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Structural evolution and finite geometry of the Siviez-Mischabel nappe, Valais, Swiss Alps

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In order to understand the formation mechanisms of large-scale crystalline basement nappes within continental collision zones, the internal geometry and structural evolution of such basement nappes has to be assessed. The Siviez-Mischabel nappe, exposed within the Penninic zone of western Switzerland, represents a major nappe complex which is ideal to study nappe-forming processes within continental collision zones. However, its large-scale geometry and structural evolution is still enigmatic. According to the classical model of Argand (1916), the Siviez-Mischabel nappe represents a large-scale, isoclinal, basement-cored, recumbent and north-vergent fold, surrounded by Permo-Triassic sediments. In contrast, Markley et al. (1996) proposed that the Siviez-Mischabel nappe consists mainly of thrust sheets which were placed on top of each other, without the development of large-scale isoclinal folds. In addition, Marthaler et al. (2008) proposed that the entire nappe complex is cross-cut by large subhorizontal post-nappe top-to-the-W shear zones, which might be kinematically linked with the Simplon-Rhone shear zone.

In this contribution we present new N-S to NNW-SSE structural profiles across the Siviez-Mischabel nappe between the Turtmann Valley and Val de Bagnes. We discuss the field evidence for the two models of Argand (1916) and Markley et al. (1996), and propose that the discrepancy between the models could be the result of the presence of a Permo-Carboniferous trough in the western part of the study area, which caused an overturned limb, and the absence of this trough in the eastern part of the study area, which exhibits mainly thrusting. We present a structural model for the investigated area, which includes (1) the preservation of a pre-alpine(?) fabric in parts of the crystalline basement, which is overprinted by (2) a south-dipping to subhorizontal top-to-the-N fabric associated with large-scale thrusts, which in turn is overprinted by (3) south-vergent folds with a N-dipping spaced cleavage associated with the large-scale Mischabel backfold. This basically two-phase alpine evolution with first a thrust-related, subhorizontal fabric overprinted by a second, backfolding-related fabric seems to be characteristic for the Middle Penninic basement nappes of the Alpine orogen (e.g. Suretta nappe, Scheiber et al., 2010).

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