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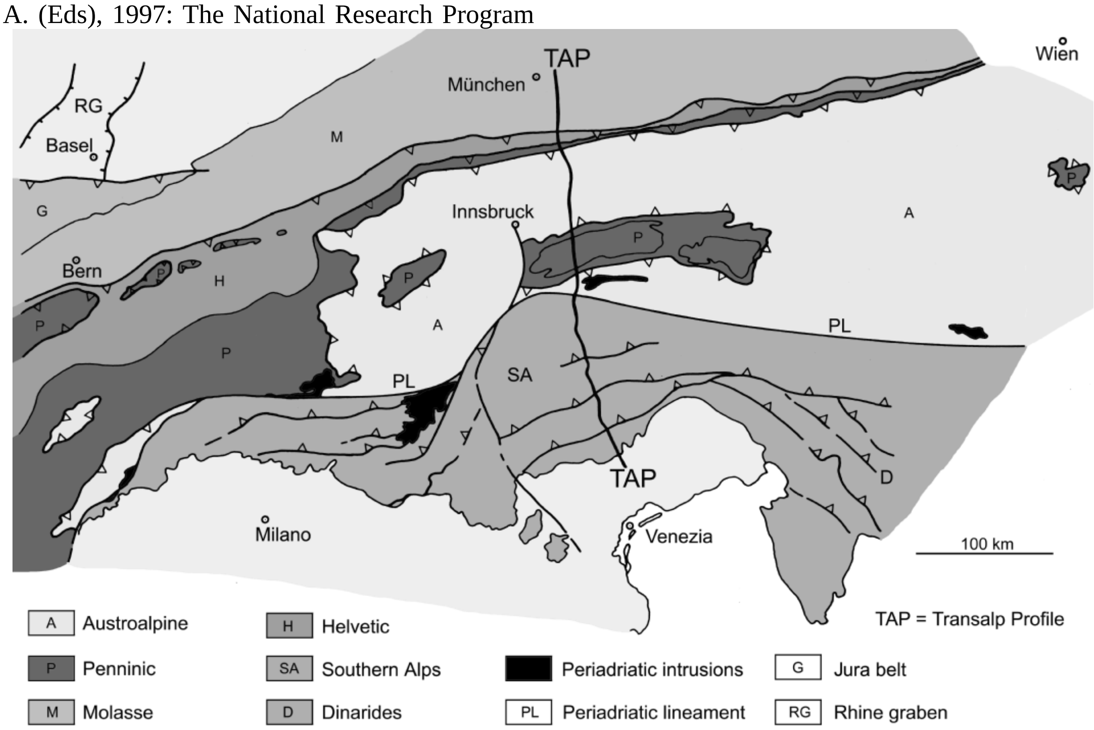


*Fig.1 The Transalp Profile location*

# Influence of shape and the particle/matrix interface conditions on the behaviour of elongated rigid particles in non coaxial flow

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The rotational behaviour of a rigid particle embedded in a linear viscous matrix undergoing a non-coaxial flow was studied in a series of 2D experiments. In particular the influence of particle-shape and the nature of the matrix/particle interface (lubricated versus unlubricated) was investigated.

The experiments were carried out using a ring shear rig, allowing high shear strains. Polyethylene particles were immersed in a polydimethyl-siloxane polymer (PDMS SGM36) and deformed at a shear strain rate of $\gamma \leq 9.10^{-4}$ $s^{-1}$. Slip boundary conditions were produced using soap with a viscosity 10000 times less than the PDMS. Particles with aspect ratios of 1, 2, 3 and 6 were investigated as well as a particle with monoclinic symmetry (rhomb or parallelopiped) for comparison with previous experiments.

A first series of experiments was carried out using elliptical particles with no slip at the matrix/particle boundary. Under these conditions the behavior of an elliptical particle undergoing simple shear is almost identical to the analytical solution of Jeffery (1922).

In a second series of experiments with elliptical particles, slip was induced at the particle/matrix boundary. Shear strains up to $\gamma = 45$ were reached. The experiments were repeated for each particle, starting with the long axis at different angles of 0°, 30°, 60° and 90° to the shear plane. The introduction of slip at the particle/matrix boundary led to considerable deviation of the measured rotation paths from the theoretical ones. The deviations are especially influenced by the initial orientation of the particle and the amount of the soap present at the matrix/particle boundary.

Concerning the influence of the initial particle orientation, all experiments produced very similar results independently of the aspect ratio. In complete contrast to Jeffery theory, objects initially oriented with the long axis parallel to the shear direction rotate backwards (i.e. antithetically) during the first increments of strain. With increasing strain, the particles temporarily stabilize at an angle between 10° and 20° to the shear plane, depending on the shape of the object. With further strain, all elliptical particles then rotate synthetically with respect to the shear sense. Back rotation was only observed at the beginning of the experiments. After a rotation of 180°, when the particles approached the shear plane for a second time, they continued to rotate synthetically. For all other initial positions of the particles (30°, 60° and 90°), only synthetic rotation was observed from the very first increment of strain.

For particles with aspect ratios 1 and 2, the observed rotation paths are more or less similar to the theoretical paths. For particle with an aspect ratio 2, experimental rotation rates are similar or slightly higher than the theoretical ones and rotation rates increase with increasing soap thickness.

With higher aspect ratios (3 and 6), the rotational behaviour of the particles increasingly differs from the theoretical curves for no-slip. The rotation rate increases compared to theoretical one with increasing thickness of the soap layer. Indeed for a soap layer reaching 10-15 % of the volume of the particle, the rotation rate is consistently always faster than the theoretical one. In contrast, with a thin layer of soap at the boundary, the rotation rate is considerably slower with respect to the theoretical ones, especially when the long axis of the particle makes a low angle with the shear plane. As a result, for particles of aspect ratio 6 the rotation rate is so slow (though never zero!), that they spend a very long time with their long axis at a low angle to the shear direction, developing a quasi-stable orientation.

For a monoclinic particle, the behavior is again different. Monoclinic particles with a non-slip boundary behave like an elliptical object and never reach a stable position. Inducing slip at the boundary leads to an effective stabilization of the particle, in contrast to what was observed for elliptical particles. Starting with the long axis of the monoclinic particle parallel to the shear plane, an antithetic rotation is observed until it reaches a stable position with its long axis at an angle of 11° with respect to the shear plane. In this orientation, the short side is parallel to the shear direction. In contrast to the elliptical particle the monoclinic particle does not start to rotate forwards with increasing strain.

The stable orientation of the monoclinic particle observed in the experiments is similar to that observed in earlier experiments and real mylonites as described by Pennacchioni et al (2001) and Mancktelow et al (2002).

The current experiments establish that the rotational behaviour of a rigid particle is strongly affected by the amount of weak material that may surround it, for example a mantle of finely recrystallyzed new grains. In particular, a small amount of very weak material dramatically decreases the rotation rate of strongly elongate particles when their long axis is close to the shear plane, while only slightly affecting the behaviour of more rounded particles. Large amounts of weak material increase rotation rates, irrespective of the form of the particle. These observations suggest that the relation between the recrystallization rate of the matrix around a porphyroclast and the rate at which the recrystallized material can be removed can play an important role in determining the rotational behaviour of porphyroclasts.

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# Die Bibliothek der Geologischen Bundesanstalt als Quelle wissenschaftshistorischer Forschungen

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Jedwede wissenschaftliche Arbeit hat nur dann einen Sinn, wenn sie sich nach Abschluss der Arbeiten in einem Medium niederschlägt und somit für weitere Arbeiten als Ausgangsgrundlage verwendet werden kann. Um aber schriftlich niedergelegte Forschungsergebnisse weiter nutzen zu können, ist neben der Verbreitung in einem Medium auch das Sammeln, Organisieren und Erschließen dieser Dokumente unerläßlich. Die Versorgung von Geowissenschaftlern, Studenten, Universitätslehrern, praktischen Anwendern (Konsulenten, Ziviltechniker usw.), Sammlern und Liebhabern der Geowissenschaften mit fundierter Fachinformation, eines für die Gesellschaft bedeutenden Wissenschaftszweiges, kann nur mit der Einrichtung entsprechenden Dokumentations– und Informationswerkzeugen gewährleistet werden.

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