High finite strain flow pattern in marbles around boudinaged dykes

Höpfl, Stephan (Universität Wien, Department für Geodynamik und Sedimentologie, Wien, AUT);
Rogowitz, Anna (Universität Wien, Department für Geodynamik und Sedimentologie, Wien, AUT);
Grasemann, Bernhard (Universität Wien, Department für Geodynamik und Sedimentologie, Wien, AUT)

Analog and numerical models of the progressive evolution of boudinage have shown that the main factors controlling the development and final shape of boudins are the orientation and spacing of the inter-boudin surface, viscosity contrast and the layer thickness. Variation of these parameters can cause complex behavior of boudin separation and rotation of the boudin segments inducing complex perturbation strain in the host rocks.

The former quarry Fehringer nearby Spitz an der Donau (Austria) represents an excellent natural laboratory to study the influence of the geometry of interboudin surfaces, viscosity contrast and layer thickness on boudin evolution at high finite strain. Geologically the exposed rocks belong to the Drosendorfer Nappe system, which is part of the central European Variscan orogeny. The Drosendorfer Nappe comprises a variety of rocks including amphibolites, quartzites, paragneiss, schists and marbles of which the latter represent the main unit within the quarry. The highly deformed rocks have experienced metamorphic conditions of around 700-800 °C at 8 kbar and have been syntectonically intruded by pegmatitic and aplitic dykes. During continuous top-to-the SE shearing, dykes have been rotated into the shear direction resulting in stretching, boudinage and rotation of boudin segments. Interestingly, the observed boudins preserve various shapes including pinch and swell, fish mouth but also blocky geometries suggesting a progressively changing viscosity contrast possibly resulting from local metamorphic or chemical induced rheological weakening or cooling.

The aim of this study is to analyze the deformation mechanisms within boudin segments and their surrounding matrix. Using space for time, the changing deformation mechanisms and flow patterns are characterized for the host rock marbles and the aplitic dykes. First results show that a metasomatic halo, which consists of a thin dark biotite rim and a few millimetres thick, lighter zone, borders the aplitic dykes and the interboudin surfaces and influences the progressive evolution of the boudins. Additionally reprecipitation of quartz can be observed in high strain zones like boudin necks likely resulting in decoupling of single segments. Metasomatism at the dyke rims but also along the interboudin surfaces suggests a feedback of chemical and mechanical processes.

A detailed characterization of the microfabrics by optical and secondary electron microscopy including electron backscatter diffraction mapping help to gain a better understanding of the mechanical and chemical feedback processes at lower crustal conditions.

References:

Dabrowski, M., & Grasemann, B. (2014). Domino boudinage under layer-parallel simple shear. Journal of Structural Geology, 68, 58-65.

Grasemann, B., Jeřábek, P., Tajcmanova, L., Menegon, L., Rogowitz, A. (2018). Deformation processes in the Lower crust (Bohemian Massif, Austria) Pre-EGU General Assembly trip. 13-14.

Chatziioannou, E., Rogowitz, A., Grasemann, B., Habler, G., Soukis, K., & Schneider, D. (2016, April). Strain localization along micro-boudinage. In EGU General Assembly Conference Abstracts (Vol. 18, p. 7271).

Ramberg, H. (1955). Natural and experimental boudinage and pinch-and-swell structures. The Journal of Geology, 63(6), 512-526.

Goscombe, B. D., Passchier, C. W., & Hand, M. (2004). Boudinage classification: end-member boudin types and modified boudin structures. Journal of Structural Geology, 26(4), 739-763.