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On the origin of microrhythmic layering in arfvedsonite lujavrite from the Ilímaussaq alkaline complex, South Greenland☆

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Abstract

Microrhythmic layering is locally developed in agpaitic arfvedsonite lujavrite from the Ilímaussaq alkaline complex, South Greenland. Three–15-cm-thick laminated dark layers alternate with 1–10-cm-thick, light-coloured granular urtitic layers. Dark layers are uniform (isomodal) but the urtitic layers are enriched in early nepheline and eudialyte in their lower parts and in late analcime and REE phosphate minerals in the upper parts. The layers are separated by sharp contacts; they are draped around rafts from the overlying roof zone and lack structures indicative of current processes or post-cumulus deformation. Compared with the background arfvedsonite lujavrite of the complex, the dark layers are richer in sodalite, microcline and arfvedsonite and poorer in analcime and eudialyte. They have higher K_2O, Cl, FeO* and S but lower Na_2O, H_2O^+, Zr and P contents, the opposite of the light-coloured layers. The complementary chemistry of the two types of layers oscillates about the composition of the background arfvedsonite lujavrite. Layers probably formed in a stagnant bottom layer of the lujavrite magma chamber. Each layer started as a liquid layer which exchanged components with the underlying crystallization front. On cooling, it crystallized primocrysts and exchanged components with the overlying magma which became a new, complementary liquid layer and, during further cooling and burial within the sequence of layers, it underwent largely closed-system interstitial crystallization. Exhaustion of Cl and a sharp decrease in a_{NaCl} relative to a_{H_2O} terminated the crystallization of a sodalite-rich dark layer and initiated abundant crystallization of nepheline in the overlying liquid layer (urtitic layer). The layered sequence represents a local K_2O-, Cl-rich but Na_2O-, H_2O-poor facies of arfvedsonite lujavrite and may have formed by exchanging components with sodalite-bearing rafts from the roof zone.

Keywords: Agpaitic; Lujavrite; Microrhythmic layering; Oscillatory crystallization; Volatile activities

1. Introduction

The intrusive complexes of the mid-Proterozoic Gardar igneous province, South Greenland, provide many examples of layered igneous rocks (Upton et al., 1996). In one of these complexes, the Ilímaussaq

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alkaline complex, the type locality of agpaitic rocks (Ussing, 1912), macro- and microrhythmic layering are displayed in an instructive way. Macrorhythmic layering exhibits layer thicknesses of metre scale; microrhythmic layering exhibits layer thicknesses of centimetre scale (Irvine, 1987).

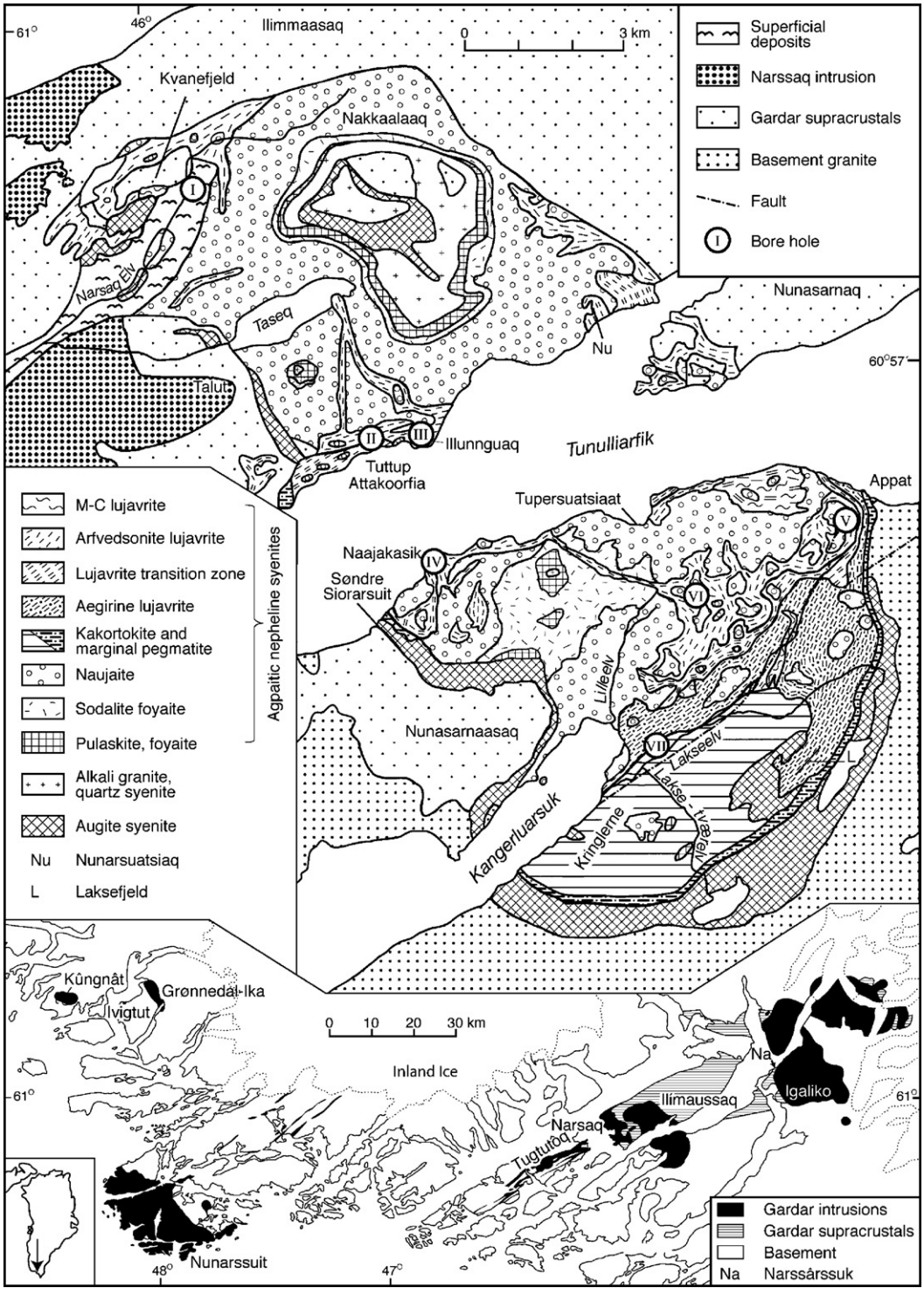

Fig. 1. Geological map of the Ilímaussaq alkaline complex with location of boreholes I to VII, from Sørensen (2001).