressure at this level so that the magma can spread out laterally (Hogan & Gilbert, 1995). For the hotter geotherm (100 mW/m^2), the magma pressure exceeds the lithostatic pressure at the brittle-ductile transition situated at 10 km and thus can act as a magma trap. For the colder geotherm (60 mW/m^2), this magma trap is active at 16 km. The depth of the magma trap for the hotter geotherm corresponds to the pressure of emplacement of the Lyngdal granodiorite (3 kbar, i.e. $\sim$11 km), which is similar to other HBG granitoids. We suggest that the emplacement of HBG granitoids is controlled by the crustal anisotropy defined by the brittle-ductile transition in a very hot crust.