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What governs the transition from miaskitic to agpaitic assemblages in peralkaline rocks?

JULIAN SCHILLING[1], MICHAEL A.W. MARKS[1] AND GREGOR MARKL[1]

[1]University of Tuebingen, Wilhelmstr. 56, 72074 Tuebingen, julian.schilling@student.uni-tuebingen.de

Peralkaline igneous rocks (molar (Na+K)/Al>1) are characterized by exceptionally high contents of generally incompatible elements like Na, Li, Be, Rb, REE and HFSE (Ti, Zr, Hf, Nb, Ta). However, based on their mineral assemblages, they can be subdivided into two groups: In the case of peralkaline miaskitic rocks, HFSE are incorporated in minerals like zircon, titanite and ilmenite, whereas in agpaitic varieties, these elements occur in complex Na-(Zr,Ti)-silicates such as eudialyte, rinkite and låvenite [Sørensen, 1997]. Commonly, peralkaline igneous complexes worldwide show either a miaskitic or an agpaitic character, or at least distinct melt batches within the same complex tend to develop to either miaskitic or agpaitic assemblages. Still, it is not clear, which processes cause either miaskitic or agpaitic assemblages to crystallize.

In the special case of the Eocene Tamazeght complex (Moroccan High Atlas mountains), a countinous transition from miaskitic nepheline syenites to agpaitic ones, including late-stage agpaitic pegmatites and veins, is observed. The earlier miaskitic rocks are characterized by nepheline, K-feldspar, aegirine-rich clinopyroxene, sodalite, titanite and rarely developed zircon. In contrast, the agpaitic varieties bear eudialyte instead of titanite and zircon, without showing any replacement textures between these minerals. However, the major mineral assemblages in the agpaites show no obvious difference compared to their miaskitic counterparts.

In this study, we compare electron microprobe data for nepheline, sodalite and clinopyroxen as well as mineral stable isotope data (O, H) of both miaskitic and agpaitic samples. Additionally, eudialyte from agpaitic samples was analyzed by electron microprobe. Preliminary fluid inclusion investigations indicate two types of inclusions in both nepheline and eudialyte, including a methane- and hydrogene-bearing population, which is known to be typical of peralkaline rocks [Potter & Konnerup-Madsen, 2003].

Based on this, we will try to shed light on the relevant changes of parameters being responsible for the transition from miaskites to agpaites.

Potter, J. and Konnerup-Madsen, J. (2003): in: Petford, N. and Mc Caffrey, K.J.W. (eds) Hydrocarbons in Crystalline Rocks. Geological Society, London, Special Publications, 214, 141-173

Sørensen, H. (1997): Mineralogical Magazine, 1997, 61, 485-498