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Introduction to Journal of Structural Geology special issue on “Deformation of the lithosphere. How small structures tell a big story”

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Editorial

Introduction to Journal of Structural Geology special issue on "Deformation of the lithosphere. How small structures tell a big story"

This special issue *Deformation of the Lithosphere. How small structures tell a big story* is dedicated to Professor **Henk Zwart** (1924–2012). The theme is inspired by Henk's retirement lecture entitled *Mountains must indeed be studied with a microscope* (19 February 1988). Henk Zwart was a pioneer in linking microstructural research with the large-scale issues concerning lithospheric rheology and deformation. The famous *Zwart's Hen House*, representing the nine diagnostic relationships of porphyroblast growth with respect to the timing of deformation, is still a key element in contemporary textbooks on structural geology and microtectonics. This particular insight may not have occurred if it wasn't for a mistake made by the thin-section maker in the Leiden lab of Henk Zwart. By accident a thin section of a Pyrenean metamorphic rock was made, not perpendicular to the lineation – as was the standard procedure in those early days of structural geology – but parallel to the lineation. That mistake and Henk's recognition that the lineation parallel view gave more useful information changed structural geology and microtectonics.

This special issue contains 10 original research papers that are collected following the 19th *International Conference on Deformation Mechanisms, Rheology and Tectonics* (DRT), held at university of Leuven (Belgium) in September 2013. Henk Zwart, together with Richard Lisle, Gordon Lister and Paul Williams, organized the *1976 Leiden Conference on Fabrics, Microtextures and Microtectonics*, the forerunner of the DRT meeting series. These biannual DRT meetings aims to bring together researchers in the broad fields of structural geology, geodynamics, rheology and material sciences. They encourage dialogue between field geologists, experimentalists, and modelers on problems and questions posed by structures and microstructures in natural rocks and synthetic materials.

Following the DRT tradition, this special issue is also devoted to the study of deformation behavior and rheology of minerals and rocks, and to deformation processes on all scales of observation. Particular interest is paid to recent advances in instrumental and experimental techniques in earth and material sciences for a better understanding and quantification of the microstructural evolution and mechanical properties of minerals and rocks in the Earth's lithosphere.

In a review article *Derez* et al. (2015) introduce a new, purely descriptive terminology for low-temperature intracrystalline deformation microstructures in quartz, based on a detailed light microscopy study of vein-quartz in a low-grade metamorphic slate belt (Belgium).

In axial compression and general shear experiments *Gonçalves* et al. (2015) illustrate the particular influence of the weak oxide phases in relation to the quartz framework on the rheology and microstructural evolution in synthetic aggregates of quartz, hematite and magnetite, as well as in banded iron formation (BIF) samples.

In a combined microstructural, geochronological and stable isotope analysis of quartzite mylonites (Raft River Mountains, Utah, USA) *Gottardi* et al. (2015) demonstrate that an extensive hydrological system was active during the evolution of the detachment shear zone capping the metamorphic core complex.

Renedo et al. (2015) reconstruct the microstructural evolution during different stages of exhumation of ultrahigh-pressure quartzofeldspathic gneiss and associated coesite-bearing eclogite (Western Gneiss Region, Norway) based on an EBSD texture analysis of omphacite and quartz and Ti-in-quartz thermobarometry.

Quilichini et al. (2015) highlight the interplay between meteoric fluid flow and deformation in quartzite-dominated lithologies during the evolution of ductile shear zone (Kettle detachment system, Washington, USA), using preserved microstructural characteristics and isotopic composition of quartz and synkinematic muscovite.

Velocity stepping rotary-shear experiments by *Hadizadeh* et al. (2015) on size-controlled powder of Westerly granite gouge, deformed at room temperature, including characterization by electron microscopy and energy dispersive X-ray analyses, illustrate that the velocity dependence of natural fault gouges is influenced by the compositional and microstructural evolution of the gouge.

Gómez Barreiro et al. (2015) apply TOF neutron diffraction on an anorthosite sample of a granulite-facies shear zone (Grenville Province, Quebec, Canada) to determine the texture and elastic anisotropy of the composing pyroxenes and plagioclase. Based on these results, they reveal the sensitivity of seismic anisotropy calculations of gabbroic rocks to texture symmetry, which should definitively be taken into account when interpreting geophysical data and building models of the lower crust.

Leslie et al. (2015) compares sillimanite microstructure and texture development in felsic tectonites from both anhydrous granulite- and hydrous amphibolite-facies shear zones (Athabasca granulite terrane, western Canadian Shield), primarily using electron backscatter diffraction. They reveal that sillimanite deformation is strongly influenced by temperature, fluid content and mineralogy of the sillimanite-bearing rock.

Haerinck et al. (2015) apply X-ray synchrotron diffraction on a chloritoid-bearing slate (Central Armorica, Brittany, France) in an attempt to explain the very high values of the degree of anisotropy of magnetic susceptibility (AMS). Extremely strong chloritoid and muscovite textures suggest that chloritoid may have a profound

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impact on the magnetic fabric of chloritoid-bearing rocks, although modelling of the AMS still indicates that the chloritoid texture only partially explains the slate's magnetic anisotropy.

Bladon et al. (2015) combine detailed outcrop studies with subsurface interpretations in reconstructing the evolution of the Barmer rift basin (Rajasthan, India), demonstrating the importance of structural inheritance of normal fault systems. Eventually, this rift basin evolution is linked with the far-field plate reorganization of the Greater India paleocontinent.

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