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Structural record of mechanisms of granite intrusion in the Achaean gneisses

L.L. Perchuk (1) and D.D. van Reenen (2)

(1) Moscow State University, Petrology, Moscow, Russian Federation (llp@geol.msu.ru, +7 095 932 8889), (2) Department of Geology, University of Johannesburg, P.O. Box 524, Auckland Park, 2006, Johannesburg, South Africa. e-mail: dirkvr@uj.ac.za

A model of diapiric formation of granite domes within green-stone areas is based on gravitational re-distribution mechanisms of rocks in the Precambrian continental crust (e.g. McGregor, 1951; Ramberg, 1951; Perchuk, 1989, 1993; Perchuk et al., 1992). In addition, the gravitational re-distribution is the leading mechanism to form Precambrian granulite facies terrains among green-stone belts. It has been proven by data on general geology, tectonics, petrology, geochemistry, isotopic geology, geophysics, and numerical modeling (Perchuk et al., 2001; Gerya et al., 2000, 2002). However the behavior of granite melt within gneisses of similar bulk composition is questionable. If the above mechanisms works well in the case of "granitic gneiss – granite melt", the ascending rocks must have structural features that indicate upward movement, while the adjacent wall rocks must demonstrate structural features of the opposite movement. In metamorphic rocks these features are represented by lineation, drag folds, orientation of fold hinges etc. Apart from "straight gneisses" (Davidson, 1984; Smit & van Reenen, 1997) no direct evidence for the internal dynamics of the formation of high-grade terrains has ever been considered. In this paper we formulate a rule allowing discrimination between cylindrical metamorphogenic and magmatogenic structures and demonstrate a model of their formation. Two types of ring structures are considered as indicators of ascending granulites toward the surface, i.e. cylindrical folds (sheath fold) and granite stocks. Systematic studies of such structures at diverse erosion sections allowing the conclusion on their formation. During exhumation (decompression) of granulite facies terrains the formation of sheath folds are resulted from generation of the granite magma within the same granitogneissic material and subsequent uprising due to difference in densities of contacting materials because all sheath folds con. This is recorded in the contrasting orientation of strong liniation and small folds axes in granulite facies complexes (see a micro model in Fig. 1a). Despite the fact that these structures are located more than hundred kilometers apart, they are characterized by similar orientation of foliation and lineations that are the evidence for their simultaneous formation. This conclusion is well supported by isotopic geochronological data (Boshoff et al., 2006; van Reenen et al., 2007). Numerical modeling (Fig. 1b-d) of this movement strongly supports this mechanism and suggests that the formation of sheath folds as the result of granite magma generation from gneisses of similar bulk composition reminds boiling of viscose liquids.
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References.

Boshoff, R., Van Reenen, D.D., Smit, C.A. t al., 2006. J. Geology, 114, 699.
Davidson, A. Journal of Geodynamics. 1984, 1, 433-444.
Gerya, T.V., Perchuk, L.L., Van Reenen, D.D. et al. 2000. J. Geodynamics, 30, 17.
Gerya T.V., Perchuk L.L., Maresch W.V et al., 2002. Europ. J Mineral., 14, 687-699.
Macgregor A.M. Transactions of Geological Society of South Africa. 1951. V. 54. P. 27-71.
Perchuk L.L., 1989. In Evolution of Metamorphic Belts. Geol. Soc. Lond. Spec. Pub. 42, P. 275.
Perchuk, L.L., Podladchikov, Yu.Yu., Polyakov, A.N., 1992. J. Metam. Geol., 10, 311.
Perchuk L.L., van Reenen D.D., Smit C.A., Boshoff, G. A. Belyanin, Yapaskurt V.O. Petrology, 2008, V. 16, No. 7, . 652–678.
Ramberg H. Gravity, deformation and the Earth's crust. Academic Press. London-New-York-Toronto-San

Francisco. 1981. 296 p.
Smit, C.A. & Van Reenen, D.D., 1997. Journal of Geology, 105, 37-57.
Van Reenen, D.D., Boshoff, R., Smit, C.A. et al., 2007, Gondwana Research (in press).

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Figure 1. Fragments of natural () and modified numerical (b – d) models of the formation of the Avoca structure with prominent lineations (see discussion in the text). Legend for models c and d: 1 – foliation, 2 – lineation (arrows indicate the direction of the movement of material), 3 – xenoliths of metabasites and gneisses from the collar [Perchuk et al., 2008].