The effect of twinning on the recrystallization of albite

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Abstract. It is shown that the large strains which accumulate in albite twinned in a chess-board pattern on the albite law may initiate recrystallization of the albite.

It is well known that feldspar, in contradistinction to, for example, calcite and quartz, recrystallizes only with great difficulty. When highly deformed, plagioclase may show incipient recrystallization at grain boundaries or along those parts of the grains which have been reoriented (deformation bands, substructures, etc.) as observed, e.g., in the anorthosites of West Norway. Twinning, likewise, under some circumstances seems to be favourable for the nucleation and growth of strain-free grains. Chess-board albite affords an example of this.

Chess-board albite is characterized by dense arrays of narrow, discontinuous albite lamellae. The twin boundaries are usually stepped or lenticular and commonly terminate abruptly. A high content of incoherent twin boundaries therefore distinguishes the chess-board pattern of twinning.

The origin of chess-board twinning is in dispute. Chess-board albite is often present in quartzo-feldspathic rocks in areas of regional metamorphism in Norway and elsewhere, and, for this reason, it has been suggested (STARKEY 1959) that chess-board twinning is a mechanical twinning. Chess-board twinning seems to be confined to rather pure albite (BATTEY 1955), and it is probable that the difficulties involved in the twinning of ordered low-albite (LAVES 1952) may be of importance in controlling the peculiar twinned pattern of this feldspar. Whatever the origin, however, there is a definite tendency for chess-board albite to recrystallize during post-tectonic annealing conditions. The description below pertains to the recrystallization reaction in quartz-keratophyres near Trondheim. Recrystallization starts along the

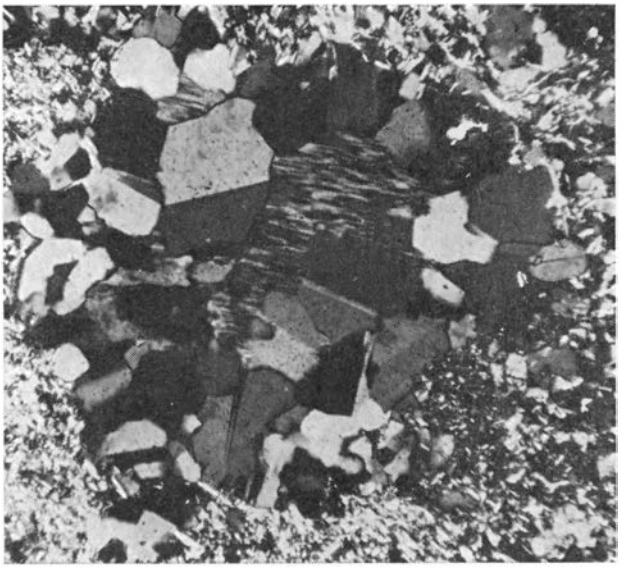

Fig. 1. Recrystallization of chess-board albite in quartz-keratophyre near Trondheim. Crossed nicols, × 145.

boundaries of the chess-board albite and proceeds inwards, eventually replacing the whole crystal by an assemblage of new strain-free grains (Fig. 1). The orientation of the new generation of albite varies, but the majority of the grains have the (010)-plane parallel to (010) of the chess-board albite. Another maximum is found for grains oriented with (010) normal to (010) of the old one. The new grains are either untwinned or simply twinned according to the albite law, the latter being the more usual. The twin plane nearly always penetrates along the middle of the recrystallized grains, thus giving the impression that they started to grow from a twinned nucleus. Grains are of fairly uniform size, about 0.1–0.2 mm in diameter, and they did not grow further after impingement.

The internal energy of albite twinned in a chess-board pattern is considerably higher than that of untwinned albite or albite having normally spaced and coherent twin lamellae. Strain energy is stored along the twin boundaries, especially along those which are incoherent. By an investigation of the mechanism of formation of mechanical twins in calcite, it has been shown (STARTSEV 1963) that the twinning is accompanied by point defects, stacking faults, and perfect dislocations in addition to the twinning dislocations. Thus, very large strains may be introduced in minerals during the act of twinning. It is this excess energy which is believed to be the driving force for recrystallization in chess-board albite. The author knows of no other example among natural minerals of recrystallization related to twinning. Deformation twinning in calcite does not appear to have any influence on the recrystallization of calcite. Kuznetzov and Kopora (HALL 1954) and others (CAHN 1954), however, have observed recrystallization of zinc crystals along twin boundaries, preferentially at twin intersections.

REFERENCES

BATTEY, M. H. 1955. Alkali metasomatism and petrology of some keratophyres. Geol. Mag. 92: 104–126.

CAHN, R. W. 1954. Twinned crystals. Advances in Physics 3: 363–445.

HALL, E. O. 1954: Twinning and diffusionless transformation in metals. Butterworths, London.

LAVES, F. 1952. Mechanische Zwillingsbildung in Feldspaten in Abhängigkeit von Ordnung-Unordnung der Si/Al-Verteilung innerhalb des $(Si,Al)_4O_8$-Gerüstes. Naturwissenschaften 23: 546–547.

STARKEY, J. 1959. Chess-board albite from New Brunswick, Canada. Geol. Mag. 96: 141–145.

STARTSEV, V. J. 1963: The formation of defects in crystal lattice by twinning. Proc. Int. Conf. Crystal Lattice Defects. Phys. Soc. Japan, 18, Suppl. III: 16–20.

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