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Petrographic and mineralogical studies of the formation of coronitic gabbros in the Ambatondrazaka region, central Madagascar

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The Cryogenian gabbros of the Ambatondrazaka region belong to the Imorona-Itsindro plutonic suite that originated from an upper mantle source after the eastward subduction of the Mozambican oceanic lithosphere beneath the Precambrian Malagasy basement from 0.8–0.7 Ga. These gabbros exhibit a particular coronitic texture where each corona consists of a core of forsteritic olivine surrounded by three successive rims. The first rim is formed by clinoenstatite, the second is formed by the clinoenstatite-diopside intergrowth with some exsolutions of pleonaste and pyrope garnet. However, the last is formed by symplectites of pargasite with exsolutions of pleonaste. Assuming that the temperature gradually decreases and that the pressure remains constant or also gradually decreases, the coronitic texture is the result of three successive stages of mineral reactions. In the first stage at rim one, the crystallization of clinoenstatites was favored by the diffusion of Fe^{2+} and Mg^{2+} from the forsteritic olivine being rich in Mg^{2+} while the supply of Si and Al comes from the surrounding labradorite. During the second stage in rim two, the formation of the clinoenstatite-diopside intergrowth follows the same crystallization process as that in rim one, but the calcium input from the surrounding labradorite favored the crystallization of diopside. Additionally, the supply of Mg and Fe from olivine and Al from labradorite resulted in the formation of pleonaste and pyrope garnet exsolutions. In the last stage at rim three, the formation of pleonaste exsolutions is identical as in stage two, while the supply of H_2O favored the crystallization of pargasite symplectites. Overall, the coronitic texture is the result of a solid-state metamorphic reaction due to orogenic uplift related to the Pan-African Orogeny (0.58 – 0.51 Ga). The anhydrous phases of the reaction in the upper mantle formed the pyroxenes, spinels, and garnet in rims one and two, while the hydrous phase in the continental crust favored the formation of pargasites in rim three.