Antiperthite in a mafic xenolith from a volcanic breccia in northern Bavaria

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Abstract: Mafic xenoliths in a Tertiary pipe breccia near Schweinshaupten (northern Bavaria) occasionally contain lamellar antiperthite. Larger grains of K-feldspar are perthitic. Usually three sets of K-feldspar lamellae are present in each plagioclase grain. The lamellar shape in one of these sets, near (512) of the plagioclase host, is better developed than that of the other two. The compositions of the plagioclase host and the Or-rich lamellae are An 62 and Or 87, respectively. The K-feldspar of the lamellae is disordered ($t_1 = 0.57$). The plagioclase is also disordered ($t_0$ near 0.50, no “e” reflections). Near the K-rich feldspar the composition of the plagioclase changes from An 62 towards An 85. The lamellae and their anorthite-rich rims were formed by unmixing, with long-range migration of the alkalies and Ba (millimetres) and short-range migration of Ca, Si, and Al (micrometres).

Key-words: volcanic xenolith, lower crust, antiperthite, structural state, orientation of interfaces during exsolution.

1. Introduction

Plagioclase from anorthosite or from high-grade metamorphic rocks is occasionally coarsely antiperthitic with lamellae of K-feldspar in several distinct orientations. Carstens (1966) compared antiperthite in anorthosites from Norway to the Widmannstätten plates of iron meteorites. This paper deals with an occurrence of antiperthite similar to those described by Carstens in gabbroic nodules from northern Bavaria. The compositions and structures of the phases, the orientations of the K-feldspar lamellae, and their origin are described and discussed.

2. Geology, petrography and chemistry

Some of the breccia pipes, erupted during the Tertiary period of alkali basaltic volcanism in northern Bavaria, contain xenoliths of metamorphic, magmatic, and sedimentary rocks (Huckenholz & Schröder, 1981). The xenolith described here was collected near Schweinshaupten (topographic map 1:25000, sheet 5829 Hofheim, r 43 98 460, h 55 61 860) along with many other gabbroic xenoliths.

The rock is equigranular, with grain sizes between 0.5 and 6 mm. Grain boundary angles are near 120°. The texture may be magmatic (acculus texture) or metamorphic in origin. The mineral association is plagioclase, clinopyroxene, orthopyroxene, ilmenite, titanomagnetite, and rare biotite. Other specimens may contain green spinel, scapolite, apatite, quartz or brown hornblende. Preferred mineral orientations cannot be recognized, but slight bending of albite-twin lamellae and irregular cracks in the feldspars and pyroxenes indicate slight deformation. Until now only one xenolith with antiperthite of the type described below has been found. Five other xenoliths show antiperthite with spindle-shaped K-feldspar.

The nodules have compositions of tholeiitic affinity (Table 1, No.1). They cannot be chemically related to the Tertiary basalts, which are mostly basanites and nephelinites (Huckenholz & Schröder, 1985).