Ladder structure of oligoclase in a biotite granite from Tanakura, Kyoto Prefecture, Japan

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Introduction

Smith and Brown (1988) first introduced the term “ladder structure” to describe broad albite twinning with very fine pericline twinning occurring in one set of the albite twins. The ladder structure in basic plagioclase was first described by Bridgwater and Harry (1968) and later by Brown and Macaudière (1986). However, the ladder structure naturally occurring in acidic plagioclase has not yet been described, as far as I know, though the ladder structure in oligoclase was artificially produced from a natural oligoclase by Wenk (1969). This paper reports naturally occurring ladder structure of oligoclase in a biotite granite, and discusses the genesis based on optical investigations.

Description of ladder structure of oligoclase in granite

The ladder structure (Figs. 1 and 2) was found in the low temperature oligoclase (26±2 mole% An) of the medium grained biotite granite intruded in late Cretaceous age (80±10 Ma, Ishizaka (1966), Hayase and Ishizaka (1967)), from Tanakura, Tsuzuki district, Kyoto Prefecture, Japan. The biotite granite is composed essentially of euhedral and subhedral plagioclase (dominantly oligoclase), subhedral and anhedral orthoclase — and a minor microcline — perthite, anhedral quartz and subhedral biotite with accessory magnetite, apatite, zircon, sphene, allanite, green hornblende and chlorite. Plagioclase sometimes shows zoning, and quartz shows undulatory extinction resulting from strain. There is very little myrmekite at the plagioclase rim. The composition of the oligoclase was determined optically using the diagram on the relation between optic axial angle 2V and mole % An (Smith, J.R. 1958 and 1960) and that on the relation between the maximum extinction angle α’\(^\wedge\) (010) and mole % An and the 2V (Shelley, 1985). The 2V, the maximum extinction angle α’\(^\wedge\) (010) and mole % An of the plagioclase of the granite are −88°, 13.4°, 26% respectively.

Fig. 1. Photomicrographs of oligoclase under crossed polars. A: the subhedral oligoclase crystal oriented nearly perpendicular to the a-axis which has nearly parallel NW–SE albite twins with fine NE-SW pericline ladder structure. B: a oligoclase gently undulating. 1 and 2 are two NE-SW transcrystalline shear fractures nearly parallel to the (001) cleavage. Scale bar 0.2 mm.
A in Fig. 1 shows a subhedral oligoclase crystal with broad NW–SE albite twins and NE–SW pericline ladder structure cut by two NE–SW transcrystalline shear fractures nearly parallel to the (001) cleavage (1 and 2 in Fig. 1). B in Fig. 1 shows an oligoclase gently undulating. Albite twins occur along the shear fracture. As apparently most of the albite twins conform exactly with both sides of the fracture 1, the albite twins are earlier than the fracture 1. On both sides of the shear fracture 2, the exact conformity seems lacking, however, suggesting either that they are of later construction than the shear fracture, or that, more likely, they are of the same age as the shear fracture and induced by it.

**Discussion on the genesis of the ladder structure**

Two alternative explanations have been presented for the genesis of the ladder structure in plagioclase are: (1) recrystallization by severe chemical action by which the H₂O-bearing stacking fault formed in untwinned material, or that above a certain temperature plagioclases were in a partially disordered state, for example, soon after crystallization (Bridgewater and Harry, 1968). (2) stress by weak deformation of rocks (Brown and Macaudière, 1986), or by inversion of plagioclase from a high-temperature structural state to a low state (Wenk, 1969).

With regard to the ladder structure in this work, the first alternative may be opposed by the fact that the granite shows little recrystallization texture. The second alternative is hereby applicable due to the presence of the strain effect as stated previously.

Thus, it is inferred that the ladder structures of oligoclase in the biotite granite were formed by stress when the granite was weakly deformed under a subsolidus condition.

**References**


