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Polyphase Strain Caps Formation Mechanism

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Strain caps are one of a series of microstructures that typically form during deformation of a softer matrix around hard objects. As such, they bear information about the kinematics around these bodies in rocks. However strain caps are barely described outside their original definition. Here we describe these microstructures that feature a new phase – not elsewhere present in the paragenesis – in the strain cap region. This feature is rare but not unique: Examples from Alaska, Sinai and Bhutan all show chlorite strain caps formed around porphyroblasts in foliated mica schists of variable metamorphic grades. Porphyroblasts may be variably muscovite, staurolite or garnet, respectively. In all of these examples strain caps formed initially dynamically during deformation but the new phase grew statically at a later stage. At least three mechanisms that can explain the formation of new phases in the strain cap region: (a) the strain cap region may have experienced different P-T conditions from the matrix during the peak metamorphism; (b) the strain cap region has different effective bulk composition from the surrounding matrix; (c) fluid flow that is preferentially focused parallel to the foliation planes causing only local adjustment to retrograde metamorphism in the strain cap region. A combination between petrography, mineral chemistry and thermodynamic modeling shows that the third hypothesis is the most preferable mechanism that can explain the formation of strain cap minerals. Indeed, the absence of chlorite outside the strain cap region allows a quantification of the amount of fluid that infiltrated the foliation.

Keywords: Strain cap, Fluid channelling, Effective bulk composition, Thermodynamic modelling