Macro- and Micro-Scale Crystal Fabrics as Indicators of Syntectonic Flow and Crystallization Processes: the Piquiri Syenite Massif (Southern Brazil)

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Macro- and microstructures of syntectonic granitoids provide numerous information about (i) crystallization, deformation and rheology history of these rocks, (ii) development of fabric anisotropy and heterogeneity during flow processes, and (iii) interaction between local and regional kinematics. The Piquiri Syenite Massif (611$\pm$ 3 Ma) is part of the post-collisional magmatism related to the Neoproterozoic Brasiliano-Pan-African Orogenic Cycle in southernmost Brazil. The ca. 150 km^2 large pluton is composed mostly of coarse-grained perthite syenites and quartz-syenites and intruded high-grade gneisses, syntectonic monzonites and granites, medium-grade metapelites, and acid metavolcanic rocks. In the pluton center, co-genetic granites are developed with gradational contacts. Border features include local development of chilled margins in the pluton, as well as hornfelses and brecciation of metamorphic wall rocks which are cemented by syenitic or granitic material. The Piquiri Syenite Massif shows several mesoscopic magmatic structures, such as cm-dm thick, locally boudinaged and folded mafic layering, mafic microgranular enclaves, and schlieren structures. Mafic layers are enriched in Cpx and Hb and partly formed by flow segregation. Platy, mm-cm sized K-feldspars as well as pyroxenes and amphiboles form a steep magmatic foliation. Based on series of outcrop photographs from three perpendicular cuts, scans of oriented rock slabs, and thin sections, both structures have been analysed and quantified by modified and automated conventional fractal-geometry methods. The anisotropy obtained on the foliation plane reveals the sub-horizontal orientation of a weak magmatic lineation, not visible in the field or in thin section. The magmatic foliation is oriented parallel to the outer rims of the pluton and locally anastomoses around sub-vertical axes. Together with the lineation, these features indicate sub-horizontal magmatic flow and, at least locally, shearing during emplacement of the pluton. On the micro-scale, nearly no solid-state deformation structures are visible in any of the different minerals. In quartz, weak chessboard subgrain pattern is rarely developed. Even where the syenite comprises up to 90% well-aligned K-feldspars, neither magmatic fracturing nor high-T deformation structures are visible. This, together with overgrowth structures, indicates that during magmatic flow feldspars were only present to a minor extent or with much smaller sizes. In general, the Piquiri Syenite Massif can be regarded as a syntectonic pluton, which developed strong flow structures during an early period of emplacement and, subsequently, static microstructures indicating stress decrease during cooling and final crystallization. The emplacement is related to weak sub-horizontal shearing along NNE-trending transcurrent brittle-ductile shear zones of the Southern Brazilian Shear Belt.

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Abs. No. **414**
Meeting: **DMG 2008**
submitted by: **Kruhl, Jörn H.**
email: **kruhl@tum.de**
date: **2008-06-02**
Req. presentation: **Poster**
Req. session: **S18**