DEVELOPMENT OF PERTHITE IN THE TOPAZ BEARING DEGANA GRANITE, RAJASTHAN

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Perthites are important disequilibrium textures found in the topaz bearing Degana Granites. Out of the two types of the perthites in the Degana Granite, the fine-grained stringlet type perthite is found in the unaltered portion while the dominant coarser type replacement perthite is present in the potassic alteration zones. In the present communication, a schematic model for the progressive evolution of perthite texture in the potassic alteration zone of the Degana Granite is proposed.

Introduction

The intimate intergrowths of two or more feldspars in form of perthite are of great genetic significance and have attracted the attention of a number of workers. The perthite is suggested to be formed by one or more of the three processes i.e. replacement, exsolution, or simultaneous growth (Vogt, 1905; Anderson, 1928). A review of the origin of perthite is given by Smith (1974). It is now well understood that not all the perthites originate by unmixing during the cooling from crystallizing temperatures but many of the perthites can only be explained satisfactorily based on metasomatism (Haapala, 1997).

The perthite is one of the important disequilibrium textures found in the topaz bearing granites of Degana. Such textures are having the great genetic significance, as these are indicative of the magmatic as well as post-magmatic changes. In the present area of study both types of perthite, i.e. primary and replacement type are present. This paper aims to establish the formation of replacement perthite from Degana Granite, which is commonly found in the potassic wall rock alteration zones around the tungsten-mineralized veins.

Petrography

The Degana Granite is mainly composed of quartz, alkali feldspars (microcline and occasionally orthoclase), plagioclase, muscovite, biotite and zinnwaldite with topaz, fluorite, wolframite, zircon, allanite and apatite as accessories. Generally, two generations of topaz and fluorite are present in these granites. Primary topaz and fluorite are associated with primary quartz and micas while secondary fluorite and topaz are present as inclusions in feldspar, perthite and along cleavage planes of zinnwaldite.

Whole of the Degana pluton is characterized by various degrees of post-magmatic changes, which are very much pronounced around the tungsten mineralized veins. Based on the mineralogical, textural and geochemical observations, three major alteration zones, namely greisen zone, silicification zone and potassic zone are marked on the both sides of the ore veins (Sukhchain, 2003).

Perthites, which are commonly observed in the Degana Granite, markedly vary in textures. Generally, two types of perthites are present in the Degana Granite. The primary perthites (Fig.1a) are mainly present in the unaltered portions of the granite. These perthites are generally finer in nature and falling in the stringlet type of Alling (1938). In the unaltered granite, the perthites are associated with the fresh plagioclase and microcline. While the perthite present in the potassic alteration zone is generally coarser in nature and containing relicts of plagioclase (Fig.1b). These types of perthites are associated with the altered mineral assemblages. Alling (1938) classifies this type perthite as replacement type perthite.

Development of Perthite in Potassic Alteration Zone

The potassic alteration zone is marked by the change in colour and appears pinkish due to abundance of alkali feldspars. The altered mineral assemblages consist of quartz, perthite and subordinate albitic plagioclase. The growth of new mica minerals are also observed along the boundary of the plagioclase. The potassic feldspars sometimes shows poorly developed fine scale crosshatch twinning containing the plagioclase fragments as relics in it. Except from the enrichment of alkali feldspars and slight depletion in plagioclase, other mineral assemblages of this zone are similar to the unaltered granite mineral assemblages. The microcline is typically developed in pockets. Replacement of plagioclase by microcline is commonly observed (Fig.1c).

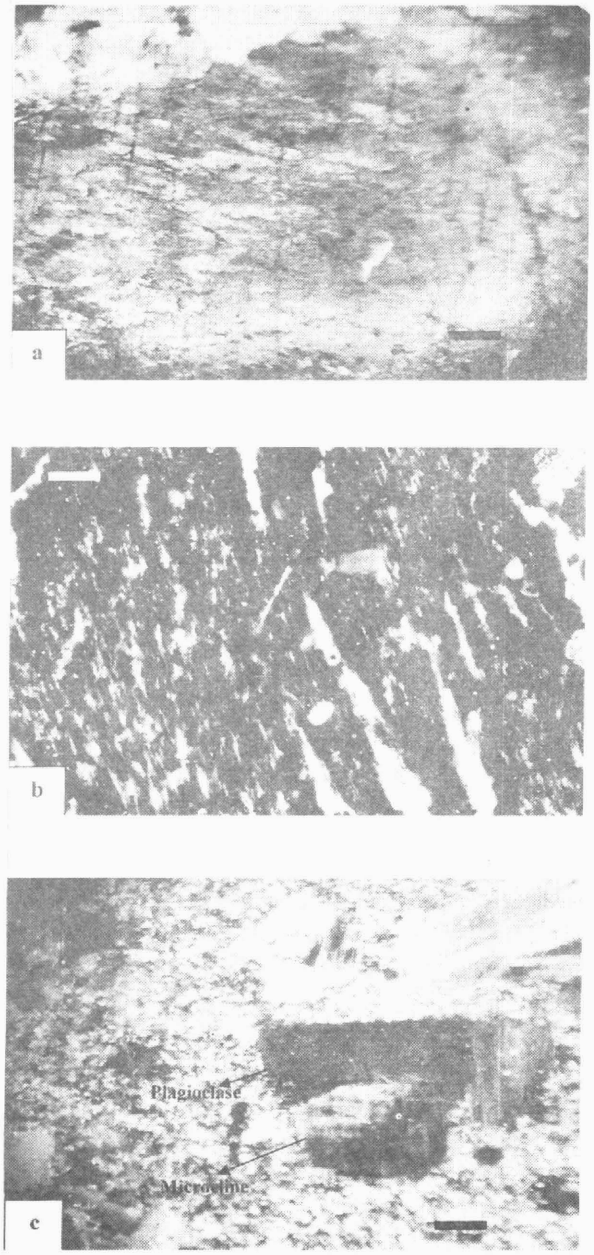

Fig.1. Photographs are taken under Cross Nicol and the length of the bar is equal to 10 μm. **(a)** The perthites of the unaltered portions of the granite which is generally finer in nature **(b)** Perthite present in the alteration zone of Degana Granite, which is generally coarser in nature and containing relicts of plagioclase.**(c)** Replacement of plagioclase by microcline.

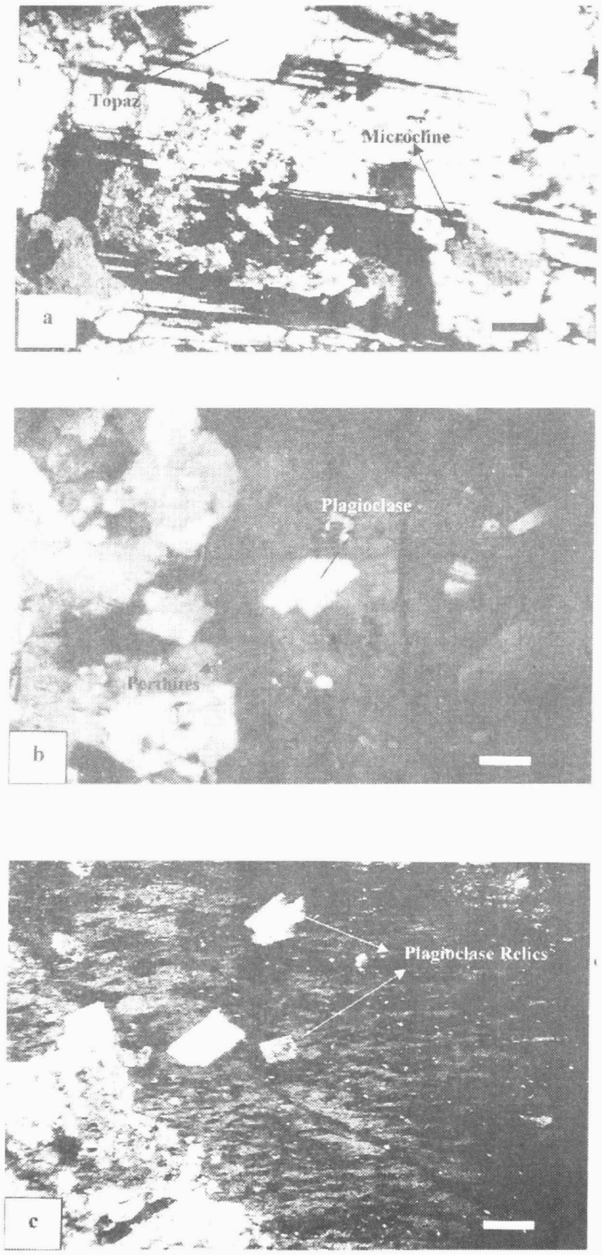

Fig.2. (**a**) Development of perthites in the potassic zone, representing replacement along the cleavage planes as well as at the expense of plagioclase. (**b**) Second stage in the development of perthite, showing irregular microclines in the plagioclase giving it a perthitic look. (**c**) Development of the turbid perthites, containing the relics of plagioclase.

The possible reaction for the development of K-feldspar may be given as:

$$NaAlSi_3O_8 + K^+ = KAlSi_3O_8 + Na^+$$

Out of the two types of perthites discussed earlier in Degana Granite, the perthite in the potassic zone represents replacement features like development of new microcline at the expense of plagioclase (Fig.2a) and turbiditic nature suggesting its secondary origin. Pirajno (1991) suggested that the perthitic textures of this nature are indicative of alkali-metasomatism rather than unmixing during the cooling of a two-phase assemblage. An aggregate

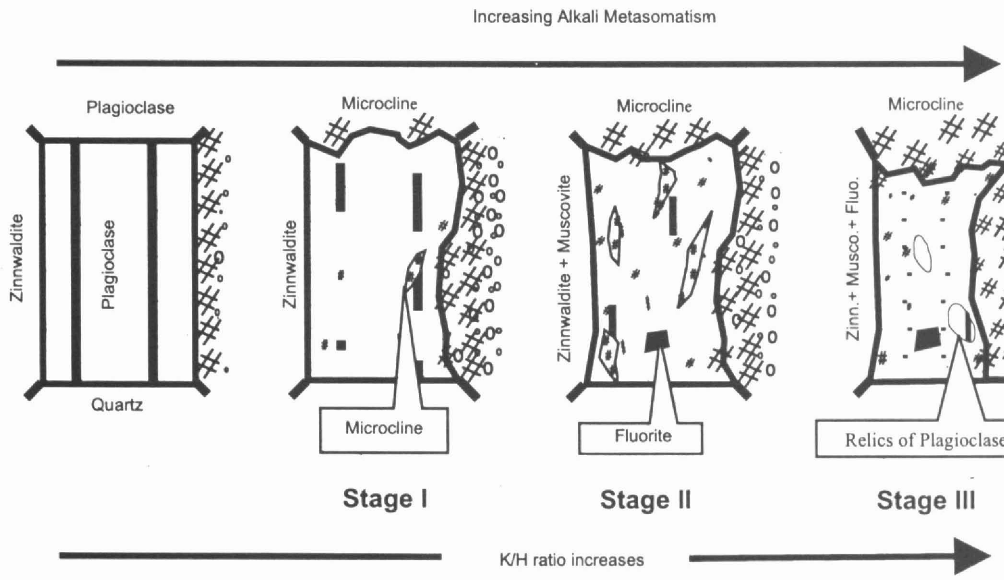

Fig.3. A schematic model showing the various stages, for the progressive evolution of replacement perthites in Degana Granite. For description see the text.

of gradually coarsening perthites from originally feldspar grains is observed, which is explained by Haapala (1997) to be produced by the volatile-catalyzed exsolution, accompanied by partial recrystallization. Kinnaird (1985) further suggested that the enhanced K/H ratio of the fluid, which facilitates the alkali metasomatism, is responsible for the development of the K-feldspars at the expense of albite and the development of secondary perthite. Fluid inclusion study of Degana tungsten deposit favours a CO_2 streaming during the hydrothermal evolution (Somani and Srivastava, 2000). This CO_2 effervescence might have enhanced the K/H ratio of the remaining fluid (Kinnaird, 1985) and caused potassic alteration in the area.

In the potassic alteration zone of Degana Granite, the development of perthite can be explained by progressive K-metasomatism in three different stages. In the stage (I), the development of new microcline is observed along the cleavage planes and at the expense of plagioclase, which shows fracturing and alteration (Fig. 2a). In the stage (II), with further pervasive potassic alteration most of the K^+ for Na^+ substitution has taken place and due to which number of minute microcline crystals developed in the plagioclase and give it a perthitic look (Fig. 2b). These microclines are normally irregular and do not show any crystallographic orientation as would be in case of solution unmixing. In the stage (III) on further alteration, the turbid perthites are developed (Fig.2c). Kinnaird (1985) explained that during K for Na replacement, Fe is released from the crystal lattices and oxidized to form very minute hematite inclusions, causing turbidity in the feldspars in the thin sections. A schematic model for the progressive evolution of perthite texture in the Degana Granite is given in Fig.3. The figure shows a plagioclase grain surrounded by another alkali feldspar, plagioclase, quartz and zinnwaldite grains. With the increasing activity of volatiles and increased K/H ratio of the fluid, an aggregate of gradually coarsening perthite from an originally homogenous plagioclase grain is explained in the figure. At the first stage due to potassic metasomatism a film and string perthite followed by vein and patch perthites are found. The relics of altered plagioclase are still present in the final stage in the mass of newly developed microcline. The post magmatic fluids may also cause the alteration of zinnwaldite to muscovite, de-anorthitization of plagioclase and formation of secondary fluorite.

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