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Development of layering during hydration reactions in the small La Cordadera gabbro intrusion, Central Chile.

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The small La Cordadera gabbro intrusion is spatially and temporally associated with the much larger felsic Cretaceous Illapel Plutonic Complex (IPC) of central Chile. The La Cordadera intrusion is undeformed, unmetamorphosed and untilted. Much of the intrusion has well-developed, subvertical layering defined by variations in plagioclase and amphibole abundances, and sometimes grain sizes. Olivine and clinopyroxene are rare in these rocks, but more common in the massive parts of the intrusion. In some areas the layering is straight, regular and rhythmic, with cycles of 5 to 20 mm, and resembles the 'inch scale' layering in the Stillwater. Elsewhere, the layering is more complex with variable layer thicknesses and cross-cutting relationships. Although some of these structures resemble channel flow, the subvertical orientation, and other features, renders this interpretation impossible. It is proposed that both types of layering developed by dissipation of crystal surface energy during equilibration, the same mechanism that is credited with creating the 'inch scale' layering. It is generally thought that such a mechanism needs the temperature to be maintained close to the liquidus for a long period of time, and hence that it rarely occurs in small intrusions. The presence of similar phase layering in some skarns (e.g. diopside-wollastonite layers) suggests another option. For the La Cordadera intrusion it is proposed that the system was directed towards equilibrium during cycles of replacement of clinopyroxene by amphibole in the semi-consolidated magma. Each cycle is envisaged as starting with the emplacement of relatively dry gabbroic magma, with some crystals, in a dyke that was fed from the base of the IPC and continued upwards, possibly to the surface. Crystallisation of plagioclase, mafics and oxides on the walls produced a semi-rigid network of crystals. Meanwhile, the composition of the magma flowing in the dyke became richer in water. The water diffused out into the crystal network, transforming some of the clinopyroxene into amphibole. At the same time the system equilibrated, coarsening plagioclase and amphibole, and producing the layering. A new cycle would then start by the injection of a fresh batch of magma into the dyke, which eroded the earlier-formed layered rocks before it stalled and began to crystallise. This layering mechanism spans the gap between the igneous and metamorphic environments. This work has been funded by the Fondecyt (Chile) project 1080468.