Deformation Microstructures in Plagioclases of the Doran Granite: An Interpretation to Emplacement of this Intrusion at the Type Locality, Zanjan

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Abstract

Observations on the microstructure of a rock, in thin section, can be used to reconstruct its tectonic evolution. This paper presents deformation microstructures, which were observed in Plagioclase of the late precambrian Doran-granite at the type locality in south of Zanjan. Two sample-sets of central and marginal parts of the Doran intrusion show similar microstructures, which can be related to temperatures up to 500°C, believed as emplacement temperature of the Doran intrusion in shale of Kahar-formation. The former structures are affected, in some samples of marginal part of the intrusion, by cataclastic flow, formed at temperatures lower than 400°C, during subsequent uplift. The good preservation of the deformation microstructures, in the studied samples, can be referred to fast decrease of temperature, meaning quickly uplift process. Microscopic deformation-induced microstructures of minerals in rocks and set the conditions for reconstruction at the time of adoption of intrusive form used in the study, because the microstructure formation in minerals affected by the different conditions of temperature and pressure, and can be different stages of the fit mass to reflect stones. In this paper, the microscopic induced deformation microstructures in plagioclase White granite outcrop in the model presented, the analysis is presented on how to fit the masses.

Keywords: Microstructure; Deformation; Plagioclase; Emplacement; Doran granite; Zanjan

Introduction

Microscopic deformation-induced microstructures of minerals in rocks and set the conditions for reconstruction in the form of intrusive fit and used the formation of these microstructures in minerals affected by the different conditions of temperature and pressure, Different stages of the adoption process should be reflected in the rock mass [1-3]. In this paper, the microscopic induced deformation microstructures in plagioclase White granite outcrop in the model presented, the analysis is presented on how to fit the masses. The granite outcrop pattern with geographic coordinates "21'45"48 and '25'48 E and" 31 '25"36 and "30'32"36 north latitude with an area of approximately 5 square kilometers, located 12 km south of Zanjan. Granite, attributed to the Precambrian period and cut the stratigraphy Kahar Formation with an erosional surface below Bayandor is located. According to geological divisions of the target region in Central Iran (CI) is located (Figure 1).

Method

Petrographic thin sections prepared from samples taken on 13 (7 thin sections of samples from the central portion and six samples from thin sections of granite near the western border of) with the help of Meiji Pvlaryzan has been carried out microscope. Requirements microscopic images using Olympus BX 31 microscope equipped with a digital camera Pvlaryzan are shooting. The mineralogical composition is relatively specific completely white granite, feldspar and quartz consists mainly based on petrographic studies. Biotite - chlorite, sphene, zircon and alkali feldspar with minor rock forming minerals Karlsbad simple twining. Between feldspar crystals - feldspar, feldspar - quartz - quartz samples studied were often jagged teeth, Granular texture, porphyry Kataklastyk tissue samples comprise dominant. Feldspar and quartz samples studied in two different crystal size appear, Tiny crystals of feldspar and quartz crystals are often smaller than a millimeter to several millimeters in size is coarse feldspar and quartz (Figures 2 and 3). Often crystals, regardless of the grain size, the extinction wave show.

Deformation of Plagioclase

Laboratory experiments and field observations of naturally
Deformed feldspars, would indicate that the deformation of feldspars strictly comply with the conditions of the transformation. Deformation of feldspars at low temperatures below 400°C, the fragmentation of the grains and the associated Kataklasty, the emergence of such an index Kataklasty split parts are in different sizes piquancy. Shattered pieces into heavy crystal deformation, and blade bending modes occur twining, as well as other evidence of scattered wave blackouts are common at this stage of deformation [1,2]. Albite formation of twinning deformation in plagioclase of the events under these conditions [4,5]. Albite twining can be formed on small faults [6,7]. Basically twining deformation under conditions of low temperature deformation formed and appear [3]. Bookshelf tiny fractures in feldspars under the usual conditions, which lead crushed grain is formed like an elongated pieces [7,8]. The number of samples collected from the peripheral portion of the mass of evidence of fragmentation of large grains of plagioclase and quartz, in different sizes, with curved blades twining Kataklasyt flow, locally in thin sections, is detected (Figure 4). In addition twining bent blades, blade composed of albite twining deformation of the cone and sharp surge scattered power outages, a bookshelf fractures in plagioclase is observed (Figures 4-7). Deformation of feldspars under conditions of low to moderate temperatures of 400 to 500°C and mostly still, creating finely crystalline cleavages within the movement is sliding along. Evidence of deformation in this stage may include disruption sharp blade deformation twining, bent blades twinning silence and delicate wavy border is marked [7]. Deformation of feldspars as local migration of grain boundaries old bulge deformation (Bulging recrystallization, BLG recrystallisation), can occur at this stage [9]. The edges of the crystal grain boundary migration in small scale and Congress appear jagged [10]. Grain boundary migration rate depends on factors such as the temperature, the position of the two crystals together, and the greatest amount of mobility and migration happens between the

**Figure 2:** Fine-grained granular texture of the granite boundary intergranular teeth, typical of the central part of the mass.

**Figure 3:** Coarse plagioclase crystals in the context of fine-grained granite sample from the central part of the mass.

**Figure 4:** Kataklyst tissue, smashing stone beads in different sizes as well as fragmentation of coarse plagioclase crystals in the center with curved blades and silence twining waves scattered from the sample Kataklyst margin of the mass.

**Figure 5:** Twinning deformation in plagioclase sharp, mass margin of sampling period.

**Figure 6:** Curved blades twinning in the center of plagioclase, the plagioclase bookcase on the right, a sample of the tumor margin.

**Figure 7:** Twinning deformation in plagioclase sharp horns, removable blades twinning by Ryzgssthyay east - west and twining growth of new blades on them, the margin of the mass of the sample period.
Evidence of deformation under conditions of low to medium degree of deformation twining like a sharp blade, blade curvature twining, wavy and displacements cocks sliding in plagioclase is observed both in the central part of the granite margin (Figures 8 and 9).

Evidence of deformation at moderate (600-450°C), probably, the mutation was associated with the relocation of the feldspars, dynamic deformation, an important phenomenon in this process, particularly along the edge of feldspar grains begins. Phenomenon of dominant deformation, deformation bulge (Bulging recrystallization, BLG recrystallisation), which under conditions of low heat - stirring up tensions in the border above a bulge into crystals and crystal deformation adjacent high density leads to the formation of small crystals independent of the boundary [2]. Most boundaries fused sutures such as plagioclase - plagioclase, plagioclase - quartz - quartz in deformed rocks are common and the stress on grain boundary migration are created. Empirical evidence shows that the deformation of plagioclase starts at about 500°C [12]. Feldspars break down at this point, but will consist of plagioclase fine. Large plagioclase, the emergence borders are unknown. Ptyt flame formed in potassic feldspar under the usual conditions [7]. Towards higher temperatures, the abundance twining deformation is reduced. Deformation of the usual moderate evidence that the granite samples are identified, we can bump deformation process (BLG recrystallization) noted that the central part of the samples and in samples of body parts appear margin (Figures 10 and 11).

In addition, smaller crystals are fractured along twining curved blade and sharp with relatively clear boundaries between plagioclase unclear sections studied in both parts of central and marginal masses are seen (Figures 12 and 13).
Conclusions

Plagioclase studied two central part of the western margin of the granite outcrop pattern in two different crystal size small, often less than 1 mm, and coarse, few mm, appear. Often crystals, regardless of the grain size, the extinction wave show. Microscopic studies performed on plagioclase granite, particularly the observation of the dynamic deformation of the bulge (BLG recrystallization), Evidence indicates deformation temperatures around 500 °C in both the central and peripheral parts of the body, the temperature can be fit as the temperature of the shale Khar Mass period, after crystallization, should be considered. Kataklastyk deformation effects that lead to big crunch and deformation of plagioclase crystals are formed at temperatures below 400 °C is, locally, the number of samples of granite seen marginal product is likely to have uplift process. If the deformation at relatively low temperatures or in the presence of trace amounts of free water occurs in rocks, fabric deformation can be, relatively, no effect of static deformation processes during uplift preserved, so that it is visible and recognizable [2]. As the fabric deformation, temperatures around 500°C, the granite mass is conserved and the assumption that one of the reasons for the lack / shortage of hydrous minerals in granite, Trace amounts of water in it, it can be concluded that the rapid decrease in temperature prevents the occurrence of static recrystallization texture, and thus evidence of deformation after crystallization of the preservation of has been. In other words, a rapid reduction in temperature indicate rapid uplift of the masses. It should be noted that evidence at the end of deformation, the same ratio, as well as the study of thin sections of granite white quartz crystals are detected during the address, it will take another chance.

References

1. Blenkinsop TG (2000) Deformation microstructures and mechanisms in minerals and rocks. Kluwer Academic Publishers, Dordrecht 150.
2. Passchier CW, Trouw RAJ (2005) Microtectonics. 2nd revised edition, Springer Verlag, Berlin, Heidelberg, 371.
3. Vernon RH (2008) A Practical Guide to Rock Microstructure. Reprinted edition, Cambridge University Press, New York 650.
4. Seifert KE (1964) The genesis of plagioclase twinning in the Nonewaug granite. Am Mineral 49: 297-320.
5. Egydio SM, Mainprice D (1999) Determination of stress directions from plagioclase fabrics in high grade deformed rocks (Alhém Paraiba shear zone, Ribeira fold belt, southeastern Brazil). J Struct Geol 21: 1751-1771.
6. McLaren AC, Pryer LL (2001) Microstructural investigation of the interaction and interdependence of cataclastic and plastic mechanisms in feldspar crystals deformed in the semi-brittle field. Tectonophysics 335: 1-15.
7. Pryer LL (1993) Microstructures in feldspars from a major crustal thrust zone: the Grenville Front, Ontario, Canada. J Struct Geol 15: 21-36.
8. Passchier CW (1982a) Mylonitic deformation in the Saint-Barthélemy Massif, French Pyrenees, with emphasis on the genetic relationship between ultramylonite and pseudotachylyte GUA. Pap Geol Ser 1: 161-173.
9. Shigematsu N (1999) Dynamic recrystallization in deformed plagioclase during progressive shear deformation. Tectonophysics 305: 437-452.
10. Drury MR Urai JL (1990) Deformation-related recrystallisation processes. Tectonophysics 172: 239-253.
11. Urai JL, Means WD, Lister GS (1986) Dynamic recrystallisation of minerals. Geophysical Monograph.
12. Tullis J, Stunitz H, Teyssier C, Heilbronner R (2000) Deformation microstructures in quartzo - feldspathic rocks. Stress, strain and structure.